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"A Definition at Last, But What Does it All Mean?"[1] Newspaper Coverage of Organic Food Production and its Effects on Milk Purchases

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This paper estimates the effects of media coverage of organic food production on food purchases. Information from several data sources links national and local newspaper coverage to fluid milk purchases. An analysis of weekly store-level scanner data in a differences-in-differences approach results in a 5% increase in organic milk sales relative to conventional milk sales. Increases in intensity of news coverage increase this relative difference in sales. Differentiating effects by media context further suggests that product category specific coverage increases sales more than general coverage. Critical coverage does not result in significant effects on organic milk sales.

Key words: consumer behavior, information media effects, organic food, scanner data

Introduction

Agricultural production is a major contributor to global environmental problems (UNEP, 2010) and obesity is a worldwide epidemic with significant negative impacts on health, burdening the U.S. economy alone with annual costs of $270 billion (Society of Actuaries, 2010). Starting with their own diets and extending to the way food is produced, consumers have grown increasingly concerned about the effects of food choices on their health and the environment. Existing research documents consumers' widespread interest in food labels (e.g., Teisl and Roe, 1998; Williams, 2005; Grunert and Wills, 2007). However, firms might not have an incentive to fully reveal their product quality (e.g., Bonroy and Constantatos, 2008), might try to highlight certain attributes while hiding others (e.g., Gabaix and Laibson, 2006), or might provide information in a less salient fashion (e.g., Chetty, Looney, and Kroft, 2007). The Industrial Organization literature has traditionally distinguished between informative and persuasive (prestige) effects of advertising (e.g., Ippolito and Mathios, 1995; Ackerberg, 2001), but there is no consistent treatment of the role of media coverage in the existing literature. More recently, two studies have examined the impact of food safety-related information and the role of media coverage on consumer risk avoidance (Shimshack, Ward, and Beatty, 2007; Schlenker and Villas-Boas, 2009).

This paper presents an analysis of the effects of media coverage as one aspect of effective policy-based information dissemination aimed at promoting sustainable food choices. More specifically, this research addresses whether media coverage of organic food production and the National Organic Program (NOP) influenced milk purchases. It examines the effect of national versus local newspaper coverage, positive versus negative media portrayal, framing within specific product categories (i.e.,

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[1] Headline from the New York Times (10.16.2002)

media coverage directly related to organic milk production and consumption), and differences in newspaper circulation and reader/shopper demographics.

I combine a set of unique scanner data provided by a major U.S. supermarket chain with information from several independent media data sources, newspaper circulation measures, and socio-demographic census information. Time-series and cross-sectional variation in media coverage allow me to identify an average treatment effect in a differences-in-differences approach (DD) commonly used in the policy evaluation literature (see Meyer, 1995; Bertrand, Duflo, and Mullainathan, 2004).

My analysis suggests average increases of 5% in organic milk sales relative to conventional milk sales during weeks for which news coverage is observed. Increases in news coverage intensity further increase this relative difference in sales, but at a diminishing rate. Media effects also seem to dissipate quickly in the weeks following news coverage, indicating that consumer attention might be relatively short-lived. Differentiating by context of observed articles suggests that product category specific coverage almost doubles the estimated effects when compared to general coverage. Furthermore, local news coverage seems to have a relatively larger impact than national news coverage. Finally, critical or negative national or local news coverage does not result in significant changes in organic milk sales.

These results provide important policy considerations, suggesting that it is not only information that matters to consumers, but also where and how it is presented. Current and future regulation must pay closer attention to media portrayal of regulatory changes in order to achieve policy goals. Supportive media portrayals can capture consumer attention and motivate at least short-term adjustments to consumer purchases. Combining these information-based interventions with incentive-based approaches such as price changes could potentially ensure long-term behavioral changes.

Background and Motivation

Information provision and dissemination is an integral part of current state and federal programs to promote more sustainable and healthier food choices. The NOP was initiated as a direct consequence of the Organic Foods Production Act. Included in the 1990 Farm Bill, it called for regulation of the production, handling, and marketing of organically produced agricultural products. Its implementation in October 2002 introduced a uniform national standard and new labeling guidelines to promote sustainably produced foods: "Organic food is produced by farmers who emphasize the use of renewable resources and the conservation of soil and water to enhance environmental quality for future generations" (U.S. Department of Agriculture, 2002).

Empirical studies of the effects of information-based policies on food choices have mainly focused on nutritional labeling (e.g., Ippolito and Mathios, 1990; Mojduszka and Caswell, 2000; Mathios, 2000; Teisl, Bockstael, and Levy, 2001). Results reported in this context are mixed, and contribute to the notion that the Nutrition, Labeling, and Education Act of 1990 has failed in light of obesity rates. However, experimental research (Cain, Loewenstein, and Moore, 2005) suggests people do not sufficiently take incentives and motives of an information source into account. Empirical research also finds prestige effect and to a lesser extent information effects of advertising (e.g. Ackerberg, 2001). Yet Ippolito and Pappalardo (2002) suggest that firms moved away from reinforcing nutritional or health claims in firm specific advertising due to regulatory rules and enforcement policies.

While potential effects of media coverage have not been addressed in this context, two studies have examined the impact of food safety-related information and media presence on risk avoidance behavior. Shimshack, Ward, and Beatty (2007) used a reduced-form approach to examine consumer response to a national FDA advisory to limit store-bought fish consumption due to the dangers of methyl-mercury. They find that information-based policies can be effective, but education and newspaper readership are important determinants of consumer response. Comparing an official

government release of the first reported case of mad cow disease in 2003 to coverage of the disease in the Oprah Winfrey Show seven years prior, Schlenker and Villas-Boas (2009) find a sharp drop in beef consumption and cattle futures in both cases, even though Oprah Winfrey merely highlighted potential dangers and presented her opinion. Her show did not have any real news content compared to the government-released information in 2003.

In this paper, I follow their reduced form approach, matching newspaper coverage and readership to store-level scanner data. Rather than investigating risk avoidance, however, I focus on the role of media coverage in promoting consumption of a more sustainable product alternative. Research linking the impact of media coverage to political attitudes and outcomes (e.g. Strömberg, 2004; Gentzkow and Shapiro, 2006; DellaVigna and Kaplan, 2007) suggests that media content can play a powerful role in leading to socially desirable changes. Other studies report the effect of news coverage on health behaviors such as reduced drug use and cancer prevention (Viswanath, Breen, and Meissner, 2006; Stryker, 2003). In contrast to these studies, I am able to isolate media effects from changes in product attributes, information interdependencies with regulatory changes, and changes in product advertising.[2]

In addition to the literature on information and media effects, several articles examine consumer preferences for organic and non-biotech foods. This literature is dominated by attitudinal surveys, choice experiments, and experimental auctions (see Marks, Kalaitzandonakes, and Vickner, 2003, for an overview). Reported results range from substantial price premiums and distinct consumer preferences to no detectable avoidance of conventional or biotech products (e.g. Roe and Teisl, 2007; Batte, Beaverson, and Hooker, 2003; Huffman et al., 2003).

The limited number of market-based studies have tended to focus on milk. Organic milk is often viewed as the gateway to organic purchases, as consumers who do not buy any other organic products purchase organic milk (DuPuis, 2000). Glaser and Thompson (2000) identify price premiums as high as 103%, and high own-price elasticities for organic milk products. The consumer segment buying organic milk also portrays significant valuation for organic production, and to a lesser extent, for milk produced without genetically modified growth hormones (rBGH) (Dhar and Foltz, 2005). Dimitri and Venezia (2007) observe a shift in the distribution of organic products from natural food stores to conventional channels such as supermarkets, and significant regional variation in price premiums for organic milk. Differences in income, educational and ethnic background, and age are associated with households purchasing organic milk. However, socio-demographic differences did not explain differences in the average share of milk expenditure allotted to organic milk and the frequency of purchases among those households. I also focus on fluid, unflavored milk as milk can be viewed as a relatively standardized and ubiquitously processed commodity. It permits abstracting from brand and taste preferences when comparing organic versus conventional products. In addition, some identified newspaper articles directly address organic milk. I can therefore investigate framing effects within this specific product category.

Previous research on milk purchases also suggested that food labels might be necessary for market segmentation of rBGH-free and organic milk to take place (Kiesel, Buschena, and Smith, 2005). The NOP introduced mandatory certification, but displaying the USDA organic seal is voluntary. Using cross-sectional variation in the display of this seal, Kiesel and Villas-Boas (2007) found an increased willingness to pay for organic milk products carrying the seal and concluded that consumer valuation exceeded the costs associated with the NOP implementation. I contribute to a more comprehensive policy evaluation of the NOP in this context. Finally, the discussion of my results provides important policy recommendations regarding the promotion of more sustainable and healthier food choices in general.

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[2] This distinction is not easily made with regard to voting behavior, for instance. Candidates and programs change over time and are influenced by media coverage and voter opinion. Here, product characteristics do not change, as none of the milk products labeled as organic before the introduction of the NOP left the market or were sold as conventionally produced milk products afterwards. I also investigate the effects of media coverage prior to the effective date of the NOP.

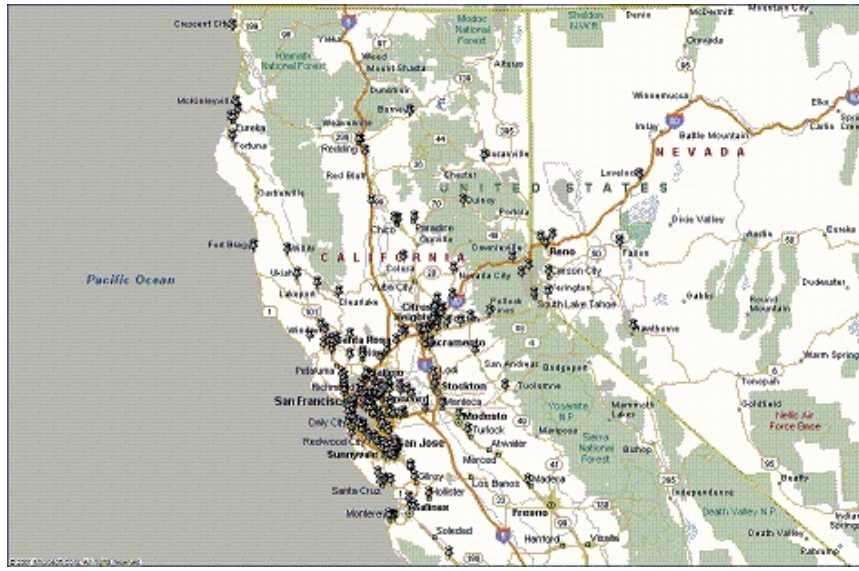

Figure 1. Location of Stores Included in Scanner Data

Notes: This figure maps all the stores included in the data according to their store address. In addition to 229 stores located in Northern California, 8 stores are located in Nevada. The remaining stores are located in Hawaii and not mapped here.

Data Sources and Descriptive Statistics

To implement the analysis, I combine information compiled from several independent data sources. The main data set consists of weekly store-level data on fluid milk purchases in Northern California (including some stores in Nevada and Hawaii based on distributional considerations of the grocery chain). This data set was provided by one of the largest U.S. grocery store chains, and includes all 52 weeks in 2002. A total of 257 stores are included, 229 are located in California. Store locations for these 229 stores and the 8 stores located in Nevada are mapped in figure 1. The density of stores varies from two stores per ZIP code in more rural areas (such as Healdsburg) to 16 stores per ZIP code in urban areas (such as San Francisco). I use the store ZIP code to merge the store-level data with socio-demographic statistics of potential consumers extracted from the United States Census Bureau (2000 Census).

Data on news coverage of NOP and organic production is obtained from three sources–LexisNexis™, Proquest®, and NewsLibrary.com–through an individual keyword search (e.g. organic food, NOP, USDA organic seal). Four national papers (*The Wall Street Journal*, *The New York Times*, *Washington Post*, and *USA Today*) as well as ten local papers (*San Francisco Chronicle*, *Oakland Tribune*, *Sacramento Bee*, *Modesto Bee*, *Fresno Bee*, *San Jose Mercury News*, *Monterey County Herald*, *Alameda Times Star*, *The Daily Review Hayward*, and *San Mateo County Times*) were searched. In addition, I searched the *Reno Gazette Journal* for the analysis of control stores in Reno, but found no relevant newspaper coverage over the investigated time. In addition, I searched for relevant television coverage using Vanderbilt Television News Archive, but could only indentify coverage on the day the NOP went into effect.

I reviewed each article for relevance and content and grouped articles into either critical or supportive coverage as well as category specific coverage (two articles in the national press specifically focused on milk consumption). A complete list of headlines, dates, and corresponding weeks of included news coverage is included in the appendix.

Finally, I merge store-level data with newspaper circulation measures compiled by the Audit Bureau of Circulations (ABC). Local publishers have to submit circulation claims to ABC every six months. The circulation numbers used here were reported in March 2003 for mid-week editions.

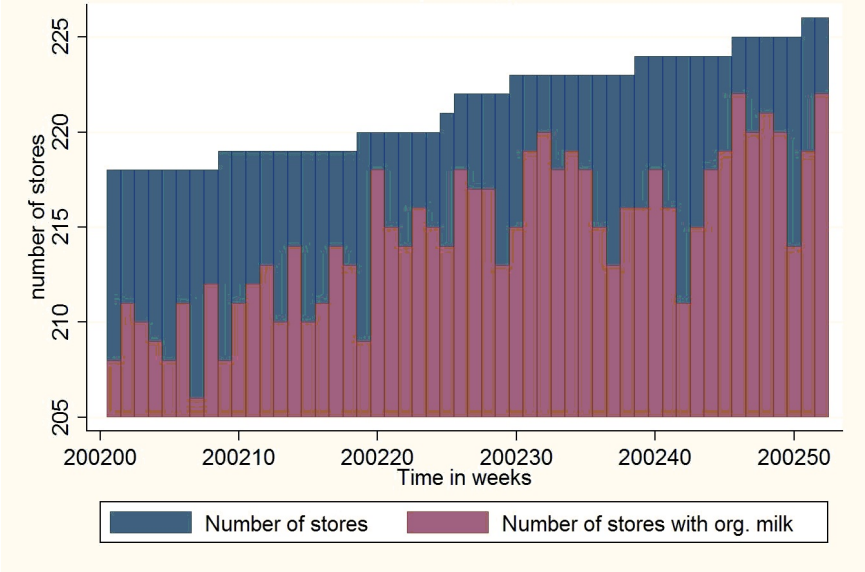

Figure 2. Availability of Organic Milk across Stores

Notes: This figure illustrates significant variation in the number of stores that report greater than zero sales of organic milk. I cannot differentiate if these missing observations result from limited availability of organic milk in these stores, or indicate no purchases during these weeks. I therefore restrict the analysis to stores that report positive organic milk sales for all weeks.

Table 1 summarizes these results. One ZIP code and one local paper could not be matched, as they were not reported in the ABC data. The last column reports weeks for which I observe local coverage at a specific paper and indicates variation in newspaper coverage for the *San Francisco Chronicle* and *Oakland Tribune* across stores and weeks only. The analysis using circulation measures therefore focuses on these two local papers.

Organic milk is offered in only one subcategory in the store-level data in 2002: fat-free, half-gallon milk. By focusing on this subcategory, comparisons across brands are limited to the inclusion of private label conventional milk in most stores. Only five stores carry an additional branded fat-free half-gallon alternative. This limited cross-sectional variation across brands is consistent with previous findings, suggesting that conventional labels dominate the market (e.g. Dhar and Foltz, 2005; Dimitri and Venezia, 2007). In addition, while 225 of the 229 California stores carried organic milk during 2002, organic milk was consistently available in 181 stores (illustrated in figure 2). I restrict my analysis to these stores and discuss possible sample selection in the result section.

Despite these data limitations, the data set is representative of organic milk demand as a whole during the analyzed time period. Overall milk sales in 2002 amounted to $133.49 million in the data, and half-gallon milk contributed $31.55 million or 23.6%. The analyzed fat-free category amounted to sales of $8.94 million or 6.7% of total sales. Within this category, organic milk sales amounted to $1.20 million or 0.9% of total sales. These numbers are consistent with previous studies reporting that organic milk accounted for less than 1% of total milk sales in 2002 (e.g. Dhar and Foltz, 2005; Dimitri and Venezia, 2007).[3]

The final data set analyzed consists of 9,412 observations. Table 2 presents descriptive statistics of key variables. Quantities of organic milk sold in a given week vary from 1 to 232 units depending upon the store, while quantities of conventional milk vary from 66 to 1,527 units. Therefore, conventional sales are 339 units, or 83.1% higher on average. Prices for fat-free, half-gallon organic milk range from $2.49 to $3.99, while conventional milk ranges from $1.37 to $2.29. This amounts

[3] Dimitri and Venezia (2007) report a market share estimate of 6% for 2005 that includes cream, acknowledging that the market share for milk alone is less than that. Accounting for reported annual growth rates of 25% and an increase in supply and distribution organic milk further discussed in their paper makes our observed market share for 2002 reasonable.

Table 1. Variation in Local Newspaper Circulation and News Coverage (Local Paper Circulation Matched with Stores and News Coverage)

Newspaper	Number of Stores	Weeks with News Coverage
The San Francisco Chronicle	179	2002 25
		2002 26
		2002 28
		2002 41
The Oakland Tribune	50	2002 28
		2002 40
		2002 41
Sacramento Bee	31	2002 42
		2002 45
Modesto Bee	2	2002 42
		2002 50
Fresno Bee	1	2002 42
San Jose Mercury News	102	2002 42
Monterey County Herald	8	2002 42
The Daily Review (Hayward)	8	2002 28
San Mateo County Times (Alameda Times Star)	8	2002 28

Notes: The above statistics summarize the number of stores in ZIP codes for which I observe positive circulation measures in the ABC data. I also report during which weeks I observe coverage of organic production and the NOP in these local papers. One local paper, the *Alameda Times Star*, was not included in the ABC data.

to an average price difference of $1.51. The price reported in the data is an average price across all observed sales for a specific product during this week. Depending on the type of promotion (e.g. club card specials), this price varies across stores based on the percentage of consumers that bought milk using this promotion. Prices and price premiums reported here are consistent with national averages for organic as well as conventional milk (see Dimitri and Venezia, 2007). Furthermore, variations in conventional milk prices are almost exclusively limited to variations of base level prices across stores, while variations of organic milk prices are due to base level variations across stores as well as price promotions. However, promotions of organic milk affect all stores uniformly as all of the stores are within the same pricing division. Promotions on organic milk appear more frequently in the second half of 2002. This increase in frequency of price promotion might be an indication of a structural change in the market after the NOP implementation and adjustments to changes in consumer demand.

Econometric Specification

To assess the impact of media coverage on consumer purchases, I specify the treatment variable as the presence of media coverage in a given week. Using repeated cross sections–weekly store-level sales–I follow a differences-in-differences-approach (DD) commonly used in the policy evaluation literature (see Meyer, 1995; Bertrand, Duflo, and Mullainathan, 2004). I cannot observe what sales of organic milk would have been at a given week in the absence of media coverage. The identification of the average treatment effect (ATE) depends on the definition of relevant control groups. In addition, identification rests on the assumption that average differences in outcomes for treated and control groups with the same values for covariates are attributable to the treatment. This assumption is satisfied when treatment assignment and the potential outcomes are independent (Imbens, 2004). DD allows for comparisons of means of the outcome of interest with or without treatment while holding observable covariates constant. I define the ATE as the mean difference in sales of organic milk relative to sales of conventional milk in weeks with and without media coverage. My control

Table 2. Summary Statistics of Final Data Set

Variable	Obs	Mean	Std. Dev.	Min	Max
Scanner data					
price organic milk	9,412	3.54	0.31	2.50	3.99
net sales organic milk	9,412	123.58	100.50	3.35	723.24
quantity organic milk	9,412	35.32	29.39	1	232
price conventional milk	9,412	1.99	0.11	1.37	2.29
quantity conventional milk	9,412	374.36	183.71	66	1,527
price difference	9,412	1.55	0.32	0.31	2.04
quantity difference	9,412	−339.04	166.54	-1,417	−29
log (quantity difference)	9,412	(2.57)	0.65	(5.73)	(0.42)
stores	9,412	103.35	62.56	1	229
week	9,412	26.50	15.01	1	52
Socio-demographic data					
population total	155	33,053.13	17,087.41	2,951	91,177
median income	155	64,552.63	22,054.74	24,346	145,425
median rent	155	1,005.08	264.33	495	2,001
Median house value	155	379,709.50	193,790	109,300	1,000,001
Percentage White	155	0.71	0.16	0.26	0.97
Percentage over 65 of age	155	0.13	0.05	0.04	0.51
Media coverage data					
news (dummy)	9,412	0.29	0.45	0	1
local & national news (dummy)	9,412	0.06	0.23	0	1
national news (dummy)	9,412	0.21	0.41	0	1
local news (dummy)	9,412	0.13	0.34	0	1
San Francisco Chronicle circulation	154	181.29	873.90	58	8,877
Oakland Tribune circulation	154	12.26	168.73	0	5,167
Oakland Tribune (dummy)* circulation (%)	154	0.04	0.53	0	12.87
San Francisco Chronicle (dummy)* circulation (%)	154	0.65	4.17	0	152.03

Notes: Circulation (%) indicates the percentage of newspapers sold compared to potential market size (population). For the San Francisco Chronicle, creating this measure results in two ZIP codes with higher than 100% circulation measures. Excluding these two ZIP codes results in a maximum circulation measure of 34.1% rather than the 152% reported above.

structure is twofold: temporal, as I compare sales in weeks with and without newspaper coverage over the range of 2002; and cross-sectional, as I compare sales across geographic regions with variation of local newspaper coverage and circulation measures.

Let $Q_{i,t} = q_{org,i,t} - q_{conv,i,t}$ be the difference between organic and conventional milk sales at a given store i and week t, measured in the number of half-gallons (quantity) sold in each category. I estimate a double difference DD specification and transform both quantity measures into logs ($\log\_Q_{i,t}$ is defined as $\log(q_{org,i,t}) - \log(q_{con,i,t})$). This specification allows me to interpret and compare regression results in terms of average percentage effects across stores rather than differences in sales in levels. Initially, I pool all news coverage and estimate the following specification:

$$\log\_Q_{i,t} = \alpha_i + \beta_0 \times P_{i,t} + \beta_1 \times trend_t + \delta \times news_t + u_{i,t}. \tag{1}$$

Store fixed effects, α_i, are included to capture unobserved, time-invariant heterogeneity across stores and allow for a shift of average differences in sales for each store. The price variable, $P_{i,t}$, is transformed into differences ($P_{i,t} = p_{org,i,t} - p_{conv,i,t}$) in this specification. I discuss alternative ways of specifying the price variable as additional robustness checks. The primary variable of interest,

news, defines the treatment effect. It is constructed as a weekly dummy variable that equals one if I observe coverage at a given week, and zero otherwise. The coefficient on *news*, δ, measures the ATE as the average percentage difference in organic versus conventional sales between weeks with and without media coverage. Alternatively, I also define this variable as a count of articles at a given week to investigate effects of increases in news coverage intensity. When including the treatment variable as a count variable, I further add a second order term to allow for non-linear effects of increased news coverage. Finally, a time trend is included to capture a general increase of organic milk sales that might be independent of media coverage.

In addition to estimating an average treatment effect of media coverage, I am also interested in differences based on supportive versus critical coverage, local versus national paper coverage, and category-specific versus general coverage. Taking these differences in treatment effects into account, I estimate the following specification:

$$\begin{aligned}\log\_Q_{i,t} = {} & \alpha_i + \beta_0 \times P_{i,t} + \beta_1 \times trend_t + \delta_1 \times newsmilk_t + \delta_2 \times \\ & natnews_t + \delta_3 \times natnews\_crit_t + \delta_2 \times locnews_t + \delta_3 \times locnews\_crit_t + u_{i,t}.\end{aligned} \tag{2}$$

I expect critical coverage of organic production to have no effect on or reduce sales of organic milk relative to conventional milk. I would also expect category-specific coverage to have a bigger impact on sales. Consumer attention is directed towards milk and benefits from organic milk production in this case. I have no clear prior hypothesis regarding the relative magnitude of local versus national news effects.

In addition, local news coverage can be assigned to specific newspapers and interacted with circulation measures for these papers. I transform circulation measures into percentage measures by using total population numbers reported in the census data. Finally, I investigate whether socio-demographic differences across ZIP codes result in significant differences in the magnitude of media effects for both national and local coverage. I interact the variables measuring media effects with a vector of demographics such as income measures (median income, house values, and rental contracts), age distribution (percentage over the age of 65), and differences in composition of ethnic groups (percentage of whites) reported at the ZIP code level.

Empirical Results

One of the advantages of using a DD approach is that it allows for a graphical analysis. As a first step, figure 3 graphs total organic sales overlaid with observed media coverage. Sales of organic milk seem to primarily increase when national news coverage is observed, suggesting that national media coverage may be more effective than local coverage. The big spike of local coverage in week 28 did not seem to affect aggregated store sales much. The local papers reporting that week are relatively small, however, and this spike results from a simultaneous print of a three-part feature on organic production and regulatory changes in several papers (*Oakland Tribune*, *Daily Review*, *The San Mateo County Times*, and *The Alameda Times Star*) under joint ownership. This figure only focuses on an article count. While it seems to suggest that national coverage in week 40 to 43 did not result in a significant increase in total sales, coverage was critical rather than supportive in these weeks.

Overlaying this graph with variation in the mean organic milk price across stores (figure 4) suggests that observed increases in organic milk sales are correlated with price promotions. Not accounting for other covariates in regression specifications, such as price promotions, might therefore falsely overstate the importance of news coverage.[4]

Finally, previous research (e.g. Kiesel and Villas-Boas, 2007; Dimitri and Venezia, 2007)

[4] When contacting the product category manager of the supermarket, I was not able to confirm that price promotions are potentially coordinated with media coverage, especially during category-specific national coverage in weeks 33 and 36.

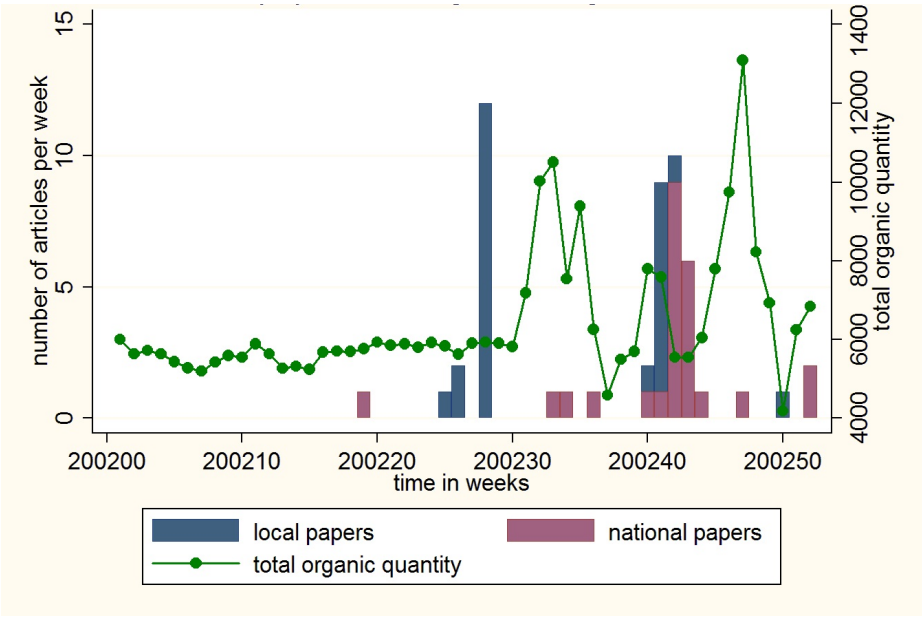

Figure 3. Newspaper Coverage and Total Organic Sales

Notes: This figure summarizes the correlation between variation in total organic sales and observed newspaper coverage. Newspaper coverage is displayed as a count of the number of articles per week, with no differentiation for content (e.g. critical versus supportive coverage).

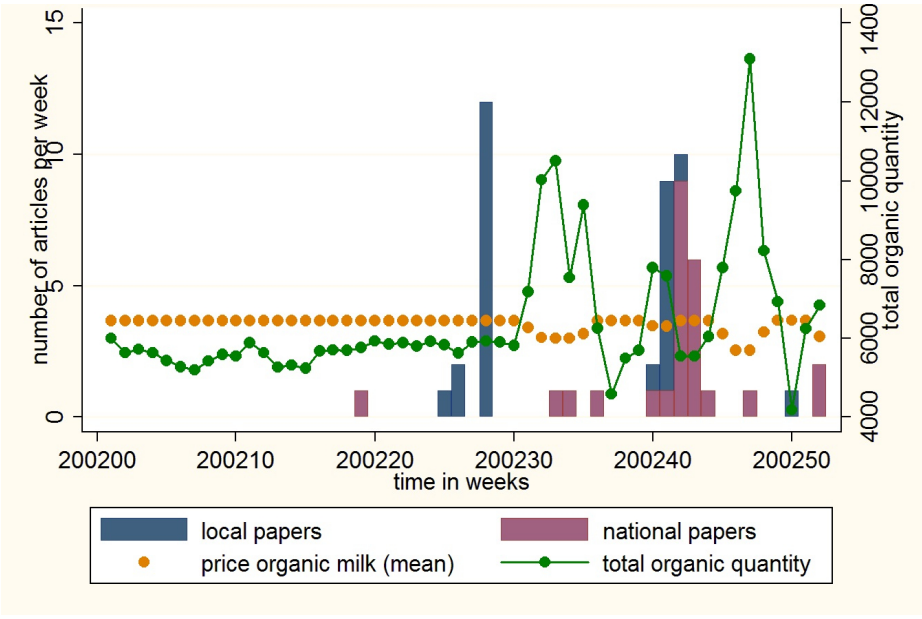

Figure 4. Newspaper Coverage, Total Organic Sales, and Price Variation

Notes: This figure adds variation in organic milk prices to figure 3 in order to motivate the regression analysis. Not accounting for other covariates such as price would likely overemphasize the media effect.

Table 3. Pooled media effects (difference-in-differences)

Dependent variable (log) quantity org milk -(log) quantity conv milk (by week, by store)		
Independent variables/statistics	(1)	(2)
price difference	−0.768***	−0.765***
	(0.027)	(0.027)
news (dummy)	0.051***	
	(0.010)	
news (count per week)		0.052***
		(0.008)
news^2		−0.004***
		(0.001)
time trend (linear)	0.003***	0.003***
	(0.000)	(0.000)
store fixed effects	yes	yes
weeks with actual news coverage	9	9
number of observations	7,421	7,421
F-statistic	112.52	114.69

Notes: The first column reports results from the base line regression, measuring the average treatment effect of news coverage based on a dummy that equals one if there is relevant local or national coverage during this week. In contrast, the second column measures the average treatment effect based on an actual count of articles with relevant coverage during this week and adds a squared term to allow for non-linear effects due to an increase in articles. Newey-West corrected standard errors (with 3 lags) are reported. Single, double, and triple asterisks (*, **, ***) represent significance at the 10%, 5%, and 1% level. Standard errors are shown in parentheses.

indicates that implementating the NOP and the USDA organic seal displayed on packages increased demand for organic products. Therefore, the independence or exogeneity assumption of treatment effects due to media coverage might not be satisfied during the week of the NOP implementation, as well as during the weeks following these regulatory changes. I restrict my analysis to weeks prior to the NOP implementation. Regression specifications comparing effects of media coverage prior and post implementation are discussed as additional robustness checks.

Pooled Media Effects

I begin the regression analysis of the effects of media coverage by estimating equation (1). Table 3 reports the results from a regression, including store fixed effects, price differences, a linear time trend, and a dummy variable equaling one for weeks in which media coverage is observed. I find an average treatment effect (ATE) across all news sources (local and national newspaper coverage independent of local versus national coverage and possible differences in portrayal) of 5.1%. This base specification is also included in all subsequent tables as column (1) to provide a reference point. In the second column, the reported treatment variable is defined as a count variable. This specification also includes a squared term to capture possible non-linear effects. Again, I find a significant increase of organic milk sales due to media coverage, suggesting that each additional article increases sales by 4.8%, but at a decreasing rate.

These specifications also suggest that consumers are very responsive to price changes. As prices are recorded in dollars, a one dollar decrease in the difference in prices between organic and conventional milk at a given week results in a significant 76.8% increase in organic sales relative to conventional sales. The average price difference observed in the data is $1.55. Therefore, a one dollar decrease corresponds to a price change of 64.5%. Transforming the estimated price effects into

a 1% decrease in the price difference results in an estimated 1.19% increase in organic sales relative to conventional milk sales.[5] The positive coefficient on the time trend further suggests a small but gradual increase in demand for organic milk of 0.3%. Finally, even though not reported individually here, store fixed effects capturing unobserved, time-invariant heterogeneity across stores allow for a shift of average differences in sales for each individual store. They are statistically significant for almost all stores included in the regression analysis.

Another interesting aspect of estimating media effects relates to the longevity or dissipation of these effects over time. Table 4 reports results for a regression specification that in addition to the news dummy includes up to three lags for observed media coverage (possible effects in up to three weeks following the initial news coverage). Weeks with only critical coverage are excluded from these regressions. These results suggest a significant decrease during the week directly following observed news coverage. No significant increase or decrease is detected in the two subsequent weeks, however. The estimated 4.8% decrease in the week following the news coverage could be explained by the shelf life of milk. Having bought milk in a given week makes consumers less likely to buy milk the following week. One could expect repeated purchases by consumers affected by news coverage in the following weeks if media-induced organic milk purchases resulted in a permanent change of purchasing patterns. While I do not observe this, it is worth noting that the decrease in sales in the week following observed media coverage does not fully offset the increase observed during the week of coverage. These results could further explain infrequent purchases previously reported in the literature. Of the households that buy organic milk, only 36% purchase organic milk frequently, while the remaining portion of consumers only pay infrequent attention to organic production (Dimitri and Venezia, 2007). This infrequent attention could be a result of infrequent news coverage.

These findings are not driven by potential serial correlation in sales across weeks. Including up to three lags of the dependent variable does not reproduce the same pattern and does not affect the magnitude or significance of the lagged media effects. Including these lags also allows me to test whether my results are driven by a correlation in sales and to conclude that potential serial correlation in the error terms is not caused by serial correlation in the dependent variable. Potential serial correlation in the error terms is addressed below.

Differentiated Media Effects

Table 5 reports regression results for differentiated rather than pooled media effects (equation 2). I classified news coverage according to category-specific coverage (only observed in national papers) and general national and local newspaper coverage. I also separated critical national and local coverage from supportive coverage. In this specification, category-specific news coverage yields the highest significant increase (10.7%) in organic sales relative to conventional sales in a given week. General national news coverage increases organic sales by 4.5% relative to conventional sales, while the effect of local coverage increases relative sales by 7.0%. This difference in magnitude is statistically significant, suggesting a relative bigger impact of local coverage.

I also make use of cross-sectional variations in local media coverage and circulation measures for local papers. This analysis focuses on the *San Francisco Chronicle* and *Oakland Tribune* only. I observe circulation measures for the *San Francisco Chronicle* ranging from 0.2% to 34.1% of the total population reported for each store ZIP code (after excluding two stores, for which I observe circulation measures higher than 100%). The circulation measures for the *Oakland Tribune* are significantly lower overall (12.9% at its maximum), and can be matched to only fifty stores included in the store-level data. The second column of table 6 (specification 6) adds a dummy variable for both the *San Francisco Chronicle* and *Oakland Tribune*. Controlling for national media coverage, a relevant article in the *San Francisco Chronicle* in a given week does not result in statistically

[5] As I follow a reduced-form approach, I only control for price sensitivity. These results cannot be interpreted as price elasticities.

Table 4. Pooled Media Effects and Dissipation of Effects over Time

Dependent variable (log) quantity org. milk -(log) quantity conv. milk (by week, by store)			
Independent variables/statistics	(1)	(3)	(4)
price difference	−0.768***	−0.748***	−0.730***
	(0.027)	(0.027)	(0.028)
news (dummy)	0.051***	0.052***	0.049***
	(0.010)	(0.011)	(0.010)
1st week after news (dummy)		−0.048***	
		(0.014)	
2nd week after news (dummy)		0.016	
		(0.018)	
3rd week after news (dummy)		−0.022	
		(0.014)	
lagged dependent variable (1st lag)			0.010
			(0.006)
lagged dependent variable (2nd lag)			0.008
			(0.006)
lagged dependent variable (3st lag)			0.018***
			(0.006)
time trend (linear)	0.003***	0.004***	0.003***
	(0.000)	(0.001)	(0.000)
store fixed effects	yes	yes	yes
number of observations	7,421	7,421	7,421
F-statistic	112.52	115.24	109.52

Notes: The first column reports results from the base line regression, measuring the average treatment effect of news coverage based on a dummy that equals one if I observe relevant coverage in either local or national news during this week. In contrast, the second column includes lagged dummies for the two weeks directly following the news coverage. The third column adds lagged terms of the dependent variable. Newey-West corrected standard errors (with 3 lags) are reported. Single, double, and triple asterisks (*, **, ***) represent significance at the 10%, 5%, and 1% level. Standard errors are shown in parentheses.

significant differences of organic milk sales relative to conventional sales. However, a relevant article in the *Oakland Tribune* results in a statistically significant increase of organic sales relative to conventional sales of 11.1% compared to weeks with no coverage. The next column adds the interactions with circulation measures. The results reported here suggest that an additional increase in circulation by 1% results in an increase in sales of organic milk by an additional 0.3% for the *San Francisco Chronicle*. Interestingly, the coefficient on the *San Francisco Chronicle* dummy not interacted with circulation is negative and significant, suggesting that sales of organic milk would have been lower on average in the absence of media coverage during these weeks. Only stores with a circulation of 14.4% or higher would experience increases in organic milk sales as a result of coverage in the *San Francisco Chronicle*. These results point to potential economies of scale or network effects only realized when local papers reach a certain circulation. This might explain why the average effect for the *San Francisco Chronicle* was statistically insignificant in specification (6).

No significant differences are detected for differences in circulation measures for the *Oakland Tribune*. This could possibly be due to the limited number of stores that could be matched with this paper's circulation, limited variation in circulation measures across those stores, and joint ownership of some of the local papers not included in this specification.[6]

[6] As mentioned earlier, the *Oakland Tribune*, the *Daily Review*, the *San Mateo County Times*, and the *Alameda Times Star* are owned by the *Alameda Newspaper Group (ANG)*. The same articles appear in all of those local papers simultaneously in some weeks.

Table 5. Differentiated Media Effects (by Local vs. National Coverage, Category-Specific, and Critical News Coverage)

Dependent variable (log) quantity org. milk -(log) quantity conv. milk (by week, by store)		
Independent variables/statistics	(1)	(5)
price difference	−0.768***	0.756***
	(0.027)	(0.028)
news (dummy)	0.051***	
	(0.010)	
(national) news milk (dummy)		0.107***
		(0.021)
national news organic (dummy)		0.045***
		(0.015)
local news organic (dummy)		0.070***
		(0.016)
national news organic critical (dummy)		−0.002
		(0.022)
local news organic critical (dummy)		−0.046
		(0.038)
time trend (linear)	0.003***	0.003***
	(0.000)	(0.000)
store fixed effects	yes	yes
number of observations	7,421	7,421
F-statistic	112.52	122.88

Notes: The first column reports results from the base line regression, measuring the average treatment effect of news coverage based on a dummy that equals one if I observe relevant coverage in either local or national news during this week. In contrast, the second column differentiates between local and national news, category specific milk (e.g. coverage that directly relates to milk), and critical coverage. Newey-West corrected standard errors (with 3 lags) are reported. Single, double, and triple asterisks (*, **, ***) represent significance at the 10%, 5%, and 1% level. Standard errors are shown in parentheses.

The Northern California division of this supermarket chain also includes a limited number of Nevada stores. I use those stores as an additional control and robustness check. Shoppers in those stores are not likely to have read either the *San Francisco Chronicle* or *Oakland Tribune*, and were not exposed to news coverage on organic production or the NOP in their local paper. Regression results for those stores are reported in the last column of table 6. As expected, the inclusion of local media coverage in the *San Francisco Chronicle* and *Oakland Tribune* resulted in no significant effects on sales of organic versus conventional milk, strengthening the significance of the findings for the California stores.

Finally, I investigate whether differences in socio-demographic composition of readers and shoppers across ZIP codes result in cross-sectional variation of media effects. I interact the treatment variable with proxies for income differences (median income, median contract rent, and median house values), the percentage of the population over 65 as a control for differences in age composition, the percentage of whites as a control for differences in ethnicity, and population size to differentiate between urban and rural areas. I estimate pooled as well as differentiated regression specifications and include linear as well as non-linear functional forms. However, I fail to detect significant differences in media effects based on these socio-demographic characteristics. This could be a result of the aggregated nature of these variables. With regards to organic preferences in general, previous studies also find that socio-demographic characteristics have limited explanatory power (see Dimitri and Venezia, 2007; Kiesel and Villas-Boas, 2007).

Table 6. Local Media Effects (*San Francisco Chronicle* and *Oakland Tribune*)

	Dependent variable (log) quantity org. milk -(log) quantity conv. milk (by week, by store)			
Independent variables/statistics	(1)	(6)	(7)	(8)
price difference	−0.768***	−0.751***	−0.752***	−1.410***
	(0.027)	(0.027)	0.(022)	(0.180)
news (dummy)	0.051***			
	(0.010)			
San Francisco Chronicle		−0.019	−0.043*	−0.026
		(0.015)	(0.022)	(0.121)
San Francisco Chronicle*circulation			0.003*	
			(0.002)	
Oakland Tribune (dummy)		0.111***	0.115***	−0.028
		(0.019)	(0.020)	(0.114)
Oakland Tribune*circulation				
national news (dummy)		0.050***	0.050***	0.069
		(0.012)	(0.012)	(0.060)
time trend (linear)	0.003***	0.003***	0.003***	0.003
	(0.000)	(0.000)	(0.000)	(0.003)
store fixed effects	yes	yes	yes	yes
number of observations	7,421	7,421	7,257	168
F-statistic	112.52	116.06	115.5	43.2

Notes: The first column reports results from the base line regression, measuring the average treatment effect of news coverage based on a dummy that equals one if I observe relevant coverage in either local or national news during this week. The second column includes a dummy measuring coverage in the San Francisco Chronicle and Oakland Tribune, as well as national paper coverage. The third column additionally adds circulation measures. In the last column, I use the Nevada stores included in the data, rather than the California stores as a robustness check. Newey-West corrected standard errors (with 3 lags) are reported. Single, double, and triple asterisks (*, **, ***) represent significance at the 10%, 5%, and 1% level. Standard errors are shown in parentheses.

Diagnostics and Additional Robustness Checks

Using a panel data set that tracks weekly milk sales across stores for 52 weeks makes it necessary to address the time-series character of the data by performing tests regarding stationarity and serial correlation. Performing Dickey-Fuller tests 1979 for stationarity allows me to reject the null hypothesis of a unit root process for all price series only. The quantity series were found to be trend stationary. The inclusion of a linear time trend in all regressions addresses this concern (Wooldridge, 2003). Another related concern with using time series in DD estimations is possible bias due to serially correlated error terms as well as serial correlation in the independent variable itself (Bertrand, Duflo, and Mullainathan, 2004). I test for serial correlation using a generalization of the Durbin-Watson test (Wooldridge, 2002) and reject the null hypothesis of no first order autocorrelation. I report Newey-West corrected standard errors with a maximum of three lags for all regression specifications to address this concern. This procedure corrects for serial correlation of unknown form in the error terms (Newey and West, 1987). The inclusions of a maximum of three lags is motivated by the maximum shelf life of milk. The results reported here are robust to including the maximum of the total number of weeks ($t - 1$) as a lag structure.

As an additional robustness check, I adapt a procedure of random inference testing based on generated placebo treatments (suggested by Bertrand, Duflo, and Mullainathan, 2004). Table 7 reports comparisons between estimated news effects from the pooled regression specification and estimated effects for four random draws of a time series of placebo news coverage during nine weeks (based on the number of weeks in which I observe media coverage). I also report how many

Table 7. Media Effects vs. Generated Placebo Effects

	Dependent variable (log) quantity org. milk -(log) quantity conv. milk (by week, by store)				
Independent variables/statistics	(1)	(10)	(11)	(12)	(13)
price difference	−0.768***	−0.767***	−0.772***	−0.769***	−0.772***
	(0.027)	(0.047)	(0.027)	(0.027)	(0.027)
news (dummy)	0.051***	−0.018**	0.016	−0.005	0.021**
	(0.010)	(0.027)	(0.010)	(0.009)	(0.009)
time trend (linear)	0.003***	0.004***	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
store fixed effects	yes	yes	yes	yes	yes
weeks with actual news	9	0	1	2	2
number of observations	7,421	7,421	7,421	7,421	7,421
F-statistic	112.52	111.43	111.87	111.56	111.46

Notes: The first column reports results from the base line regression, measuring the average treatment effect of news coverage based on a dummy that equals one if I observe relevant coverage in either local or national news during this week. The second to forth column report regressions results when I generate a random draw of nine weeks each to define placebo news dummies. The overlap with actual news coverage is reported as well. Newey-West corrected standard errors (with 3 lags) are reported. Single, double, and triple asterisks (*, **, ***) represent significance at the 10%, 5%, and 1% level. Standard errors are shown in parentheses.

weeks of the randomly drawn weeks coincide with actual weeks of media coverage observed in the data. Two of the randomly generated placebo news series resulted in a negative treatment effect, one of which is statistically significant at the 1% significance level. The other two placebo series included two of the actual weeks of coverage and resulted in positive and significant effects, but these effects are lower in magnitude than the actual treatment effects.

As I am restricting the above reported analysis to include stores that had organic milk available over the entire time period, one might also be concerned about selection bias regarding the socio-demographic composition of the neighborhoods in which these stores are located. I address this concern by estimating a probit regression of inclusion of a given store in the analysis. I use observable socio-demographics as explanatory variables for this possible selection bias. The results reported in table 8 indicate some significant differences in the stores included in the analysis. However, these results do not clearly suggest a systematic selection bias. As an additional robustness check, I follow the Heckman two-step approach by including the estimated computed inverse mills ratio based on the first stage's regressions in the second stage regression addressing media effects (Heckman, 1979; Wooldridge, 2002). Table 9 reports the results of this adjustment. Including the inverse Mills ratio results in a negative and significant estimate of -.73, but does not alter the magnitude and significance of the remaining variables of interest. The adjustment for selection bias did affect the estimated fixed effects in this regression, however, suggesting that store fixed effects absorb possible time-invariant differences across stores.

Finally, as I am regressing quantity measures on price, one might be concerned about possible endogeneity of prices. Retailers consider all product characteristics and account for changes in demand when setting prices. This introduces a simultaneity problem in that the quantity demanded might also affect prices, or unobserved variables affect prices and quantities simultaneously. In both cases, prices would be correlated with the disturbance terms included in the regression specification. The data exhibits considerable variation in quantities sold for both conventional and organic milk. However, prices of conventional milk almost exclusively vary across stores, not across weeks. This suggests that prices for conventional milk were not adjusted due to demand shocks during the time period investigated. In addition, I would expect to see a price increase for organic milk after the

Table 8. Investigating Selection Bias due to Limited Availability of Organic Milk in Some Stores

	Dependent variable analyzed stores (coded as 1)	
Independent variables/statistics	**marginal effects (a)**	**marginal effects (b)**
population total	1.08×10^{-6}	
	(0.000)	
median income	$-8.40 \times 10^{-6***}$	$-8.51 \times 10^{-6***}$
	(0.000)	(0.000)
percentage of White	0.395**	0.370***
	(0.161)	(0.141)
median house value	$1.17 \times 10^{-6***}$	$1.50 \times 10^{-6***}$
	(0.000)	(0.000)
median rental contract	0.0004*	0.0004*
	(0.0002)	(0.0002)
percentage over 65 of age	0.152	
	(0.461)	
number of observations	240	240
Pseudo R^2	0.278	0.275

Notes: The dependent variable in these regressions equals one if the store is included in the regression analysis. 240 stores are included in the data, 181 of which are included in the regressions reported above. The first column includes all socio-demographic variables, while the second column re-estimates the regression excluding the insignificant variables. Robust and clustered (by store) standard errors are reported. Single, double, and triple asterisks (*, **, ***) represent significance at the 10%, 5%, and 1% level. Standard errors are shown in parentheses.

implementation of the USDA organic seal due to an expected increase in demand for organic milk. However, I do not observe increases in the price of organic milk for that time period. Furthermore, observed price promotions for organic milk are uniform across all stores, contradicting responses to store-specific changes in demand over time. Time-invariant variations in organic milk demand relative to conventional milk and price differences across stores will be captured by store-fixed effects, however, and while some of price reductions appear to coincide with national news coverage, cross-sectional variation in local newspapers supports the assumption that price promotions and news coverage are exogenous.

Alternative Specifications and Estimation over Entire Sample

The results reported above seem qualitatively robust to a number of alternative specifications. For instance, I define the dependent variable as the ratio of organic sales over total sales, estimate the regressions in levels, and use only organic sales. As the inclusion of the price difference also restricts the price effects to be symmetric (a decrease in organic milk price versus increase in conventional milk price), I further estimate specifications that only include organic prices. I focused on the results presented above, as consumers face two milk alternatives at a given store. I assume that it is the difference in prices between these two alternatives rather than individual prices that matters in making a milk purchasing choice once the consumer is in the store.

I also extend this analysis and include the entire time period available in the data. I first address possible effects of the actual USDA organic seal on packages including a NOP dummy equaling one for week 42–the week during which NOP went into effect. Alternatively, I include a dummy variable equaling one for all weeks thereafter.[7] Table 10 summarizes these regression results. These results indicate that sales for organic milk compared to sales of conventional milk actually decreased after NOP went into effect. This is somewhat counterintuitive and contrary to findings reported in

[7] In contacting milk processors, I verified that processors tried to ensure their products were carrying the USDA seal on the day the NOP went into effect. Different processors followed different strategies in this regard as display of the seal is voluntary, but the processor included in this analysis did post the USDA seal.

Table 9. Media Effects Accounting for Possible Selection Bias

Dependent variable (log) quantity org. milk -(log) quantity conv. milk (by week, by store)		
Independent variables/statistics	(5)	(9)
price difference	0.756***	0.758***
	(0.028)	(0.029)
(national) news milk (dummy)	0.107***	0.106***
	(0.021)	(0.021)
national news organic (dummy)	0.045***	0.045***
	(0.015)	(0.015)
local news organic (dummy)	0.070***	0.071***
	(0.016)	(0.023)
national news organic critical (dummy)	−0.002	−0.004
	(0.022)	(0.023)
local news organic critical (dummy)	−0.046	−0.022
	(0.038)	(0.039)
time trend (linear)	0.003***	0.003
	(0.000)	(0.000)
inverse Mills ratio		−.0736***
		(0.097)
store fixed effects	yes	yes
number of observations	7,421	7,421
F-statistic	122.88	123.27

Notes: The first column repeats results reported in table 5 (column 2) and the second column adds the inverse Mills ratio to account for possible section bias. Including the inverse Mills ratio has an effect on the store fixed effects not separately reported here. Newey-West corrected standard errors (with 3 lags) are reported. Single, double, and triple asterisks (*, **, ***) represent significance at the 10%, 5%, and 1% level. Standard errors are shown in parentheses.

earlier studies (e.g. Kiesel and Villas-Boas, 2007). One possible explanation might be shortages in the supply chain that resulted in a limited availability of organic milk in these stores. For instance, during week 42, the number of stores in which organic milk is available decreases (see figure 2). The results for selection bias potentially support this argument, as stores excluded from the analysis have a higher median income. An alternative explanation might be that the NOP, in addition to product choice, also affected the store choice of consumers. This is especially likely considering the limited assortment of organic products in mainstream supermarkets during this time. For instance, consumers were only able to buy fat-free half-gallon organic milk in the stores included here.

I investigate this possible structural change by estimating an unrestricted specification that does not constrain coefficients to be equal before and after the regulatory change. Comparisons of the restricted and unrestricted model allow me to reject the hypothesis of equal coefficients for the price variable, media effects, and time trend individually (using t-tests) as well as combined (using F-tests) at the 1% significance level. These tests are equivalent to Chow tests for structural change (Chow, 1960; Wooldridge, 2003). Estimating media effects prior to and after NOP regulation separately results in a positive and significant 4.5% increase in the quantity of organic half-gallon fat-free milk sold relative to conventional milk prior to the NOP. This estimate is consistent with previously discussed results. The unrestricted model also results in a large and significant decrease in organic sales due to media coverage after the NOP went into effect. As a general trend, media coverage was more critical after the regulations went into effect. When I further differentiate news coverage by local versus national news coverage and supportive versus critical portrayal, as well as category-specific coverage, I recover a positive significant effect for supportive local and national news coverage. The estimated treatment effect for local coverage increases slightly in magnitude

Table 10. Pooled Media Effect and Possible Structural Change due to NOP Implementation

	Dependent variable (log) quantity org. milk -(log) quantity conv. milk (by week, by store)						
Independent variables/statistics	(1)	(14)	(15)	(16)	(17)	(18)	
						before NOP	after NOP
price difference	−0.768***	−0.688***	−0.699***	−0.696***	−0.692***	−0.745***	−0.560***
	(0.027)	(0.017)	(0.016)	(0.016)	(0.017)	(0.026)	(0.021)
NOP week (dummy		−0.120***			−0.091***		−0.049
		(0.027)			(0.028)		(0.031)
post NOP period (dummy)			−0.068***		−0.058***		0.068
			(0.014)		(0.015)		(0.147)
news (dummy)	0.051***			−0.001	0.003	0.045***	0.209***
	(0.010)			(0.009)	(0.009)	(0.010)	(0.017)
time trend (linear)	0.003***	0.004***	0.005***	0.004***	0.005***	0.004***	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
store fixed effects	yes	yes	yes	yes	yes	yes	
number of observations	7,421	9,412	9,412	9,412	9,412	9,412	
F-statistic	112.52	139.78	140.04	141.7	137.75	136.87	

Notes: The first column reports results from the base line regression, measuring the average treatment effect of news coverage based on a dummy that equals one if I observe relevant coverage in either local or national news during this week. The second column includes an identifier for the week during which NOP was implemented, while the third column includes an identifier for all weeks post implementation as well. The fourth column includes both identifiers, and the last column estimates weeks prior and post implementation separately. Newey-West corrected standard errors (with 3 lags) are reported. Single, double, and triple asterisks (*, **, ***) represent significance at the 10%, 5%, and 1% level. Standard errors are shown in parentheses.

compared to treatment effects prior to the NOP, and decreases in magnitude for national coverage. Estimated negative and significant effects for critical coverage post the NOP vary considerably in magnitude for both national and local papers. These results might be explained by the fact that identification of these effects rests on only two weeks–week 42 and week 50. As mentioned previously, reductions in sales in week 42 might result from supply shortages. The dummy variable capturing the change in labeling regulations in week 42 is dropped due to collinearity in this specification. This effect is therefore absorbed in the media dummy variable. Week 50 might similarly be affected by supply shocks, as the number of stores in which organic milk is available is also significantly lower during this week (see figure 2). A similar argument can be made for national coverage. Here, identification is based on three weeks. One of these weeks includes Christmas Day and New Years Eve. As my identification of media effects partly relies on time-series variation, I cannot include weekly time fixed effects to absorb these seasonal effects. However, as I regress organic milk sales relative to conventional milk sales, I account for seasonal patterns that affect the demand for milk in general. Households might be more income constrained during the holidays, possibly resulting in a bigger decrease in organic milk relative to conventional milk during this time period.

Conclusions

This paper provides an empirical analysis of the effect of media coverage of organic production and regulatory changes on milk consumption. By combining data from several sources, I create a unique data set. I use time-series and cross-sectional variation in observed media coverage to identify media effects on actual purchases of organic fluid milk. Using a differences-in-differences approach (DD) allows me to compare mean differences in weekly sales of organic versus conventional half-gallon, fat-free milk with and without news coverage. My results suggest that media coverage significantly affects consumer purchases. Specifically, pooling news coverage to estimate an average treatment effect across newspapers suggests average increases in organic milk sales relative to conventional milk sales of 5% during weeks for which I observe relevant news coverage. When accounting for increases in news coverage intensity (measured by the number of articles in a given week), my results further suggest increases in media effect as a result of increased media coverage intensity. Each additional article increases organic sales at a decreasing rate, however. I also find that these media effects dissipate quickly in the weeks following news coverage, potentially suggesting that news coverage motivates infrequent organic milk purchases observed in the existing literature (e.g. Dimitri and Venezia, 2007). Finally, category specific news coverage resulted in significantly higher observed increases in sales than general coverage of organic production. Critical national and local coverage did not result in significant changes in organic milk sales prior to the NOP implementation.

An additional comparison of media effects before and after the NOP implementation suggests a structural change in the market for fluid milk, possibly resulting from supply chain shortages or changes in consumers' store choice in addition to product choice. I actually detect a smaller difference in sales of organic versus conventional milk after the NOP implementation, which is inconsistent with results reported in previous studies relying on multiple grocery outlets.

Admittedly, this analysis is limited in scope. It looks at sales within one major U.S. supermarket chain only and focuses exclusively on milk purchases. The limited availability of organic milk varieties in mainstream grocery outlets prior to the NOP further restricted the analysis to half-gallon, fat-free milk. In addition, availability of organic milk across stores varies significantly, especially post implementation. This could be an indication of shortages and adjustments in the supply chain for organic milk. I detect significant media coverage around the actual NOP implementation, but I cannot separate effects of media coverage from the actual policy effect, or the change in labeling after the NOP implementation. As this limitation directly relates to the identification assumption in the DD approach, I place a higher emphasis on the results from a restricted sample that focuses on a time period prior to the NOP.

Increases in relative sales of organic milk reported here might seem small in magnitude, as weekly sales of organic milk range from 1 to 232 units at a given store, or overall sales of $1.2 million (about 1% of all milk sales in the data). However, given that this increase occurred as a result of general coverage, I would expect to observe similar effects across all product categories and outlets. Considering the overall size of the organic food industry of $24.8 billion (Organic Trade Association, 2010), a 5% increase might seem more economically relevant. More importantly, while still a niche market, the U.S. organic market was one of the fastest growing categories in food business. At five-year compound annual growth rates of 21.4% between 2002 and 2007 (Organic Trade Association, 2010), large food companies such as General Mills, Kraft, Dean Foods,[8] and Dannon started marketing many of the branded organic products or added their own organic store brands (e.g. Kroger, Safeway, Costco, and Wal-Mart). Media coverage and its effect on consumer preferences might have successfully promoted these market trends.

I also want to highlight that the effects measured here are strictly media effects isolated from actual policy changes and brand specific advertising efforts. For instance, articles focusing on organic milk in particular doubled purchase response when compared to a general coverage on organic production. Further, aligning brand-specific advertising and promotions with these media events would most likely result in even larger effects. For instance, I find that consumers respond quite strongly to price promotions for organic milk. Supportive media coverage on organic production seems to have reinforced both firm-specific decisions and regulatory changes under the NOP.

Relating my results back to the literature on nutritional labeling, media coverage might also explain the mixed results found here. Critical news coverage of regulatory challenges (Nestle, 2002) and the "Food News Blues" in general (Kantrowitz and Kalb, 2006) might have resulted in firms moving away from reinforcing nutritional or health claims, not just the regulatory rules and enforcement policies themselves. Isolating labeling changes from these competing information sources suggests that consumers could be motivated to alter purchasing decisions in this context (e.g. Kiesel and Villas-Boas, 2010).

The results presented therefore highlight the need for more comprehensive policies and policy evaluations. They emphasize the importance of a consideration of interdependencies between different information channels. It is not only the information itself that matters to consumers, but also where and how this information is presented. Adding this market-based approach to the existing literature suggests that media presence and a positive media portrayal can capture consumer attention and foster changes in purchasing behavior. Information-based interventions supported by an investment in media presence and supportive portrayal can effectively promote more sustainable and healthier food choices. Especially when supported by firm-specific marketing and incentive-based approaches such as price promotions, they could ensure long-term behavioral changes.

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Appendix

Table A1. News Coverage Included in Regression Analysis

Week	Date	Source	Title
200233	08.20.2002	*The Wall Street Journal*	Is that $5 Gallon Milk Really Organic?
200234	08.26.2002		Would World Starve on Organic Farming
200236	09.11.2002		**Stamp of Approval from U.S. to Help Horizon Organic**
200243	10.25.2002		**Taste–Review & Outlook: Hard to Swallow**
200247	11.20.2002		**Where Organic Beef Roam**
200252	12.26.2002		**The Organic Myth**
200252	12.26.2002		**Organic Food Aren't Necessarily the Healthiest Choice**
200240	10.09.2002	*The Washington Post*	A Guide to New Organic Terminology
200243	10.21.2002		The New Standards; What Does 'Organic' Really Mean?
200244	11.04.2002		Nothing Organic about Factory Farms
200219	05.08.2002	*The New York Times*	Study finds far less Pesticide Residue on Organic Produce
200241	10.14.2002		Small Organic Farmers pull up Stakes
200242	10.16.2002		**A Definition at Last, but What Does It All Mean?**
200242	10.18.2002		Clearly Organic
200242	10.20.2002		**The 'Organic' Label: Who Wins at the Bank? [Interview]**
200242	10.20.2002		**Going Organic**
200242	10.20.2002		**Eat, and Buy Organic**
200242	10.21.2002		**Organic Gets an Additive: A U.S.D.A. Seal to Certify It**
200242	10.21.2002		**A New Organic Era [Editorial]**
200243	10.23.2002		**Sharing the Organic Harvest**
200243	10.29.2002		**How Foods Earns the Organic Seal**
200252	12.25.2002		**North of San Francisco, Cream Rises to the Top**
200242	10.16.2002	*USA TODAY*	USDA gives bite to organic label
200242	10.21.2002		With new organic labels, each purchase equals a vote
200243	10.28.2002		Big Business Gobbling up Small Organic Farms
200243	10.29.2002		Healthy Food Turns up in Unusual Places
200225	06.22.2002	*The San Francisco Chronicle*	Organic Dairies feel squeezed; Lawsuit contests State Fees
200226	06.27.2002		Bay Area tops State in Concern for Earth; More buy Organic, Recycle. Poll finds
200228	07.15.2002		Voices against Agribusiness
200241	10.13.2002		Agribusiness goes organic, New law and growing appetite for wholesome foods bring mega growers to the Table
200241	10.13.2002		Standards Grew out of Long Process
200228	07.16.2002	*The Oakland Tribune*	Learning More About Organic
200228	07.16.2002		Getting to the Root of Organic
200228	07.16.2002		Its Easy being Green: Northern California enjoys Fruit and Organic Renaissance
200240	10.06.2002		Organic Foods Definitely Worth Price
200241	10.09.2002		USDA Organic Rule Takes Effect in 12 Days
200241	10.09.2002		Why Organic Costs More
200241	10.09.2002		Organic Rules: Government's New Standards Aim to Take Guesswork Out of Buying Organic
200242	10.16.2002	*Sacramento Bee*	Stamp of Approval What's Organic? Government Hopes New Rules on Labeling Will End the Confusion
200242	10.16.2002		What the Various Organic Terms Mean

(continued on next page. . .)

Table A1. – continued from previous page

Week	Date	Source	Title
200242	10.22.2002		Organic foods go Mainstream USDA's Label Rules Take Effect
200245	11.08.2002		Organic, Shmorganic
200242	10.22.2002	*Modesto Bee*	National Organic Food Standard Finally go Into Effect
200242	10.22.2002		Organic Market Tastes Change Uniform USDA Seals expected to Boost Profits
200250	12.12.2002		Small California Growers fear Being Squeezed from Market Due to Organic Boost
200242	10.21.2002	*Fresno Bee*	FDA Launches Stricter Standards for Organic Food Claims
200242	10.20.2002		New Labels help Buyers Federal Regulations will ensure Products meet Standards
200242	10.17.2002	*San Jose Mercury News*	'Organic' Label Frustrates Small Farmers
200242	10.22.2002		Federally Certified Organic Foods Make Way to Grocery Stores
200242	10.21.2002	*Monterey County Herald*	'Organic' Foods Law takes Effect
200228	07.16.2002	*Alameda Times Star*	Learning More About Organic
200228	07.16.2002		Getting to the Root of Organic
200228	07.16.2002		ItâĂŹs Easy being Green: Northern California enjoys Fruit and Organic Renaissance
200240	10.06.2002		Organic definitely worth the price
200241	10.09.2002		USDA Organic Rule Takes Effect in 12 Days
200241	10.09.2002		Why organic costs more
200228	07.16.2002	*The Daily Review (Hayward)*	Learning More About Organic
200228	07.16. 2002		Getting to the Root of Organic
200228	07.16. 2002		ItâĂŹs Easy being Green: Northern California enjoys Fruit and Organic Renaissance
200228	07.16. 2002	*San Mateo County Times*	Learning More About Organic
200228	07.16. 2002		Getting to the Root of Organic