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Testing for Supply Asymmetry in the Market for Organic Lettuce



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# Testing for Supply Asymmetry in the Market for Organic Lettuce

The presence of a price premium in the market for fresh produce designated "organic" is frequently cited as an impetus for farmers to switch from chemical-intensive technologies (commonly called "conventional agriculture") to those using no synthetic chemicals. Certification programs based on production practices may be a source of irreversibility in the supply function for organic produce. As farmers adopt organic technology, they face higher costs for returning to conventional practices in terms of lost price premiums, adjustment costs and loss of flexibility in market choice. This paper explores the supply relationship for organic lettuce in California and tests for supply irreversibility.

In the first section, the features of the market which lead to an hypothesis of irreversibility are described. Previous theoretical work is outlined in the second section, followed by model specification and data description in the third section. Results and conclusions are presented in the last sections.

## Certification as a Determinant of Irreversibility

There are a variety of definitions used to determine what qualifies as organic produce, most based on production practices. Certification programs exist in 18 states and a bill establishing a definition at the national level is currently before the U. S. Senate (*Alternative Agriculture News*, 1990).

Certification programs such as that of the California Certified Organic Farmers (CCOF) require multi-year phase-ins with inspections. Once the production system has been designated organic, the output may legally carry the CCOF seal. This seal assures buyers that the product has been raised in accordance with the standards of the CCOF, which prohibit synthetic chemical additives. "Certified organic" produce may command a retail price from 25 to 35 percent higher than noncertified produce in supermarkets and up to 50 percent higher in health food stores (*Food Institute Report*, 1989).

From the producer's standpoint, there are costs to converting from using chemical inputs to being a strictly organic farmer. These costs may include purchase of different equipment, changing the mix of farm labor hired, and facing temporarily or permanently reduced yields, depending on the success of the transition.

The decision to switch to organic production methods is in part related to the cost of adjustment. This cost varies by the crop grown and the methods already employed by the farmer. The cost of becoming certified by the CCOF includes the phase-in and testing period. Organic produce may be marketed in either the certified or the noncertified system.

The cost of switching from a certified to a noncertified production system includes input adjustment and lower prices received for output. Noncertified produce may not be sold through the certified organic marketing system.

The traditional explanation of supply irreversibility describes a positive response to price increases from previous periods. Farmers invest in technology in an effort to expand production to take advantage of the price rises. Once the choice is made, disinvestment is too costly to undertake, so the grower must continue to produce with the new technology or inputs. The market supply has irreversibly increased.

A different view of supply irreversibility relates to reinvestment costs. For the organic grower who has invested the time and cost of input changes to become certified, the costs of switching back to a conventional system include not only adjustment costs and price premium penalties, but also the cost of lost flexibility in marketing. After losing certification, the entire multi-year process must again be undergone to regain it. This limits the grower's ability to quickly re-enter the organic market in the event of future price increases. Reinvestment imposes the opportunity cost of the waiting period, even if other input-switching costs are zero.

Depending on expectations about prices for the organic market, this may discourage a return to conventional methods. The certification acts to alter a bundle of inputs and technology, rather than a single input or technology. Thus, the supply of certified organic produce might exhibit supply irreversibility.

Irreversibility due to disinvestment costs indicates a positive relationship between quantity supplied and rising prices for organic produce. However, irreversibility due to reinvestment costs suggests a relationship between quantity supplied and falling prices for organic produce which may be nonnegative, especially in the very short run.

Growers who began the certification process in previous years and have entered the market at any given point in time will utilize organic outlets as long as the price premiums remain. Existing growers continue to sell in the organic market for the same reason. The certification becomes, in effect, a fixed asset.

In the present market, growers seem to count on continued price premiums for certified produce. Recent events demonstrating consumer concern for food safety have fueled this expectation. If the market for organic produce is currently at a disequilibrium point then this assumption may be rational for the short term. Under conditions of excess demand, supply could increase even as prices decline, as the market moves toward equilibrium. As long as the prices in the certified market are above those in the noncertified market, and if salvage value of certification lies below acquisition cost, then growers will continue to sell in the organic, rather than the conventional market. Even after adjustment to equilibrium, consumer preferences may be such as to bestow a continued premium on the certified market.

Unlike the disinvestment problem associated with inputs such as purchased capital or planted tree crops, organic certification is easily forfeited. The return to a noncertified system may occur at any time. Certification is revoked for use of any input at any time which does not conform to the standards. The problem is one of reinvestment, because the organic grower does not want to chance losing future premiums, even if in the current period, the premium falls or becomes zero or negative. Growers might expand production, even in the face of prices which fall below previous minimums.

## Modelling Supply Asymmetry

Previous work in estimating irreversible supply (Tweeten and Quance; Wolffram; Houck; Traill, Colman, and Young) focused on separating price data into increasing and decreasing portions and comparing relative slope estimates for the two portions. Where the slope coefficient for the increasing portion was significantly greater than for the decreasing portion, irreversible supply was inferred.

The approach was modified slightly by Young in splitting the price variable and then estimating each equation separately to model irreversibility in demand. Burton criticized the applicability of the Traill *et al.* model on the basis that it is unsuitable for modelling long run supply irreversibility since it does not allow for capital stock deterioration. He used a modified partial adjustment model to describe a dynamic asymmetric supply in the market.

The model used by Traill *et al.* was

$$(1)\quad Q_t = \beta_0 + \beta_1\, MWF_t + \beta_2\, MWR_t + \epsilon_t$$

where $Q_t$ is the quantity supplied in time t, $MWR_t$ is the sum of all expected price differences for which the current expected price is above the previous maximum expected price and $MWF_t$ is the sum of all other expected price differences. Mathematically, $MWR_t = \sum_{i=1}^{t} \Delta PMAX_i^*$ is the maximum expected price paid to date and $\Delta PMAX_i^* = P_i^* - PMAX_{i-1}^*$ if $P_i^* >$

$PMAX^*_{i-1}$ and 0 otherwise. $MWF_t = \sum_{i=1}^{t} \Delta P^*_i$; where $\Delta P^*_i = P^*_i - P^*_{i-1}$ if $P^*_i <$ $PMAX^*_{i-1}$ and 0 otherwise.

This model is based on the theory of asset fixity. In theory, as output price increases, the grower buys more of the input. The purchases of the input are made only when the output price exceeds the previous maximum. When the output price declines or rises to less than the previous maximum, the grower neither disinvests nor adds to the capital stock, but produces with already owned stock. If the output price declines below the previous minimum, the grower disinvests at salvage value.

The basis for this model was developed by Wolffram, where the rise and fall variables were given by $WF_t$ and $WR_t$, the sum of expected price differences between time t and t-1 for which the difference was negative and positive, respectively. By recognizing that $P_t = P_0 + WF_t + WR_t$, Young reconstructed the Wolffram model as

$$(2)\quad Q_t = \beta_0^* + \beta_2^* \, TWR_t + \beta_3 \, P_t + \epsilon_t$$

where $TWR_t$ is the same as $MWR_t$ in Equation 1, $P_t$ is the current output price and other variables are as in Equation 1. The coefficient $\beta_0^*$ is actually equivalent to $(\beta_0 - \beta_2 P_0)$ and $\beta_2^*$ is equivalent to $(\beta_2 - \beta_1)$. The price is actual, rather than expected in this specification.

The Young model subsumes the Traill *et al*. approach, since the test of irreversibility is reduced to the sign of the $\beta_2^*$ variable, rather than a comparison of $\beta_1$ and $\beta_2$ separately. Young described cases for $\beta_2^*$

> 0, representing a lack of market information, leading to lower demand than would be expected under a regime of falling prices and for $\beta_2^* < 0$, representing addiction of consumers to competing products, which occurs when consumers switch to a new product when record high prices are observed for the old product.

Young also developed the variable, $TWF_t$, representing the sum of all price differences between time t and t-1 for which price falls below the previous minimum price. Mathematically, $TWF_t$ is analogous to TWRt. $TWF_t = \sum_{i=1}^{t} \Delta PMIN_i$, $PMIN_i$ being the minimum price paid to date and $\Delta PMIN_i = P_i - PMIN_{i-1}$ if $P_i < PMIN_{i-1}$ and 0 otherwise. For $TWF_t$, the coefficient would be $\beta_1^*$, equivalent to $(\beta_1 - \beta_2)$. Young described the case of $\beta_1^* < 0$ as product addiction due to habits formed when consumers switch to the product at a record low price.

Characterization of organic produce supply has been limited to plots of prices and quantities over time (Franco) and descriptions of the overall market (Cook). Using the Young and Traill *et al.* models and expected prices, it is possible to test several hypotheses about supply.

If supply is irreversible and growers are in the elastic portion of the supply curve relating to rising expected prices, then $\beta_2 > \beta_1$ in Equation 1 or $\beta_2^* > 0$ in Equation 2. In this case, the theory of asset fixity holds with respect to acquisition since the price must rise above previous maximums to encourage new investment and higher output.

If $\beta_2 < \beta_1$ in Equation 1 or $\beta_2^* < 0$ in Equation 2, prices do not have to rise above the previous maximum to encourage expansion of output. In this case, a price reduction could result in increased quantity supplied. As explained, this would depend on market conditions, particularly price premiums and salvage value in the certified market.

Equations 1 and 2 may both be modified to reflect prices falling below previous minimum. This case was ignored by Traill *et al.*, but by redefining $MWF_t$ to represent the sum of price differences for which the price in time t is less than the previous minimum and $MWR_t$ to represent the sum of all other price differences, Equation 1 may be used to assess this condition. Young described the variable $TWF_t$ to represent this situation.

For Equations 1 and 2 modified, if $\beta_2 < \beta_1$ or if $\beta_1^* > 0$, then prices below the previous minimum will result in a reduction in quantity supplied, as growers disinvest. This is consistent with the theory of asset fixity.

If $\beta_2 > \beta_1$ or if $\beta_1^* < 0$, then prices above the previous minimum cause greater declines in quantity supplied than do new minimum prices. This is the least justifiable result in terms of existing organic market conditions.

A symmetric supply function was hypothesized and estimated. The model presented by Young was used to test the supply function for asymmetry. A simple price expectation form was used, where $P_t^* = P_{t-1}$, due to the requirement that prior knowledge be available for segmenting prices into rising and falling expected prices. The estimation results for the symmetric and asymmetric models were compared. Variable selection and model specification are described in the next section.

## Description of Organic Lettuce Supply

Supply characteristics for fresh organic produce are difficult to quantify, because the market is not as well-defined as the conventional market and data on acreage planted and harvested and farm prices received are not readily available. In California, Cook reported survey results indicating that an estimated 30,000 acres are farmed organically by 900 growers. Wholesale returns for these crops were estimated at $50 million. Franco projected wholesale returns at over $300 million by 1992, if current sales trends continue.

In the absence of farm level surveys, data from the Organic Market News and Information Service (OMNIS) were used. This database gives weekly farm prices and quantities of organic produce sold based on responses from wholesalers in California, Oregon and Washington.

The data have been criticized by Franco for several reasons. The data overall are somewhat inconsistent over time because produce descriptions and methods of data collection have changed. The number of wholesalers reporting and their identity varies by week, giving some geographical skewness.

To mitigate the effect of these problems, lettuce was chosen as the test crop since it has had a consistent description (24 bunches per unit sold) throughout the publication of OMNIS reports. Size specification and changing numbers of wholesalers reporting affect the observed linkage between quantity supplied and price, making it weaker than with a well-defined market.

In addition, organic farmers have three alternatives with respect to marketing their crops from week to week. They may sell through certified markets, sell through uncertified markets, or hold the crop back and harvest it the next week. Variation in weekly quantity supplied in this market may be related to harvesting constraints and weekly market accessibility as well as to organic price, so variation in the number of wholesalers reporting organic purchases and in the quantity reported is not necessarily evidence of poor quality in the data set.

The OMNIS wholesalers represent a large share of the organic market. Cook's survey indicated that 40 percent of CCOF certified growers use wholesalers and brokers as their main organic outlet. Among farmers with larger acreages, the percentages wholesaled are about the same - 41 percent for farms from 10 to 50 acres and 38 percent for farms larger than 50 acres. Thus, the data may be taken as representative of, if not comprehensive for, the organic industry.

Conventionally grown lettuce from different parts of the state is marketed year round in California. Four types of lettuce - romaine, green leaf, butter (Boston) and red - are consistently listed in the OMNIS reports on a weekly basis. Consumer familiarity with these varieties is increasing. The 1990 Fresh Trends survey of 2,000 households determined that 77 percent of households surveyed found romaine lettuce available in stores, while 27 percent had purchased it in the previous 12 months (King and Zind). Green leaf lettuce was available for 76 percent of shoppers, with 35 percent having bought it in the last year. Eighteen percent of households surveyed had purchased Boston lettuce and 32 percent bought red leaf lettuce.

Romaine lettuce was selected for analysis based on availability and familiarity to consumers. Weekly quantity and price data from September 19, 1985 through December 30, 1989 were used. High and low prices paid to growers were averaged to represent the overall market price.

Both conventional and organic lettuce growers face year-round demand. The lack of strong seasonal patterns in conventional lettuce prices has been attributed to this factor (Economic Research Service). A weak seasonal pattern was described for December and January, with slight, though uncertain, supply increases, based on an analysis of monthly data between 1981 and 1987.

The difficulty with incorporating a linear trend variable in a weekly data set to reflect seasonal changes is that it must trend either upward or downward and will likely fit the data only at a few points. A more flexible method for trend measurement in weekly data was proposed by Hahn, based on previous work with monthly trend analysis by Doran and Quilkey. This methods relies on the harmonic motion mapped by sine and cosine waves. This approach was adopted and both elements were incorporated into the supply specification.

Since organic farmers have the option of selling their produce through either organic or conventional channels, there was a need to include some factor reflecting this choice. As conventional farm prices were not available, conventional wholesale prices, measured as the average of weekly prices for romaine lettuce at the San Francisco and

Los Angeles terminals was included. This price was lagged to reflect the need for the farmer to form a price expectation for the market before selling the crop.

Regional concentration for lettuce production has an influence on susceptibility of the market to weather, disease and pest problems in particular geographic locations. The regional specialization is even more pronounced in the production of organic lettuce, because less acreage and fewer growers supply the market. Wholesalers contacted said they obtain most of their supply from the areas around Watsonville, Santa Cruz, Salinas, Monterey, Oxnard, El Centro and Bakersfield, with substantial quantities purchased locally during the summer months.

Bakersfield and El Centro were mentioned as primary sources from mid- to late November through mid-March to mid-April. The other locations provide the majority of lettuce from late March to early April through late October to mid-November. This information was taken into account in attempting to construct relevant weather variables.

Temperature is a significant factor in plant growth, particularly as it relates to seed germination and disease and pest problems. Since Watsonville and Bakersfield were mentioned most frequently by wholesalers and since these areas have significant acreages in CCOF-certified lettuce production, weather data were taken from stations at these sites. Daily maximum and minimum temperature data were collected from National Oceanographic and Atmospheric Administration documents. Both heating and cooling degree days (with a 65°F base) were calculated and summed for the seven-day period preceding the dates of the weekly OMNIS reports.

The weekly cumulative degree days were then dummied with the appropriate months by location to reflect their importance in the overall market at given times of the year. For Bakersfield, two variables, SUMBCDD and SUMBHDD (for cooling and heating degree days, respectively) were created, with nonnegative values in the months from November through March and zero values the rest of the year. For Watsonville, analogous variables SUMWCDD and SUMWHDD were created, with nonnegative values from April through October and zero values the rest of the year.

Various combinations of these four variables were tested in the basic supply model, with the final form selected being

$$(3)\quad QUANT_t = \beta_0 + \beta_1\ PRICE_{t-1} + \beta_2\ SINE + \beta_3\ COSINE + \beta_4\ CONV_{t-1} + \beta_5\ SUMBCDD_t + \beta_6\ SUMWCDD_t + \epsilon_t$$

where $QUANT_t$ is the quantity of romaine lettuce sold in boxes of 24, $PRICE_{t-1}$ is the lagged organic price in dollars per box and represents expected organic price in period t, SINE and COSINE are harmonic terms based on weekly information and indexed to the week ending December 31, 1985, $CONV_{t-1}$ is the average weekly conventional wholesale price and represents a markup over expected conventional price, SUMBCDD and SUMWCDD are weekly cumulative cooling degree days in Bakersfield and

Watsonville dummied by the relevant months. The effect of multicollinearity was minimized with this specification.

Equation 3 was modified using the Young model to derive the specification for testing supply asymmetry. The price term in Equation 3, $PRICE_{t-1}$ was segmented in the manner described

$$(4) \quad QUANT_t = \beta_0 + \beta_1\ PRICE_{t-1} + \beta_2\ TWR_t + \beta_3\ SINE + \beta_4\ COSINE + \beta_5\ CONV_{t-1} + \beta_6\ SUMBCDD_t + \beta_7\ SUMWCDD_t + \epsilon_t$$

where $TWR_t$ is the same as in Equation 2.

To test asymmetry in the elastic portion of the supply curve, Equation 4 was respecified as

$$(5) \quad QUANT_t = \beta_0 + \beta_1\ PRICE_{t-1} + \beta_2\ TWF_t + \beta_3\ SINE + \beta_4\ COSINE + \beta_5\ CONV_{t-1} + \beta_6\ SUMBCDD_t + \beta_7\ SUMWCDD_t + \epsilon_t$$

where $TWF_t$ is as explained previously.

Equations 3, 4 and 5 were estimated using ordinary least squares. Due to special interest in the price variables, Equation 3 was also estimated without the weather data included, for a total of two symmetric models, designated 3.A and 3.B.

A Wu-Hausman test was applied to the supply specification in Equation 3.B to test the endogeneity of the price for organically grown romaine lettuce. If the price for romaine lettuce is predetermined, the ordinary least squares estimate yields best linear unbiased estimates, denoted by $\hat{b}$. If prices of romaine lettuce are endogenous in the supply specification, instrumental variable estimates, denoted by $\breve{b}$, are consistent, while ordinary least squares estimates are biased and inconsistent. A test statistic for the endogeneity of the lettuce price is based on

$$(5)\quad T = (\hat{b} - \breve{b})\ [\ \hat{V}(q)\ ]^{-1}\ (\hat{b} - \breve{b})$$

where $\hat{V}(q)$ is a consistent estimate of the variance-covariance matrix under the null hypothesis and T is asymptotically distributed $\chi^2$.

Instrumental variable estimates were obtained using two-stage least squares. The predetermined variable used as an instrument was the lagged farm price for organic red lettuce.

RESULTS

The results of the regressions for models 3.A, 3.B, 4 and 5 are given in Table 1. The symmetric models 3.A and 3.B provide some information about factors important in the supply function for the organic romaine lettuce market.

Of the trend variables, SINE and COSINE, the latter was significant at $\alpha = 0.01$ for both symmetric models. The estimated coefficients were 103.38 and 97.19 in models 3.A and 3.B. SINE was not significant, but needed to be included to correctly generate the harmonic series.

In model 3.A, the coefficients on the price variables reflect the choices made by certified organic farmers to sell in either the conventional or the organic market. The coefficient estimate for

$PRICE_{t-1}$ was 15.03, significant at $\alpha = 0.01$, while for $CONV_{t-1}$, the value was -10.02, significant at $\alpha = 0.05$. These results indicate that quantity supplied in the organic market is positively influenced by higher organic prices received in the previous week and is negatively affected by higher conventional wholesale prices in the same time frame.

As mentioned, on a week to week basis, organic farmers have three options in marketing their crop. The price variables in the model describe two of these choices, while the harmonic trend may partially track the third.

The conventional wholesale price is an indicator of the magnitude and direction in which farmers may expect relative prices to change. For some crops, there may be a strong negative correlation between the conventional price and the quantity supplied to the organic market. If, for a given crop, conventional channels are more accessible and less costly to enter, then price in the conventional market may not need to equal the organic price in order for farmers to market their organic produce in the noncertified market.

In model 3.B, neither coefficient estimate for the price variables was significant, although the signs on the estimates remained the same as in model 3.A. In this model, the estimates for the coefficients on the weather variables, $SUMBCDD_t$ and $SUMWCDD_t$, were both significant at $\alpha = 0.01$. For the two variables, the estimates were 19.73 and 3.66, respectively. In conjunction with the information about the timing of production from each location, the results indicate that cumulative cooling degree days in Bakersfield has a greater effect on quantity supplied in the organic market than cooling degree days in Watsonville.

There are several possible reasons for this outcome. One is that marketing may be less costly from Bakersfield, because there is one very large grower of organic lettuce there who performs both the growing and the marketing activities. This would mean the timing dummy incorporated in the weather variable, rather than the influence of cooling degree days, is actually causing the result. However, subsequent tests using only the seasonal dummy did not indicate this result.

Another reason may be the greater variability around a mean temperature that occurs in Bakersfield relative to Watsonville. The temperature in Watsonville is moderated by its proximity to the Pacific Ocean, while Bakersfield, lying in the southern part of California'a Central Valley experiences greater extremes in cold and heat. Growth factors affected by heat could be more obvious in the Bakersfield data.

Since cooling degree days are enumerated for average daily temperature above 65°, the positive sign on the coefficients could mean that as the number of cooling degree days increases, the pressure to harvest and sell the crops becomes greater. Heat stress and heat-activated pests could be negative growth factors associated with increasing cooling degree days which cause farmers to harvest and sell more, despite price expectations. This may help explain why the estimated price coefficients in this model are not significant when the weather data is included in the specification.

The Wu-Hausman test on model 3.B resulted in a test statistic of 3.65, below the $\chi^2$ test value of 3.84. This result implies that price is endogenous in this model and that ordinary least squares provides unbiased and consistent estimates.

In models 4 and 5, the significance and signs on the estimated coefficients were the same as in model 3.B, with price variables still not significant. Asymmetry was rejected in both models, with neither $TWF_t$ nor $TWR_t$ producing significant coefficient estimates. This is the reason for the similarity in the magnitudes of estimated coefficients in modles 4 and 5.

These results do not conclusively rule out supply asymmetry in the organic lettuce market. The time frame of the data set may be too short for asymmetry to be demonstrated. However, within the scope of this data, the conclusion of irreversibility was not supported.

If both the organic and the conventional markets are accessible, the certified farmer has more options than the noncertified farmer. The ease of switching between markets may distort the usual tests based on price segmentations, particularly if other factors besides price affect the decision of which market to sell in. If this is the case, the correct specification of the supply function becomes even more important.

Conclusion

This paper represents a first attempt to model supply in the market for organic produce. In the market for organic romaine lettuce, factors which influence supply may include seasonal weekly cooling degree days, organic and conventional prices and a flexible time trend. With only these variables included in the basic supply specification, the $R^2$ goodness of fit statistic was relatively low at 0.24. The hypothesis of symmetry could not be rejected, based on information evaluated by this model specification.

The organic farmer has some flexibility on a weekly basis in selecting among market alternatives. The choice of which market to sell in or whether to sell any output in a particular week appears to be influenced by other factors in addition to prices in the two markets. Further investigation into these factors is needed.

Another means of testing supply asymmetry is the use of the partial adjustment model proposed by Burton. This approach makes asset fixity a special case of the general cost of adjustment form. Impact and long run elasticities may be computed using this method. The weakness in defining excess assets are overcome by quantifying excess capacity in terms of the difference between maximum and desired output. This model should be applied to test the validity of the results in this paper.

Table 1. Estimated Coefficients and T-Statistics for Symmetric and Asymmetric Supply Specifications for Organic Romaine Lettuce

| Variable | 3.A | 3.B | 4 | 5 |
|---|---|---|---|---|
| $PRICE_{t-1}$ | 15.03** | 9.76 | 9.65 | 13.00 |
| | (2.47) | (1.61) | (1.15) | (1.45) |
| SINE | -4.59 | -2.21 | -2.21 | 1.24 |
| | (-0.22) | (-0.11) | (-0.11) | (0.06) |
| COSINE | 103.38** | 97.19** | 97.43** | 93.50** |
| | (5.00) | (4.74) | (4.04) | (4.27) |
| $CONV_{t-1}$ | -10.02* | -5.33 | -5.27 | -6.37 |
| | (-2.10) | (-1.12) | (-0.99) | (-1.22) |
| $SUMBCDD_t$ | | 19.73** | 19.72** | 19.53** |
| | | (3.48) | (3.47) | (3.43) |
| $SUMWCDD_t$ | | 3.66** | 3.65** | 3.71** |
| | | (2.54) | (2.47) | (2.56) |
| $TWF_t$ | | | -0.19 | |
| | | | (-0.02) | |
| $TWR_t$ | | | | -2.39 |
| | | | | (-0.49) |
| CONSTANT | 143.51** | 115.69* | 115.73* | 113.06* |
| | (2.54) | (2.06) | (2.06) | (2.00) |
| $R^2$ | 0.17 | 0.24 | 0.24 | 0.24 |
| *d* | 1.50 | 1.58 | 1.58 | 1.59 |
| T | | 3.65 | | |

Note: Quantity is the dependent variable. Figures in parentheses are t-ratios. Significance at the $\alpha$=0.05 level is represented by *. Significance at the $\alpha$=0.01 level is represented by **. *d* is the Durbin-Watson statistic. T is the Wu-Hausman test statistic, distributed $\chi^2$.

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