Ashley Spalding

Telephone: 707 616 6658

Email: acspalding@gmail.com

Sofia B. Villas-Boas[1]

Associate Professor

University of California, Berkeley

207 Giannini Hall

Berkeley, CA 94720-3310 USA

Email: Sberto@are.berkeley.edu

[1] We thank two anonymous reviewers for their suggestions and the Giannini Foundation of Agricultural Economics for financial support and Phillip Cory, Sarah Wong, and Maggie Crawford for excellent research assistance. Corresponding author, Villas-Boas: sberto@berkeley.edu. University of California, Berkeley, Department of Agricultural and Research Economics, 226 Giannini Hall , Berkeley CA 94720-3310.

Investigating Price Pass-Through in Local Milk Markets

Abstract

We investigate empirically whether prices of local food items are impacted less by changes in oil/gasoline prices than prices of non-locally produced food items. We merge oil prices and a panel of regional gasoline prices with scanner data on weekly prices during five consecutive years 2001 to 2005 for numerous milk products produced by a large number of vendors sold at several retail stores in 51 different cities located in 32 states. This empirical strategy allows us to take into account variations in price caused by changes in input costs while controlling for both location and time in a hedonic fixed effects model that takes into account both characteristics of the product and input costs. Overall we find that higher oil prices, past and present, positively impact milk prices. We find that there is a significant and typically negative difference in the way oil prices are passed through to local and non-local milk prices. This means that increased oil prices lead to larger price increases for non-local goods than they do for local milk products.

Keywords: Local foods, dairy, oil, gas, input price

1. Introduction

Taking a closer look at the typical American meal or snack, we find that each item of food within it has traveled an average of 1,500 miles to get there (Kingsolver et al. 2007). Because of this, agriculture accounts for 17% of our nation's energy consumption, second only to vehicular use. While other aspects of farming (i.e. operating tractors and other farm equipment, producing synthetic fertilizers, pesticides, and herbicides, and processing, storing, and refrigerating food products) are partially to blame for this high number, 80% of the fossil fuels used in agriculture come from transporting food from the farm to our plates. Such large amounts of oil are used to transport food, in fact, that if every person within the United States ate just one meal per week containing only foods grown locally, U.S. oil consumption would decrease by over 1.1 million barrels of oil per week (Kingsolver et al. 2007). Thus, it is not difficult to comprehend why many have come to view eating local as an easy and relatively cost-effective way to reduce our impact on the environment.[2]

Eating a diet rich in locally grown and raised foods has become a fully integrated component of environmentalism in recent years. Dubbed the local food movement (for obvious reasons), its proponents, often referred to as locavores, advocate a diet free of foods that have been shipped from out of state or overseas. This is done in an effort to "build more locally based, self-reliant food economies, in which sustainable food production, processing, distribution, and consumption are integrated to enhance the economic, environmental and social health of a particular place" (Feenstra, 2002). To achieve this, many adhere to the "100 mile diet", meaning that only food grown or raised within a hundred mile radius of one's home is consumed.[3] This may have health benefits as well, as fresh and local food often contains higher levels of nutrients than food that had been shipped great distances[4], and thus several non-profit movements and political figures promote eating local, such as the SlowFood Movement,[5] and introduce the notion of local gardens, e.g, the recent addition of an 11,000 square foot organic garden to the White House Lawn.[6]

Though not everyone has the space or means to grow their own food, the availability of local foods for purchase has increased dramatically in recent years. This is in large part due to the emergence and growth of farmer's markets and Community Supported Agriculture (CSA) farms in the past two decades. The former refers to a designated public place at which a group of farmers gather each week (or some other predetermined interval) to sell their products. This allows consumers to choose from a wide array of fresh and local items from numerous nearby farms. As of August 2008, the Agricultural Marketing Service noted that there were astounding

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[2] Burros, Marion. "Preserving Fossil Fuels and Nearby Farmland by Eating Locally." The New York Times. 25 Apr. 2007. 8 May 2009 <http://www.nytimes.com/2007/04/25/dining/25loca.html?_r=1>.

[3] "Why Eat Local?" 100 Mile Diet: Local Eating for Global Change. 1 May 2009 <http://100milediet.org/why-eat-local>.

[4] Condo, Maria. "5 healthy food trends worth following." CNN. 2 Oct. 2007. 10 Apr.

[5] Slow Food USA. 6 Apr. 2009 <http://www.slowfoodusa.org/>. Founded in Italy during the 1980s as a way to combat fast food, promotes and preserves old seeds and local recipes and create meals that require little to no cooking or processing, so that the food remains in its freshest condition

[6] Waters, Alice. "Alice Waters' Open Letter to the Obamas: Food Politics : gourmet.com." Gourmet.com. Jan. 2009. Gourmet Magazine. 10 May 2009; Burros, Marion. "Obamas to Plant Vegetable Garden at White House." The New York Times. 19 Mar. 2009. 5 Apr. 2009.

4,685 farmers markets across the United States. This marks a 6.8% increase over the 4,385 farms in existence in August of 2006. Over 3,000 farmers markets have been created since the AMS first began to track farmers markets in 1994.[7]

We investigate whether high and increasing oil prices in the past decade may have been beneficial in that they effectively lessened or eliminated existing price gaps between local and non local products. The empirical strategy is to assess whether gasoline price increases are passed through to a lesser degree for local versus non local products. We hypothesize that oil prices have less of an impact on the output price of local food items than non-local products. This is because local goods are transported shorter distances than non-local goods, purchases of gasoline make up a smaller portion of producer's total costs.

We use an Information Resources Incorporated (IRI) panel scanner data set on prices for numerous milk products by a large number of vendors sold at several retail stores in 51 different cities located in 32 states. The prices span five consecutive years, beginning on January 1, 2001 and ending on December 31, 2005. In addition we use weekly gasoline prices from the Energy Information Administration (Official Energy Statistics from the US Government) for the corresponding period. We include prices for regular grade gasoline for the five regions in the scanner price dataset, as well as the national average gasoline price. A composite of US No 2 diesel prices for all sellers is also included because it is assumed that milk products from both local and non local vendors are shipped to stores in large vehicles that require diesel. Finally, price per barrel of oil is included as a proxy of future oil prices. The price model for milk products is a fixed effects hedonic pricing model that takes into account both characteristics of the product and input costs. This empirical strategy allows us to take into account variations in price caused by changes in input costs while controlling for both location and time. We find that that higher oil prices, past and present, positively impact milk prices and, moreover, that there is a significant and typically negative difference in the way oil prices are passed through to local and non-local milk prices, which means that increased oil prices lead to larger price increases for non-local goods than they do for local milk products.

[7] Shaffer, Joan, and Billy Cox . "Agricultural Marketing Service - Number of Farmers Markets Continues to Rise in U.S." Agricultural Marketing Service - Home. 22 Sept. 2008. 6 Apr. 2009.

Although to date we are the first paper to investigate different pass through rates for local and non-local foods, there have been numerous studies (Reed et al, 1997; Lee, 2002; Gicheva et. at, 2010) on the impact of energy prices (such as oil) on overall food prices with no distinction being made between local and non local goods. While Gicheva et al (2010) concluded that there is no overall effect on shelf prices at the stores from increasing gasoline prices, they found that the prices consumers pay (the net prices) are higher when gasoline prices spike. The way retailers pass-through the increasing gasoline prices is thus by offering less price discounts, and so, motivated by this, in our study we investigate the effect on net prices but extend Gicheva et al (2010) by breaking up the analysis into local and non-localproducts. Reed et al (1997) looked into the relationship between changing input prices and changes in retail food prices in both the short run and the long run. They found that energy prices have a small but positive impact on the average price consumers pay for food, the impact is smaller in the long run, and finally, the magnitude of the impact varies between food products depending on the amount of oil used in the particular sector. Lee (2002) found a positive correlation between electricity prices and food prices. The purpose of the study was to examine the effects of intermediate goods prices on output prices in various sectors of the food industry. Here, intermediate goods were defined as inputs bought by one industry from other industries to produce its own outputs. Oil is not directly identified as one of these inputs within the study, but electricity, which includes refined petroleum, electricity, and natural gas, is analyzed. Lee found that a 10% increase in prices in the energy sector will lead to changes in food prices anywhere from 0.4% in the beverage industry to 0.93% in the sugar processing industry. It is clear that discrepancies in the magnitude occur due to differences in the share of energy costs with respect to output prices across various sectors of the food industry. In this case, the share of intermediate inputs of energy was larger for sugar processing than for any other industry, with energy costs consisting of $0.035 for every dollar's worth of output. Thus, both Lee (2002) and Reed et al (1997) stress the importance of assessing the amount of energy/oil used to produce a product in determining its impact on the products price, and in our paper we investigate discrepancies in pass through of input prices into retail prices by distinguishing local and non local milk products in the analysis.

The rest of the paper proceeds as follows. The next section describes the several datasets used and outlines our empirical strategy. Section 3 presents the results and section 4 concludes and derives implications of our findings.

2. Data and Empirical Strategy

2.1. Data

We use an Information Resources Incorporated (IRI) panel scanner data set (see Bronnenberg, et. al, (2008) for a complete data set description) on prices for numerous milk products by a large number of vendors sold at several retail stores in 51 different cities located in 32 states, as can be seen in Table 1. The prices span five consecutive years, beginning on January 1, 2001 and ending on December 31, 2005. Milk was chosen because both local and non-local versions are available in many states and stores, and milk items have barcodes, which make prices easy to track over time. It is also available in many sizes, brands, and types (organic, non-fat, chocolate, etc.). This allows us to include a large variety of items for each store and increases our sample size.

In addition, we use weekly gasoline prices from the Energy Information Administration (Official Energy Statistics from the US Government) for the corresponding period, where prices are categorized by region, grade, and type of gasoline. We include prices for regular grade gasoline for the five regions in the scanner price dataset, as well as the national average gasoline price. A composite of US No 2 diesel prices for all sellers is also included because it is assumed that milk products from both local and non local vendors are shipped to stores in large vehicles that require diesel. Finally, price per barrel of oil is included as a proxy of future oil prices.

2.2. Hedonic Price Model

The price model for milk products is a fixed effects hedonic pricing model that takes into account both characteristics of the product and input costs. This empirical strategy allows us to take into account variations in price caused by changes in input costs while controlling for both location and time. Let the price of milk product *i* during time period *t* be given as the following hedonic regression:

$$P_{it} = \beta_1(Floz) + \beta_2\,(Local) + \beta_3(Gas)_{rt} + \beta_4(Diesel)_{rt} + \beta_5(Barrel)_t + \beta_6(Local*Gas_{rt}) + X_{it}\,\gamma + \varepsilon_{it}\,,$$

where *β* and *γ* are parameters to be estimated, *Floz* is the number of liquid ounces in milk product *i* in time *t* and state *s*, *Local* is a dummy variable equal to one if the milk product is only sold in one state, *Gas* is the price of a gallon of gas in week *t* in gas region *r*, *Barrel* is the price per barrel of oil in week *t*, *diesel* is the price of a gallon of conventional grade diesel in week *t*, and the coefficient associated with *Local*Gas* represents the added effect of gas prices on local products. In *X* we include other controls such as year and state fixed effects, lagged diesel, lagged gas, and lagged barrel prices, and interactions of local dummy variable with contemporaneous and lagged diesel, barrel, and gasoline prices.

The empirical model allows us to take into account variations in price caused by changes in input costs while controlling for both location and time. By including a time dummy and location fixed effect, we are able to control for unobserved variables that vary across states but not over time as well as for variables that vary over time but not across states. The interactions between the local dummy and gas, diesel, and barrel variables show the additional effect of these input costs on the price of local milk products as opposed to conventional products. Variations in prices signal demand and/or supply side shifts. Thus, an increase in price is the result of increasing input costs, in the form of oil for transportation, on the supply side. On the demand side, and increase in costs may show that consumers place a higher value on the characteristics of each product.

3. Results

Four regression specifications were estimated in order to measure the differences in input-price pass through between local and non-local milk products. Results are presented in Table 2 of Appendix A that has four columns of estimated coefficients, one column for each of the four regressions estimated. The first three regressions are essentially included only to determine to what extent variation in milk prices can be explained by changes in each of the three distinct groups of variables: time and location, product characteristics, and input costs. The final regression combines these things to look at the individual effects of each variable on milk prices. In each of the regressions where they were included, the local dummy and fluid ounce and oil variables are statistically significant, though the same cannot always be said for the interactions between the local dummy and oil variables. The total difference between how oil prices are passed through to the final price of local products compared to non-local products can be found by aggregating the interactions between the local dummy and various gasoline prices, including those with time lags.

The first regression in the first column of Table 2 estimates only the effect of time and location on milk prices. This allows us to see the extent to which changes in milk prices are the result of regional and seasonal variations, such as temperature and various other weather conditions, which are not included in the overall price model. In this regression specification price is regressed on year and state fixed effects, where all week parameter point estimates are in reference to the first year. the fixed effects are omitted from the table due to space. Though the magnitude of the effect varies, all states and years are found to have a statistically significant impact on price, with prices in year 5 being \$0.40 greater than in year 1, and prices in state 14 being \$0.68 less than in state1. Given the R squared, location and time explain 7.1% of the variation in milk prices.

The second regression results as shown in column 2 of Table 2 also include time and location fixed effects but add product characteristics in an effort to discover how much of the variation in milk prices can be attributed to differing characteristics among the products. Here, we see that included product characteristics, *Floz,* the Local product indicator as well as brand fixed effects explain an additional 24.7% of the variation in prices relative to the specification in column 1.

The third regression specification, with estimates shown in column 3 of Table 2 adds gas prices to the specification listed in column 1 of the same table. That is, in it we omit product characteristics from the regression specification and examine how gas prices help explain price variation in addition to what is already explained by differences in space and time.

When looking at the R^2 and subtracting the amount generated by the time and location variables when explaining price variation, we see that gas and oil prices explain only a infinitesimal fraction of the variation in milk prices, namely, only 0.7%.

The final regression in column 4 of Table 2 is a combination of the previous three specifications. Here, we are able to ascertain the true impact of gas/oil prices on local goods. We find that milk from local dairies cost significantly more than that from more commercial, non-local dairies by an amount of $0.66. In this specification every parameter is highly statistically significant, including all Oil and Gas parameters. In addition, all local/oil interactions show a decrease in local milk prices with respect to non-local milk prices when oil prices increase. We note as an exception that the contemporaneous *localdiesel* parameter point estimate, that is positive, although all the lagged corresponding interactions are negative as we were expecting.

In summary, although gasoline price variation while distinguishing by local and non local firms, helps explain 0.7% of the observed milk price variation, after controlling for product location and time effects, we find that indeed local firms do react differently to gas price changes relative to non local milk producing firms.

4. Conclusion

We use scanner data in U.S. geographical markets to show different pass through rates for local and non local milk products. We find that higher oil prices, past and present, positively impact milk prices, however, the impact is very small in magnitude. It is possible that the cost of transportation makes up only a small portion of total costs, and, thus, has little to no impact on final output prices. We find evidence of this in Lee (2002), where the magnitude to which changes in a particular input cost affect output prices is directly related to the share of total input costs it comprises. He goes on to say that transportation makes up only 0.41% of the total intermediate input costs faced by dairy plants. Because of this, it is logical to conclude that changes in transportation costs, i.e. oil prices, would have little effect on milk prices. This is consistent with our findings that in both datasets oil prices explain only a miniscule portion of the variation in milk prices.

Our main novel finding is that there is a substantial and negative difference in the way increases in oil prices affect the price of local and non-local milk products. This means that increased oil prices lead to larger price increases for non-local goods than they do for local milk products. It is clear that the health and environmental costs of transporting food have lead to an increased awareness and abundance of local food products. There are other costs, however, to transporting food across countries, namely monetary costs. These costs reached new heights in 2008 when oil prices spiked to record highs. The price of a barrel of oil went from $65 dollars in

May of 2007 to an all time high of $147. During this same time, the average price of a gallon of gasoline rose to $4.11[8]. Taken together with our empirical findings, the extremely high oil prices experienced in 2008 may have been beneficial in that they effectively lessened or eliminated existing price gaps between the two types of goods, therefore making it more affordable for people to purchase goods that are both good for their health and the environment.

These results could be further strengthened by including other product characteristics in the regression in order to control for their impact on prices; however, this information was not available to us. Additional studies may be needed to assess whether or not added product information alters the results found here. Furthermore, in our analysis, we define local brands as those that are sold in only one state. This does not account for national and/or store brands that purchase milk from local suppliers in regions where products are sold or small brands that purchase milk from out of state. These anomalies may exist in our sample, but we did not have access to the location where each milk product originated, only the brand name. Thus, it was necessary to define locality based solely on brand information.

The extent to which our findings can be used by managers and producers when developing their business plans is limited by the fact that the local assignment is not random in our investigation. Our investigation takes the local and non-local decision as given and then analyzes the differences in price adjustment for local versus non-local firms. Because of this, we cannot make out of sample predictions as to what could be the best managerial practice for a manager deciding on changing its prices when switching to serve more globally if before he was a local firm.

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APPENDIX A

Table 1: Summary of Store Locations for the Scanner Dataset

Region	State	Cities/Regions
East Coast	Georgia	Atlanta
	Massachusetts	Boston, New England, Pittsfield
	New York	Buffalo/Rochester, New York City, Syracuse
	North Carolina	Charlotte, Raleigh/Durham
	Pennsylvania	Harrisburg/Scranton, Philadelphia
	Connecticut	Hartford
	Rhode Island	Rhode Island
	Virginia	Richmond/Norfolk, Roanoke
	South Carolina	South Carolina
	Washington dc	Washington DC
Gulf Coast	Alabama	Birmingham
	Texas	Dallas, Houston,
	Mississippi	Mississippi
	Louisiana	New Orleans
	New Mexico	West Texas/New Mexico
	Illinois	Chicago, Peoria/Springfield
	Ohio	Cleveland, Toledo
	Iowa	Des Moines
	Michigan	Detroit, Grand Rapids
	Wisconsin	Eau Claire, Milwaukee, Green Bay

Midwest	Indiana	Indianapolis
	Missouri	Kansas City, St. Louis
	Tennessee	Knoxville
	Minnesota	Minneapolis/St. Paul
	Oklahoma	Oklahoma City, Tulsa
	Nebraska	Omaha
Rocky Mountain	Utah	Salt Lake City
West Coast	California	Los Angeles, San Diego, San Francisco, Sacramento
	Arizona	Phoenix
	Oregon	Portland
	Washington	Seattle/Tacoma, Spokane

Table 2: OLS Results Price Hedonic Regressions

Dependent Variable: Price of milk product *i* at time *t*

	1		2		3		4	
	coefficient	std	coefficient	std	coefficient	std	coefficient	std
floz			0.014***	0.0000			0.0140***	0.0000
local			0.0094***	0.0012	0.7701***	0.0088	0.6646***	0.0075
dieselprice					0.0764***	0.0025	0.0374***	0.0022
gasprice					0.0193***	0.0027	0.0426***	0.0023
barrelprice					0.0007***	0.0001	0.0006***	0.0001
localdiesel					0.0133	0.0091	0.1079***	0.0078
localgas					-0.006	0.0099	-0.0328***	0.0085
localbarrel					-0.0064***	0.0003	-0.0079***	0.0003
diesel1					0.1077***	0.0006	0.0869***	0.0005
diesel2					0.1080***	0.0006	0.0871***	0.0005
diesel3					0.1080***	0.0006	0.0874***	0.0005
localdiesel1					-0.1188***	0.0024	-0.1039***	0.0020
localdiesel2					-0.1238***	0.0024	-0.1075***	0.0020
localdiesel3					-0.1205***	0.0024	-0.1053***	0.0020
State Fixed Effects	**YES**		**YES**		**YES**		**YES**	
Year Fixed Effects	**YES**		**YES**		**YES**		**YES**	
Product Fixed Effects	**NO**		**YES**		**NO**		**YES**	
R squared	**0.07**		0.318		0.08		0.323	
Number Observations	**16,103,465**		**16,103,465**		**16,103,465**		**16,103,465**	
*** significant at the 1 percent level.								