De Gustibus Asparagus:

Habits, Trade, and Welfare from

Out of Season Imports of Fresh Vegetables

Abstract:

Fresh vegetables, including asparagus, are now available in months outside of the domestic growing season for most U.S. consumers. We use the virtual price method to calculate the equivalent variation for increased availability in a demand system for fresh and frozen vegetables and find that virtual price of out-of-season asparagus is roughly three times higher than its in-season price in years prior to year round availability. We find the equivalent variation between 1986-1991 (when asparagus was available approximately half the year) and 1993-1999 (when it was available year round) to be 0.91 of consumer vegetable budgets, implying a welfare benefit of approximately $86 million annually. We also find evidence of habit formation for fresh but not frozen goods.

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> *"How much would a consumer pay to have the privilege of choosing from the variety of items available in today's supermarket instead of being constrained to the much more limited variety available 30 years ago? A conservative estimate of the value of extra variety and convenience might be 10 percent for food consumed at home other than produce, 20 percent for produce where the increased variety in winter (as well as summer farmers' markets) has been so notable..."* Boskin Commission Report to Senate Finance Committee (1996)

Until 1991, fresh asparagus was largely unavailable in the U.S. from July to January. In 2008, imports from Mexico and Peru made it available year-round. Similar increases in availability are present with Chilean peaches, plums and grapes. Prior to these changes, out-of-season fruits and vegetable consumption relied heavily on preserved goods. In 1991, the consumption share of fresh vegetables to frozen or canned vegetable was 52%, a relatively stable rate since 1970 (ERS, 2009)[1]. From 1991 through 2008, per capita frozen and canned vegetables consumption fell 13% while fresh vegetable consumption rose 23%, making the current fresh share 60%.

The welfare benefits of increased choice and availability are thought to be substantial. While trade liberalization that increases imports typically benefits domestic consumers and harm domestic products, the benefits are greater and the harm smaller when such trade involves counter-seasonal imports of perishable goods. Empirically, previously unavailable goods may be treated as new goods. And, with increased availability, consumers may form habits that shift preferences over time. Habits, in the Stigler and Becker sense ("De Gustibus Non Est Disputandum", 1977), arise when consumers, through the good's consumption, build knowledge of its uses, quality, and complementarities with other goods. As asparagus, for example, becomes available year-round, consumers learn about its preparation, and restaurants use it as a regular ingredient. As a perishable commodity with a well-established consumption profile, the

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[1] Consumption, here, refers to per capita farm-level disappearance. Of disappearance quantities, the amount of food eaten is, by definition, smaller due to spoilage, processing, disposal or other loss (Kantor et al, 1997). Loss is likely to be higher for fresh rather than frozen food.

confounding effects of novelty, learning, and market power are minimal and consumption choices are frequent, making habit formation a more apparent process.

To quantify the welfare benefits of increased availability in the presence of habit formation, we estimate a translog (TL) demand system for asparagus, broccoli, carrots, cauliflower, and a composite frozen vegetable using monthly national aggregate data from 1992 to 2008. We then test for habits using lagged own- and cross-commodity consumption while controlling for time trends and seasonality. For most goods habits are significant and positive, except for frozen goods, where lagged frozen consumption reduces current frozen demand. We then generate virtual prices – "choke prices", the minimum price for which consumers do not purchase the good – for asparagus in off-season months between 1986 and 1991 when it was unavailable. Virtual prices are approximately 3 times higher than the average in-season price. We then calculate the equivalent variation between years using the indirect utility function derived from the translog demand system. We estimate the equivalent variation between 1986 and 1991 (the period of unavailability) and 1993-1999 at 0.91, implying that consumers in the later period would be as happy as those in the earlier period with a 9% smaller budget.

Literature Review

Duality theory emphasizes the general equivalence of the direct utility function, which is dependent on quantities, and the indirect utility function, which is dependent on prices and budgets. Indirect utility functions are useful for estimating the welfare benefits of changing prices. When a good is not consumed, however, the relevant price faced by consumers is not the observed price. If one estimates a demand system based on a price-dependent indirect utility

function to calculate the value to consumers of the falling prices between periods of zero and positive consumption, predicted demand may be negative in periods when goods are not consumed, a nonsensical result violating the non-negativity constraint. The virtual price concept allows for welfare analysis calculations using the indirect utility function by incorporating the corner solution for periods when zero consumption occurs.

When all goods are consumed, the virtual price is equal to the actual price. When a good is not consumed, the virtual price is the minimum price in which the consumer purchases a quantity of zero. In periods when all goods are consumed, the distinction is moot. However, when some goods are seasonal issues surrounding the failure to incorporate virtual prices because the failure to incorporate such prices may cause consumer welfare benefits to be underestimated, as the following example illustrates.

Consider Figure (1) in which two goods, A (asparagus) and B (broccoli), are consumed in period t at levels q_A^t and q_B^t. In period 1, only broccoli is consumed, although list prices – p_A^1 and p_B^1 – are observed for both goods. In period 2, both goods are consumed. Suppose that an indirect utility function, $\psi(p, y)$, can be reliably estimated from income-normalized prices. Consumers facing p_A^2 and p_B^2 in period 2 will consume q_A^2 and q_B^2 as the non-negativity constraint on consumption is not binding. However, in period 1, the estimated utility function may erroneously imply that consumers facing p_A^1 and p_B^1 will consume q_A^1 and q_B^1 where q_A^1 is negative. Additionally, it will imply that utility is ψ_1'. Let π_A^1 equal the virtual price in period 1, which creates a tangency with ψ_1, which is lower ψ_1'. To calculate the equivalent variation – the change in income that equates the period 2 utility with period 1 utility at period 2 prices – re-scale the budget downward (or equivalently, rescale all prices upward) by e. In figure (1), the rescaling of the budget is equivalent to a parallel inward shift of the budget line. The equivalent

variation e is equal to $C/(C+D)$. Multiplying this value by income in period 2 will convert it to a unit (dollar) value, rather than a percentage value.

Figure 1 – Interpreting the Equivalent Variation in Quantity Space
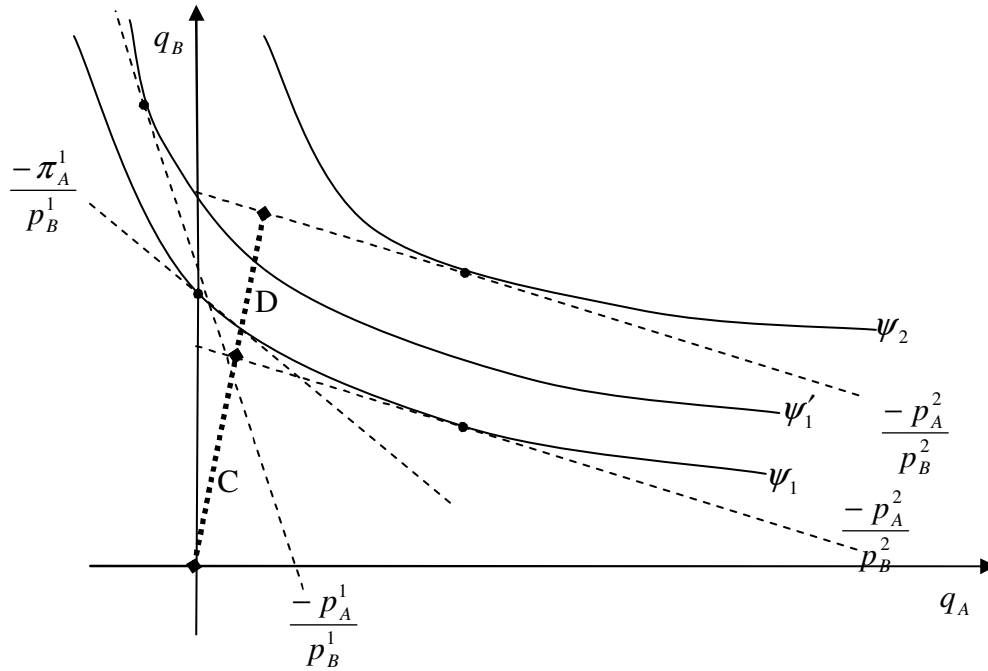
Calculating the equivalent variation requires knowledge of the indirect utility function and virtual prices. These may be estimated in two ways. The Lee and Pitt method (1986) separates periods in which all goods are consumed and those in which not all goods are consumed. The virtual price for the non-consumed good is derived from the share equations as a function of the model parameters, the (observed) prices of other goods consumed, and its estimation error. The virtual price solution is reinserted into the estimated share equations for the remaining goods, which now depend on the errors of the missing good, their own error, observed prices of positively consumed goods and the parameters to be estimated. The own-errors of the positively consumed goods can be solved for as a function of the actual and

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predicted shares (which include the own-share error).   By multiplying the probability density functions of each share error term, the likelihood function for each observation with zero budget shares is recovered. Then, the product of the likelihood functions including goods with a zero budget shares and those with (all) non-zero budget shares is the likelihood function to be maximized in estimation.

While the Lee and Pitt method benefits from the inclusion of more observations, it generates the same set of parameters as a demand system in which all prices are observed. Moreover, the Lee and Pitt method suffers from the curse of dimensionality, as it requires the evaluation of multivariate probability integrals when evaluating the likelihood function, and the coherency problem, in that the method does not guarantee a "one-to-one mapping between all feasible realizations of the stochastic components of the model and all possible vectors of demand" (Milliment and Tchernis, 2009).   A simpler method estimates the utility function parameters using the abbreviated dataset in which all goods are consumed.   Then, from the estimated demand system parameters, one can recover virtual prices for periods in which some goods are not consumed.

Virtual prices have been used in a variety of applications to consider the value of new goods or of increased variety. Phaneuf (1999) estimates the willingness to pay for new recreation sites that differ by key characteristics. Yue and Beghin (2009) calculate the tariff rate equivalent of a quarantine restriction that prevents the importation of New Zealand apples to Australia as the difference between the virtual and imported prices of that fruit. Hausman (1997, 1999) finds that newly-introduced cereals and cell phones generate substantial welfare benefits. While a consumer's willingness to pay for new goods is exaggerated in the short-run when those goods are novel or fashionable (Bresnahan, 1996) or when consumers are sampling new goods to

learn their quality, our application involves an established product with stable, known

characteristics[2].

The virtual price method is typically estimated with the translog utility function owing to

its neat parametric solutions for virtual prices. Like the comparable AI demand system, the TL

demand system is flexible in that it can be regarded as a second-order approximation to any

utility function (Jorgensen, Christensen, and Lau, 1975). In the basic specification, the models

share the same number of parameters and generate similar elasticity estimates. Generally,

goodness of fit measures (R-squares, likelihood function values) are similar (Wang et al, 1996;

Piggott, 2003; Holt and Goodwin, 2009).

Several studies have tested habit formation in a variety of applications, often with

emphasis on addiction (e.g. to cigarettes) and aggregate consumption. Holt and Goodwin (1996)

and Zhen and Wohlgenant (2006, 2009) have incorporated habit formation into demand systems

for meats. However, habits and seasonality are typically not included in demand systems for

vegetables as, for example, in the Stanton (2007) study showing that out-of-season Chilean grape

imports do not depress U.S. grape prices.

Demand Model

Let $\tilde{p}_t(p_t/y_t)$ be prices normalized by expenditure, q the vector of (lagged) quantities, α and β,

the model parameters to be estimated, and ε_t, the error term. The translog indirect utility

function is specified as :

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[2]Consumers may demonstrate a preference for local (i.e. U.S. produced) foods that might have unmeasured quality
differences. Our empirical estimation strategy largely ignores this variation because through most of our data period
the local appellation was not available and products of different origins did not compete directly. In this case,
differences in quality would be absorbed into seasonal dummy variables.

$$\ln \Psi_t\left(\tilde{p}_t\left(p_t/y_t\right), q, \alpha, \beta, \varepsilon\right) = \alpha_0 + \sum_{i=1}^{M} \alpha_{i,t} \ln \tilde{p}_{i,t} + \frac{1}{2}\sum_{i=1}^{M}\sum_{j=1}^{M} \beta_{ij} \ln \tilde{p}_{i,t} \ln \tilde{p}_{j,t} + \sum_{i=1}^{M} \varepsilon_{i,t} \ln \tilde{p}_{i,t} \qquad (1)$$

Habit effects, seasonality, and the time trend are all controlled for through the α and *lag* terms as

follows in (2) and (3)

$$\alpha_{i,t} = \alpha_{i,0} + \sum_{Mon} \alpha_{i,Mon} D_{Mon} + \alpha_{t,i} t + \sum_j \alpha_{i,j,lag} lag_{i,j} \qquad (2)$$

$$lag_{j,t} = \sum_i^{12} d^{i-1} q_{j,t-i} \qquad (3)$$

While the discounted lag length may feasibly be set indefinitely, discounting typically precludes

older observations from having a significant effect[3]. Previous empirical studies of habit

formation have found that using the most recent lags would capture most of the dynamics in

consumption (Fuhrer, 2000; Chen and Ludvigson, 2009). Additionally, symmetry, equality and

additivity restrictions suggested by Phaneuf (1999) imply:

$$\beta_{ij} = \beta_{ji} \qquad (4)$$

$$\sum_{i=1}^{M} \beta_{ij} = \sum_{i=1}^{M} \beta_{ji} = 0 \qquad (5)$$

$$\sum_{i=1}^{M} \alpha_{i,0} = 1, \text{ where } \sum_i \alpha_{i,Mon} = 0, \ \sum_i \alpha_{i,t} = 0, \ \sum_i \alpha_{i,j,lag} = 0 \qquad (6)$$

In discussing share equations hereafter, we suppress the *t* subscript. Let good 1 be the good

whose consumption is sometimes zero and set v_1 to be its virtual price in those periods. Via

Roy's identity, the expenditure shares are:

$$s_i = \tilde{p}_i q_i = -\left(\alpha_i + \sum_{j=1}^{M} \beta_{ij} \ln \tilde{p}_j + \varepsilon_i\right) \qquad (7)$$

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[3] If the lag term is set for increments other than 12 months, it may inadvertently capture seasonality. We test for
longer lags and find that effects are negligible.

From (7), the income-normalized virtual price for good 1 $(\tilde{\pi}_1)$ is a function of prices $(\tilde{p})$ and the demand system parameters (α, β) as shown in (8):

$$\ln(\tilde{\pi}_1) = -\left(\alpha_1 + \sum_{j=2}^{M} \beta_{1j} \ln \tilde{p}_j + \varepsilon_1 \right) \Big/ \beta_{11} \tag{8}$$

Given our parameter estimates, we evaluate the equivalent variation using the virtual price provided by increased availability over time. Because availability fluctuates over the course of the year, we evaluate the equivalent variation for each month and then average them over the months of the time periods being compared. The equivalent variation (*e*) solves the following equation:

$$\psi\big(\tilde{\pi}(p^1/y^1), \theta, \varepsilon\big) = \psi\big(\tilde{p}(p^2/(e * y^2)), \theta, \varepsilon\big) \tag{9}$$

For goods with positive demand, the virtual price $(\tilde{\pi}_i)$ is equal to the observed price. A value of *e* that is less than one indicates that consumers facing period 2 prices require less income to be as happy as consumers in period 1. A value of *e* that is greater than one indicates that consumers in period 2 require more income to be as happy as consumers in period 1. The unit (dollar) value equivalent of the equivalent variation is simply $(1-e) \times y_2$.

Data
Our data came from several USDA sources. To analyze seasonality, we use monthly price and quantity data on fresh vegetable shipments from the USDA-ERS vegetable and melon yearbook. We included asparagus, broccoli, carrots, and cauliflower within the demand system because prices for these goods are collected over a longer time period than for other goods, the goods are tightly defined (unlike beans and lettuce, which include many varieties) and each good is often used with minimal processing. Underlying the yearbook, fresh quantities data came from the Agricultural Marketing Service's annual fresh fruit and vegetable shipment reports covering total

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monthly imports (disaggregated by country) and domestic (disaggregated by region) vegetable shipments in 100,000 pound units. Quantity data is a comprehensive aggregate of national level availability. Although AMS quantity data can omit home-grown and locally sold items, the concentrated geography of production of these goods minimizes that problem. For months when domestic, but not imported, fresh asparagus is unavailable, fresh prices are unavailable from AMS. For these 71 months, we use the Caribbean Import Price (for South Florida) adjusted upward by 8.76%[4]. For 38 months between 1986 and 1991, prices were unavailable for asparagus and both domestic and imported quantities were trivial (less than $1/10^{th}$ in-season production.) For these months, we treated the quantity as zero and employed the virtual price method.

Frozen vegetable quantities are the sum of quantities of frozen asparagus, broccoli, carrots, cauliflower, bean, peas and corn. Of these goods, corn represents approximately half of all frozen vegetable production. Cold storage is substantial with frozen vegetables. Monthly consumption at the wholesale levels is inferred as the monthly change in cold storage, net imports and production. Unfortunately, only annual production of frozen vegetables is available. We distribute annual production across months by multiplying annual production by the share of cold storage depletion (the amount depleted from cold storage in months it fell) on a good-by-good basis. Summing across goods, the frozen quantity consumed (q_t^f) is:

$$q_t = NI_t + \Delta Stock_t + AnnFzProd_t \times \tau_t$$

where NI_t is monthly net imports, $\Delta Stock_t$ is the monthly change in frozen stock, $AnnFzProd_t$ is annual frozen production and τ_t is the share of cold storage depletion in each month.

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[4]This figure is found by comparing domestic and import prices in the 73 months in which both where available. The percentage difference had a mean and variance of -.0876 and .1372 respectively. Fumigation, importation, and transport costs may reflect the difference.

Unfortunately, no direct price data for frozen vegetables exists. Although some contract price data is available for a portion of our observations, these prices remain constant for lengthy periods and may obscure substantial producer incentives for quality and volume. Instead, we use the producer price index for frozen vegetables adjusted to reflect the prices implied by the contract prices in January 2000. Table (1) provides a summary of the prices, quantities and market shares of fresh and frozen goods for 1992 to 2008 (when all budget shares were positive). Fresh asparagus sells at a considerably higher price relative to other fresh goods and represents approximately 32% of the consumer's vegetable budget. Frozen prices are considerably lower than fresh prices and subsequently have a market share of only 3.6%.

Estimation and Results

Several initial attempts were made to estimate this model using the Lee and Pitt method in Matlab. However, our results, reflected extreme sensitivity to the starting points chosen, an outcome we attributed to non-linearity introduced to the model via habit effects. Additionally, a comprehensive measure of frozen goods volume was unavailable prior to 1992. Instead, we estimated our model solely with data in which budget shares are positive. Table (1) indicates in the R-squared values that the goodness of fit, being greater than 83%, is strong,

Tables (2) and (3) provide the estimated parameters of the demand systems in Equation (7) with goods listed in alphabetical order (1 = asparagus, 2 = broccoli, 3 = carrots, 4 = cauliflower, and 5 = frozen, where frozen is the omitted budget share). As Equation (7) indicates, the smaller value of α implies a strengthening of demand. Also, prices in the demand system $(\tilde{p})$ are logged, income-normalized observed prices. Consequently, they are negative, and therefore a negative values of β is consistent with downward-sloping demand. In Table (2),

the $\alpha_{0,i}$ can be loosely interpreted as the base-intercept term in a demand equation. This term is negative for each of the goods except asparagus, but the additive factors affecting habits, time, and seasonality may make the "total α" term negative in specific months. In our estimation, the time trend, beginning at one in January 1984, grows by one per month and is captured by $\alpha_{0,t}$. The growth in asparagus, carrot and cauliflower demand is steady and significant. For frozen goods, it is negative, a finding consistent with our basic understanding of vegetable market trends.

Table (3) indicates that some seasonality is present with each good, as indicated by those months in which $\alpha_{Mon,i}$ is relatively small. Seasonality is particularly strong with asparagus demand in the domestic in-season months of February through May. Unique cultural events may have evolved to cope with the large quantities of asparagus available within the regular growing season. An old world crop, asparagus is consumed in large quantities during Spargelfest (literally, asparagus festival) in Germany, an event that may have evolved specifically to handle large perishable volumes. In the U.S., strawberry festivals seem to hold a similar function. Unfortunately, our data cannot separate unmeasured quality changes associated with ripeness or the psychic benefit of local or domestic production. However, with asparagus, production is geographically concentrated so that little consumption is local.

In Table (2), the formation of positive habits occurs when lagged consumption affects current demand. Lagged consumption can have both own- and cross-commodity effects. The memory term (*d*) on previous consumption measures the extent to which consumers discount the effect of previous consumption on current consumption. At .703, this term indicates that relative to one-month lagged consumption, the effect of 7-month lagged consumption is about 9% and that of 13-month lagged consumption is 1%. The $\alpha_{lag,i,j}$ terms indicate that, with fresh

goods, lagged consumption increases current consumption. With the composite frozen good, lagged consumption has a negative effect, a "negative" habit that could address storage of frozen goods. Additionally, some cross-commodity effects are significant. For example, lagged carrot consumption significantly reduces asparagus consumption and significantly increases broccoli consumption as measured by $\alpha_{lag,1,3}$ and $\alpha_{lag,2,3}$. Lagged fresh broccoli, carrot, and cauliflower consumption reduces frozen consumption as measured by the $\alpha_{lag,5,2}$, $\alpha_{lag,5,3}$, and $\alpha_{lag,5,4}$ imputed from the restrictions. This finding is consistent with the perception that fresh consumption crowds out frozen consumption, especially for broccoli, carrots and cauliflower for which frozen and fresh volumes are large. Table (5) presents elasticity estimates where the elasticity is estimated in each time period and averaged.

Table (4) presents the welfare change inferred from the estimated utility function using virtual prices when asparagus is unavailable. For all the months between 1992 and 1993, the average estimated virtual price of asparagus was 4.1, which is approximately three times higher than the actual average price of 1.4. The compensated variation was calculated between various time periods and this value shows variability across years owing to availability and habits as well as idiosyncratic supply factors characterizing agricultural production. Aggregation across years smoothed out this seasonality, with monthly utility values being summed across periods. In our calculations, the α term varied according to seasonal and habit effects, but the time trend effect was fixed at its value in January 2004. To best isolate the direct effect of availability on welfare, we find the equivalent variation between 1986 and 1991 (during which asparagus was unavailable in 38 months) and 1993 and 1998 (during which it was always available) as .9109. This indicates that consumers facing the prices and availability of 1993 to 1998 would be equally well-off with 91.09% of their average monthly budget as identical consumers facing the prices

and availability of 1986 to 1991. Between 1993 and 1998, the annual budget for the vegetables in our demand system (at the wholesale level) averaged $965 million. In dollar terms, our equivalent variation is equal to $86 million.

Importantly, this simulation method included the value, after controlling for inflation, of all prices and availability changes associated with all fresh and frozen goods in our periods of analysis. For example, while broccoli may have been available in every month of the earlier period, a reliance on domestic supplies may have made supplies low in out-of-season months and consequently more expensive. Increased availability, in this instance, involved a smoothing of seasonal price spikes but did not necessitate the use of virtual prices, as demand is not censored owing to non-negativity constraints. The subsequent changes in availability and prices in the years following 1998 also generate significant increases in consumer welfare but the causality for these changes is less clear cut.

If one attributes the entirety of the estimated equivalent variation in our 12-year period to asparagus, the welfare benefit would represent approximate 28.5% of asparagus expenditure because asparagus is roughly 1/3 of the consumer budget for vegetables in our demand system. However, this specific good was chosen in this study specifically owing to its seasonality, and we excluded certain other vegetables owing to lack of data. Undoubtedly, however, certain goods are more seasonal by the nature of their production, and the general welfare benefits of increased availability are more attributable to certain goods. Furthermore, when consumers form habits, the appropriateness of long-range inter-temporal comparisons of utility is questionable if fresh vegetable consumption crowds out less perishable vegetables (cabbage, other root crops) not included in the demand system. However, our finding covering a 12-year

span suggests that the Boskin Commission's conjecture – that availability of fresh fruits and vegetables increased consumer welfare by 20% over 30 years – is reasonable.

Conclusions

We found significant evidence of habits effects for fresh goods after controlling for seasonality and time trends. Fresh consumption generally crowds out frozen consumption and may explain the generally falling per capita consumption of frozen and canned vegetables since 1991. We also find that the increased availability of fresh vegetables between 1986 and 1998 generated an increase in welfare equal to about 9% of vegetable expenditure, or $86 million.

Other goods, such as grapes and stone fruits, show similar patterns of increasing out-of-season availability. Also, the availability of certain tropical fruits has generally increased. Both these shifts are attributable in part to trade agreements with countries that have either different climates (Central America) or counter-cyclical growing patterns relative to the U.S. (Chile, Peru). In some market, the consumer benefits of increased trade may accrue as much from changes in availability as price.

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Table (1) – Summary Stats of Prices, Quantities, Shares and R-squared

	Asparagus	Brocolli	Carrots	Cauliflower	Frozen
Prices - Mean	1.431	0.302	0.17	0.333	0.059
Prices - Std	0.451	0.088	0.038	0.102	0.003
Quantities - Mean	0.798	2.755	3.985	1.371	1.657
Quantities - Std	0.485	0.451	1.076	0.301	0.941
Shares - Mean	0.321	0.273	0.221	0.149	0.035
Shares - Std	0.114	0.058	0.056	0.038	0.027
R-squared	84.50%	87.70%	86.80%	83.60%	

Parm.	Est.	St. Dev.	t-value	p-value	Parm.	Est.	St. Dev.	t-value	p-value
$\alpha_{0,1}$	0.1206	0.1185	1.02	0.3101	$\alpha_{lag,1,1}$	-0.0147	0.0140	-1.05	0.2951
$\alpha_{0,2}$	-0.3078	0.0602	-5.12	<.0001	$\alpha_{lag,1,2}$	0.0074	0.0076	0.98	0.3307
$\alpha_{0,3}$	-0.4671	0.0542	-8.62	<.0001	$\alpha_{lag,1,3}$	0.0117	0.0045	2.62	0.0095
$\alpha_{0,4}$	-0.2178	0.0425	-5.12	<.0001	$\alpha_{lag,1,4}$	-0.0236	0.0102	-2.31	0.0222
$\beta_{1,1}$	-0.1782	0.0146	-12.17	<.0001	$\alpha_{lag,1,5}$	0.0102	0.0066	1.55	0.1218
$\beta_{1,2}$	0.0646	0.0072	9	<.0001	$\alpha_{lag,2,1}$	-0.0012	0.0071	-0.17	0.8613
$\beta_{1,3}$	0.0684	0.0066	10.37	<.0001	$\alpha_{lag,2,2}$	-0.0098	0.0043	-2.31	0.0218
$\beta_{1,4}$	0.0387	0.0050	7.69	<.0001	$\alpha_{lag,2,3}$	-0.0047	0.0022	-2.14	0.0334
$\beta_{2,2}$	-0.1642	0.0062	-26.6	<.0001	$\alpha_{lag,2,4}$	0.0214	0.0057	3.79	0.0002
$\beta_{2,3}$	0.0534	0.0042	12.81	<.0001	$\alpha_{lag,2,5}$	-0.0042	0.0034	-1.25	0.2141
$\beta_{2,4}$	0.0292	0.0041	7.1	<.0001	$\alpha_{lag,3,1}$	0.0125	0.0065	1.93	0.0547
$\beta_{3,3}$	-0.1523	0.0055	-27.9	<.0001	$\alpha_{lag,3,2}$	0.0022	0.0034	0.65	0.5169
$\beta_{3,4}$	0.0153	0.0035	4.4	<.0001	$\alpha_{lag,3,3}$	-0.0080	0.0022	-3.68	0.0003
$\beta_{4,4}$	-0.0794	0.0045	-17.67	<.0001	$\alpha_{lag,3,4}$	0.0086	0.0046	1.9	0.0597
$\alpha_{t,1}$	-0.0009	0.0003	-3.4	0.0008	$\alpha_{lag,3,5}$	-0.0014	0.0029	-0.5	0.6175
$\alpha_{t,2}$	0.0001	0.0001	0.87	0.3846	$\alpha_{lag,4,1}$	0.0045	0.0048	0.93	0.3541
$\alpha_{t,3}$	0.0004	0.0001	3.41	0.0008	$\alpha_{lag,4,2}$	-0.0005	0.0027	-0.19	0.8532
$\alpha_{t,4}$	0.0003	0.0001	3	0.0031	$\alpha_{lag,4,3}$	0.0009	0.0015	0.58	0.5659
					$\alpha_{lag,4,4}$	-0.0109	0.0035	-3.1	0.0023
d	0.7025	0.0640	10.98	<.0001	$\alpha_{lag,4,5}$	-0.0047	0.0023	-2.06	0.0409

Table (2) - Parameter Estimates for the Translog Utility Function (Prices, Habit, Time Effects)

Table (3) - Parameter Estimates for the Translog Utility Function (Monthly Effects)

	$\alpha_{Mon,1}$ (asparagus)			$\alpha_{Mon,2}$ (brocolli)			$\alpha_{Mon,3}$ (carrots)			$\alpha_{Mon,4}$ (cauliflower)		
	Est.	St. Dev.	t-value	Est.	St. Dev.	t-value	Est.	St. Dev.	t-value	Est.	St. Dev.	t-value
Jan	-0.0640	0.0164	-3.91	0.0194	0.0084	2.3	0.0198	0.0074	2.66	0.0230	0.0058	3.97
Feb	-0.1972	0.0173	-11.39	0.0671	0.0089	7.53	0.0741	0.0080	9.32	0.0507	0.0062	8.23
Mar	-0.2673	0.0204	-13.1	0.1165	0.0103	11.29	0.0786	0.0095	8.3	0.0618	0.0072	8.62
Apr	-0.2230	0.0272	-8.2	0.1008	0.0137	7.36	0.0532	0.0126	4.21	0.0571	0.0095	6.03
May	-0.1293	0.0320	-4.04	0.0780	0.0162	4.8	0.0176	0.0148	1.19	0.0252	0.0112	2.25
Jun	-0.0255	0.0303	-0.84	0.0356	0.0155	2.29	-0.0152	0.0138	-1.1	0.0024	0.0106	0.23
Jul	0.0113	0.0241	0.47	0.0321	0.0126	2.55	-0.0019	0.0110	-0.17	0.0041	0.0086	0.47
Aug	0.0009	0.0184	0.05	0.0518	0.0094	5.49	0.0051	0.0084	0.61	0.0148	0.0068	2.16
Sep	-0.0373	0.0232	-1.61	0.0317	0.0116	2.73	0.0047	0.0102	0.46	0.0091	0.0085	1.08
Oct	-0.0439	0.0180	-2.44	0.0231	0.0092	2.52	0.0086	0.0082	1.05	0.0136	0.0066	2.06
Nov	-0.0346	0.0158	-2.18	0.0226	0.0082	2.77	-0.0035	0.0072	-0.48	0.0173	0.0057	3.05

Table (4) –Equivalent Variation Estimates for Various Time Periods

Time Period	Comp. Var		Time Period	Comp. Var
1986→1987	0.5598		1997→1998	0.7704
1987→1988	0.71		1998→1999	0.6025
1988→1989	0.4505		1999→2000	0.825
1989→1990	0.5845		2000→2001	0.9745
1990→1991	0.9791		2001→2002	1.1059
1991→1992	3.0138		2002→2003	0.7947
1992→1993	1.1802		2003→2004	0.9271
1993→1994	0.8118		2004→2005	0.8952
1994→1995	0.5974		2005→2006	1.0938
1995→1996	0.8631		2006→2007	0.8059
1996→1997	0.7465		2007→2008	1.1479
1986-92→1993-99			0.9109	
1986-92→1993-08			0.4157	
1986-92→2000-08			0.3119	

Table (5) – Marshallian Own-Price and Income Elasticities

	Asparagus	Broccoli	Carrot	Cauliflower	Frozen
Asp.	-0.3372	-0.2403	-0.2545	-0.144	-0.0241
Broccoli	-0.2484	-0.3686	-0.2053	-0.1123	-0.0653
Carrot	-0.3302	-0.2576	-0.265	-0.0739	-0.0733
Cauliflower	-0.2777	-0.2096	-0.1099	-0.43	0.0272
Frozen	-0.2515	-0.6605	-0.5907	0.1473	0.3554
Income	**1.445**	**1.7366**	**1.4255**	**0.6128**	**-0.2199**