"A Definition at Last, but What Does It All Mean?"[1]

—Newspaper Coverage of the USDA Organic Seal and its Effects on Food Purchases—

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Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Orlando, FL, July 27-29, 2008

[1] Headline from New York Times (10. 16. 2002).

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Abstract

This paper estimates the effects of media coverage in organic food production and the National Organic Program (NOP) on food purchases. Information from several independent data sources is complied into a unique data set that directly links national and local newspaper coverage to fluid milk consumption. An analysis of weekly store-level scanner data in a difference-in-differences approach suggests average increases in organic milk sales relative to conventional milk sales of 5 percent during weeks for which relevant news coverage is observed. Increases in intensity of news coverage, measured by the number of articles in a given week, are further found to increase the relative difference in sales but at a decreasing rate. However, these effects dissipate quickly in the weeks following news coverage. Differentiating by context of observed articles suggests that product category specific coverage doubles observed increases in sales when compared to general coverage, while critical national and local coverage does not result in significant changes in organic milk sales. Furthermore, local news coverage seems to have a relatively higher impact than national news coverage, with increases in circulation of one local newspaper resulting in increased organic milk sales as well. Our results provide valuable insights for the evaluation of existing labeling regulations and future regulations on specialty foods in this context.

Keywords: consumer demand, labeling, media effect, organic food, scanner data

[2] Headline from New York Times (10. 16. 2002).

*I would like to thank Sofia Villas-Boas and Jeff Perloff, as well as participants of the ERE seminar at UC Berkeley, and participants of the 10th Occasional California Workshop on Environmental and Resource Economics at UCSB for helpful comments and suggestions. I am also thankful to Stefano DellaVigna for providing me with access to the ABC data.

1. Introduction

The myriad of words and symbols printed on food and beverage containers keeps growing in complexity and diversity. But do the intricacies of these labels really inform consumers? And what motivates them to read a label and ultimately alter their purchase decisions? In this paper, we present an empirical analysis of the effects of media coverage in organic production and the National Organic Program (NOP) on food purchases. The NOP was initiated as a direct consequence of the Organic Foods Production Act in the 1990 Farm Bill, calling for regulations of production, handling, and marketing of organically produced agricultural products. Its implementation in October 2002 introduces uniform national standards, new labeling guidelines, and the USDA organic seal added to food packages:

> *"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. Organic meat, poultry, eggs, and dairy products come from animals that are given no antibiotics or growth hormones. Organic food is produced without using most conventional pesticides; fertilizers made with synthetic ingredients or sewage sludge; bioengineering; or ionizing radiation." (USDA, NOP 2002)*

While the USDA and other agencies directly provide information and definitions through their websites and other educational materials, consumers are more likely to learn about regulatory changes through mainstream media. The questions this paper addresses are: (i) Does media coverage of organic food production and the NOP influence consumer purchases? (ii) Do media effects vary by national versus local newspaper coverage? (iii) Do media effects differ depending on positive versus negative portrayal, as well as general coverage versus framing within specific product categories? (iv) Do media effects differ based on differences in circulation of newspapers, and demographics of readers and shoppers?

A unique data set is utilized, combining information from several independent data sources. It matches weekly store-level data on fluid milk purchases in Northern California provided by a major supermarket

chain, with newspaper coverage, newspaper circulation measures, and socio-demographic census information. The analysis focuses on fluid unflavored milk sales as milk can be viewed as a relatively standardized and ubiquitously processed commodity, which permits abstracting from brand and taste preferences when comparing organic versus conventional products. In addition, some identified newspaper articles directly address milk and allow investigating framing effects within a specific product category.

Time-series and cross-sectional variation on media coverage is used to identify an average treatment effect defined as newspaper coverage observed at a given week. The reduced form approach followed in this paper evaluates average sales of organic milk versus conventional milk for weeks with and without news coverage. A difference-in-differences approach (DD) allows for comparisons of means of differences in weekly sales with and without news treatment, while holding potentially important observable covariates such as price promotions, constant.

Our results suggest average increases in organic milk sales relative to conventional milk sales of 5 percent during the weeks for which relevant news coverage is observed. Increases in intensity of news coverage, measured by the number of articles in a given week, are further found to increase the relative difference in sales, but at a decreasing rate. However, these significant effects dissipate quickly in the weeks following news coverage, indicating that consumers captured attention is relatively short-lived. Differentiating by context of observed articles further suggests that product category specific coverage doubles observed increases in sales when compared to general coverage, while critical national and local coverage does not result in significant changes in organic milk sales. Furthermore, local news coverage seems to have a relatively higher impact than national news coverage, with increases in circulation of one local newspaper resulting in increased organic milk sales as well. Differences in media effects due to differences in the socio-demographic composition of readers and shoppers could not be detected.

Extending the analysis to a comparison of media effects prior and post implementation of the NOP suggest a structural change in consumer demand for fluid milk, possibly resulting from effects on consumers store choice in addition to product choice due to the NOP and the USDA organic seal.

By presenting the first study that directly links newspaper coverage to consumer purchases in the context of food labeling, we add a market based approach to the literature on organic labeling dominated by attitudinal surveys, choice experiments, and experimental auction. We further addresses a major shortcoming in the existing literature on food labeling in general, as little attention has been paid to interdependencies between regulation, media coverage, and product marketing.

Overall our findings consistently suggest that portrayal of regulatory changes under the NOP in the media significantly affects consumer purchases. These findings are not only economically relevant when considering the $30 billion organic food industry. They can also be applied to other labeling regulations such as nutritional labeling. Here, critical news coverage of regulatory challenges (Nestle 2002), the "Food News Blues" in general (Newsweek 2006), and a move away from reinforcing related nutritional and health claims by firms as a result of regulatory changes under the Nutritional Labeling and Education Act (Ippolito and Pappalardo 2002) might be one possible explanation for inconsistent results found in the existing literature. Ignoring interdependencies between regulatory changes, media coverage, and product advertisement can potentially bias the results of policy analysis. Our research suggests that the consideration of changes in alternative information sources can lead to more comprehensive policy evaluations and provide important implications for future regulations on specialty foods in this context.

The paper proceeds as follows. The next section discusses the related literature. Data sources and descriptive statistics are described in section 3. Section 4 introduces the empirical framework and

identification strategies and section 5 summarizes our results and discusses robustness checks. The paper concludes with section 6.

2. Related Literature

The existing literature on consumer responses to labeling claims regarding organic and genetically modified food production are dominated by attitudinal surveys, choice experiments and experimental auctions (see Marks, Kalaitzandonakes and Vickner, 2003 for an overview). Results range from substantial price premiums and distinct consumer segments to no avoidance behavior or detectable effects. Roe and Teisl (2007) combine differences in non-GMO labeling information with variation in agencies that certified these claims. They find that simple claims are viewed as most accurate, and labels certified by the US Food and Drug Administration (FDA), and in some cases, USDA certified claims are perceived as more credible than third party and consumer organization certification. While Batte et al (2003) find that the willingness to pay for organic content post NOP varied with income and other demographics such as age and education, Huffman et al (2003) find that household demographics had no significant effect on willingness to pay for non-genetically modified products in experimental auctions of products displaying divergent labeling claims. In addition to the general criticism of applicability of results in market settings, the limited range of items and focus on one particular aspect of food preferences, this literature does not address the complexity of alternative information sources and constraints in this regard in markets based settings.

A limited number of market-based, but mainly descriptive studies have tended to focus on organic milk as milk is often viewed as the gateway to organic purchases. Consumers that do not buy any other organic products purchase organic milk (DuPuis 2000). Dimitri and Venezia (2007) provide a summary

of industry analysis with conflicting views on characterization of consumers purchasing organic products. They further suggest a gradual shift in the distribution of organic products after the NOP. In 2005 the share of organic food sold in natural stores had actually decreased from 68% in 1991 to 48%, while the share of organic food sold in conventional stores increased from 7% to 46%. The limited number of market based studies in this field is directly linked to these distribution characteristics: Limited availability of organic alternatives in conventional stores, and limited access to data from natural channels. In addition, even when utilizing data sources like AC Nielson which include a number of alterative channels, a small percentage of households purchases organic products (e.g. in 2004, only 4% of the households included in the AC Nielson panel purchased organic milk). Focusing on price differences and elasticities, Glaser and Thompson (2000) identified price premiums as high as 103%, and high own-price elasticities for organic milk products. Dhar and Foltz (2005) used a quadratic, almost ideal demand system (AIDS) for differentiated milk types in combination with supermarket scanner data. They found significant consumer valuation of organic milk, and to a lesser extent, rBGH-free[3] milk applying quadratic, almost ideal demand systems (AIDS) for differentiated milk types.

In our previous research, we focused on product attribute uncertainty faced by the consumer and his/her search costs with respect to genetically modified food products (Kiesel, Buschena and Smith, 2005). Utilizing a random utility framework and fluid milk demand, we reported similar findings to Dhar and Foltz. By identifying rBGH-free labeled and unlabeled products, our results further suggest that the provision of relevant information on a label might be required if market segmentation is to take place. In a cost-benefit analysis of the National Organic Program, we utilized AC Nielson household level data and the fact that while certification is mandatory, adding the USDA seal to packages is voluntary under the NOP. We found an increased willingness to pay for milk products that added the USDA seal in both,

[3] rBGH stands for the genetically modified Bovine Growth hormone.

a reduced form hedonic price function approach, as well as more structural simulations in a random utility framework. In addition, our aggregated welfare estimates based on consumer valuation of labeling changes seems to outweigh the costs incurred by this regulation (Kiesel, Villas-Boas 2007). The research presented in this paper is an extension of this research aimed at a more comprehensive policy evaluation of the effect of the NOP on consumer purchases through consideration of alternative information sources.

Other empirical studies of the effects of product labeling on food choices have tended to focus on the provision of nutritional information and exhibit mixed results regarding effectiveness of information provision. Ippolito and Mathios (1990) found significant effects of voluntary labels on consumer choices, while Mojduszka and Caswell (2000) argue that information provided by firms voluntarily prior to the Nutritional Labeling and Education Act (NLEA) was incomplete and not reliable. Mathios (2000) employed pre- and post-NLEA scanner data to investigate the effects of mandatory disclosure laws on consumer choice of salad dressing. He finds that despite voluntary disclosure of low-fat products, mandatory guidelines resulted in a significant decline in sales of high fat products. In a similar study, Teisl, Bockstael and Levy (2001) found that consumer behavior was significantly altered, but purchases of "healthy" products increased only in some of the product categories. Evaluating eco-labels, Teisl, Roe and Hicks (2002) report that dolphin-safe labels resulted in changes in aggregate tuna consumption, but found little effect of firm-level dolphin safe tuna labels.

Ignoring interdependencies between information sources can potentially bias the results of policy analysis and limit the implications for further policies. Critical news coverage of regulatory challenges (Nestle 2002) and the "Food News Blues" in general (Newsweek 2006) might be one possible explanation for mixed results reported for nutritional labeling. In addition, as one of the exceptions in the existing literature, Ippolito and Pappalardo (2002) address interdependencies with advertisement

claims, and suggest that regulatory rules and enforcement policy in the nutritional context might have induced firms to move away from reinforcing nutritional or health claims. Empirical studies of consumer level responses to related advertising did find responses in purchasing decisions to advertisement (e.g. Ackerberg 2001). Additional experimental research (Cain, Loewenstein, and Moore 2005) in the context of legal studies or medical advice seems to suggest that when evaluating information, people do not sufficiently take the incentives and motives of the information source into account, and even after disclosure of conflicts of interest. Our research specifically addresses and isolates interdependencies of regulatory changes and media coverage in a policy relevant setting.

By analyzing media coverage, this research also adds to the literature linking media effects to economic outcomes. Research in this area has mainly focused on the impact of media expansion and media bias on political attitudes and outcomes (e.g. Stroemberg 2004, Gentzkow and Shapiro 2004. DellaVigna and Kaplan 2007). In contrast, our research directly links newspaper coverage to consumers' product choice. It allows isolating media effects from changes in product attributes, while with regards to voting behavior, isolation of media effects and actual changes in attributes are not easily separable. Candidates and programs change over time and both are affected by the media and voter opinion themselves. We also differentiate between local versus national newspaper coverage. Detectable media effects as well as possible significant differences between local and national newspaper coverage could indirectly provide support for governmental media regulations on ownership built upon two propositions: Media content plays a powerful role in leading to socially desirable outcomes, and diffuse ownership diversifies viewpoints (see Gentzkow and Shapiro 2006). Our research tests if purchase decisions are influenced by media coverage. It further allows addressing how much consumers rely on different media sources. Combining demographic information and newspaper circulation data with the actual news coverage further allows differentiating effects of content according to audience differences. The policy

background of this quasi-natural market level experiment, further allows testing the role of media in promoting socially desirable outcomes, such as environmentally conscious consumption choices.

3. Data Sources and Descriptive Statistics

To implement our analysis, we utilize a unique data set by combining information we 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[4]) provided by one of the largest U.S. grocery store chains for 2002. This data set contains 257 stores, with 229 actually located in California. We obtain the address of each of the stores included in the analysis. Store locations are mapped in Figure 1. The density of stores varies from 2 stores per zip code in more rural areas such as Healdsburg to 16 stores per zip code in more dense and urban areas such as San Francisco, for instance. We use the provided zip code to merge socio-economic statistics provided by the United States Census Bureau from the 2000 Census. In order to extract variables of interest, an automated script is utilized. Socio-demographic variables included in the analysis are summarized as part of Table 1, which provides complete summary statistics.

Data on news coverage of the 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, etc.). Four national papers—*The Wall Street Journal, The New York Times, Washington Post, and USA Today*—as well as 10 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*—

[4] The stores included in the Northern California region are defined based on distributional considerations of the grocery chain rather than geographic boundaries.

were searched.[5] Each returned article was reviewed for relevance as well as characterization of neutral versus critical coverage, and direct relevance to and mention of milk consumption. Figure 2 summarizes relevant news coverage across weeks, differentiated by local versus national coverage. Furthermore, we observed articles in the national press that specifically focused on milk consumption in week 33 and 36. Appendix A provides a list of papers, headlines, dates, and corresponding weeks of included news coverage.

And finally, a zip code identifier was used to merge the store level data with circulation measures compiled by the Audit Bureau of Circulations (ABC). Publishers submit circulation claims to ABC every 6 month, with the circulation numbers used in our analysis reported in March 2003. ABC data provides circulation measures for local papers only. We are using the reported gross total circulation numbers for mid-week editions of the papers identified in our matched data set. For one zip code included in our store level analysis, circulation measures were not available for any of the local papers, such that the analysis of on differences in circulation measures excludes the two stores located in this zip code. Furthermore, for one of the local papers (*Alameda Times Star*), circulation measures were not available from this source. Finally, Table 2 summarizes cross-sectional and time-series variation in local newspaper coverage after matching store level information with circulation measures. The last column reports the weeks for which we observe local coverage at the specific paper. Only for the *San Francisco Chronicle* and *Oakland Tribune* do we observe variation across store and weeks in newspaper coverage. The analysis utilizing circulation measures will therefore focus on these two major local papers.

Our data analysis further focuses on a conventional supermarket chain and specific geographic region. An organic milk alternative was only offered in one milk type category in our data set, fat-free half-

[5] The Reno Gazette Journal was also searched for the analysis of control stores in Reno, but no relevant newspaper coverage was detected over the investigated time period.

gallon milk. In addition, while 225 of the 229 California stores carried organic milk during 2002 at one point, organic milk was consistently available in 181 stores only.[6] Figure 3 illustrates variation in availability of organic milk across stores and weeks for the California stores. We restrict our analysis to stores that carried organic milk for the entire time period and discuss possible sample selection in the result section. While overall milk sales for the original data set and 2002 amount to $133.49 million, half gallon milk contributes $31.55 million or 23.6% and the analyzed fat free category amounts to sales of $8.94 million or 6.7% of total sales. Organic milk sales amount to $1.20 million or 0.9% of total sales which is consistent with estimates that organic milk accounted for less than 1% of total milk sales in 2002 (e.g. Dhar and Foltz 2005, Schultz 2006, Dimitri and Venezia 2007[7]). Despite these data limitations, the restricted data set analyzed therefore seems representative of organic milk demand as a whole during the analyzed time period. Focusing on the fat-free half-gallon milk category also restricts comparisons across brands to comparisons against private label conventional milk for most stores.[8] This limited cross-sectional variation stems from the fact that even though the conventional sector includes more than 100 brands of milk nationwide, private conventional labels dominate the market (e.g. Dhar and Foltz 2005, Schultz 2006, Dimitri and Venezia 2007).

The resulting final data set analyzed consists of 9412 observations. Descriptive statistics of key variables are summarized in Table 1. Quantities of organic milk sold at a given week vary from 1 to 232 depending on the store, while quantities of conventional milk vary from 66 to 1527. Conventional sales are therefore 339 units or 83.1% higher on average. Prices for organic fat free half gallon milk range from $2.49 to 3.99, while conventional milk ranges from $1.37 to $2.29, amounting to an average price

[6] Furthermore, 5 of 10 Nevada stores included in the data set carried organic fat free half-gallon organic milk in all weeks in 2002. The Nevada stores are not included in the analysis, but used as a control in the cross-sectional identification strategy of media effects in alternative regression specifications.

[7] 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.

[8] Only 5 stores carry an additional branded fat free half gallon alternative.

difference of $1.51. These prices and price premiums seem consistent with national averages for organic as well as conventional milk (see Dimitri and Venezia 2007). Furthermore, variation of conventional milk prices is almost exclusively limited to variation across stores, while variation of organic milk prices are due to variations across stores as well as price promotions. Promotions on organic milk appear more frequently in the second half of 2002 as illustrated in Figure 4. Figure 5 further graphs aggregated total organic milk sales.

4. Econometric Specification

To assess the impact of media coverage on consumer purchases, we specify the treatment variable of interest as media coverage at a given week. As we cannot observe what sales of organic milk would have been at a given week in the absence of media coverage, identification depends on the definition of relevant control groups. Estimation of average treatment effects (ATE) in this context 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, which is satisfied when treatment assignment and the potential outcomes are independent (Imbens 2004). As we observe repeated cross sections—weekly store-level sales—we follow a difference-in differences-approach (DD) commonly used in the policy evaluation literature (see Meyer 1995; Bertrand, Duflo, and Mullainathan 2004) to identify ATE. DD allows for comparisons of means of the outcome of interest with or without treatment while certain observable covariates are held constant. We therefore 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. Our control structure is twofold: temporal, as we compare sales in weeks with and without newspaper coverage over

the range of 2002; and cross-sectional, as we compare sales across geographic regions with varying circulation measures of local papers as well as articles printed. [9]

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.[10] Our primary interest is in comparing average differences in sales across weeks with and without media coverage, which defines our second difference in the DD approach. Due to data limitations and the inclusion of two products only in the analysis, we estimate a double difference form rather than the standard DD estimation.[11] We further transform both quantity measures into logs and compare the difference in log sales($log\_Q_{i,t}\ is\ defined\ as\ \log(q_{org,i,t}) - \log(q_{con,i,t})$). This specification allows us to interpret and compare our regression results in terms of average percentage effects across stores rather than differences in sales in levels. Comparisons of sales in levels might be affected by variation of store size and sales across stores. Initially, we pool all news coverage and estimate the following base reduced form specification:

$$log\_Q_{i,t} = \alpha_i + \beta_0 * P_{i,t} + \beta_1 * trend_t + \delta * news_t + u_{i,t} \quad (1)$$

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 ($P_{i,t} = p_{org,i,t} - p_{conv,i,t}$). Our primary variable of interest, *news,* defining our treatment is constructed as a weekly dummy that equals one if we observe coverage at a given week, and zero otherwise. The coefficient on *news*, δ, measures the treatment effect as the average percentage difference

[9] We also searched for relevant Television coverage using Vanderbilt Television News Archive, but could only indentify coverage on the day the NOP went into effect.

[10] Organic milk sells at significant price premiums, such that we are using the actual quantities of half-gallon milk sold rather than dollar sales.

[11] In the standard estimation, both differences are identified by the inclusion of dummy variables and an interaction of dummy variables. Due to our data limitation of two available products only in the investigated category in most stores, this specification cannot be employed due to collinearity issues. Both specifications are conceptually identical.

in organic versus conventional sales between weeks with and without media coverage. Alternatively, we define this variable as a count of articles at a given week to investigate effects of intensity of news coverage. When including the treatment variable as a count, we further add second order terms to allow for non-linear effects of an increase in news coverage. And finally, a time trend is included to address a possible general increase of organic milk sales independently of media coverage.

In addition to estimating an average treatment effect for media attention, we are also interested in differences based on neutral versus critical coverage, local versus national paper coverage and category specific articles. With regards to critical coverage of organic production, our hypothesis would be that it does not affect sales or possibly reduce sales of organic milk relative to conventional milk. We would also expect category specific coverage to have a bigger impact on sales, as consumer attention is directly drawn to milk and benefits are described specifically with regards to milk. It is not clear whether local versus national news coverage should have a bigger impact *a priori*, however. Taking these differences in specific treatment effects into account, we estimate the following specification:

$$log\_Q_{i,t} = \alpha_i + \beta_0 * P_{i,t} + \beta_1 * trend_t + \delta_1 * newsmilk_t + \delta_2 * natnews_t + \delta_3 * natnews\_crit_t \; +$$

$$+\delta_2 * locnews_t + \delta_3 * locnews\_crit_t + u_{i,t} \qquad (2)$$

Due to limited variation across stores and time, the analysis based on differences in circulation is based on the two biggest local papers, the *Oakland Tribune* and *San Francisco Chronicle* only. The following specification is estimated:

$$log\_Q_{i,t} = \alpha_i + \beta_0 * P_{i,t} + \beta_1 * trend_t + \delta_1 * SFCnews_t + \delta_2 * SFCnews_t * circ_{i,t} +$$

$$+\delta_3 * OTnews_t + \delta_4 * OTnews_t * circ_{i,t} + \delta_5 * natnews_t + u_{i,t} \qquad (3)$$

SFCnews is defined as a weekly dummy equaling one whenever the *San Francisco Chronicle* featured an article. Circulation measures interacted with news coverage in these regressions are transformed into percentage measures by using total population numbers extracted from the Census data. Similar variables are used for the *Oakland Tribune*.

We further investigate if average socio-demographic differences across zip codes in readership and consumer base results in significant differences in the magnitude of media effects for both national and local coverage by interacting the variables measuring the media effects with a vector of demographics (D) such 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):

$$\log\_Q_{i,t} = \alpha_i + \beta_0 * P_{i,t} + \beta_1 * trend_t + \delta_0 * news_t + \delta_j * news_t * D_{i,j} + u_{i,t} \quad (4)$$

Similarly to the inclusion in the pooled regression, socio-demographic differences are included in the regression specifications for specific treatment effects. Additional regression specifications are also employed and discussed as robustness checks in the next section.

5. Results

Our econometric approach essentially compares average differences in weekly organic milk sales with and without media treatment. As a first step, we graph total organic sales overlaid with observed media coverage in Figure 6. This graphical analysis suggests a possible causal relationship between media coverage and increased organic milk sales. Sales of organic milk seem to primarily increase when we observe national news coverage, possibly suggesting that national media coverage is more effective than local coverage. The big spike of local coverage in week 28 results from a simultaneous print of a 3 part feature on organic production and regulatory changes in the *Oakland Tribune* and two smaller local papers resulting from joint ownership of those papers. And as we are not differentiating critical

coverage from favorable or neutral portrayal in this graphical analysis, it might suggest asymmetric effects based on portrayal of product attributes and regulation that explain differences in organic milk sales across weeks with observed media coverage. For weeks 40 to 43 for instance, we observe critical articles in national papers.

Additionally overlaying this graph with variation in the mean organic milk price across stores (Figure 7) however, suggest that observed increases in organic sales are also correlated with price promotions[12], and suggests that not accounting for simultaneous variation of other covariates when analyzing media effects might falsely overstate the importance of news coverage. This first graphical analysis therefore provides a motivation for taking a DD approach.

We begin the regression analysis of media effects by first pooling all observed media coverage, and investigating the effects of increased intensity as well as how fast media effects dissipate over time. Then, we differentiate specific media effects based on content, portrayal, source, and circulation. Finally, differences in the socio-demographic composition of readers and shoppers are considered. A discussion of regression diagnostics and additional robustness checks concludes this result section.

Pooled media effects

We first address the strong correlation between price promotions and sales of organic products observed in the above graphical analysis in a regression specification to test whether we observe remaining unexplained variation in sales possibly attributable to news coverage. In figure 8, we plot the residuals (mean residuals across stores by week) resulting from regressing the difference in logarithmic quantities of organic versus conventional milk sales at a given store and week on store fixed effects, price

[12] Price promotions happen uniformly across stores such that the mean price across stores captures variation in prices.

differences, and a linear time trend. This graph suggests remaining unexplained variation in sales which coincides with time periods for which we observe media coverage.

We begin the regression analysis of the effects of media coverage by estimating equation (1) described above. As identification of treatment effects in the DD approach critically depends on the assumption of exogeneity of treatment effects, we first focus our regression analysis on the weeks prior to the implementation of the NOP. For this time period, media coverage can be assumed to be independent of changes in milk consumption.[13] Results from a regression of the difference in logarithmic quantities of organic versus conventional milk sales at a given store and week on store fixed effects, price differences, a linear time trend, and a dummy variable equaling one for weeks in which we observe media coverage and zero otherwise are reported in the first column of Table 3. This base regression is also included in all subsequent tables as column (1) to serve as a reference point. We estimate an average treatment effect (ATE) across alternative news sources (local versus national news paper coverage) and possible content during the time period prior to the implementation of the NOP of 5.1%, which is statistically significant at the 1% significance level. This effect indicates that quantity sales of organic milk relative to conventional milk are significantly higher (5.1%) during the weeks we observe relevant news coverage. The second column defines the treatment variable as a count variable rather than a dummy variable and includes a squared term to account for non-linear effects as well. Results again suggest a significant increase of organic milk sales due to media coverage, with a decreasing rate of increase for each additional article. The average increase in organic quantity sales relative to conventional sales due to one article per week is estimated as 4.8% in this specification. This estimate is slightly lower than the effect

[13] Previous research (e.g. Kiesel and Villas-Boas 2007, Dimitri and Venezia 2007) indicates that the USDA organic seal displayed on packages awareness, willingness to pay and ultimately increased demand for organic products. Therefore, the independence or exogeneity assumption might not be satisfied during the week of the implementation of the NOP, as well as the weeks following the regulatory changes. Extended regression analysis comparing effects of media coverage prior and post implementation, while attempting to control for regulatory changes, are discussed in the subsection on additional robustness checks.

estimated when including a dummy variable only. However, including a dummy for newspaper coverage only measures the average effect of one or more articles for the observed weeks of news coverage. A second article at a given week is estimated to increase sales by an additional 3.6% in this specification, for instance, resulting in a higher overall effect that the one estimated in the dummy variable specification.

Our results further indicate 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 76.8% increase in organic sales relative to conventional sales, significant at the 1% significance level. The average price difference observed in the data amounts to $1.55, such that 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, therefore results in an estimated 1.19% increase in organic sales relative to conventional milk sales. Our results therefore suggest that organic milk sales are very responsive to price changes. This responsiveness seems consistent with more recent developments in that supermarkets added private label organic product varieties and big players such as Walmart entered the natural food market. These changes in the market structure might be motivated by cost savings, but also by the potential to capture additional consumer segments based on this price sensitivity.[14]

Store fixed effects capturing unobserved, time-invariant heterogeneity across stores, and allowing for a shift of average differences in sales for each individual store, are also statistically significant for almost all stores included in the regression analysis. And a statistically significant (at 1% significance level) and positive coefficient on the time trend suggests a small but gradual increase in demand for organic milk of 0.3 percent per week.

[14] Endogeneity concerns regarding prices are discussed in section 5.1.

Dissipation of media effects over time

Another interesting aspect of the above estimated media effects relates to the longevity or dissipation of such effects. Table 4 reports results for a regression specification that in addition to the news dummy also includes up to three lags for observed media coverage. These lags are defined as dummy variables for the weeks after the actual appearance of relevant articles. Our results suggest a significant decrease during the week directly following observed news coverage, while no significant increase or decrease is detected in the weeks afterwards.[15] The estimated 4.8% (statistically significant at the 1% significance level) decrease in the week following the news coverage seems reasonable due to the shelf life of milk. Having bought milk in a given week makes consumers less likely to buy milk the following week. During the following two weeks, however, one would expect repeated purchases by consumers affected by news coverage, if media induced organic milk purchases resulted in a permanent change of purchasing patterns. It worth noting, however, that the decrease in sales in the week after the observed media coverage does not fully offset the increase from the previous week. Furthermore, these findings are not driven by serial correlation in sales across weeks in general, as including up to three lags of the dependent variable does not reproduce the same pattern.[16] Our results therefore suggest that while media effects are considerable in magnitude and significant, they might only be short-lived. These findings are consistent with findings in other studies in that, of the households that buy organic milk, only a small percentage purchases organic milk regularly. Dimitri and Venezia (2007) for instance report that of the households that buy organic milk, only 36 % organic milk frequently. The remaining portion of

[15] Weeks with only critical coverage are excluded from those regressions.

[16] By including lags, we additionally provide a robustness check and test if our results are driven by correlation in sales. And, it further suggests that serial correlation detected in the error terms is not driven by serial correlation in the dependent variable. Including up to three lags further does not affect the magnitude and significance of the coefficients for media effects.

consumers might only pay infrequent attention to organic production, and might therefore react to signals like media coverage to capture their attention and alter their purchasing decision in the short run.

Local versus national newspaper effects, category specific and critical coverage

Table 5 reports regression results for differentiated rather than pooled media effects described by equation (2). We classify news coverage according to category specific coverage (only observed in national papers), general national and local newspaper coverage, as well as critical national and local coverage. In this specification, category specific news coverage yields the highest increase (10.7%) in organic sales relative to conventional sales at a given week, statistically significant at the 1% significance level. General national news coverage significantly increases organic sales by 4.5% relative to conventional sales, while the effect of local coverage is estimated at 7.0%. The difference in magnitude is statistically significant, indicating a relative bigger impact of local coverage over national coverage. Critical coverage for both, local and national coverage on the other hand, does not result in significant increases or decreases in organic milk sales in weeks those articles are observed. An article focusing on the implications of the NOP for organic milk rather than talking about organic production and the NOP in general therefore seems to draw more attention to potential benefits of organic versus conventional milk. And while critical coverage can draw attention to the regulation, it does not necessarily convince consumers to buy the regulated products. There is no clear prediction regarding the importance of local versus national news coverage. But our results in this regard provide some support for regulations ensuring diffuse ownership and media landscape, as we find that local news not only affect behavior significantly but seem to have a bigger impact than national news.

Cross-sectional variation of local media coverage

To further strengthen our results in this regard, we make use of cross-sectional variation of media coverage. For local newspaper coverage, we observe circulation measures by zip code. Due to limited news coverage and circulation of smaller local papers, our analysis in this regard focuses on the *Francisco Chronicle* and *Oakland Tribune* only (see table 2). Table 6 reports results for regression specifications addressing news featured in the *San Francisco Chronicle* and *Oakland Tribune*. This regression excludes two additional stores since adjusting circulation numbers by the total number of population reported in the census resulted in circulation measures higher than 100% for those stores. Within the remaining stores, we observe circulation measures for the *San Francisco Chronicle* of 0.2 % to 34.1% of the total population reported by zip code. Circulation measures for the *Oakland Tribune* are significantly lower than the circulation measures for the *San Francisco Chronicle.* While the *San Francisco Chronicle* was circulated across all zip codes included in our analysis, we observe circulation numbers greater than zero for the *Oakland Tribune* for 50 stores included in the analysis, only, with a maximum circulation of 12.9% of the total population. We also observe significantly lower variation in circulation measures across zip codes when compared to the *San Francisco Chronicle* (see standard deviations reported in table 1). The first column of Table 6 repeats the results for the pooled analysis, while column (6) adds a dummy variable for the *San Francisco Chronicle* and *Oakland Tribune* each. Controlling for national media coverage, a feature of a relevant article in the *San Francisco Chronicle* at a given week does not result in statistically significant differences of organic milk sales relative to conventional sales. Feature of a relevant article in the *Oakland Tribune*, on the other hand, results in a 11.1% increase of organic sales relative to conventional sales compared to weeks with no coverage. The last column adds interactions with circulation measures. For the *San Francisco Chronicle,* regression specification (8) included in table 6 suggests that an additional increase in circulation by 1% is estimated to increase sales of organic milk by an additional 0.3%. This increase is statistically significant at the

10% significance level. Given the circulation measures observed in our sample, the increase in organic milk sales relative to conventional milk sales due to media coverage in the *San Francisco Chronicle* at a given week therefore ranges from .47% for areas with low circulation measures to 10.6% for areas with high circulation measures. Interestingly, the coefficient on the *San Francisco Chronicle* dummy not interacted with circulation is negative and significant. As we do not observe stores with zero circulation, it suggests that sales of organic milk would have been lower on average in the absence of media coverage during these weeks compared to other weeks. Only for stores with a circulation of 14.4 % or higher, do we estimate a significant increase in organic milk sales during these weeks. This might indicate economies of scale or network effects only realized once local papers reach a certain circulation. No significant differences are detected for differences in circulation measures for the *Oakland Tribune*. As mentioned above, circulation measures for the *Oakland Tribune* are significantly lower than the circulation measures for the *San Francisco Chronicle,* combined with a lower variation across zip codes. Observed circulation measures are for instance lower than the threshold circulation that resulted in an increase in sales for the *San Francisco Chronicle*. Failure to detect differences in media effects due to differences in circulation might also be explained by joint ownership of several local papers by the same news corporation. The *Oakland Tribune*, the *Daily Review*, the *San Mateo County Times*, and the *Alameda Times Star* are all owned by *The Alameda Newspaper Group (ANG)*, and the same articles appear in all of those local papers simultaneously at times. For one of those papers, the *Alameda Times* we have no information on circulation measures and we therefore cannot control sufficiently for those effects. But the joint coverage across these four papers might actually result in the detected increase in sales for coverage in the *Oakland Tribune*.

As the Northern California division of this supermarket chain also includes a limited number of Nevada stores, we use those stores as an additional control and robustness check. Shoppers in those stores

where 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. Including media coverage identifiers in these regressions resulted in no significant effects on sales of organic milk for the *San Francisco Chronicle*, or the *Oakland Tribune*. These cross-sectional comparisons therefore strengthen our results from time-series comparisons in that local news coverage affected purchasing behavior.

Socio-demographic differences across readers and shoppers

We further investigate whether differences in socio-demographic composition of readers and shoppers across zip codes result in cross-sectional variation of media effects. We interact the treatment variable with median income, median contract rent and median house values as controls for variation in income; the percentage of the population over 65 as a control for age composition; the percentage of White as a control for ethical composition; and population size to differentiate between more urban and more rural areas. We experiment with a pooled treatment specification as well as differentiation between national and local coverage, category specific coverage, critical portrayal, and coverage in the *Oakland Tribune* and *San Francisco Chronicle.* We further include linear as well as non-linear functional forms. However, in all estimated regression specifications, we fail to detect significant differences in media effects based on these socio-demographic characteristics. One might argue that the aggregated nature of these variables do not sufficiently capture potential differences in this regard. But with regards to organic preferences, previous studies also report little variation or conflicting results regarding socio-demographic characteristics (see Dimitri and Venezia 2007 for a discussion of conflicting findings, Kiesel and Villas-Boas 2007). Our results in this regard therefore seem consistent with the existing literature.

5.1. Diagnostics and Additional Robustness Checks

As we are utilizing a panel data set tracking weekly milk sales across stores for 52 weeks, we need to address the time-series character of the data. We perform tests regarding stationarity and serial correlation to investigate possible spurious correlations and bias in the estimated standard errors in the above reported estimation results.

Stationarity assumptions and correction for serial correlation

We first perform Dickey-Fuller tests (1979) for stationarity on both, the price and the quantity time series used in our regression specifications. Such tests allowed rejecting the null hypothesis of a unit root process for all price series only. The quantity series were found to be trend stationary and a linear time trend is included in all regression estimations (Wooldridge 2003).

Another related concern utilizing time series data and the primary critique of difference-in-differences estimators applied to time series and panel data is possible bias due to serially correlated error terms as well as serial correlation in the independent variable itself (Bertrand, Duflo, and Mullainathan 2004). We test for serial correlation using a generalization of the Durbin-Watson test applicable to panel data (Wooldridge 2002). The null hypothesis of no first order autocorrelation is rejected with an F-statistic of 14.86. As Bertrand, et al. (2004) point out that correcting using a parametric autoregressive (AR) based correction might not eliminate all bias in the standard errors due to serial correlation, we report Newey-West corrected standard errors with a maximum of three lags for all regression specifications.[17] This procedure corrects for serial correlation of unknown form in the error terms (Newey and West, 1987). As an additional robustness check, we adapt their preferred procedure of random inference testing based on generated placebo treatments. Table 7 reports comparisons between estimated news

[17] The inclusions of a maximum of 3 lags is motivated by the maximum shelve life of milk. Including a maximum of the total number of weeks (T-1) as a lag structure, does not significantly change the results, however.

effects from our pooled regression specification and estimated effects of placebo news coverage. Random draws of placebo news series of 9 weeks—based on the number of weeks in which we observe media yield the estimation results reported in columns (10) to (13) of Table 7. We also report how many 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 statistically significant at the 1% significance level. The other two placebo series resulted in positive effect. Only one of the placebo series resulted in a positive and significant effect, but lower in magnitude than the estimated effect for the actual news coverage. This placebo series did include two of the actual weeks, however, which might explain this significant and positive effect. This additional robustness check therefore supports our findings of an increase in organic sales due to media coverage in a given week.[18]

Selection bias due to limited availability

As we are 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 socio-demographic composition of the neighborhoods selected stores are located in. We address this concern by estimating a probit regression of inclusion of a given store in the analysis, based on observable socio-demographics. Results reported in Table 8 indicate some significant differences in the stores included in the analysis, neither of which seems to have clearly suggest systematic of bias in our results. We for instance find that a marginal increase in median income makes a store slightly less likely to be included in our analysis. And while an increase in the percentage of the population classified as White increases the probability for a given store to be included in the analyzed sample, we do not have a clear prediction of this

[18] This approach is currently extended to a more rigorous randomization inference. Estimation of a large random sample of placebo news not including weeks for which we observe media coverage should only lead to rejection of a coefficient statistically different from zero in 5% of the overall regressions (see Bertrand, Duflo, and Mullainathan 2004) .

characteristic once we control for income. Nevertheless, as an additional robustness check, we follow the Heckman two-step approach by including the estimated computed inverse mills ratio based on this first stage regressions in the second stage—the regression addressing media effects (Heckman 1979, Wooldridge 2002). Results of this adjustment are reported in Table 9. While the coefficient on the inverse mills ratio supports selection bias[19], our findings on media effects are neither quantitatively nor qualitatively affected. Adjustment for selection bias mainly seems to affect the estimated fixed effects in this regression. The inclusion of store fixed effects in the reduced sample therefore seems to account for differences in socio-demographic composition of the neighborhoods, stores are located in. Excluding some of the stores based on limited availability, shifts the store specific intercepts or average differences, but does not seem to affect the slope coefficients we are interested in when estimating the treatment effect.

Endogeneity of prices with quantity measures and treatment effects

As we are regressing quantity measures on price, one might be concerned about possible endogeneity. 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 affect prices, or prices and quantities are affected by unobserved variables simultaneously. In both cases, prices are correlated with the disturbances included in the regression specification. However, while our data exhibits considerable variation in quantities sold for both, conventional and organic milk, prices of conventional milk almost exclusively vary across stores but not across weeks. Hence, it seems as if prices for conventional milk were not adjusted due to demand shocks during the time period investigated. In addition, for organic milk prices, one would expect to see a price increases for organic milk after the implementation of the

[19] 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.

USDA organic seal due to expected increased demand, if prices and organic quantities are endogenous. We do not observe increases in the price of organic milk for that time period, however. Time-invariant variations in demand for organic milk relative to conventional milk, as well as price differences across stores are captured by store-fixed effects, on the other hand. Furthermore, promotions are uniform across all stores as indicated in Figure 4.

An additional concern is possible endogeneity of price promotions and media coverage. The graphical analysis in Figure 7 indicates that price changes and media coverage happens simultaneous for some weeks. But again, as illustrated by Figure 4, price promotions are uniform across all stores. We do however observe cross-sectional variation in local news coverage. If price changes are endogenous to local coverage, one would expect price promotions to vary accordingly in the cross section. We therefore can at least for local news support the assumption that price promotions and news coverage are exogenous to the cross-sectional impact of local media coverage.

Alternative specifications and estimation over entire sample

The above reported results seem further qualitatively robust to a number of alternative specifications such as the definition of the dependent variable as the ratio of organic sales over total sales, estimation in levels and regression using organic sales only. 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), we further estimate specification that only includes organic prices. This robustness check further reproduces a similar price coefficient, supporting the above explanation of a high responsiveness to price promotions on organic milk. As variation in conventional milk prices almost exclusively results from differences across stores, we cannot make inferences on responsiveness to conventional milk sales. We prefer the specifications estimated above as we believe, once consumers are faced with two

alternatives at a given store the difference between these prices matters for substitution patterns between milk choices. And including the price differences rather than organic prices only allows us to control for variation in conventional milk prices across stores.

And finally, we extend our analysis to include the entire time period. We first address possible effects of the actual USDA organic seal on packages by estimating the same specification, but including a labeling dummy equaling one for week 42—the week in which the NOP became into effect, and alternatively, equaling one for all time periods thereafter.[20] Table 10 summarizes the results of these regressions. The results indicate that sales for organic milk actually significantly decreased during the week the NOP went into effect and thereafter when not taking media coverage into account. This result is somewhat counterintuitive and contrary to findings in earlier studies (e.g. Kiesel, Villas- Boas 2007). One possible explanation might be shortages in supply, or new necessary adjustments to changes in demand and distribution of organic milk. During week 42, the number of stores in which organic milk is available, decreases for instance (see Figure 3). This argument could be supported by the results for selection bias. Stores excluded from the analysis have a higher median income, which seems counterintuitive. Some stores might have sold out of organic milk for some of these weeks and not been able to restock fast enough in order to meet increased demand.

An alternative explanation might be that the NOP in addition to product choice also affected store choice of consumers. This is especially likely considering the limited assortment of organic products in mainstream supermarkets during this time. This explanation is supported by findings in previous work comparing several distribution channels (Kiesel and Villas-Boas 2007, Dimitri and Venezia 2007). In order to test this argument, we are currently compiling information on alternative grocery stores, including natural food stores such as Whole Foods by zip codes to be included in the regression specification. Using the data currently available, we

[20] In contacting the milk processor, we verified that this processor invested 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.

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 allows us to reject the hypothesis of equal coefficients for the price variable, media effects, and time trend individually by using t-tests as well as in combined F-tests at the 1% significance level.[21] Estimating media effects prior and post 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 in the same category prior to the NOP, an estimate consistent with our previously discussed results. The unrestricted model also results in a large and significant decrease of organic sales due to media coverage after the NOP went into effect. As a general trend, from our observations of news content, media coverage tended to be more critical after the regulations went into effect. When we further differentiate news coverage by local versus national news coverage, critical portrayal, as well as category specific referencing reproduces results for the period prior to week 42 to disaggregate this effect, we recover a positive significant effect of neutral local and national news coverage. The estimated treatment effects for local coverage slightly increase in magnitude compared to treatment effects prior NOP and decrease in magnitude for national coverage. Estimated negative and significant effects for critical coverage post NOP remains negative and significant, however. These treatment effects remain very large in magnitude for both national and local papers. Especially, since local coverage in the two major local papers (*San Francisco Chronicle* and *Oakland Tribune*) is not observed after week 41, such sizable reductions are unlikely to result from coverage in the relatively smaller local papers with limited distribution. The results might be explained by the fact that identification of these effects rests on two weeks only—week 42 and week 50. As discussed previously, reductions in sales in week 42 might result from supply shortages.[22] Week 50 might similarly be affected by supply shocks as similar to week 42, the number of stores in which organic milk is available drops during this week (see Figure 3). A similar argument can be made for national coverage. Here, identification is based on three

[21] These tests are equivalent to Chow tests for structural change (Chow 1960, Wooldridge 2003).

[22] The dummy variable capturing the change in labeling regulation is dropped in an alternative specification due to collinearity such that this effect is absorbed in the media dummy variable.

weeks, one of which includes the week spanning Christmas day and New Years Eve.[23] As mentioned above, we are currently expanding our analysis to proxy for alternative grocery store choice as an argument for structural change. This extension might affect the estimated treatment effects for the time period post NOP as well.

6. Conclusions

This paper provides an empirical analysis of the effect of media coverage of organic production and regulatory changes under the NOP on milk consumption. By combining data from several sources, we create a unique data set that allows us to utilize time-series and cross-sectional variation to credibly identify media effects on sales of organic fluid milk in a major supermarket chain. Following a reduced from approach that relies on identification of mean differences in sales of organic milk relative to conventional milk, our results suggest that media coverage significantly affects consumer purchases. In addition to graphical analysis, a difference-in-differences approach (DD) allows for comparisons of means of differences in weekly sales with and without news treatment, while holding potentially important observable covariates such as price promotions constant. Pooling news coverage to estimate a average treatment effect across newspapers, coverage, and weeks suggests average increases in organic milk sales relative to conventional milk sales of 5 percent during weeks for which relevant news coverage is observed. When accounting for increases in intensity of news coverage, measured by the number of articles in a given week, our results further suggest increases in the relative difference in sales due to increased intensity, but at a decreasing rate. However, we find that significant media effects dissipate quickly in the weeks following news coverage. And finally, category specific news coverage

[23] As our identification of media effects partly relies on time-series variation, we cannot include weekly time fixed effects to absorb some these seasonal effects. However, as we regress organic milk sales relative to conventional milk sales, we account for seasonal patterns that affect the demand for milk in general. As households might be more income constrained during the holidays, one could possibly expect a bigger decrease on organic milk relative to conventional milk during this time period, however.

resulted in significantly higher observed increases in sales than general coverage, while critical national and local coverage does not result in significant changes in organic milk sales prior to the implementation of the NOP, and negative and significant effects post NOP. And finally, comparisons of media effects prior and past implementation of the NOP suggest a structural change in consumer demand for fluid milk, possibly resulting from effects on consumers store choice in addition to product choice. Current research extensions expand on this possible structural change by collecting additional data in support of this possible explanation.

Overall, our results consistently suggest that newspaper coverage significantly affects consumer purchases. These detected media effects as well as significant differences between local and national newspaper coverage indirectly provide support for governmental media regulations building on the two propositions that media content plays a powerful role in leading to socially desirable outcomes, and that diffuse ownership diversifies viewpoints (see Gentzkow and Shapiro 2006). Our results indicate that purchase decisions are influenced by media coverage andconsumers rely on both, national and local news sources.

Our findings regarding dissipation of these effects over the weeks following media attention might offer an explanation for findings in previous studies. Of households that are observed to buy organic products, only a small percentage (e.g. 36% reported in Dimitri and Venezia 2007) buy these products frequently. The remaining portion of consumers might only pay infrequent attention to those product attributes. Relevant media attention might capture their attention and alter their purchase behavior in the short run only. We further address these possible effects in our future research that develops a structural framework of food consumption incorporating information search and attention focus in a household production function approach.

And finally, as critical coverage did not capture the attention of potential consumers and resulted in no detectable or even negative effects on purchases, our results suggest that effectiveness of regulatory changes critically depends on portrayal of these regulations in the media.

As previous analysis of labeling regulations did not incorporate interdependencies between regulatory changes and media coverage, our results further suggest that the mixed results previously published mainly in the context of nutritional labeling might be explained by omitted variable bias. By presenting the first study that directly links newspaper coverage to consumer purchases in the context of food labeling, our paper therefore makes a valuable contribution to the existing literature on food labeling. Our results suggest that consideration of changes in alternative information changes in future research might lead to more comprehensive policy evaluations and provide important implications for future regulations on specialty foods.

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Appendix A: News coverage included in 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. 9. 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. 6.2002		Organic Foods Definitely Worth Price
200241	10. 9.2002		USDA Organic Rule Takes Effect in 12 Days

200241	10. 9.2002		Why Organic Costs More
200241	10. 9.2002		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
200242	10.22.2002		Organic foods go Mainstream USDA's Label Rules Take Effect
200245	11.8.2002		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		Its 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	10.9.2002		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		Its 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

Figure 1: Location of stores

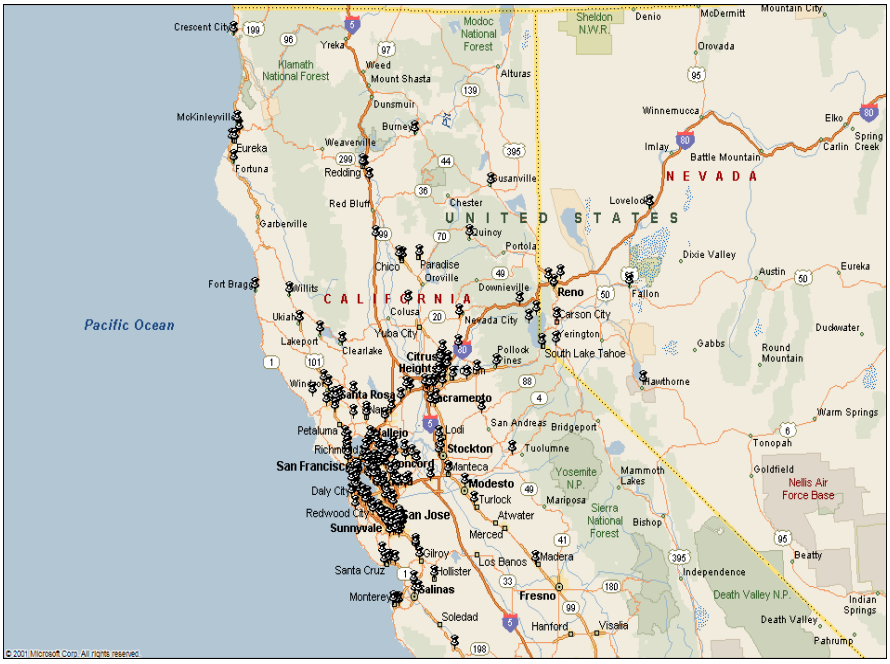

Figure 2: National and local newspaper coverage

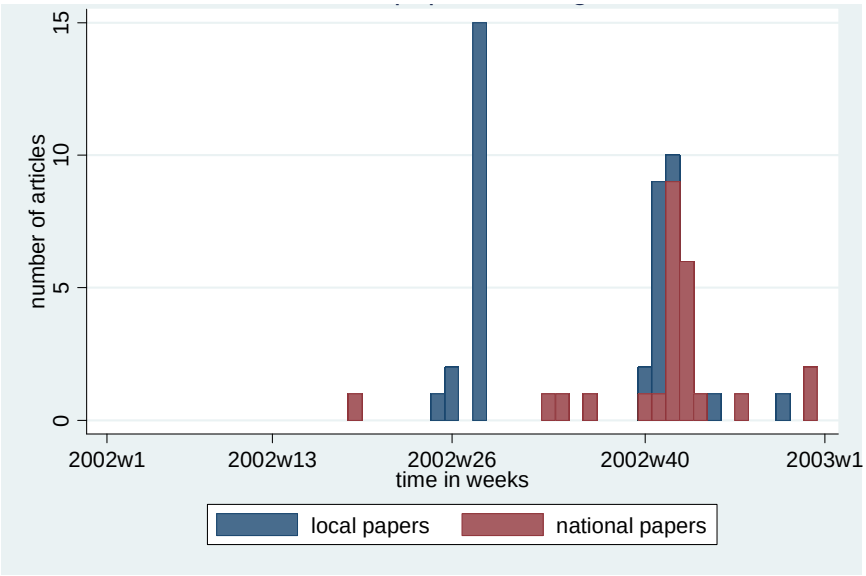

Figure 3: Availability of organic milk across stores

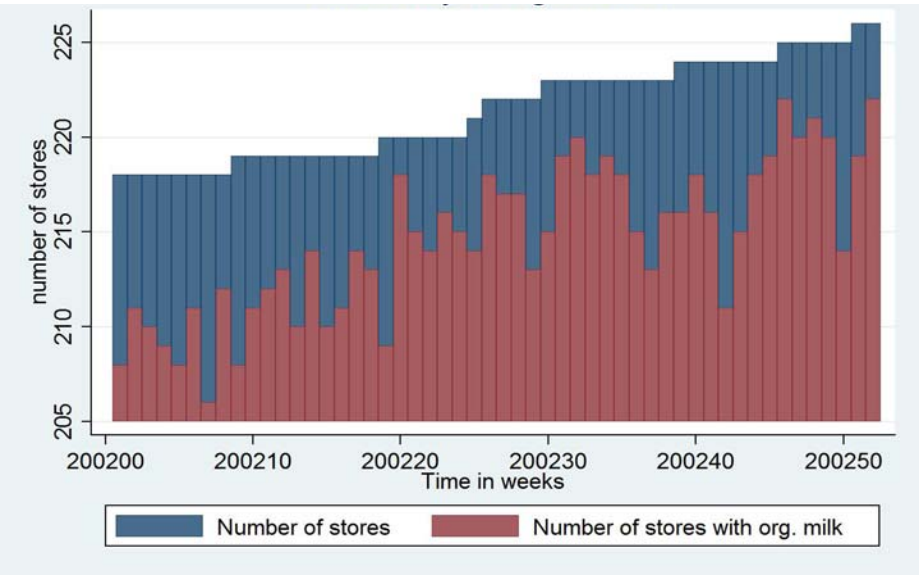

Figure 4: Price variation of organic milk across stores

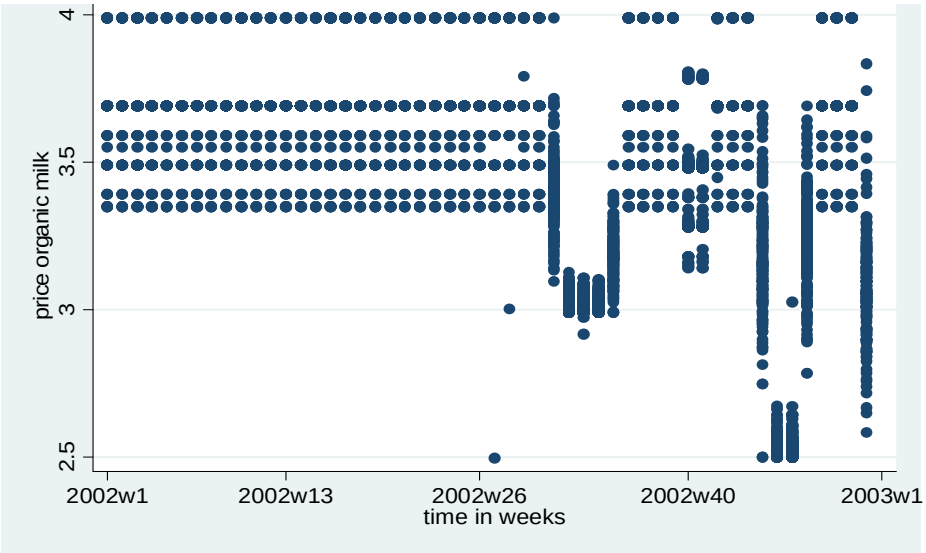

Figure 5: Total organic quantity aggregated by stores

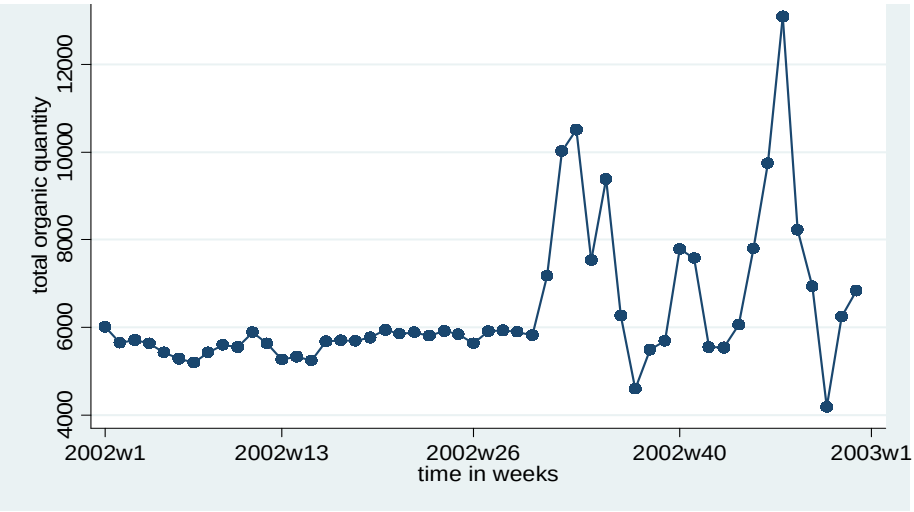

Figure 6: Newspaper coverage and organic sales

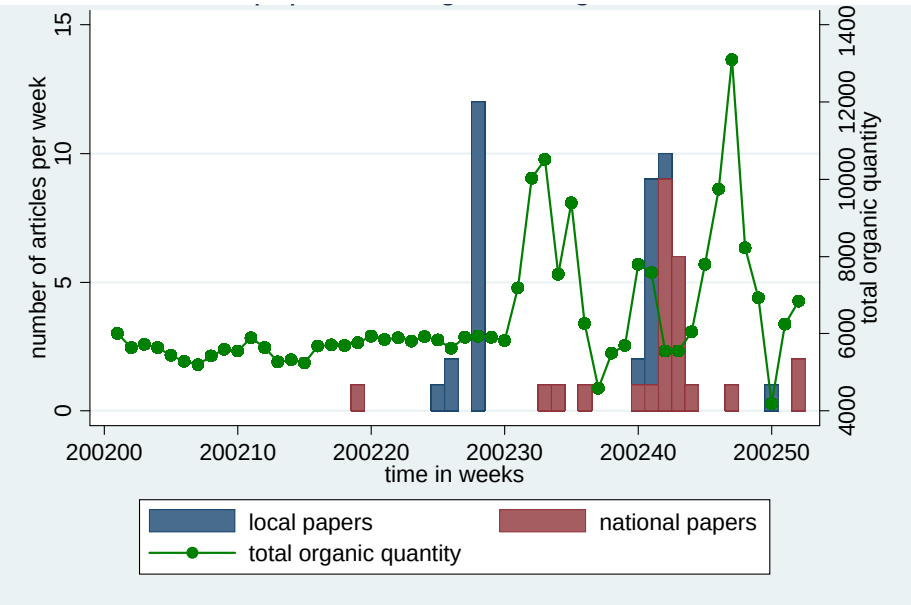

Figure 7: Newspaper coverage, organic sales, and price variation

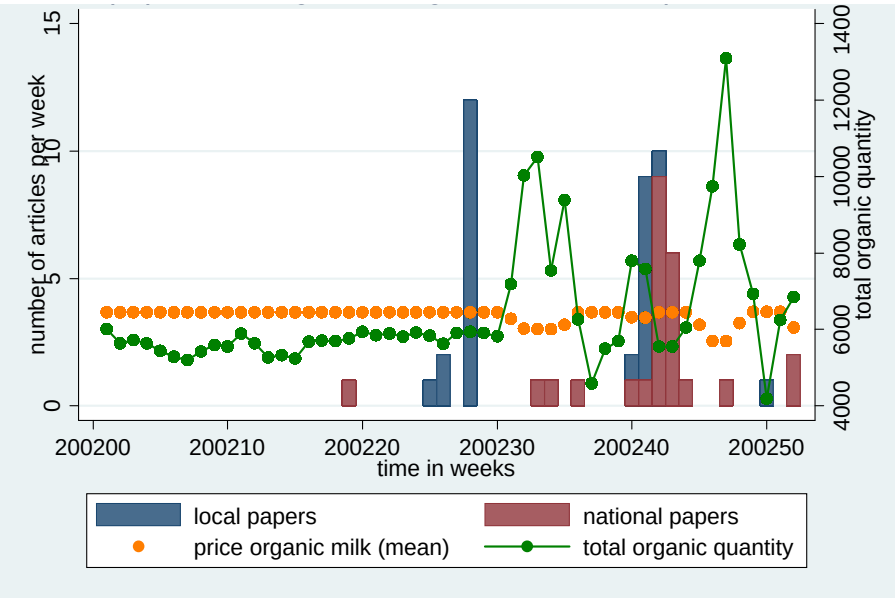

Figure 8: Mean residuals and standard deviations from regressions not including media effects

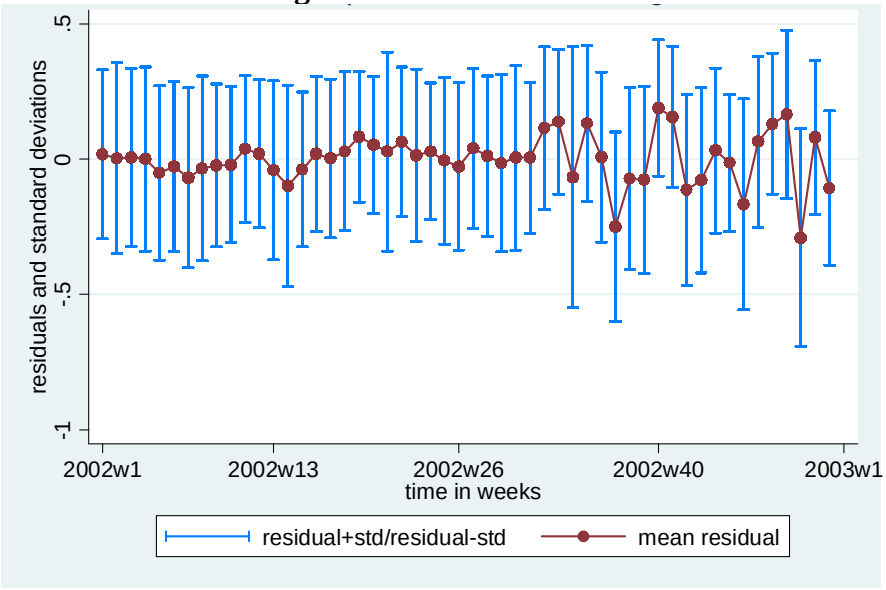

Table 1: Summary statistics of final data set

Summary Statistics					
Variable	Obs	Mean	Std. Dev.	Min	Max
price organic milk	9412	3.537692	0.309256	2.495882	3.99
net sales organic milk	9412	123.575	100.4969	3.35	723.24
quantity organic milk	9412	35.3181	29.39137	1	232
price conventional milk	9412	1.989057	0.113137	1.37	2.29
quantity conventional milk	9412	374.3574	183.7072	66	1527
price difference	9412	1.548635	0.318139	0.31	2.037778
quantity difference	9412	-339.039	166.5415	-1417	-29
net sales difference	9412	748.4364	379.0906	130.26	3313.59
log (quantity)	9412	3.234058	0.851007	0	5.446737
log (net sales)	9412	4.493264	0.844457	1.20896	6.583741
log (quantity difference)	9412	-2.57285	0.653617	-5.73334	-0.42348
stores	9412	103.3536	62.55997	1	229
week	9412	26.5	15.00913	1	52
population total	155	33053.13	17087.41	2951	91177
median income	155	64552.63	22054.74	24346	145425
median rent	155	1005.078	264.3284	495	2001
Median house value	155	379709.5	193790	109300	1000001
Pecentage White	155	0.710735	0.16421	0.259237	0.970625
Percentaqe over 65 of age	155	0.128199	0.054638	0.039537	0.514172
news (dummy)	9412	0.288462	0.453071	0	1
local & national news (dummy)	9412	0.057692	0.233173	0	1
national news (dummy)	9412	0.211539	0.408421	0	1
local news (dummy)	9412	0.134615	0.34133	0	1
local news only (dummy)	9412	0.153846	0.36082	0	1
national news only (dummy)	9412	0.153846	0.36082	0	1
San Francisco Chronicle circulation	154	181.2936	873.8977	58	8877
Oakland Tribune circulation	154	12.25769	168.7309	0	5167
Oakland Tribune (dummy)* circulation (%)	154	0.040116	0.528177	0	12.87291
San Francisco Chronicle (dummy)* circulation	154	0.645556	4.166203	0	152.0291

Table 2: Variation in local newspaper circulation

Local paper circulation matched with stores		
paper	**number of stores**	**weeks with news coverage**
San Francisco Chronicle	179	200225
		200226
		200228
		200241
Oakland Tribune	50	200228
		200240
		200241
Sacramento Bee	31	200242
		200245
Modesto Bee	2	200242
		200250
Fresno Bee	1	200242
San Jose Mercury News	102	200242
Monterey County Herald	8	200242
The Daily Review (Hayward)	8	200228
San Mateo County Times (Alameda Times Star)	8	200228

Table 3: Pooled media effects

Pooled media effects (difference-in-differences)		
dependent variable: (log) quantity org milk -(log) quantity conv milk (by week, by store)		
independent variables:	(1)	(2)
price difference	-0.768 ***	-0.765 ***
	0.027	0.027
news (dummy)	0.051 ***	
	0.010	
		0.052 ***
news (count per week)		0.008
		-0.004 ***
$news^2$		0.001
timetrend	0.003 ***	0.003 ***
	0.000	0.000
Store fixed effects	yes	yes
weeks with actual news	9	9
Number of observations	7421	7421
F-statistic	112.52	114.69

Note: Newey-West corrected standard errors (with 3 lags) are reported and *, **, *** denote statistical significance at the 10%, 5% and 1% significance level.

Table 4: Dissipation of media effects over time

Dissipation of media effects (difference-in-differences) **dependent variable:** (log) quantity org. milk -(log) quantity conv. milk (by week, by store)			
independent variables:	(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 dep. variable (1st lag)			0.010
			0.006
lagged dep. variable (2nd lag)			0.008
			0.006
lagged dep. variable (3st lag)			0.018 ***
			0.006
timetrend	0.003 ***	0.004 ***	0.003 ***
	0.000	0.001	0.000
Store fixed effects	yes	yes	yes
Number of observations	7421	7421	7421
F-statistic	112.52	115.24	109.52

Note: Newey-West corrected standard errors (with 3 lags) are reported and *, **, *** denote statistical significance at the 10%, 5% and 1% significance level.

*When considering lagged effects, news coverage excludes critical coverage

Table 5: Differences in media effects by local versus national coverage, category specific, and critical news coverage

General, category specific, critical coverage (difference-in- difference) **dep. variable: (log) quantity org. milk -(log) quantity conv. milk (by week, by store)**		
independent variables:	(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
timetrend	0.003 ***	0.003 ***
	0.000	0.000
Store fixed effects	yes	yes
Number of observations	7421	7421
F-statistic	112.52	122.88

Note: Newey-West corrected standard errors (with 3 lags) are reported and *, **, *** denote statistica
significance at the 10%, 5% and 1% significance level.

Table 6: Effects of news coverage in the *San Francisco Chronicle* and *Oakland Tribune*

Local paper coverage (difference-in-difference) **dependent variable: (log) quantity organic milk -(log) quantity conventional milk (by week, by store)**				
independent variables:	(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
timetrend	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	7421	7421	7257	168
F-statistic	112.52	116.06	115.5	43.2

Note: Newey West corrected standard errors (with 3 lags) are reported and *, **, *** denote statistical significance at the 10%, 5% and 1% significance level.

Table 7: Media effects versus generated placebo effects

Media and placebo effects (difference-in difference) **dependent variable: (log) quantity organic milk -(log) quantity conventional milk (by week, by store)**					
independent variables:	(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
timetrend	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	
weeks with actual news	9	0	1	2	2
Number of observations	7421	7421	7421	7421	7421
F-statistic	112.52	111.43	111.87	111.56	111.46

Note: Newey-West corrected standard errors (with 3 lags) are reported and *, **, *** denote statistical significance at the 10%, 5% and 1% significance level.

Table 8: Selection bias due restriction of stores

Selection bias (Probit regression) **dependent variable:** analyzed stores (coded as 1)		
mean	0.871	0.872
independent variables:	marginal effects (a)	marginal effects (b)
population total	$1.08*10^{-6}$	
	0	
median income	$-8.40*10^{-6}$ ***	$-8.51*10^{-6}$ ***
	0	0
percentage of White	0.395 **	0.370 ***
	0.161	0.141
median house value	$1.17*10^{-6}$ ***	$1.50*10^{-6}$ ***
	0	0
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

Note: robust and clustered (by store) standard errors are reported and *, **, *** denote statistical significance at the 10%, 5% and 1% significance level.

240 stores were included. 181 analyzed stores are restricted to stores that report organic sales for all weeks in 2002.

Table 9: Media effects accounting for selection bias

Media effects accounting for selection bias (difference-in differences) **dependent variable: (log) quantity organic milk -(log) quantity conventional milk (by week, by store)**			
independent variables:	(1)	(5)	(9)
price difference	-0.768 ***	0.756 ***	-0.758 ***
	0.027	0.028	0.029
(national) news milk (dummy)	0.051 ***	0.107 ***	0.106 ***
	0.010	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
timetrend	0.003 ***	0.003 ***	0.003
	0.000	0.000	0.000
inverse Mills ratio			-0.736 ***
			0.097
Store fixed effects	yes	yes	yes
Number of observations	7421	7421	7421
F-statistic	112.52	122.88	123.27

Note: Newey_West corrected standard errors (with 3 lags) are reported and *, **, *** denote statistical significance at the 10%, 5% and 1% significance level.

Table 10: Structural change due to NOP

Structural change (difference-in-differences) **dependent variable: (log) quantity organic milk -(log) quantity conventional milk (by week, by store)**							
independent variables:	(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
label week (dummy)		-0.120 ***			-0.091 ***		-0.049
		0.027			0.028		0.031
label 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
timetrend	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	7421	9412	9412	9412	9412	9412	
F-statistic	112.52	139.78	140.04	141.65	137.75	136.87	

Note: Newey-West corrected standard errors (with 3 lags) are reported and *, **, *** denote statistical significance at the 10%, 5% and 1% significance level.