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**European Union Preferential Trade Agreements with
Developing Countries and Their Impact on Colombian and
Kenyan Carnation Exports to the United Kingdom**

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ABSTRACT

United Kingdom (UK) demand for carnations by exporting country was estimated using a production version of the Rotterdam model, and model estimates were used to assess the effects of EU preferential trade agreements on import demand. Of particular importance was how these agreements affected Colombian and Kenyan carnation exports to the UK, the second largest market for Colombian carnations and the largest market for Kenyan carnations. Results showed that Colombia benefited from preferential access to the UK more so than Kenya: the benefit to Colombia was due to both trade creation and diversion, whereas the benefit to Kenya was mostly due to trade diversion. Results further showed that the competition between Colombian and Kenyan carnations was insignificant, and there was no evidence that the preferences given to Colombia harmed Kenya or vice versa.

Keywords: Kenya, Colombia, carnations, UK, preferential trade agreements, trade diversion

JEL classification: Q17, Q18, F17, F53

1. INTRODUCTION

The United Kingdom (UK) is the largest importer of carnations in the world. According to the UN, world carnation trade was valued at \$498 million in 2007 and UK imports were valued at \$126 million—25% of total world trade that year. The United States was the next largest importer, at \$88.9 million. Carnations in the UK were mostly sourced from Colombia, Kenya, the Netherlands, and Spain. In 2007, these countries represented 90% of total carnation imports in the UK and individually represented 38%, 23%, 19%, and 10%, respectively (UNCOMTRADE from Developing Countries 2008). From 2001 through 2004, carnations were the most popular flower in the UK, accounting for 30% of total cut flower demand on average. This is in part due to carnations being relatively inexpensive and having a longer vase life when compared with other flower species (CBI 2007b).

Although other UK flower imports are mostly sourced from within the European Union, carnation imports are mostly sourced from outside the European Union, where developing countries have become increasingly important as import suppliers (Eurostat 2008; CBI 2007b). Carnations in the UK are primarily sourced from two developing countries: Colombia and Kenya. Both have emerged as important participants in world flower trade and have benefited from nonreciprocal tariff-free access to the European Union (Meier 1999; Hughes 2001). Since Colombia has implemented campaigns against drug trafficking, her exports qualify for the special Generalized System of Preferences incentive scheme to combat drugs (Gallezot 2005; Panagariya 2002). Prior to 2008, Kenya enjoyed open access to the European Union under the Lomé Convention (Candau and Jean 2005; Panagariya 2002). Kenya's access has been extended under the current economic partnership agreement (EPA) between the European Union and the East African Community (Ministry of Trade and Industry 2007).

Colombia and Kenya account for 70% of all carnations exported to the UK (Eurostat 2008), and the UK is also an important destination market for these two countries. According to the UN, in 2007, world trade in Colombian carnations was valued at US\$262.2 million, of which the UK was the second largest destination market, accounting for 18% of total Colombian sales (\$48 million). The United States was first at 33% (\$87.2 million). For Kenya, the UK is much more important. In 2007, world trade in Kenyan carnations was valued at \$36.2 million, of which the UK accounted for 79% (\$28.8 million). The next largest market for Kenyan carnations, the Netherlands, was much smaller by comparison (\$3.7 million; see Table 1).

Two important issues regarding EU preferential trade agreements (PTAs) and UK carnation imports from developing countries are addressed in this study. First, PTAs have likely diverted UK imports from the EU countries to the developing countries. UK imports from the Netherlands are comprised of both domestic flowers and re-exports from developing countries, whereas imports from Spain are domestic production only (Eurostat 2008). Given that increased carnation imports directly from developing countries could lead to decreased indirect imports from these countries via European intermediaries, which are recorded as intra-EU imports, the increase in imports from Colombia and Kenya has probably affected the Netherlands more so than Spain. For instance, there has been increased trade through contractual arrangements between Kenyan flower producers and UK supermarket chains, which has supplanted trade previously facilitated by European wholesalers and Dutch intermediaries (Barrett et al. 1999; Dolan and Humphrey 2004).

Second, we address the importance of PTAs to Colombia and Kenya through their increased exports to the UK. It is likely that carnation exports from Colombia and Kenya have been enhanced by tariff-free access to European markets. However, the degree to which developing countries benefit from PTAs is not always obvious because the preferences given to one developing country may come at the expense of another (Panagariya 2002). Past studies have focused on preference utilization and the impact of preferential agreements on aggregate trade, the trade balance, and economic performance of developing countries. Our study addresses the sector-specific effects of preferential agreements that are the created and diverted trade in a given sector due to PTAs.

Table 1. Colombian and Kenyan carnation exports (US\$) by destination market: 2007^a

Colombia		Kenya	
World	\$262,183,755	World	\$36,226,760
United States	87,164,885	United Kingdom	28,794,439
United Kingdom	47,997,239	Netherlands	3,652,283
Japan	32,236,325	Belgium	2,852,662
Russia	21,607,748	France	392,542
Netherlands	20,410,786	Switzerland	342,314
Spain	19,279,593	Norway	119,199
Canada	13,358,650	Germany	17,000
Germany	8,309,000	South Africa	16,442
Czech Rep.	2,771,241	Russia	13,811
Finland	1,845,079	Japan	9,844
Austria	1,319,842	Czech Rep.	4,281
Latvia	1,214,148	Hungary	3,000
France	1,177,627	Poland	2,466
Slovakia	1,049,351	Italy	2,461
All Others	2,442,241	All Others	4,016

Source: UNCOMTRADE 2008

^a The reported data are for all countries that reported imports from Colombia or Kenya. Thus, world estimates may not include all destination markets.

In this study, we estimate the demand for fresh-cut carnations in the UK where carnation imports are differentiated by country of origin (Armington 1969). The Armington framework assumes that carnations from each of these countries are individual goods that are imperfect substitutes due to country-of-origin specific factors. Given the role of intermediaries and retailers in the UK carnation trade, imports are treated as inputs and a production version of the Rotterdam model is used in demand estimation (Theil 1980; Laitinen 1980). Sanyal and Jones (1982) note that even when imports are not physically altered (e.g., carnations), activities such as handling, insurance, transportation, storing, repackaging, and retailing still occur, resulting in a significant amount of domestic value added before final demand delivery. Thus, production theory should apply even in the case of carnations, which are mostly imported in final form.

In treating imports as inputs, we specify and estimate a system of origin-specific conditional import demand equations and an unconditional total expenditure function (aggregate import expenditures as a function of domestic, import, and resource prices). Given the model estimates, the unconditional price effects are derived for each exporting country and are used to estimate the impact of PTAs on Colombian and Kenyan carnation exports to the UK, and the trade creation and diversion effects of PTAs in the UK carnation market.

The remainder of this paper is organized as follows. In Section 2, we give an overview of the Colombian and Kenyan cut flower sectors and their preferential arrangements with the European Union. An overview of the UK market for fresh-cut flowers with particular focus on carnation imports is also provided in this section. In Section 3, the theoretical and empirical models are presented, and in the penultimate section, empirical results are given where the unconditional demand elasticities and PTA policy simulations are highlighted. We close the paper with a brief summary, concluding remarks, and policy implications.

2. BACKGROUND

Colombia and Kenya

Colombia is the first Latin American country to have cultivated cut flowers. Cut flower cultivation began in the late 1960s, mainly over the tropical highland area of Sabana de Bogota, where cheap, fertile land and labor were available. Colombia's climate is favorable for year-round production of flowers such as carnations and roses, and the location of most production is in proximity to the capital and international airport (Madrid and Lovell 2007; Meier 1999).

Colombian carnations enter the European Union duty-free under the Generalized System of Preferences (GSP) incentive scheme to encourage sustainable development and good governance in developing countries (GSP+). The GSP+ scheme specific to Colombia includes those special arrangements given to developing countries that combat drug production and trafficking (European Commission 2004). To be eligible, developing countries must implement key international conventions on human and labor rights, sustainable development, and good governance. Access to the European Union could be denied if found in noncompliance.

To be eligible for GSP+, a developing country must be classified as "vulnerable." The vulnerable status requires that a country is not classified by the World Bank as a high-income country. Additionally, at least 75% percent of a country's total GSP exports to the European Union must be concentrated within five sectors, and a country's total GSP exports to the European Union must be less than 1% of total EU GSP imports from all countries. Thus, an increase in export diversity and activity could result in a loss of preferential access.

GSP+ eligibility is approved for only two years. This requires that developing countries reapply and prove compliance every two years. Before 2005, GSP was negotiated every 10 years, and the last round of preferential arrangements lasted from 1995 to 2005. In 2005, GSP+ was reauthorized for 2006–2008 only. In October of 2008, qualifying countries had to reapply for 2009–2011.¹

The floriculture sector in Kenya has become a major foreign exchange earner due to increased exports to European markets. Export revenues from flower production have overtaken coffee and tourism and rank second only to tea (EPZA 2005). Kenya is currently the largest exporter of cut flowers to Europe, accounting for about 35% of EU flower imports. European countries account for over 90% of Kenya's cut flower exports, with the Netherlands, UK, and Germany accounting for 68%, 19%, and 6% respectively (CBI 2005).

Prior to 2008, Kenya benefited from open, nonreciprocal access under the Lomé Convention agreement. In 2008, the nonreciprocal arrangements under Lomé were replaced with reciprocal EPAs in 2008 (Odhiambo and Sambu 2007; Candau and Jean 2005; Panagariya 2002). Although EPAs required African countries to eliminate tariff barriers on EU products, a reprieve on this provision has been granted. In November 2007, Kenya and other East African Community (EAC) states signed the framework for an interim EU-EAC EPA that allowed for tariff-free access to EU markets for all products except rice and sugar. The EAC also secured a 25-year reprieve from full liberalization, which delayed the requirement to grant tariff concession to the European Union (Odhiambo and Sambu 2007; Ministry of Trade and Industry 2007).

The United Kingdom

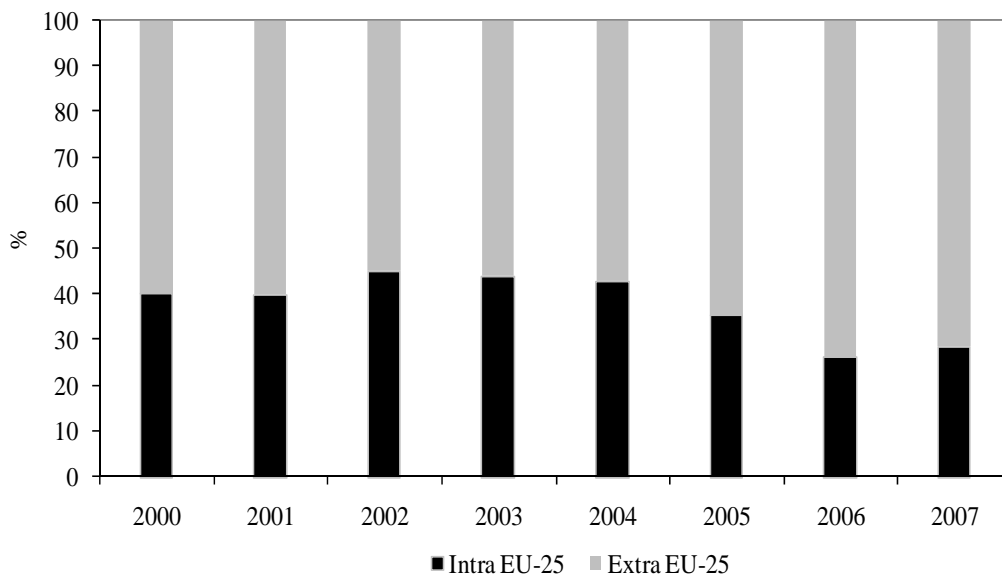
In 2006, UK cut flower imports were valued at approximately €0.8 billion, accounting for 24% of total EU cut flower imports. Comparable EU importers are Germany, the Netherlands, and France, with market

¹ All information pertaining to GSP+ was obtained from various documents found at http://trade.ec.europa.eu/doclib/cfm/doclib_section.cfm?order=date&sec=160&lev=2&sta=1&en=20. There are 16 GSP+ beneficiaries for 2009–2011: Armenia, Azerbaijan, Bolivia, Colombia, Costa Rica, Ecuador, El Salvador, Georgia, Guatemala, Honduras, Mongolia, Nicaragua, Paraguay, Peru, Sri Lanka, and Venezuela. The eligibility of El Salvador and Sri Lanka is under investigation. Panama was among the beneficiaries in 2006–2008 but did not reapply.

shares of 23%, 15%, and 12%, respectively (CB 2007a). Although carnations have been the most important flower import, in recent years the range of flower species demanded by UK consumers has widened, resulting in carnations accounting for a smaller share of total imports. Interestingly, carnation imports from developing countries have increased by 10% per year on average from 2002 to 2006. In 2000, UK carnation imports from developing countries accounted for 59% of total carnation imports; in 2006, developing countries accounted for 71% (Figure 1). In 2000, 27.2 million kilograms (kg) of carnations were exported to the UK, valued at €15.3 million. This has steadily decreased to 21.9 million kg in 2007 (€1.2 million; Figure 2).

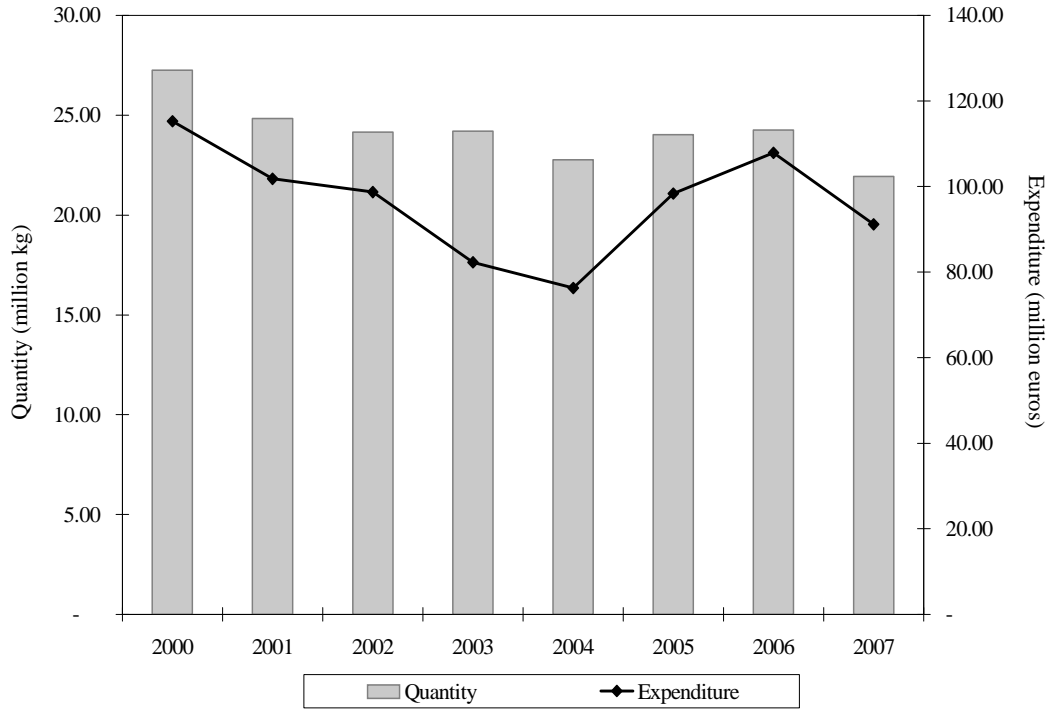
The share of the UK market supplied by Colombia and Kenya, and UK carnation expenditures from 2000–2007 are reported in Figure 3. Colombia and Kenya are the primary suppliers of carnations to the UK and together have accounted for as little as 46% of the total UK market in 2004, to as high as 67% in 2006. For the most part, Colombia’s share of the UK carnation market has been steady at about 40%; however, Kenya’s share reached a low of about 4% in 2003 but has steadily increased since then. From 2004 to 2005, Kenya’s share of the UK market increased from about 6% to nearly 19%, and then increased to nearly 29% in 2006. During this period (2004–2006), UK total expenditures on carnations also increased (from €32.3 million to €107.9 million). In 2007, however, Kenya’s share of the UK market decreased to 23% (Figure 3). Despite the recent growth in carnation imports from Kenya, Colombia remains the UK’s leading supplier. In 2000, UK imports of Colombian carnations were 9.1 million kg. In 2001 and 2002, UK imports from Colombia decreased, making Spain the leading supplier during this period. However, since 2003, carnation imports from Colombia rebounded, and Colombia has been the UK’s leading supplier ever since (Eurostat 2008).

Figure 1. UK Carnation import shares: 2000–2007



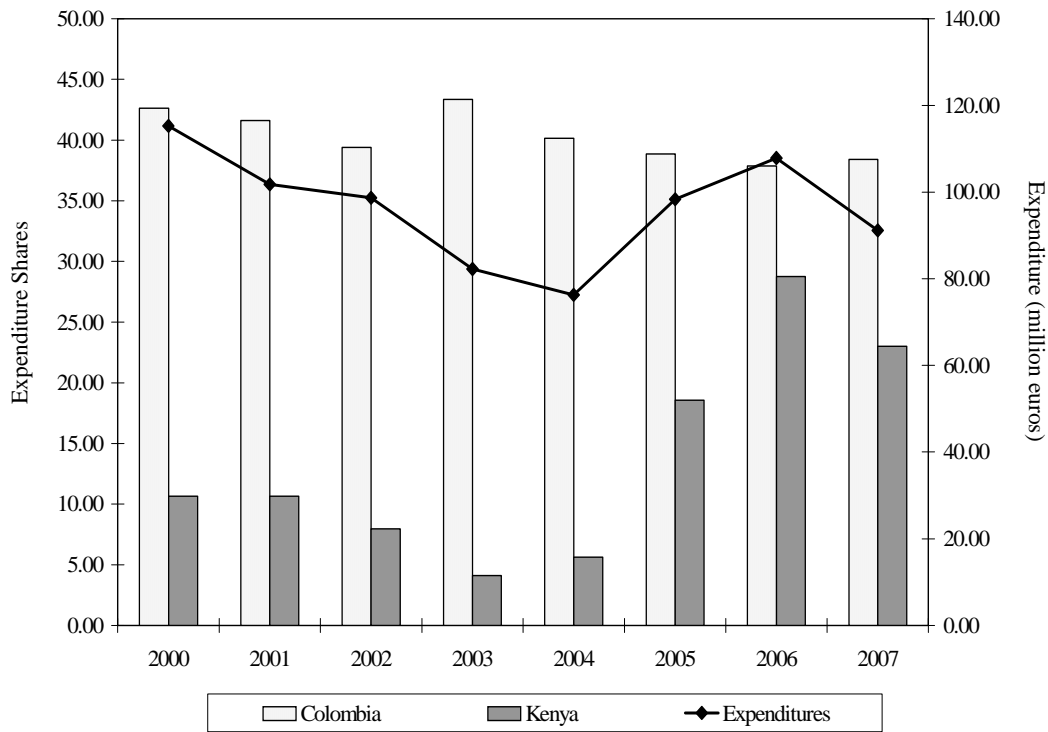
Source: Eurostat 2008

Figure 2. UK carnation imports (quantity and expenditure): 2000–2007



Source: Eurostat 2008

Figure 3. UK market shares (Colombia and Kenya) and carnation expenditures: 2000–2007



Source: Eurostat 2008

The observed changes in UK carnation imports are associated with the development of supermarkets as the main sales channel for carnations. Larger supermarket chains, due to their enormous buying power, have directly influenced the way products are sourced. Since supermarkets often prefer to source flowers directly from growers, shorter distribution lines are increasing in importance. The share of supermarkets is expected to increase, at the cost of traditional retail channels such as florists. The increase in supermarket share is mainly explained by the ability of supermarkets to lower profit margins because they are often supplied by specialized wholesale companies with their own production in developing countries. Florists' prices tend to be three times higher than supermarkets', and the price of mail order is almost five times higher (CBI 2007b).

3. THEORETICAL AND EMPIRICAL MODEL

Theoretical Model

The production version of the Rotterdam model (differential production model), which is derived from the differential approach to production theory (Theil 1980; Laitinen 1980), is used in estimating UK demand for imported carnations. The consumer-based Rotterdam model has been used more frequently in import demand analysis. See Mutondo and Henneberry (2007); Schmitz and Seale (2002); Winters and Brenton (1993); and Seale, Sparks, and Buxton (1992) for examples. It should be noted, however, that the original ‘‘Rotterdam’’ applications to import demand utilized the differential production model and not the more popular consumer-based specification (Clements and Theil 1978; Theil and Clements 1978).² As mentioned, Sanyal and Jones (1982) noted that given the intermediate nature of traded goods, producer theory may be more appropriate for modeling import demand; and even when a traded product is not physically altered, activities such as handling, insurance, transportation, storing, repackaging, and retailing still occur, resulting in a significant amount of domestic value added when the final product reaches the consumer. Recent import demand applications using the differential production model include Davis (1997); Washington and Kilmer (2002); Muhammad, Jones, and Hahn (2007); and Muhammad (2007). Unless specified, what follows can be attributed to these studies.

To derive the empirical model, we assume a two-step profit maximization procedure. First, firms minimize input expenditures subject to a technology constraint to get the conditional input demands; and second, firms maximize profit by varying output to get the output supply. Letting x represent input quantity and w represent input price, the conditional demand for the i th input is specified as (Theil 1980, p. 35):

$$f_i d(\log x_i) = \theta_i d(\log X) - \psi \sum_{j=1}^n (\theta_{ij} - \theta_i \theta_j) d(\log w_j) \quad (1)$$

Note that $i, j \in n$ where n is the number of inputs in the system. f_i is the share of the i th input in total cost $(w_i x_i / \sum_{i \in n} w_i x_i)$. θ_i is the marginal share of the i th input in total cost $[\partial(w_i x_i) / \partial(\sum_{i \in n} w_i x_i)]$.

$d(\log X)$ is the Divisia volume input index (Divisia index) where $d(\log X) = \sum_{i \in n} f_i d(\log x_i)$ and is a measure of change in real input expenditures. ψ is a positive scalar and may be regarded as a measure of the curvature of the logarithmic cost function. θ_{ij} is the i th- j th element of Θ , which is a symmetric

positive definite matrix where $\Theta = (1/\psi)\mathbf{F}(\mathbf{F} - \gamma\mathbf{H})^{-1}\mathbf{F}$, and $\sum_{j=1}^n \theta_{ij} = \theta_i$, and $\sum_{i=1}^n \theta_i = 1$. \mathbf{F} is a

diagonal matrix with factor shares (f_i) along the diagonal, and \mathbf{H} is a Hessian matrix of the firm’s implicit production function. The elements of \mathbf{H} are the second partials with respect to inputs

$(\partial^2 h / \partial \mathbf{x} \partial \mathbf{x}')$. γ is the revenue-cost ratio $(pQ / \sum_{i \in n} w_i x_i)$.

Letting Q represent firm output and p the output price, the log differential supply equation is expressed as follows (Theil 1980, p. 38):

$$d(\log Q) = \frac{\psi}{\gamma - \psi} \left[d(\log p) - \sum_{j=1}^n \theta_j d(\log w_j) \right] \quad (2)$$

² The theoretical approach is a nonissue when the focus of analysis is the conditional stage of demand because the production specification is empirically identical to the consumer specification (Theil 1980). The theoretical approach does matter, however, when unconditional estimates are of interest because the unconditional stages are empirically different with each approach. Given this distinction, the unconditional estimates could significantly differ between the two approaches (Davis and Jensen 1994; Washington and Kilmer 2002).

All terms are as previously defined. The relationship between equations (1) and (2) is due to changes in total input expenditures (as measured by the Divisia index) being proportional to changes in output by the factor γ (Theil 1980, p. 35). This is expressed as follows:

$$d(\log X) = \gamma d(\log Q) \quad (3)$$

Model Application to Import Demand

Following Armington (1969), we assume that carnations from each exporting country are individual goods (e.g., Kenyan carnations) that make up the product group *carnations*, where each country's export is assumed differentiated by country of origin. There are a number of reasons for differentiation of this type. Similar products from different sources may be physically different, but more often than not there are perceived differences, such as a country's reputation for quality products, trade history, reliability and consistency, and political issues tied to trade that give rise to price differences that are not explained by product attributes alone (Blonigen and Wilson 1999; Lopez, Pagoulatos, and Gonzalez 2006; Zhou and Novakovic 1996). Firms may view homogeneous products from different countries as differentiated given perceptions about exporting countries. For example, the regulatory issues or unreliability of one country may result in an importer's willingness to pay more for the same product from another country. In this context, cross-country competitiveness implies that changes in relative prices shift import demand to or away from riskier import sources, and the allocation of total imports across countries may be a way to minimize import risk (Seo 2001).

Following Theil and Clements (1978) and Clements and Theil (1978), we also assume that carnation imports are intermediate goods weakly separable from domestic inputs such as labor and fuel. For convenience, we denote the total number of inputs n , the number individual imports/source countries n_1 , and the number of domestic resources n_2 , where $n = n_1 + n_2$. The weak separability of domestic inputs and imports obviates the need to model domestic resource demand as part of the import allocation system. We employ this assumption because although resource prices were readily available, industry-specific resource quantities were not.

Given weak separability, the demand for an individual import can be expressed as a function of total import expenditures and individual import prices,

$$\bar{f}_i \Delta x_{it} = \theta_i \Delta X_t + \sum_{j=1}^{n_1} \pi_{ij} \Delta w_{jt} + \sum_{h=1}^{12} \delta_{ih} d_h + \varepsilon_{it} \quad (4)$$

Equation (4) is the import allocation model and is the finite version of equation (1) where x_i is the quantity of the i th import and w_j is the j th import price. As suggested by Theil (1980), continuous log changes have been replaced with finite log changes where for any x or w ,

$$\Delta x_{it} = \log(x_{it} / x_{it-1}) \approx d \log(x_i) \quad \text{and} \quad \Delta w_{it} = \log(w_{it} / w_{it-1}) \approx d \log(w_i) \quad \bar{f}_i = 0.5(f_{it} + f_{it-1}), \quad \text{where } f_i$$

is the share of the i th import in total import cost $(w_i x_i / \sum_{i=1}^{n_1} w_i x_i; \forall i \in n_1)$. $\Delta X_t = \sum_{i=1}^{n_1} \bar{f}_i \Delta x_{it}$ is the finite version of the Divisia index and is a measure of aggregated expenditures (in real terms) on imported carnations in the UK.

$\theta_i = \partial(w_i x_i) / \partial(\sum_i w_i x_i)$ is the marginal share of the i th import in total import cost.

$\pi_{ij} = -\psi(\theta_{ij} - \theta_i \theta_j)$ is the Slutsky price coefficient or conditional import price effect, which measures the effect of the j th product price on imports of the i th product. To account for the seasonal variation in carnation demand, monthly dummy variables (d_h) are included in equation (4), where δ_{ih} measures the impact of seasonality on the demand for the i th import. θ_i , π_{ij} and δ_{ih} are assumed constant for estimation. ε_{it} is a random disturbance term.

The import allocation model requires that the following parameter restrictions be met in order to conform to theoretical considerations: $\sum_i \theta_i = 1$, $\sum_i \pi_{ij} = 0$, and $\sum_i \delta_{ih} = 0$ (adding up); $\sum_j \pi_{ij} = 0$ (homogeneity); $\pi_{ij} = \pi_{ji}$ (symmetry); and the matrix of conditional price effects $[\pi_{ij}]$ should be negative semidefinite (Laitinen 1980). The import allocation model satisfies adding up by construction. We test for homogeneity and symmetry using likelihood ratio tests. The negative semidefinite property is confirmed when all conditional own-price effects are nonpositive ($\pi_{ii} \leq 0 \forall i \in n_1$).

The aggregate import expenditure function is derived from equation (2). Multiplying equation (2) by γ and using the relationship in equation (3), the determination of total import expenditures (also in finite log changes) is specified as

$$\Delta X_t = \eta \Delta p_t + \sum_{j=1}^{n_1} \pi_j \Delta w_{jt} + \sum_{k=1}^{n_2} \pi_k \Delta w_{kt} + \sum_{h=1}^{12} \delta_h d_h + \varepsilon_t \quad (5)$$

$$\eta = \gamma\psi / (\gamma - \psi); \quad \pi_j = -\gamma\theta_j [\psi / (\gamma - \psi)] \forall j \in n_1; \quad \text{and} \quad \pi_k = -\gamma\theta_j [\psi / (\gamma - \psi)] \forall j \in n_2.$$

Equation (5) states that the total expenditures on imported carnations are a function of the domestic carnation price (p), individual import prices (w_j), and resource prices (w_k). η , π_j , and π_k are assumed constant for estimation. ε_t is a random disturbance term.

Equations (4) and (5) form a system where (4) is the allocation of real import expenditures across exporting sources and (5) is the determination of real import expenditures. Substituting equation (5) for the Divisia index term in equation (4), we solve for the unconditional elasticities of demand with respect to the domestic price, resource prices, and import prices. These are respectively specified as

$$\eta_{xp} = \frac{\Delta x_i}{\Delta p} = \frac{\theta_i}{f_i} \eta \quad (6)$$

$$\eta_{xw_k} = \frac{\Delta x_i}{\Delta w_k} = \frac{\theta_i}{f_i} \pi_k \quad (7)$$

$$\eta_{xw_j} = \frac{\Delta x_i}{\Delta w_j} = \frac{\theta_i \pi_j}{f_i} + \frac{\pi_{ij}}{f_i} \quad (8)$$

Equations (6) and (7) are the responsiveness of the i th import to changes in the domestic retail price (p) and resource price (w_k), respectively. Equation (8) is the responsiveness of the i th import to changes in own-price ($i = j$) or the price of a competing import ($i \neq j$).

Equation (8) is comprised of two effects. The first term ($\theta_i \pi_j / \bar{f}_i$) is the indirect or expenditure effect of a change in price. The second term (π_{ij} / \bar{f}_i) is the relative or conditional price effect, that is, the effect of a price change holding total expenditures constant. The expenditure effect should be negative because $\pi_j < 0$ (an increase in import prices should lower total import expenditures) and $\theta_i > 0$ (an increase in total import expenditures should increase imported quantities). The relative price effect should be positive for cross-products (although not always the case) because a competitive relationship should exist for any two imports if total import expenditures are held constant. In a trade policy context, $\theta_i \pi_j / \bar{f}_i$ is the trade creation effect because it measures the increase in a specific import due to an

increase in total expenditures induced by a price decrease. π_{ij} / \bar{f}_i is the trade diversion effect because it measures the rate at which any two imports are substituted for one another given a change in their relative prices.

Policy Simulation Procedure

The chief objective of this study is to simulate the impact of PTAs on UK carnation demand. Following Kastens and Brester (1996) and Gustavsen and Rickertsen (2003), origin-specific import demand projections are derived using an elasticity-based forecasting equation where the projected quantity of the i th import is given as

$$x_{it+1} = \left(\eta_{xp} \left[\frac{p_{t+1} - p_t}{p_t} \right] + \sum_{j=1}^{n_1} \eta_{xw_j} \left[\frac{w_{jt+1} - w_{jt}}{w_{jt}} \right] + \sum_{k=1}^{n_2} \eta_{xw_k} \left[\frac{w_{kt+1} - w_{kt}}{w_{kt}} \right] \right) x_{it} + x_{it} \quad (9)$$

Equation (9) states that the quantity of the i th import in period $t+1$ is a function of the quantity imported the previous period (t) and the percentage changes in the domestic price, resource prices, and origin-specific import prices. Note that the η 's are the unconditional elasticities defined by equations (6) through (8).

Carnation imports from countries without special agreements are assessed the third country duty rate of 12% (Taxation and Customs Union 2008). We apply this tariff rate to carnation imports from Colombia and Kenya to assess the impact of PTAs on import demand. At present, no duties are imposed on carnations from these countries (Taxation and Customs Union 2008). Thus, the percentage change in their import prices due to the tariff should equal the tariff rate,

$$(w_{jt+1} - w_{jt}) / w_{jt} = (w_{jt}(1.12) - w_{jt}) / w_{jt} = 0.12 \quad (10)$$

Using equations (8), (9), and (10), and assuming no change in p or w_k , the impact of the tariff on the i th import is as follows:

$$x_{it+1} = \left[\sum_{j \in \{C, K\}} \frac{\theta_i \pi_j}{\bar{f}_i} + \sum_{j \in \{C, K\}} \frac{\pi_{ij}}{\bar{f}_i} \right] (0.12)x_{it} + x_{it} \quad (11)$$

j denotes Colombia (C) and/or Kenya (K) in this instance. Equation (11) gives the impact of a change in the j th price on the i th import. The expenditure and relative price effects are the first and second terms in brackets, respectively. The first term measures the trade destruction (negative trade creation) effect of the tariff, which is the decrease in x_i due to a tariff-induced decrease in aggregate expenditures. The second term is the trade diversion effect of the tariff, which is the substitution of j for i due to a tariff-induced increase in the price of j relative to i . We used equation (11) to derive the trade creation and diversion effects of each PTA (EPA and GSP+) separately and both PTAs jointly.

4. EMPIRICAL RESULTS

Data and Estimation Results

The External Trade Section of the Statistical Office of the European Communities (Eurostat) provided the import data used in this study, which was the harmonized system classification “fresh cut carnations and buds of a kind suitable for bouquets or for ornamental purposes.” Monthly data were used for estimation, and the time period was from January 2000 to February 2008. Source-specific imported quantities of fresh-cut carnations for the UK were measured in units of 100 kg, and values were in euros. Import values were on a cost-insurance-freight basis. The exporting countries were Spain, the Netherlands, Kenya, Colombia, and the rest of the world (ROW). The ROW was an aggregation of UK imports from non-EU countries other than Colombia and Kenya. Given that carnations from Spain and the Netherlands accounted for the overwhelming majority of UK imports from EU countries, imports from other EU countries were negligible and were excluded from this analysis. Domestic carnations (UK production) were also excluded for the same reason.³

Import prices were calculated by dividing the value of the commodity by the quantity, which resulted in a euro per 100 kg unit of measurement. Given that monthly domestic carnation prices at the retail level were not available, the UK consumer price index for garden plants and flowers was used as a proxy. Note that carnations account for about 15% of total cut flower imports in the UK, and an even smaller percentage of total plant and flower demand. Thus, changes in carnation prices may not be completely represented by this index. However, this index does reflect the overall viability of the plant and flower sector in the UK, which could affect flower imports overall and carnation imports in particular. A wage index for the retail trade sector was used to account for the cost of labor. Both indexes were provided by the UK Statistics Authority, Office for National Statistics. Diesel fuel prices in euros per liter were used to account for in-country transportation cost and other energy expenses. Fuel prices were provided by Eurostat.

Descriptive statistics for all variables are presented in Table 2. The average monthly price of Kenyan carnations in the UK was €401.53/kg for the data period January 2006–February 2008. During this period Kenyan prices were as high as €603.20/kg and as low as €23.89/kg. UK importers paid about €88.00 more for Colombian carnations on average and paid as much as €74.62/kg. During the data period, there was little change in the UK plant and flower price index, which ranged from 98.3 to 107.1. Fuel prices ranged from €1.05/liter to €1.44/liter, and the wage index ranged from 98.20 to 127.40.

The import allocation model in equation (4) and total expenditure equation (5) were estimated separately using the nonlinear least squares (LSQ) procedure in TSP (Time Series Processor) version 5.0.⁴ This procedure uses the multivariate Gauss-Newton method to estimate the parameters in the system (Hall and Cummins 2005). Due to the adding up property, the import allocation system was singular and required that an equation be deleted for estimation. The ROW equation was deleted for this purpose; however, as shown by Barten (1969), maximum likelihood estimates are invariant to the chosen deleted equation.

Likelihood ratio (LR) tests were used to test for first-order autocorrelated disturbances in equations (4) and (5) and the economic properties, homogeneity, and symmetry. The autocorrelation parameter in the import allocation system was obtained using the maximum likelihood procedure for singular systems found in Beach and MacKinnon (1979). The hypothesis of no autocorrelation was rejected at any reasonable significance level in the import allocation system and failed to be rejected in the total expenditure equation. The properties of homogeneity and symmetry (given homogeneity) were initially rejected at the 0.01 and 0.05 significance levels. Moschini, Moro, and Green (1994) note that the

³ In 2006, UK carnations accounted for less than 0.5% of the total available supply.

⁴ Theil (1980, pp. 92–94) shows that if the parameters in equations (4) and (5) are assumed constant and the errors normally distributed, then $\text{COV}(\mathcal{E}, \mathcal{E}_i) = 0$. Thus, the total expenditure equation and import allocation system needn't be estimated jointly.

LR test is biased toward rejection and suggest a correction given by Italianer (1985). This correction somewhat improved test results where homogeneity and symmetry failed to be rejected at the 0.01 significance level; however, both were still rejected at the 0.05 significance level. All results that follow have homogeneity and symmetry imposed.

Table 2. Descriptive statistics (monthly): January 2006–February 2008

	Spain	Netherlands	Kenya	Colombia	ROW [†]
Price (€/100kg)					
Mean	318.93	524.62	401.53	489.83	274.58
Standard Deviation	92.26	147.53	89.47	77.31	88.11
Minimum	149.77	92.21	223.89	304.49	116.33
Maximum	879.56	952.88	603.20	674.62	553.15
Import quantity (100kg)					
Mean	4,914	2,849	2,658	6,642	2,772
Standard Deviation	2,736	1,470	1,756	1,422	2,125
Minimum	782	1,072	339	3,822	20
Maximum	12,435	12,260	6,548	10,130	9,256
Import value (€)					
Mean	1,523,870	1,395,701	1,154,383	3,232,261	655,074
Standard Deviation	912,240	532,771	885,495	806,149	399,669
Minimum	306,874	542,413	114,106	1,803,969	11,063
Maximum	4,148,160	3,171,778	3,306,040	5,726,876	1,530,212
Value share (%)					
Mean	18.95	17.25	13.88	40.85	8.05
Standard Deviation	10.27	4.84	10.05	8.20	4.65
Minimum	4.27	8.36	1.44	25.61	0.15
Maximum	47.66	30.12	38.88	63.75	18.28
Total Expenditure Variables					
	UK Price (index)	Fuel Price (€/liter)	Wages (index)		
Mean	101.68	1.25	114.11		
Standard Deviation	2.06	0.10	8.73		
Minimum	98.30	1.05	98.20		
Maximum	107.10	1.44	127.40		

Note: [†] ROW is the rest of the world.

Conditional import demand estimates (marginal share and price coefficients) are presented in Table 3. The seasonality estimates can be furnished upon request. Most of the variation in origin-specific import demand was explained by the import allocation model. The marginal factor share estimates indicated a positive and significant relationship between total import expenditures and origin-specific imports. As total import expenditures increased, imports from Colombia had the largest increase (0.349). The marginal share estimates for Spain (0.199) and the Netherlands (0.214) were relatively smaller but still larger than Kenya (0.171) and the ROW (0.067). The estimates for Colombia and Kenya indicate that for every one euro increase in carnation expenditures in the UK, €0.35 is allocated to Colombian carnations and €0.17 is allocated to Kenyan carnations.

The conditional own-price effects were all negative as expected and significant for all countries except Kenya. See the diagonal elements in Table 3. Colombia had the largest own-price estimate (-0.165), which is in part due to Colombia's accounting for the larger share of the UK carnation market. The own-price estimates for the remaining countries were as follows: -0.042 (Spain), -0.093 (the

Netherlands), -0.027 (Kenya), and -0.067 (ROW). The conditional cross-price estimates indicated that carnations from the Netherlands and Kenya were substitutes (0.026). Colombian carnations were substitutes for carnations from the Netherlands (0.054) and the ROW (0.062). No significant relationship existed between Spain and the other exporting countries. This confirms what was previously mentioned in the introduction, that is, there was no significant competition between Spain and Colombia or Kenya, but there was significant competition between the Netherlands and Colombia or Kenya. Thus, a decrease in the price of Colombian or Kenyan carnations relative to intra-EU carnation prices would have no effect on Spain but would negatively affect carnations from the Netherlands. Interestingly, there was not a significant relationship between Colombian and Kenyan carnations, which may be due to contractual arrangements between UK importers and developing countries. This is partly reflected in Figure 3, which shows that Kenya's share of the UK market significantly increased while Colombia's market share remained relatively unchanged.

The cross-price estimates for the Netherlands and the non-EU countries (particularly Kenya) are in part due to the decreased use of Dutch intermediaries. Moreover, the replacement of carnations from the Netherlands with imports from developing countries may actually reflect the change in the method of importing (re-exports through EU intermediaries versus direct imports) more so than origin-specific product substitution (Dutch carnations versus Colombian or Kenyan carnations). As carnations from developing countries become relatively less expensive, particularly when compared with those received by Dutch intermediaries, UK importers may have bypassed Dutch middlemen and purchased directly from the developing countries (CBI 2007b). For Spain, the Armington specification (origin-specific uniqueness) is more fitting given that its carnation exports to the UK were conditionally unrelated to carnations from the other source countries.

Table 3. Conditional import demand estimates

Exporting country	Marginal share θ_i	Price coefficients π_{ij}				
		Spain	Netherlands	Kenya	Colombia	ROW
Spain	0.199 ^a (.043)	-0.042 ^b (.020)	0.004 (.013)	-0.003 (.014)	0.026 (.019)	0.014 (.011)
Netherlands	0.214 ^a (.039)		-0.093 ^a (.026)	0.026 ^b (.012)	0.054 ^a (.016)	0.009 (.010)
Kenya	0.171 ^a (.037)			-0.027 (.022)	0.022 (.022)	-0.019 (.013)
Colombia	0.349 ^a (.046)				-0.165 ^a (.036)	0.062 ^a (.017)
ROW	0.067 ^b (.029)					-0.067 ^a (.015)
Equation R^2		0.68	0.63	0.37	0.81	0.82

Notes: Homogeneity and symmetry are imposed. Asymptotic standard errors are in parentheses.

^a Significance level = 0.01; ^b Significance level = 0.05.

Table 4 presents estimates for the total expenditure equation. To account for domestic price expectations, a one-period lag in p was used in estimating equation (5). Here we assume that wholesalers procure carnation imports based on the expected returns from domestic sales and not on present domestic prices, which could be endogenous. p lagged one-period was used as a proxy for expected domestic prices. The domestic price estimate (1.704) was positive, as expected, and significant at the 0.05 level, indicating that an increase in the domestic price increased total import expenditures. Although the price of fuel and labor had the expected negative signs (-0.560 and -0.491, respectively), neither was significant. Although labor was highly insignificant, fuel prices were not (P value = 0.16).

Table 4. Total expenditure estimates

Variable	Estimate	
(η) Domestic price	1.704	(.872) ^b
(π_j) Import prices		
Spain	-0.161	(.041) ^a
Netherlands	-0.129	(.035) ^a
Kenya	0.053	(.069)
Colombia	-0.296	(.119) ^b
ROW	-0.016	(.053)
(π_k) Resource prices		
Fuel	-0.560	(.399)
Labor	-0.491	(.919)
(δ_h) Seasonal Dummies		
January	-0.276	(.040) ^a
February	0.187	(.038) ^a
March	0.199	(.034) ^a
April	-0.207	(.044) ^a
May	0.042	(.035)
June	-0.183	(.036) ^a
July	0.002	(.039)
August	-0.028	(.039)
September	0.037	(.034)
October	0.024	(.034)
November	0.058	(.035)
December	0.235	(.038) ^a

Notes: $R^2 = 0.79$

Asymptotic standard errors are in parentheses.

^a Significance level = 0.01; ^b Significance level = 0.05.

The impact of import prices on total expenditures was negative (as expected) for all exporting countries except Kenya and was significant for Spain (-0.160), the Netherlands (-0.129), and Colombia (-0.296). Given that Colombia is the UK's largest supplier, the price of Colombian carnations had the largest effect on total import expenditures.

Unconditional Import Demand Elasticities

The unconditional import demand elasticities are reported in Table 5. The domestic price elasticities, which measure the impact of percentage changes in the domestic price on individual imports, were relatively large when compared with the other elasticities. However, none of these elasticities were significant at the 5% level; and for the ROW, this elasticity was not significant at the 10% level. With the exception of Kenya, the unconditional own-price elasticities were all significant where demand was inelastic for each individual product. ROW carnations were the least inelastic (-0.84). The unconditional own-price elasticities for the Netherlands and Colombia were relative smaller in absolute value (-0.70 and -0.66), but larger than the estimate for Spain (-0.39).

The unconditional cross-price elasticities show that carnations from each country were mostly unrelated or substitutes with the exception of the complementary effect of Spain's price on imports from Kenya (-0.22). This is due to carnations from Kenya and Spain being unrelated (conditionally) and the significant negative effect of Spain's price on total import expenditures. Given that total import expenditures were statistically invariant to changes in the price of Kenyan carnations, the conditional competitive relationship between Kenya and the Netherlands held unconditionally (0.22). This suggests that the Netherlands would be the only country to benefit from a tariff on Kenyan carnations. For Colombia, the cross-price elasticities were insignificant for all countries except the ROW, where Colombia and ROW were both positively affected by each other's prices.

Table 5. Unconditional import demand elasticities

Exporting country	Domestic price	Own-price	Cross-price				
			Spain	Netherlands	Kenya	Colombia	ROW
Spain	1.78 (0.99)	-0.39 ^a (0.19)		-0.11 (0.08)	0.04 (0.10)	-0.17 (0.18)	0.06 (0.08)
Netherlands	2.12 (1.09)	-0.70 ^a (0.10)	0.18 (0.09)		0.22 ^b (0.11)	-0.05 (0.19)	0.03 (0.09)
Kenya	2.11 (1.17)	-0.13 (0.22)	-0.22 ^b (0.11)	0.03 (0.09)		-0.20 (0.23)	-0.16 (0.11)
Colombia	1.46 (0.77)	-0.66 ^a (0.14)	-0.07 (0.06)	0.02 (0.09)	0.10 (0.08)		0.14 ^b (0.06)
ROW	1.41 (0.95)	-0.84 ^a (0.19)	0.05 (0.14)	0.00 (0.12)	-0.19 (0.17)	0.53 ^b (0.27)	

Notes: Elasticities are evaluated at mean expenditure shares. Asymptotic standard errors are in parentheses.

^a Significance level = 0.01; ^b Significance level = 0.05.

Policy Simulations: The Impact of the 12% Tariff on Colombia and Kenya

Import demand projections are reported in Table 6 and are based on three policy scenarios: the termination of the GSP+ agreement with Colombia, the termination of the EPA with Kenya, and the termination of both the GSP+ and EPA. For each scenario, we simply increased the appropriate price(s) by 12% and assessed the changes in imports due to trade creation and diversion. UK carnation imports in 2007 are used as the no-tariff baseline.

Given the 12% tariff on Colombian carnations, total UK imports decreased by 5,684 hundred kg. Results show that Colombia is the primary beneficiary of not being assessed the 12% tariff. UK imports from competing countries are also greater without this tariff (ROW is the exception). Since the total price effects for Colombia were mostly insignificant, the projected increases for the competing countries in Table 6 should not be statistically different from zero.

Results show that the effect of the PTA between the European Union and Colombia on the UK carnation market is mostly trade creation. Note that the increase in total UK imports due to trade creation (8,005 hundred kg) outweighed the trade diversion (-2,371 hundred kg). The increase in UK imports from Colombia (5,400 hundred kg) is due to both trade creation (2,084 hundred kg) and trade diversion (3,317 hundred kg), where the trade diversion is primarily the substitution of ROW imports with Colombian imports.

Given the insignificant price elasticities for Kenya, the difference in total UK imports with and without the tariff on Kenyan carnations was only 747 hundred kg and is likely not statistically different from zero. Additionally, the trade creation projections for all countries are probably not different from zero as well. The trade diversion outcome for the Netherlands is the only result that is statistically reliable. With that being said, the effect of the PTA between the European Union and Kenya is mostly

trade diversion, assuming that the trade creation results are statistically zero. The results show that the increase in UK imports from Kenya (752 hundred kg) is mostly due to a decrease in imports from the Netherlands (-832 hundred kg).

Table 6. Impact of the 12% tariff on Colombia and Kenya

Country	Quantity (100kg)		Tariff on Colombian carnations		
	Without tariff	With tariff	Difference	Trade creation	Trade diversion
Spain	27,087	26,526	561	1,006	-445
Netherlands	45,534	45,241	293	2,009	-1,716
Kenya	48,644	47,449	1,195	2,136	-941
Colombia	68,580	63,180	5,400	2,084	3,317
ROW	27,861	29,627	-1,766	820	-2,586
Total	217,706	212,022	5,684	8,055	-2,371

Country	Quantity (100kg)		Tariff on Kenyan carnations		
	Without tariff	With tariff	Difference	Trade creation	Trade diversion
Spain	27,087	27,220	-133	-179	46
Netherlands	45,534	46,723	-1,189	-357	-832
Kenya	48,644	47,892	752	-379	1,131
Colombia	68,580	69,400	-820	-370	-450
ROW	27,861	27,218	643	-146	788
Total	217,706	218,453	-747	-1,430	683

Country	Quantity (100kg)		Tariff on Colombian and Kenyan carnations		
	Without tariff	With tariff	Difference	Trade creation	Trade diversion
Spain	27,087	26,659	428	827	-399
Netherlands	45,534	46,430	-896	1,652	-2,548
Kenya	48,644	46,697	1,947	1,757	190
Colombia	68,580	63,999	4,581	1,714	2,867
ROW	27,861	28,984	-1,123	674	-1,798
Total	217,706	212,769	4,937	6,624	-1,688

5. SUMMARY AND CONCLUSION

In this study, we estimated the demand for fresh-cut carnations in the UK, where it was assumed that carnation imports were differentiated by country of origin. Given the role of intermediaries and retailers in the UK carnation trade, imports were treated as inputs and a production version of the Rotterdam model was used in demand estimation. In treating imports as such, we specified and estimated a system of import demand equations. Estimates were then used to derive the unconditional price effects for each exporting country and estimate the trade creation and diversion effects of PTAs in the UK market for carnations.

Results showed that both Colombia and Kenya benefit from their preferential agreements with the European Union in the UK carnation market. Colombia benefited more so than Kenya: the benefit to Colombia was due to both trade creation and diversion, whereas the benefit to Kenya was mostly due to trade diversion. Given the insignificant competition between Colombian and Kenyan carnations, projection results provided no evidence that the preferences given to Colombia harmed Kenya or vice versa. When the 12% tariff was applied to both countries, the results were similar to the outcome when the tariff was applied to Colombia only. This is due to the insignificant impact of Kenya's price on import demand.

Kenya is clearly better off with the Colombian PTA because of the limited substitutability between the two countries and the significant negative relationship between Colombia's price and total UK expenditures on carnations. Spain is better off, or at worst unaffected, by these preferential agreements. In contrast, the Netherlands is worse off due to significant competition from Kenya. The ROW is also worse off due to significant competition from Colombia.

Overall, the projections indicated that preferential access for these developing countries is for the most part trade creating in the UK carnation market. The competing developing countries (Colombia and Kenya) were made better off by their preferential agreements and given Colombia's importance to the UK, Kenya was made better off by Colombia's having tariff-free access to the European Union. Colombia for the most part was unaffected (statistically) by Kenya's having tariff-free access to the European Union. This suggests that exporters in one country should not be concerned with the access given to a competing developing country. While this may not be the case for all sectors, this appears to be the case for the carnation market in the UK.

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