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National Brands, Private Labels, and Food Price Inflation

Rickard James Volpe III

This article investigates the extent to which national brand and private label (store brand) prices behave differently as food price inflation changes. Empirical tests using a range of indices support the hypotheses that rising commodity and fuel prices lead to relatively larger surges in private label prices. When food prices are rising or high, the average price difference between national brands and private labels shrinks. The findings have implications for understanding the welfare effects of private labels. Moreover, they suggest that food price inflation is stronger for low-income households as food prices rise.

Key Words: Consumer Price Index, food prices, input costs, price inflation, private labels, seemingly unrelated regression

JEL Classifications: E31, L16, P42, Q11, E31

Private labels (PLs), also known as store brands, have become a prominent feature in the landscape of the food retail sector. Retailers can obtain PLs through a form of vertical integration or from manufacturers operating regionally or on the competitive fringe (Berges-Sennou, Bontems, and Requillart, 2004). In certain cases, national brand (NB) manufacturers supply PLs by using their excess capacity (Private Label Marketing Association, 2011). Regardless of how they are obtained, PLs are marketed as being unique to their retail chains, and that is a key distinguishing characteristic between NBs and PLs. In recent years, PLs have been the subject of heightened attention because they have made sharp increases in terms of quality, sales, and total products offered (Consumer Reports, 2009; Food Institute, 2010). PLs have become pervasive even among organic foods and other supermarket niches (Hassan and Monier-Dilhan, 2006; Park and Lohr, 2010).

Much of the economic research on PLs and their ascension in food retailing has focused on price effects using approaches rooted in industrial organization. An overarching goal of this stream of literature is to understand the welfare effects of PLs for consumers. Several studies have examined the effect of PL introduction and expansion on retail food prices, specifically NB prices. Mills (1995) as well as Bontems, Monier-Dilhan, and Requillart (1999) found that PL entry can result in lower food prices. The studies argue that a primary motivating factor retailers have for offering PLs is the potential to overcome double marginalization. Double marginalization occurs when both manufacturers and retailers apply markups for food prices, resulting in inefficiently high prices.

More recent, empirical studies (Bonanno and Lopez, 2005; Bontemps, Orozco, and Requillart, 2005, 2008; Ward et al., 2002) have generally not supported these implications. Several results demonstrate that PL introduction and market

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share are associated with higher NB prices.[1] It is possible, therefore, that double marginalization is not the dominant factor in shaping retail food prices when studying the role of PLs. Additionally, the NB/PL relationship may have changed fundamentally between the timing of the older, industrial organizational studies and the more recent empirical studies.

This study takes a different approach in studying NB and PL prices. NBs are almost uniformly more expensive than comparable PLs (Ailawadi, Neslin, and Gedenk, 2001; Parcell and Schroeder, 2007). However, given that they follow different paths from the farm gate to the store shelf, I investigate the possibility that upstream costs or macroeconomic factors drive prices for the two brands in the same direction but with differing magnitudes.[2] Specifically, I explain how factors that drive food prices upward can affect PLs relatively more than NBs. The results indicate that during times of high food prices, the NB/PL price difference is relatively narrow, because product lines are positioned to be closer in price. This is demonstrated across data from the Consumer Price Index (CPI) and the International Monetary Fund (IMF).

The results have implications for consumer expenditures and the welfare effects of PLs. Given that the relationship between NB and PL prices changes as the overall level of food prices changes, it matters not only how PL welfare effects are measured, but when. Private label prices rise more, in percentage terms, than NB prices as overall food prices increase, and thus the cost savings that can be achieved through the purchase of PLs is minimized while food prices are high. Thus, any welfare-enhancing effects of PLs are likely decreased or minimized while food prices are high. Additionally, this dynamic may help explain why lower-income household food expenditures rise the most, in percentage terms, when retail food prices increase.

Background and Analytical Framework

There are several macroeconomic factors that affect retail food prices in the United States. The supply-side factors in particular have been summarized and discussed by Gilbert (2010), Lamm and Westcott (1981), Trostle (2008), and Wilson (2012), among others. Raw commodities are the primary inputs for almost any food or beverage product that can be purchased at the retail level, and hence much of the discussion on the determinants of food prices tends to focus on the drivers of commodity prices. The major considerations therein include, in no order of importance, weather and seasonality, rising international demand, the price of oil, the production of biofuels (particularly corn-based ethanol), and the international exchange rates that determine the strength of the U.S. dollar.

To be sure, most if not all of these factors are interrelated. Further complicating matters is the fact that several of these factors affect food prices beyond the farm gate. For example, fuel prices determine not only the cost of production for commodities, but also transportation costs in the processing and retailing sectors. Therefore, to obtain a clear picture of the determinants of retail food prices that enables a comparison between NBs and PLs, I focus on the value-added shares of the consumer food dollar by industry.[3] The value-added industry shares give the percentage of each consumer dollar spent domestically on food that can be attributed to the various industries and stages of production involved in agribusiness. Figure 1 reports the breakdown for the 2008 food-at-home consumer dollar, as reported by Canning (2011).

Taking into consideration the value-added industry group shares reported in Figure 1, the

[1] Ward et al. (2002) in particular provide a thorough discussion of how economic theory might explain increased NB prices as a result of PL introduction or expansion.

[2] MacDonald (2000) found suggestive evidence in this regard while investigating an entirely different research question. He noted that retail food prices typically fall during periods of peak demand. In an effort to attribute this to cost factors, he compared national brand and private label prices within product categories. In the majority of cases, the NB–PL price margin narrowed during peak demand periods, because the NB prices fell relatively more than PL prices.

[3] The food dollar is defined by the Economic Research Service as the total annual market value for all purchases of domestically produced food by persons living in the United States.

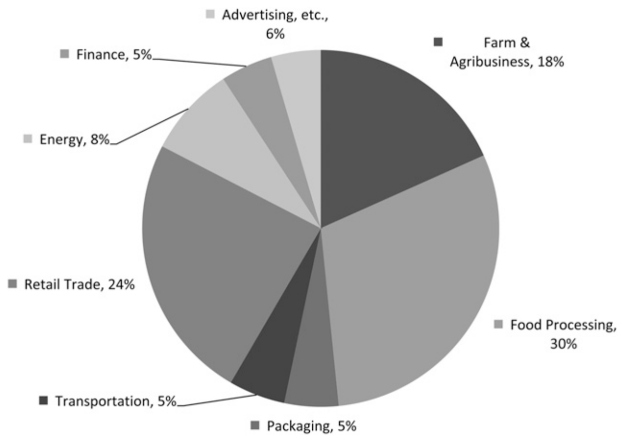

Figure 1. The Industry Group Value-Added Shares of the Food Dollar (Source: Canning (2011), estimates of the value-added industry group shares for the 2008 food-at-home dollar. Any errors are the author's alone)

supply-side determinants of food prices become clear. Food prices, both NB and PL, are a function of agricultural commodity prices, processing costs, packaging costs, transportation costs, retail costs, utility costs such as energy for heating, cooling, etc., throughout the food supply chain, finance and accounting costs, and advertising costs.

There is no reason to expect systematic differences among the commodity markets, processors, transportation industries, or energy inputs of NBs and PLs. As recently as the early 1990s, this assertion might have seemed outrageous. For example, Connor and Peterson (1992) based their analysis on the assumption that PL prices could be assumed to proxy for marginal costs for NBs. However, a steadily increasing body of research is demonstrating that today NBs and PLs differ primarily in the way they are priced and advertised in retail (Steiner, 2004; Volpe, 2011). This is most evident in the fact that in many cases, PLs are actually produced and distributed by NB manufacturers (Private Label Marketing Association, 2011; Quelch and Harding, 2002).[4] However, industry research and customer surveys (Consumer Reports, 2009) have reported that the perceived gap in quality between NBs and PLs has effectively closed. The transportation costs of PLs are not significantly lower than those of NBs, because PLs are not to be confused with "local foods." Commodities for use in creating PL products originate from the same locales as those used for NBs, must travel to the processing or manufacturing plant nearest to the region in which they will ultimately be sold if necessary, and then undergo dispersal to individual retailers.

It is, however, reasonable to expect that retail and advertising costs are higher for NBs than they are for PLs. Retail costs, in the context of branding, can be thought to embed the inefficiency of double marginalization, which would be higher for NBs. Hard data on advertising costs or intensity by label are difficult to come by, but several studies on NB/PL dynamics (Bronnenberg, Dhar, and Dube, 2009; De Wulf et al., 2005; Dhar and Hoch, 1997) have all made arguments centered on the fact that NB advertising is greater than PL advertising. Connor and Peterson (1992) exploited the fact that PL manufacturers do not advertise at all in their study, although this is no longer true today.

Given that retail and advertising costs constitute a larger share of NB prices than PL prices, the shares of the remaining cost components of the food dollar are collectively larger for PLs

[4] Hard data on the share of PLs that are produced by NB manufacturers in the United States are not available, to my knowledge. However, the Private Label Marketing Association, the international trade association of PL manufacturers and distributors, cites NB manufacturers and excess capacity first among the four major sources of food and nonfood PLs.

prices. Moreover, research has shown that double marginalization is a source of price stickiness (Neiman, 2010) and that it mitigates pass-through to retail food prices (Bonnet et al., 2013). Therefore, the marginal effects of increases in upstream costs included illustrated in Figure 1 are expected to be greater for PLs than for NBs.

To the extent that PLs are produced through a form of vertical integration, market power is another important factor when considering the impact of input price increases on food prices. PLs are of interest in the study of industrial organization for their role in generating market power for retailers in the food supply chain, and researchers have found this to be a key motivating factor in offering PLs (Cotterill and Putsis, 2000; Mills, 1995). Richards et al. (2012) found that commodity price increases are more likely to be passed along to retail prices among retailers with market power. Within this framework, input price pass-through may be expected to be stronger or more complete among PLs, for which retailers have greater control over prices.

The demand side is often discounted when studying food prices in the United States as a result of the fact that aggregate food demand is inelastic in wealthy, developed nations (Andreyeva, Long, and Brownell, 2010; Blanciforti and Green, 1983). However, demand is a relevant consideration when considering food categories or brands. Given that PLs are almost universally less expensive than comparable NBs (Berges-Sennou, Bontems, and Requillart, 2004), PL demand tends to rise during times of high food prices (Lamey et al., 2007). This phenomenon has also been documented in food retail industry publications (Food Institute, 2010). Therefore, during times of rising food prices, there are factors on both the supply and demand side that suggest that NB/PL price differences may fall.

Finally, even if one does not accept either of the supply or demand arguments for relatively higher PL prices during times of increasing food prices, it is important to keep in mind that PLs should be expected to rise relatively more simply as a result of the fact that NB prices are higher for comparable products. Suppose that, as a result of any confluence of events, the wholesale price of a given product category for a food retailer increases by x. The actual degree to which retailers are able to pass these cost increases onto consumers depends on factors such as local market concentration as well as the structural relationship between retailers and manufacturers. However, any absolute price increase applied equally to NBs and PLs within a category will lead to higher percentage increases in PL prices.

Data on National Brands and Private Labels

I use a data set of retail prices drawn from the corporate web sites of two major supermarket chains, Safeway and Albertsons, that operate primarily in the western United States. Both chains offer online retail, meaning that consumers in certain metropolitan areas have the option of selecting and purchasing their groceries online and then choosing home delivery or, in certain cases, in-store pickup. Owing to this service, the prices and promotions of most products offered by both chains are available for viewing to consumers simply by inputting their zip codes.[5,6]

The cities sampled are Los Angeles, California, San Francisco, California, San Jose, California, and Seattle, Washington. These four cities allowed for the pairing of online retail price data with consistent time series of CPI data from the Bureau of Labor Statistics (BLS). All of the cities sampled for this study include multiple zip codes. In general in the data, all of the zip codes for any given city typically report the same prices and promotions within the same week. This suggests that the online price data may not incorporate price changes made at the smaller pricing zone level, as found by Levy et al. (1998). Such variation, however, is not pertinent to this study, given that the primary objective is to examine how average NB and PL prices move with respect to nationally

[5] The data set is necessarily limited to those products available for online retail. The major exceptions from the data set include alcohol and tobacco, many seasonal and holiday-themed items, greeting cards and stationary, large general merchandise products, certain bakery and butcher items, and many recently introduced products.

[6] The data were gathered weekly at a scheduled time using an automated program and stored in spreadsheets for analysis.

measured sources of input costs.[7] Volpe and Li (2012) provide a comprehensive discussion of the data collection process and the statistical properties of the data.

Safeway and Albertsons are both major players in all four of these cities. This is convenient because it means that the variation observed in the NB and PL prices for these chains can be considered representative of dynamics for retail food prices more generally in these cities. That is, there is no reason to consider this analysis a firm-level case study. According to the 2008 edition of *Marketing Guidebook*, an industry publication by Nielsen, the combined food markets shares for these two chains for the approximate period of data collection were 33% for Los Angeles and Seattle and 38% for San Francisco and San Jose, whose market boundaries are indistinguishable in the report.

The weekly retail price data cover the time period from March 2008 through August, 2010, a period of 110 complete weeks or 27 months. Food prices underwent a significant deal of fluctuation during this time period, owing in part to the recession that ended in June 2009 and the subsequent recovery of the U.S. economy. This was also a period of turbulent agricultural commodity prices. The IMF maintains a global index of commodity prices. Consider that the coefficient of variation (standard deviation divided by mean) for this index during our data collection period is 0.23. From September 2010 through December 2012, it is only 0.07. As a result, these data provide an excellent opportunity to examine the potential effects of macroeconomic factors and economic conditions on NB and PL food prices.

One important issue in studying the difference between NB and PL prices is the matching of NB and PL substitutes. The data set includes only those products for which very close pairings were possible across NBs and PLs. The criteria for matching across labels required that potential substitutes be within the same product category and have the same characteristics used as descriptors in the product names. Therefore, each pair of products examined in this study is matched according to product size as well as defining taste and nutritional attributes such as flavor, low sodium content, etc., that are included in the product name.[8] In total this study analyzes the pricing and promotional behavior of over 5800 unique NB products, each paired with an appropriate PL substitute. Many PL products are paired with more than one NB, because most product categories contain multiple NBs with similar characteristics. The products span over 200 product categories and cover every major food department in the supermarket. The complete list of matched products is available from the author on request, and Table 1 provides several illustrative examples of matched NB/PL product pairs.

Measuring Aggregate National Brand and Private Label Prices

With such a large number of heterogeneous products, it is necessary to take efforts to make an empirical investigation into price dynamics tractable. The price difference between NB and PL prices, or the NB/PL margin, is one such possibility. It has been used by Connor and Peterson (1992) as well as a number of studies reviewed in an NB/PL survey by Steiner (2004).

The NB/PL price margin for product pair i in city j during week t is given by

[7] Conversations with professionals from both chains have revealed that prices match up in-store and online except in the case of inventory shortages. Moreover, the author conducted comparisons for a basket of 50 products in stores in Sacramento and Davis, California, for 2 weeks and found only one discrepancy between the prices in the stores and those reported online.

[8] At the time of data collection, one of the chains in the sample offered a considerably smaller line of premium private labels. Premium PLs are a relatively new and growing phenomenon among food retailers with the largest example in terms of geographic coverage being Kroger's Private Selection. Premium PLs are marketed to be of higher quality than flagship PLs and are typically priced much closer to comparable NBs. Premium PLs are excluded from the data used in this analysis. Geyskens, Gielens, and Gijsbrechts (2010) provide a review of the literature on premium PLs from a marketing perspective.

Table 1. Examples of Matched National Brand–Private Label Pairs in the Data

National Brand Product	Private Label Product
Stove Top Chicken Stuffing Mix—6 oz	Safeway Chicken Stuffing Mix—6 oz
Pepsi Diet Max Invigorating Cola—2 L	Safeway Go 2 Cola Diet Soda—2 L
Chicken of the Sea Solid White Albacore Tuna In Water—5 oz	Safeway Solid White Albacore in Water Tuna—5 oz
Bigelow Lemon Lift Tea Bags—20-count	Safeway Lemon Herbal Tea—20-count
Nestle Fat Free Rich Chocolate Hot Cocoa Mix with Calcium—8–28 oz	Safeway Rich Chocolate Flavor Fat Free Hot Cocoa Mix—8–.28 oz
Pepperidge Farm Farmhouse 100% Soft Whole Wheat Bread—24 oz	Safeway 100% Whole Wheat Bread—24 oz
Campbell's Chicken Mushroom Barley Condensed Soup—10.5 oz	Safeway Kids Chicken Alphabet Condensed Soup—10.5 oz
Minute Maid Calcium Fortified Orange Juice—16 fl oz	Safeway Calcium Rich Orange Juice—16 fl oz
Aunt Jemima Syrup Lite—24 fl oz	Albertsons Syrup Lite Reduced Calorie 24 fl oz
Kraft Philadelphia Cream Cheese Fat Free Tub—8 oz	Albertsons Cream Cheese Soft Fat Free—8 oz
Nestle Drumstick Vanilla Caramel Ice Cream Cones—4–4.6 fl oz	Safeway Lucerne Vanilla Ice Cream Cone—4–4.6 fl oz
Sun-Maid Dried California Apricots Prepacked—6 oz	Safeway California Apricots—6 oz
Nabisco Reduced Fat Wheat Thins Crackers—9 oz	Safeway Reduced Fat Thin Wheat Crackers—9 oz
Old Orchard Frozen Cranberry Juice—12 oz	Albertsons Frozen Juice Concentrate Cranberry Cocktail—12 oz

$$(1) \qquad Margin_{ij,t} = \frac{NBPrice_{i,j,t} - PLPrice_{i,j,t}}{NBPrice_{i,j,t}}$$

and is the proportional difference in price, not the absolute difference. For the purposes of this study, a unique product pair is defined by an NB/PL pairing, a chain, and a city. The margin is unitless, which affords many advantages in a setting such as this one. The NB/PL margin can be compared directly across different product pairings and thus lends itself to simple aggregation for the purposes of understanding percent changes. To that end, for the bulk of this analysis, I use the average NB/PL margin by city, wherein

$$(2) \qquad Margin_{j,t} = \frac{\sum_{i=1}^{N} Margin_{i,j,t}}{N},$$

but this study also includes an analysis focusing on individual departments as well.

A potential drawback with margins is that they can only demonstrate whether the NB/PL price difference is narrowing or widening. They cannot inform as to whether the change is the result of greater relative changes in NB or PL prices. To that end, it is necessary to conduct some measurement of the aggregate dynamics of NB and PL prices, respectively. However, that requires the use of an index of some form. Yu and Connor (2002) demonstrate that it is a mistake to use unweighted prices when making comparisons or aggregations across product categories because products that are intrinsically more expensive receive more weight in the analysis. Therefore, when examining the movement of NB or PL prices individually, I construct and rely on normalized prices. The shelf prices are each normalized by the mean price for product i. Once again, product i is any unique combination of a product name, chain, and city. Hence, the normalized, or relative, price for brand b (b = NB or PL) of product i in city j at time t is

$$(3) \qquad rp^b_{ijt} = \frac{p^b_{ijt}}{\overline{p^b_{ij}}}.$$

where $\overline{p_{ij}}$ is the mean price of product i in city j over the time series. As a result of this normalization, changes in these prices can be interpreted approximately as proportions. This allows for the convenient calculation of relative price indices, which report the approximate percentage change in the price of baskets of goods.[9] Like with the margins, for the majority of the analysis, we focus on averages per month and city and use

$$(4) \qquad rp_{j,t}^{b} = \frac{\sum_{i=1}^{N} rp_{i,j,t}^{b}}{N},$$

although this approach is tailored to specific departments as well.

Figure 2 provides frequency histograms for the NB/PL margin as well as the normalized NB and PL prices. The distribution of the NB/PL margin clearly shows two peaks, a large one for price differences of approximately 21–23% and a smaller one for 28–30%. Very few price differences across paired NBs and PLs are smaller than 18% or larger than 30%. The normalized price histograms both include large peaks to the right of the center, for NBs at 4% above the mean and for PLs 8% above the mean. Hosken and Reiffen (2004) examined a large data set of retail food prices and found that price deviations from the central tendency are more likely to be increased rather than decreased. This setting is much different from theirs, but the evidence in Figure 2 corroborates this finding. Additionally, PLs show a larger degree of price dispersion. Monthly indices for NBs range from 8% below the mean to 5% above the mean, whereas PL prices range from 13% below to 11% above. Among other factors, this is consistent with the notion that retailers have a greater deal of control and flexibility in the pricing of PLs, relative to NBs, for which wholesalers have influence.

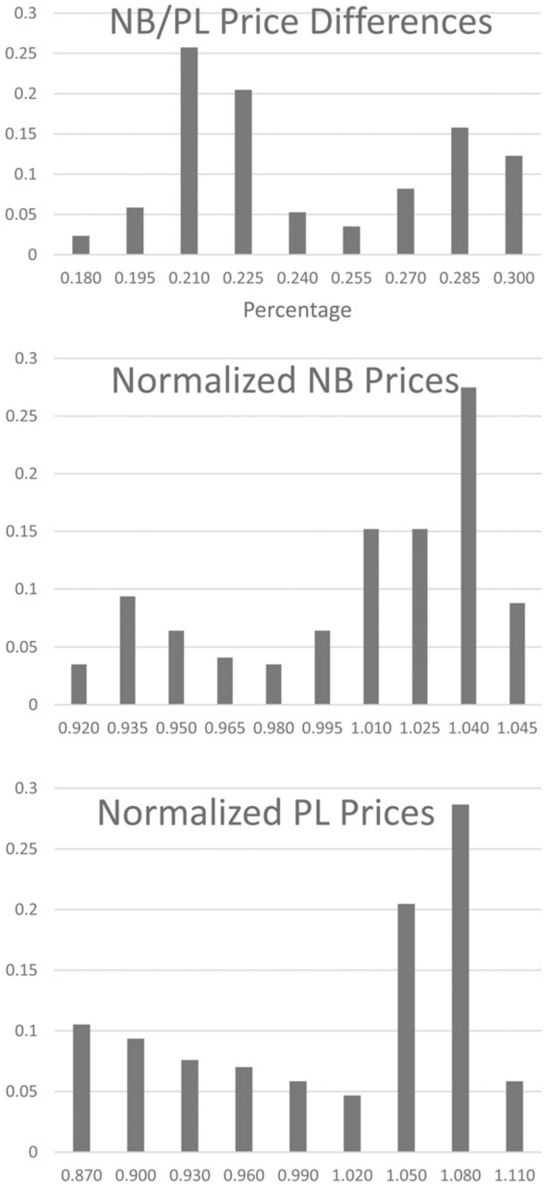

Figure 2. Frequency Histograms for Average Monthly National Brand/Private Label (NB/PL) Price Differences and Normalized Prices

The following section presents an econometric approach to studying NB and PL price dynamics. Using the margins calculated in equation (2) and the relative prices in equation (4), I test if the price difference between NBs and PLs tends to fall when average food prices rise, and if so,

[9] Another commonly used approach to mitigate this problem is to construct expenditure-weighted price indices. However, we do not have quantity sales data. Expenditure-weighted indices are attractive in that price changes for more popular products play larger roles in determining inflation. By using relative price indices, all price changes are given equal weight, but each PL product is paired with an NB product, meaning there is no systematic bias between the two sets of prices. Therefore, this approach is valid for measuring differences in the rates of inflation for NBs and PLs but would be potentially problematic for determining inflation for either brand reflective of consumer preferences.

this can be attributed to PL prices relatively more than NB prices. Then I investigate the potential role of key cost factors, which may be helping to shape these phenomena.

Empirical Approach and Results

The BLS publishes CPI data monthly for retail goods and services in the United States. Of specific interest to this study is the food-at-home CPI, which is calculated from the prices of foods and beverages purchased for at-home consumption. Henceforth, unless otherwise noted, the term "CPI" refers specifically to the food-at-home CPI. The CPI captures average movements in retail prices and smoothes over microeconomic factors such as local market concentration. It is useful for examining whether NB and PL prices behave differently as overall retail food prices change.[10] The time series used may be too short to reflect structural changes in the food retail industry, but a time trend addresses such a possibility. As a starting point, Table 2 shows the differences in NB and PL relative prices and the average NB/PL margin across cities and between relatively high and low CPI values. High CPI values exceed the median value for the time series and city; low CPI values fall below the median.

When interpreting the statistics reported in Table 2, recall that the NB and PL prices are not normalized to each other and are only intended for intralabel comparisons. With that distinction in mind, it is readily apparent that the NB/PL margin is significantly slimmer when food prices are high compared with when they are low. When food prices are high, the margin is an average of 8.6% smaller for high food prices in Los Angeles and over 19% lower in San Francisco. This reduction in the margin is the result of greater price fluctuations for PLs. Naturally, as food prices increase as a result of macroeconomic factors, both NB and PL prices rise. However, the increase in PL prices, in percentage terms, is two to three times the increase in NB prices. Table 2 also includes correlation coefficients between the city-specific food CPI and the average NB/PL margin. In each case, the correlation is negative and highly significant, supporting the notion that rising food prices are associated with decreases in the price differences across brands.

I use a simple linear regression framework to investigate these findings further. The regression model to be estimated is given by:

$$(5) \qquad Margin_{jt} = \beta CPI_{jt} + \theta' C + \gamma' Q + \delta t + \mu_{jt}$$

where *Margin* is the percentage price difference between comparable NB and PL products, as defined by equation (1). The subscripts are familiar from equations (2) and (4). *CPI* is the city-specific food CPI from BLS, intended to simply capture the general dynamics of retail prices. *C* is a vector of city dummies, *Q* is quarterly (seasonal) fixed effects, and *t* is a time trend. The weekly margins calculated using equation (2) are aggregated to months to match the frequency and timing of the CPI data. The data-gathering process yielded 30 usable months of data from Los Angeles, San Francisco, and Seattle and 21 months from San Jose, which was added to the sample later.

Table 3 presents the results of estimating two variants of equation (5), taking the log of each continuous variable for ease of interpretation. Note that in each case, the sample size (n = 111) is the number of city/month combinations in the data set. It is convenient to estimate nested versions of equation (5) to get a clearer picture of the robustness of the results and to circumvent potential concerns regarding the endogeneity of *PL*. The simplest estimation, (A), includes only city dummies, whereas (B) adds the trend variable and quarterly dummies.

To confirm that the narrowing of the NB/PL margin owes to PL prices rising more than NB prices, I regress the food-at-home CPI separately on NB and PL normalized prices. To facilitate

[10] In their empirical approach, Ward et al. (2002) deflate nominal prices by the CPI to obtain real prices. However, their data cover the years 1997 and 1998, a time during which food price inflation was low and exhibited minimal variation. According to the BLS, the year-over-year inflationary figures for food-at-home prices were 2.5% and 1.9%, respectively, for the years examined by Ward et al. However, for 2008 and 2009, two years covered by my data, the figures were 6.4% and 0.5%, respectively. The Bontemps, Orozco, and Requillart (2008) paper used French price data.

Table 2. Average National Brand and Private Label Price Indices, by City and CPI Level

City		Low CPI	High CPI	Percentage Difference	CPI, Margin Correlation
Los Angeles, CA	NB normalized Price	0.963	1.026	6.47***	
		(0.04)	(0.01)		
	PL normalized price	0.941	1.035	10.01***	
		(0.06)	(0.04)		
	NB/PL margin (%)	25.70	23.50	8.63***	–0.50***
		(2.15)	(1.91)		
San Jose, CA	NB normalized price	0.974	1.022	4.87***	
		(0.03)	(0.01)		
	PL normalized price	0.944	1.048	10.99***	
		(0.09)	(0.01)		
	NB/PL margin (%)	24.70	20.60	16.72***	
		(4.41)	(1.01)		
San Francisco, CA	NB normalized price	0.979	1.024	4.64***	–0.58***
		(0.04)	(0.02)		
	PL normalized price	0.936	1.065	18.76***	
		(0.06)	(0.04)		
	NB/PL margin (%)	27.10	21.90	19.15***	–0.67***
		(3.23)	(1.88)		
Seattle, WA	NB normalized price	0.975	1.017	4.25***	
		(0.04)	(0.02)		
	PL normalized price	0.943	1.034	9.67***	
		(0.07)	(0.03)		
	NB/PL margin (%)	24.90	21.00	15.70***	–0.60***
		(3.02)	(1.55)		

Notes: Standard deviations are in parentheses. "Low CPI" includes food-at-home CPI values below the median of the time series, whereas "High CPI" includes those values above the median, by city. *** Difference is statistically significant at the 0.01 level based on a *t* test of equal means across the subset of low CPI values and the subset of high CPI values. CPI, Consumer Price Index; NB, national brand; PL, private label.

hypothesis tests of coefficients across equations as well as exploit potential efficiency gains, I estimate equations for NBs and PLs simultaneously using seemingly-unrelated-regression (SUR). Table 4 presents the results of these regressions, again estimating a nested version of equation (5). Models (A) and (B) reveal that, even when controlling for a time trend, city effects, and quarterly dummies, increases in the CPI translate into significantly higher PL price increases than NB price increases. Regressing on the full set of controls reveals that a 1% increase in the food-at-home CPI is associated with a 1.5% increase in average NB prices and a 2.2% increase in average PL prices.

Evidence from Upstream Cost Measures

The previous section and accompanying analysis indicated that PL prices increase proportionally more than NB prices during periods of rising retail food prices. The results are informative but can only be considered to reflect correlations, illustrating that higher food prices are associated with a smaller gap in NB/PL prices as a result of greater increases in PL prices. In this section, I attempt to provide some causal evidence to support the notion that one factor driving these findings is the fact that PLs are more responsive to upstream costs, at least in percentage terms. Owing to a lack of granular data on PL demand or purchases, I am unable to scrutinize the demand side.

The measurements for tracking the components of the retail food dollar come from two sources. First, there are alternative CPI measures of prices for upstream factors. Second, the IMF calculates and publishes a wide range of indices measuring the prices for a number of

Table 3. OLS Regression Results Examining the Relationship between the CPI and the NB/PL Margin

	(A)	(B)
lnCPI	–4.845***	–2.782***
	(7.29)	(4.80)
Seattle	0.154	–0.121***
	(4.97)	(5.06)
San Jose	–0.208***	–0.120***
	(5.83)	(4.08)
San Francisco	–0.152***	–0.091***
	(4.34)	(3.29)
Trend		0.009***
		(7.89)
Q1		–0.008
		(0.34)
Q2		–0.079***
		(3.38)
Q3		–0.028
		(1.19)
lnPLShare		
Intercept	2.666***	0.825*
	(4.77)	(1.66)
Adjusted R^2	0.386	0.639
N	111	111

Notes: (A) Model includes only the listed price index and city dummies. (B) Model contains price index, city dummies, quarterly dummies, and a time trend. *** Coefficient is statistically significant at the 0.01 level. ** At the 0.05 level. * At the 0.10 level. OLS, ordinary least squares; CPI, Consumer Price Index; NB/PL, national brand/private label; Q, quartile.

important factors that shape food prices. The measures used and their relevance to the retail food dollar, with references to Figure 1, are provided in Table 5.

Timing is certainly an issue of importance when studying the importance of upstream costs in determining retail food prices. It is not an objective of this study to obtain precise measurements of the timing or magnitude of transmission throughout the food supply chain. However, researchers have found that there is typically a significant time lapse, up to as long as a year, between changes in upstream costs, particularly commodity prices, and changes in retail food prices (Leibtag, 2009; Vavra and Goodwin, 2005). Hence the estimation of equation (5) in this section does not include contemporaneous measures of upstream costs, but rather costs lagged from one to 12 months. This is intended to give a more robust understanding of NB/PL price dynamics during times of rising or falling food costs. Table 6 provides a wide breadth of evidence of the impacts of upstream cost changes on the retail NB/PL margin.

The focus of the discussion pertains to the full estimation of equation (5), reported as (B) in Tables 3 and 4. The impact of most upstream cost measures, when lagged for a short period of time, is a statistically significant increase in the NB/PL margin. However, there is strong reasoning to suggest that these findings are spurious given that commodity and energy prices must traverse several stages of production and transaction before appearing on supermarket shelves (Harris et al., 2002). Once the lag lengths reach four months and longer, corresponding better to the transmission estimates of Leibtag (2009) as an example, increases in upstream costs are nearly uniformly associated with decreases in the NB/PL margin. This is true for all commodity prices, including food and nonfood, energy prices, and transportation costs. Hence, taken in consideration alongside the results shown in Table 3, it seems evident that the NB/PL margin narrows considerably during times of high food prices, which are in turn driven by increases in the costs of the major components of the food dollar.

Given that increases in most upstream, or input, costs narrow the NB/PL margin, the next step is to confirm that this is the result of relatively larger impacts on PL prices than on NB prices. Table 7 presents the SUR results of estimating equation (5) on the same assortment of upstream costs. Each estimation consists of a system with the equations regressing the full components of equation (5) on, respectively, normalized NB and PL prices, as was the case with results presented in Table 4.

For all cost sources, there is a clear pattern that persists throughout the results. Starting with a lag of four months in many cases and including longer lags, increases in costs associated with commodity prices, the energy sector, and transportation are all associated with significant increases for both NB and PL prices. More importantly, the SUR setting allows for the

Table 4. SUR Regression Results Examining the Relationship between the CPI and the NB and PL Normalized Prices

	(A)		(B)	
	NB	PL	NB	PL
lnCPI	1.586***	3.333***	1.538***	2.331***
	(9.32)	(9.48)	(8.40)	(7.50)
Seattle	0.025***	0.052***	0.024***	0.035***
	(3.18)	(3.11)	(3.25)	(2.72)
San Jose	0.040***	0.085***	0.037***	0.042***
	(4.38)	(4.52)	(3.95)	(2.66)
San Francisco	0.052***	0.107***	0.050***	0.077***
	(5.77)	(5.74)	(5.75)	(5.17)
Trend			–0.001	–0.004***
			(1.32)	(7.35)
Q1			0.001	0.006
			(0.08)	(0.46)
Q2			0.024***	0.048***
			(3.24)	(3.84)
Q3			0.021***	0.027**
			(2.78)	(2.12)
lnPLShare				
Intercept	–1.34***	–2.82***	–1.30***	–1.93***
		(9.15)	(8.29)	(7.22)
H_O: NB = PL[a]	55.07***		22.24***	
Adjusted R^2	0.431	0.440	0.509	0.674
N	111	111	111	111

Notes: (A) Model includes only the listed price index and city dummies. (B) Model contains price index, city dummies, quarterly dummies, and a time trend. Absolute values of t-statistics are in parentheses. *** Coefficient is statistically significant at the 0.01 level. ** At the 0.05 level. * At the 0.10 level. SUR, seemingly-unrelated-regression; CPI, Consumer Price Index; NB, national brand; PL, private label; Q, quartile.

[a] This test statistic is drawn from the hypothesis test that the coefficient on lnCPI is identical between the NB and PL equations.

confirmation that the magnitudes of these impacts are significantly larger for PL prices in virtually all cases. Thus, the narrowing of the NB/PL margin seen in Table 6 is the result of relatively larger increases in PL prices after rising input costs and other macroeconomic factors.

The magnitudes portrayed in Tables 6 and 7 are to be interpreted with care. The empirical objective here is not to measure input price pass-through. To do so would require modeling multiple upstream costs simultaneously to capture the roles played by inputs as well as the potential for factor substitution in the face of changing relative input prices. Such an exercise is beyond the scope of this study. Perhaps the best approach is to consider the relative magnitudes of the NB and PL coefficients reported in Table 7. With few exceptions, mostly occurring where the estimated coefficients are very close to zero, the PL coefficients are between 50% and 250% larger than the NB coefficients in magnitude. On average, across all estimations of model (B), the PL coefficient is 86% larger, or almost twice the NB coefficient. This underscores the greater relative importance of input prices and upstream factors for PL prices.

Discussion

Economists have studied PLs for decades, many in an attempt to understand their welfare effects for consumers. As noted previously, the economic picture remains unclear, in that PLs increase variety and are typically less expensive than comparable NBs, but they may result

Table 5. Indices Used to Measure the Upstream Costs

Index	Description	Food Dollar Component (if applicable)
IMF Food	Index of all food commodity prices	Farm & Agribusiness
IMF All Commodities	Index of all food and nonfood prices	Farm & Agribusiness, Food Processing, Energy
IMF Nonfuel Commodities	Index of nonfuel commodity prices	Farm & Agribusiness
IMF Raw Agricultural	Index of raw agricultural commodity prices	Farm & Agribusiness
IMF Fuel	Index of overall fuel and energy prices	Energy
IMF Crude Oil	Index of crude oil prices	Energy
IMF Wheat	Index of U.S. No. 1 hard red winter wheat	
Commodities CPI	CPI for the prices of agricultural commodities in the United States	Farm & Agribusiness
Transportation Services CPI	CPI for the prices of transportation services in the United States	Transportation

Notes: IMF, International Monetary Fund; CPI, Consumer Price Index.

in higher NB prices and there are also quality considerations. This study introduces a new wrinkle to that consideration, namely that the average price difference between comparable NB and PL considerations is fluid, depending on upstream cost considerations and macroeconomic conditions. In general, as food prices rise, the NB/PL price gap narrows, and the extent to which it can vary is fairly large. This means that estimates of potential PL price savings for consumers or the impacts of PL market share on NB prices are time-dependent.

Even a back-of-the-envelope measure of how variation in the NB/PL margin can affect consumer welfare quickly grows complicated. However, national sales figures help to stimulate and focus discussion, at least to the extent to which PLs enable consumers to economize. According to the Nielsen corporation, between 2007 and 2010, total NB sales increased $12 billion, or 3%. However, PL sales increased over $14 billion, an increase of 20%. This implies that a large number of consumers shifted at least a portion of their food shopping from NBs to PLs during this time in an effort to contain their food costs during a period of rising commodity and energy prices. However, to estimate total savings achieved, even at the most basic level, the price difference must be treated as variable and calculated at least annually. Any estimate of the NB/PL price difference, applied to the entire time period, will certainly over- or underestimate total savings. Further confounding matters are factors such as consumers' proclivity to substitute for larger product sizes or less perishable foods as price rise (Leibtag and Kaufman, 2003) and the evidence that consumers who switch to PLs as prices rise generally do not fully revert back to NBs as prices come back down (Lamey et al., 2007). This study is intended to serve as an important first step in fully analyzing this issue of consumer welfare effects and food prices.

The calculation of cost-savings, or lack thereof, attributable to PLs is of particular interest to researchers interested in the food expenditures and consumption of lower-income households. The BLS Consumer Expenditure Survey tracks average food expenditures among American households across a wide range of demographic groups. Between 2007 and 2011, a period of time of heavy retail price inflation and volatility, households earning between $5000 and $10,000 per year increased their food-at-home expenditures by 13.5% in unadjusted dollars. However, households earning more than $70,000 saw a comparable increase of 0.36%.[11] Considering that low-income

[11] During this time, food-away-from-home spending fell for all income groups, but the percentage decreased fell with income.

Table 6. OLS Estimates of the Impacts of Upstream Costs on the NB/PL Price Margin

	IMF						CPI	
	Food	All Commodities	Nonfuel Commodities	Raw Agricultural	Fuel	Crude Oil	U.S. Commodities	Transport. Services
Lag1	0.552*	0.241*	0.404*	0.308*	0.196*	0.184*	1.716*	0.206
Lag2	0.490*	0.181*	0.310*	0.207*	0.147*	0.144*	1.306*	–1.618*
Lag3	0.363*	0.113*	0.199*	0.090*	0.091*	0.099*	0.699*	–3.697*
Lag4	0.153*	0.028*	0.060*	–0.030	0.022*	0.036*	0.176	–4.620*
Lag5	0.096*	–0.007	0.025	–0.066*	–0.010	0.007	–0.207*	–3.514*
Lag6	–0.046	–0.070*	–0.077*	–0.191*	–0.062*	–0.042*	–0.704*	–3.490*
Lag7	–0.234*	–0.146*	–0.198*	–0.316*	–0.125*	–0.102*	–1.496*	–4.964*
Lag8	–0.412*	–0.214*	–0.297*	–0.377*	–0.180*	–0.144*	–2.248*	–5.232*
Lag9	–0.563*	–0.260*	–0.386*	–0.441*	–0.212*	–0.169*	–1.958*	–5.747*
Lag10	–0.593*	–0.348*	–0.489*	–0.714*	–0.290*	–0.236*	–2.253*	–4.107*
Lag11	–0.543*	–0.392*	–0.549*	–0.651*	–0.319*	–0.259*	–2.720*	1.392*
Lag12	–0.378*	–0.244*	–0.686*	–0.584*	–0.156*	–0.161*	0.032	5.556*
Average R^2	0.693	0.711	0.712	0.706	0.709	0.709	0.701	0.686

Notes: All results reflect the full estimation of equation (5), including the listed price index, city dummies, quarterly dummies, and a time trend. * Coefficient is statistically significant at the 0.05 level. The reported coefficients correspond to the upstream cost measures. IMF, International Monetary Fund; CPI, Consumer Price Index; OLS, ordinary least squares; NB/PL, national brand/private label.

Table 7. SUR Estimates of the Impacts of Upstream Costs on NB and PL Prices

	IMF					
	Food		Raw Agricultural		Fuel	
	NB	PL	NB	PL	NB	PL
Lag1	–0.164*	–0.304*	–0.027*	–0.095*	–0.045*	–0.093*
Lag2	–0.103*	–0.222*	0.026*	–0.011	–0.014*	–0.046*
Lag3	–0.015	–0.091*	0.079*	0.075*	0.021*	0.006
Lag4	0.101*	0.087*	**0.138***	**0.168***	0.058*	0.063*
Lag5	0.181*	0.187*	**0.176***	**0.218***	**0.082***	**0.097***
Lag6	**0.257***	**0.301***	**0.204***	**0.277***	**0.096***	**0.124***
Lag7	**0.281***	**0.376***	**0.241***	**0.351***	**0.112***	**0.157***
Lag8	**0.263***	**0.399***	**0.272***	**0.397***	**0.119***	**0.178***
Lag9	**0.293***	**0.473***	**0.328***	**0.472***	**0.116***	**0.182***
Lag10	**0.244***	**0.420***	**0.430***	**0.647***	**0.121***	**0.205***
Lag11	**0.305***	**0.460***	**0.366***	**0.563***	**0.160***	**0.251***
Lag12	**0.471***	**0.589***	**0.272***	**0.442***	**0.102***	**0.147***

	IMF					
	All Commodities		Crude Oil		Nonfuel Commodities	
	NB	PL	NB	PL	NB	PL
Lag1	–0.056*	–0.114*	–0.051*	–0.098*	–0.096*	–0.195*
Lag2	–0.018*	–0.058*	–0.023*	–0.056*	–0.041*	–0.112*
Lag3	0.023*	0.004	0.008*	–0.011*	0.021*	–0.015
Lag4	**0.068***	**0.074***	0.044*	0.044*	0.092*	0.096*
Lag5	**0.097***	**0.114***	**0.065***	**0.074***	**0.135***	**0.151***
Lag6	**0.118***	**0.151***	**0.079***	**0.099***	**0.180***	**0.223***
Lag7	**0.136***	**0.189***	**0.095***	**0.132***	**0.207***	**0.283***
Lag8	**0.144***	**0.214***	**0.098***	**0.146***	**0.217***	**0.317***
Lag9	**0.148***	**0.230***	**0.099***	**0.152***	**0.263***	**0.391***
Lag10	**0.153***	**0.255***	**0.107***	**0.177***	**0.276***	**0.426***
Lag11	**0.199***	**0.312***	**0.140***	**0.216***	**0.322***	**0.486***
Lag12	**0.154***	**0.226***	**0.107***	**0.155***	**0.420***	**0.626***

	CPI			
	U.S. Commodities		Transportation Services	
	NB	PL	NB	PL
Lag1	–0.377*	–0.791*	1.503*	1.758*
Lag2	–0.048	–0.321*	2.227*	3.003*
Lag3	0.310*	0.220*	**2.980***	**4.275***
Lag4	**0.700***	**0.766***	**3.627***	**5.175***
Lag5	**0.979***	**1.164***	**3.419***	**4.622***
Lag6	**0.982***	**1.285***	**3.725***	**4.908***
Lag7	**1.049***	**1.551***	**3.240***	**4.773***
Lag8	**1.178***	**1.875***	**1.462***	**2.905***
Lag9	**0.916***	**1.511***	**–0.131**	**1.169***
Lag10	**0.676***	**1.284***	**–2.316***	**–1.590***
Lag11	**0.831***	**1.523***	**–2.937***	**–3.601***
Lag12	0.283*	0.297*	**–2.668***	**–4.349***

Notes: All results reflect the full estimation of equation (5), including the listed price index, city dummies, quarterly dummies, and a time trend. **Bold** indicates where the NB and PL coefficient estimates are significantly different from one another at the 0.05 level. * Coefficient is statistically significant at the 0.05 level. SUR, seemingly-unrelated-regression; NB, national brand; PL, private label; INF, International Monetary Fund; CPI, Consumer Price Index.

households are far more likely to eat at home and to purchase PLs, the NB/PL price dynamics identified in this study may help to explain this disparity. This suggests potential policy implications regarding the pricing of PLs during times of high food prices, particularly when considering the allotted benefits of various food assistance programs.

The results also raise interesting insights with respect to price transmission in the food supply chain. Given the increased prominence of PLs in food retail, the study of price transmission increasingly needs to account for the fact that systematic differences exist between NBs and PLs in terms of both timing and magnitude. A wealth of research on price transmission has examined complicating factors such as market power among buyers and sellers or vertical integration, but few have examined the importance of branding. Further research is motivated into extent to which PLs are more responsive to upstream changes and whether this can garner important insights into the mechanics of price transmission across industry sectors.

Conclusions

Economists have been researching the effect of PLs on retail food prices and, in turn, consumer welfare for two decades. This study takes a macroeconomic approach to the problem to examine how the major forces that affect prices in the supermarket affect NBs and PLs separately. Empirical work using CPI and IMF data indicates that the growing consensus in the literature that PL introduction and expansion leads to higher NB prices might require an important caveat, particularly during times of inflationary pressure. As food prices rise in the United States, PL prices rise more than NBs and the price gap between the two narrows, even controlling for aggregate PL market share.

I argue that efforts to determine the welfare effects of PLs for consumers are dependent not only how to measure such effects, but when. This study does not rule out the notion that PLs can lead to higher NB prices or higher prices overall, particularly within individual product categories. However, any measure of welfare owed to PLs must incorporate the NB/PL price margin, which varies widely depending on economic conditions. The empirical work shows that, in the city of San Francisco for example, the average NB/PL margin can swing from approximately 27% when food prices are low to approximately 21% when food prices are high. Moreover, given that PL prices seem to be more responsive to macroeconomic conditions as measured by the BLS and IMF, they may provide a clearer opportunity for researchers to measure and understand the impacts of various factors or shocks to retail food prices going forward.

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