

The Price Effects of a Large Merger of Manufacturers: A Case Study of Maytag-Whirlpool[†]

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Many experts speculate that US antitrust policy towards horizontal mergers has been too lenient. We estimate the price effects of Whirlpool's acquisition of Maytag to provide new evidence on this debate. We compare price changes in appliance markets most affected by the merger to markets where concentration changed much less or not at all. We estimate price increases for dishwashers and relatively large price increases for clothes dryers, but no price effects for refrigerators or clothes washers. The combined firm's market share fell across all four affected categories, and the number of distinct appliance products offered for sale fell. (JEL G34, K21, L11, L41, L68)

Each year thousands of mergers are proposed to the US Federal Trade Commission and US Department of Justice. After filing, the merging firms must wait while the antitrust authority attempts to identify and block mergers that would increase consumer prices. The challenge of identifying those mergers that would increase prices, while not interfering with those that would not, is enormous. Enforcement decisions must be made quickly and often with imperfect information on consumer demand, the ease of entry, and the possibility of merger-induced efficiencies. Unsurprisingly, whether antitrust enforcement has been too lenient or too strict is the subject of much debate (Crandall and Winston 2003; Baker 2003). A straightforward way to inform this debate is to evaluate whether approved mergers actually increased price. Without evidence of this sort, it is impossible to know whether antitrust policy is achieving the objective of protecting consumer surplus.

This paper presents exactly that kind of evidence by estimating the price effects of a large and controversial merger—Whirlpool's acquisition of Maytag. This merger combined two of the largest appliance manufacturers in the United States, and is particularly interesting for our purposes because it was likely nearly blocked.¹

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[†]To comment on this article in the online discussion forum, or to view additional materials, visit the article page at <http://dx.doi.org/10.1257/pol.5.1.239>.

¹Baker and Shapiro (2008) state, “the perception that the Justice Department has adopted a very lax merger enforcement policy was unquestionably fueled by the March, 2006 decision of Assistant Attorney General Barnett not to take any enforcement action when Whirlpool sought to obtain Maytag,” and that they are “confident that the Whirlpool/Maytag deal would have been challenged by Assistant Attorney General Klein ten years ago.”

The Whirlpool/Maytag case arguably presents an opportunity to evaluate whether a change in antitrust policy, allowing a merger that otherwise would have been challenged, resulted in a price increase.

Using scanner data covering a period before and after Whirlpool's purchase of Maytag, we estimate how markets for different types of appliances were impacted by the acquisition. Before the merger, Whirlpool and Maytag were both large manufacturers of clothes washers, clothes dryers, dishwashers, and refrigerators. In contrast, both firms had essentially no presence in the market for freezers and Maytag was a relatively less important producer of cooktops, ovens, and ranges. Comparing the prices of dryers, washers, refrigerators, and dishwashers to appliance markets that experienced no or small changes in concentration before and after the merger offers a simple test of whether the merger increased prices. We find that the prices for dishwashers and clothes dryers increased relative to each comparison appliance category, we find small price changes for refrigerators, and essentially no change in prices of washing machines.

Comparisons within appliance categories between products produced by Maytag or Whirlpool and rival appliance manufacturers provide an alternative test of whether the merger raised prices. Consistent with models of oligopoly commonly used to study mergers (Deneckere and Davidson 1985), we find evidence that dryers and dishwashers owned by the merging parties, and introduced after the merger occurred, experienced an increase in price relative to rivals' dryers and dishwashers.

We also estimate the effects of the merger on market share and a simple measure of product variety. Consistent with our estimated price effects, we find that the merging parties' combined market share fell in the product categories experiencing the largest price increases. However, similar decreases in relative sales were experienced in other appliance categories for which prices did not increase. We also find that the number of distinct products, as measured by stock-keeping units (SKUs), offered to consumers by Whirlpool/Maytag fell after the merger, both in absolute terms and relative to rival appliance manufacturers.

This paper complements a small number of papers that directly estimate the effects of mergers in consumer product markets.² The studies in this literature are typically case studies. This approach makes it feasible to focus on industry specific institutions that are often necessary to account for when estimating merger effects.³ Most studies which estimate the price effects of mergers find that mergers increase prices.⁴ The ability to draw conclusions regarding the efficacy of horizontal merger policy from the published literature, however, is limited. Only a tiny fraction of the thousands of mergers filed with the US antitrust agencies have been studied, and

²See Whinston (2006); Pautler (2003); Weinberg (2008); or Hunter, Leonard, and Olley (2008) for a survey.

³The literature on collusion (see, Asker 2010; Genesove and Mullin 2001) also frequently uses the case study approach.

⁴The major exception is the petroleum industry, where the evidence is mixed. To our knowledge, there are nine studies which have estimated the price effects of petroleum mergers in the United States. Roughly half of these papers find price increases following mergers while the remainder find little change in consumer prices. Chouinard and Perloff (2009); GAO (2004); Hastings (2004); Hastings and Gilbert (2005) find price increases following mergers while Simpson and Taylor (2008); Taylor, Zimmerman, and Kriesle (2010); Silvia and Taylor (forthcoming); and Hosken, Silvia, and Taylor (2011) find no meaningful change in price. Taylor and Hosken (2007) finds evidence of an increase in wholesale prices, but no increase in retail prices.

the majority of those have examined mergers in a handful of industries with a history of regulation, e.g., banking, airlines, hospitals, and petroleum.⁵ As pointed out by Carlton (2009), determining if mergers of competitors lead to increased prices is potentially complicated by a selection issue—the antitrust agencies attempt to identify and block mergers that would increase prices paid by consumers. Selection implies that the average price change resulting from a random sample of approved mergers will be a lower bound on the average price effect of a merger in a world with no merger enforcement. This lower bound, however, is not an informative measure of whether potentially problematic mergers allowed by the government have increased prices, because the overwhelming majority of proposed mergers raise no competitive concerns.⁶ A more useful measure of whether antitrust enforcement is at the right level is the average effect of mergers that were nearly blocked. A negative mean price effect of the marginal merger would imply enforcement is too strict; that is the government is discouraging acquisitions that would result in lower final good prices. Similarly a positive price effect would imply that merger enforcement has been too lenient. This paper attempts to account for this selection issue by focusing on the Maytag-Whirlpool case precisely because it's viewed as a merger that was nearly challenged during a time period in which relatively few mergers were challenged.⁷

We begin the paper by providing background information on the merger. We next describe the data and the construction of our sample of appliances. We then report the detailed results of our study and explore the robustness of our findings.

I. Merger Background

Whirlpool's acquisition of Maytag was much more controversial than the typical antitrust case. In mid-2005, a group of private investors agreed to purchase Maytag for \$1.13 billion. Before this transaction was consummated, the Haier Group (a Chinese-owned appliance manufacturer), offered \$1.3 billion dollars for Maytag. While Haier was the leading appliance manufacturer in China, it had relatively little presence in the US. According to press reports, Haier's goal was to move the manufacturing of Maytag's products to its much lower cost Chinese factories while maintaining Maytag's extensive US dealer and service network.⁸ Haier's proposed acquisition was controversial both because of general concerns about the purchase of well-known US brands by Chinese firms, and the potential loss of a large number of relatively high-paid manufacturing jobs. On July 17th, the largest US

⁵Examples include Borenstein (1990) and Kim and Singal (1993) studies of airline mergers; Focarelli and Panetta (2003); Sapienza (2002); and Prager and Hannan (1998) studies of banking mergers. Chandra and Collard-Wexler (2009) estimate the price effects of Canadian newspaper mergers. Winston, Dennis, and Maheshri (2011) study two large railroad mergers using a different approach. This paper estimates demand and supply and assumes a model of competition to study the short and long-run effects mergers.

⁶Ashenfelter and Hosken (2010) report that from 1991–2004, 97 percent of mergers proposed through the HSR office were consummated without modification.

⁷For example, Baker and Shapiro (2008) cite Dennis Berman, "Handicapping Deal Hype and Hubris," *Wall Street Journal*, January 16, 2007, which states: "The federal government has nearly stepped out of the antitrust business...the message is clear for deals with antitrust issues: It's now or never."

⁸"China's Haier withdraws Maytag Bid on Pricing, Integration Concerns," AFX News, July 20, 2005, accessed November 27, 2012, <http://www.finanznachrichten.de/nachrichten-2005-07/1935957-china-s-haier-withdraws-maytag-bid-on-pricing-integration-concerns-report-020.htm>.

appliance manufacturer, Whirlpool, offered to purchase Maytag for \$1.4 billion. On July 20th Haier Group withdrew its offer to purchase Maytag. Ultimately, Whirlpool was able to purchase Maytag for \$1.79 billion after a long investigation by the US Department of Justice's (DOJ) antitrust division on March 30, 2006. Because of the large increase in concentration in several appliance markets, visibility of the merging parties, and the alleged incongruity with the DOJ's relatively long history in enforcement action towards mergers in traditional manufacturing industries, the merger and DOJ's decision received significant attention both amongst antitrust experts and the popular press, much of it negative.⁹

The merger reduced the number of major appliance manufacturers (Whirlpool, Maytag, GE, and Electrolux) in the United States from four to three. Both Maytag and Whirlpool had sales in seven of the eight major home appliance categories: dishwashers, clothes dryers, refrigerators, clothes washers, cooktops, ovens, and ranges.¹⁰ Within each appliance category there is substantial product differentiation.¹¹ There are two leading sources of differentiation. The first comes from measurable product characteristics. Second, products are also differentiated by brand marketing. The major appliance manufacturers typically sell luxury variations of their appliances under a different brand name. Further, a number of smaller niche firms sell very high end appliances in each major category. Miele and Bosch, for example, sell very expensive, quiet, and highly efficient dishwashers and LG sells relatively expensive and efficient front-loading washing machines.

According to public documents, much of DOJ's investigation focused on clothes washers and dryers.^{12, 13} While the merger increased concentration most dramatically in the washer and dryer markets, it also substantially affected concentration in the markets for dishwashers and refrigerators. Table 1 contains pre-merger revenue shares calculated using our data. Whirlpool was the largest manufacturer in each of these appliance categories, and Maytag was the second largest producer of washers and dryers. Table 2 presents pre-merger market shares for cooktops, freezers, ovens, and ranges. Maytag had relatively little market share in these categories, and while the merger did increase concentration in cooktops, ovens, and ranges, it did so to a much lesser extent than for dryers, washers, dishwashers, and refrigerators.

One of the largest appliance brands, Kenmore, is owned and sold exclusively by the retailer Sears. Sears contracts with appliance manufacturers like Whirlpool to

⁹See Steven Pearlstein, "Arguments for Whirlpool-Maytag Just Don't Wash," *Washington Post*, February 22, 2006, accessed November 27, 2012, <http://www.washingtonpost.com/wp-dyn/content/article/2006/02/21/AR2006022101670.html> and Baker and Shapiro (2008).

¹⁰Prior to the merger only Electrolux was a significant participant in the eighth category, freezers. According to Moss (2006), Maytag and Whirlpool began selling freezers in 2005. However, in our data neither firm had more than a 1 percent revenue share of freezer sales before the merger occurred.

¹¹For example, the ratio of the price in the seventy-fifth percentile of the price distribution to the twenty-fifth percentile ranges from 1.7 for dishwashers to 2.8 for ovens.

¹²The Department of Justice's statement is available at <http://www.justice.gov/atr/public/pressreleases/2006/215326.htm>.

¹³Most of the appliance products we study are essentially self-explanatory. There may be some ambiguity among the three appliance categories used to cook food. A cooktop is an appliance that contains burners (powered by electricity or natural gas) to cook food. An oven is an appliance that holds an enclosed space for cooking food, such as baking a cake. A range is an appliance that contains both a cooktop and an oven. A range is the most frequently purchased cooking appliance in a US kitchen. Ovens and cooktops are sold separately and typically professionally installed in a kitchen.

produce all of its Kenmore appliances. Our data does not contain information on Kenmore. While this poses no problem in directly estimating the price effects of the merger on the products for which we do have data, we are unable to determine if Kenmore's prices changed differentially from its competitors.

II. Data and Sample Construction

Our data from the NPD Group covers each of the major appliance categories. We obtained the most disaggregated data NPD would provide: national monthly retail unit sales and revenues for each appliance measured at the level of a specific appliance model, defined as a stock keeping unit (SKU). The data spans the time period from January 2005 to September 2008. NPD collects its data from a nationally representative sample of national and regional major appliance retailers. Representatives of NPD told us that the codes used to identify appliances (SKUs) are unique to a product and common across retailers; that is, different retailers selling an identical product will sell a product with a common SKU.¹⁴ Our dataset also includes a rich set of descriptive information for each appliance including brand name and product characteristics.¹⁵ Product characteristics explain a large fraction of the variation in appliance prices, typically 85 to 95 percent.

There are two institutional features of appliance markets that are important for our study. First, products in six of the eight appliance categories we study (clothes washers and dryers, dishwashers, freezers, refrigerators, and ranges) have, on average, relatively short shelf lives lasting roughly one calendar year. The price and volume sold of these products declines as the date in which a product exits the market approaches. This can be seen by examining the relationship between an appliance product's price and unit sales and its age. We estimate this relationship separately for each appliance category in equations (1) and (2) below, conditional on observing each product's birth:

$$(1) \quad \log p_{it} = \alpha_i + \sum_{k=2}^{25} \theta_k \text{Age}_{it}^k + \sum_{l=2}^{43} \delta_l \text{TimePeriod}_{it}^l + e_{it}$$

$$(2) \quad \log q_{it} = \psi_i + \sum_{k=3}^{25} \lambda_k \text{Age}_{it}^k + \sum_{l=3}^{43} \gamma_l \text{TimePeriod}_{it}^l + u_{it},$$

where α_i and ψ_i are product specific fixed effects, Age_{it}^k are age indicators, and TimePeriod_{it}^l are separate indicators for each month in our regression sample. Figures 1 and 2 plot the coefficients corresponding to the Age indicators in equations (1) and (2) respectively.¹⁶ Ovens and cooktops appear to be relatively long lived, and do not experience systematic declines in pricing or sales with age

¹⁴To protect a retailer's confidentiality, NPD does not release disaggregated data which would allow a researcher to identify a specific retailer. Within our data, less than 1.4 percent of sales are not associated with a specific product.

¹⁵See the online Appendix for a list of the characteristics that describe each appliance in our data.

¹⁶The age coefficients in Figure 1 are measured relative to prices in the product's first month with positive sales. Because our data is measured at the monthly frequency we cannot determine how many weeks within a month the item has been on sale in its first month; that is, for most of the items in our data the first month's sales correspond to a partial month. For this reason in measuring how an item's unit sales change with age we drop the month in which the product was introduced and measure the age coefficients relative to month two's volume.

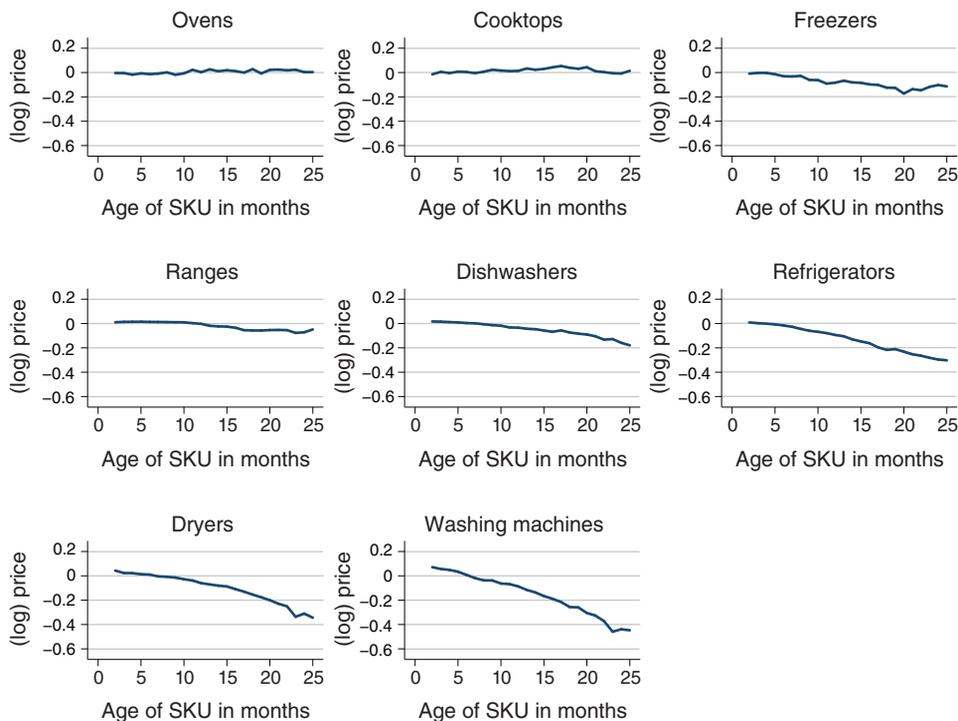


FIGURE 1. AVERAGE LOG PRICE BY AGE

Notes: The figures plot coefficients on age dummies from a regression of log volume on SKU fixed effects, age dummies, and time effects. Average log prices are measured relative to SKU's first month with positive sales.

in their first 25 months on the market. Unit sales of ovens and cooktops, for example, at 20 months of age appear to be very similar to sales in their fourth month.¹⁷ Similarly, prices appear to be relatively constant over time. The other appliance categories appear to have much lower prices and unit sales as a product ages. Prices fall significantly after a product has been on the market for more than one year, typically more than 10 percent, and monthly unit sales fall by about 50 percent relative to a product's sales after it has been on the market for a few months.¹⁸ In the remainder of this study we limit attention to the pricing of models within their first full year of existence due to the rapidly declining price and volume profile at the end

¹⁷We suspect that the reason cooktop and oven models are so much longer lived is that these product categories are much smaller than the other major appliance categories (see sales figures in footnotes 19 and 20). To the extent there are fixed costs associated with introducing a new product, it is not surprising that new product introductions are much more rare for cooktops and ovens.

¹⁸The rapid fall in both the prices and sales of clothes washers and dryers, refrigerators, and to a somewhat lesser extent ranges and freezers as these products age is similar to that observed in the sale of new automobiles. Copeland, Dunn, and Hall (2011) find that a "new" old vintage automobile sells at a large discount (9 percent on average) relative to a new vintage automobile; that is, when two model years of a given auto model are being sold simultaneously the older vintage sells at a discount of 9 percent. Copeland, Dunn, and Hall (2011) find that a major reason for this discount on the older vintage is that consumers have strong preferences for new vintages and view the old vintage as a very distant substitute to the new vintage of a given model. A similar preference for the latest vintage of an appliance product would explain the substantial price reductions seen in the major appliance categories as new models are introduced.

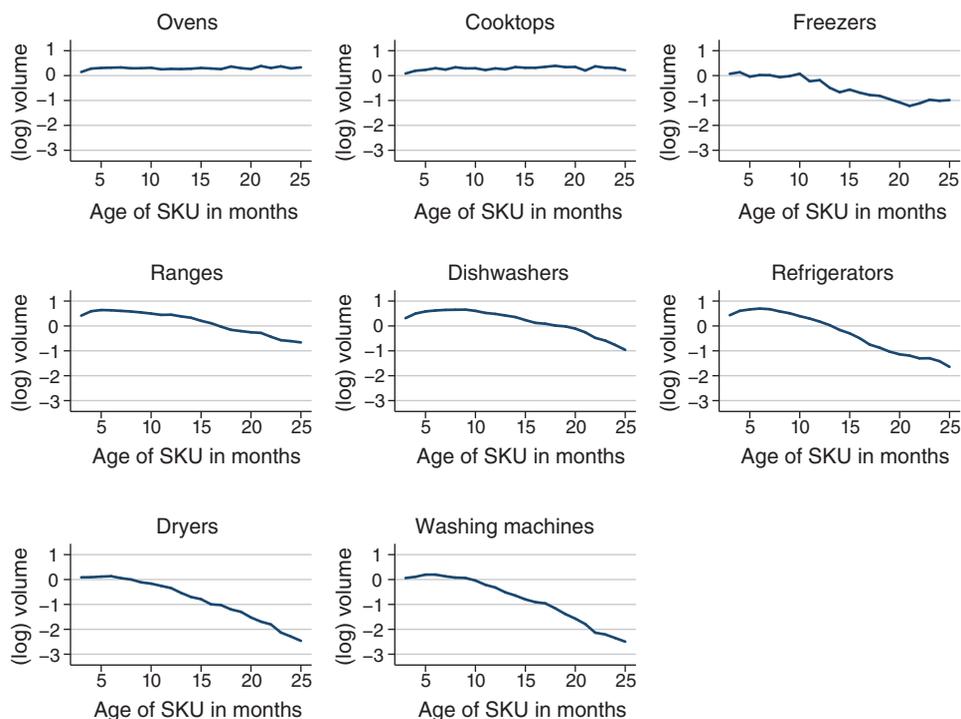


FIGURE 2. AVERAGE LOG VOLUME BY AGE

Notes: The figures plot coefficients on age dummies from a regression of log volume on SKU fixed effects, age dummies, and time effects. Average log prices are measured relative to SKU's second month with positive sales.

of a product's lifetime. Further, because the shape of the age-sales and age-pricing relationship varies across appliance categories, all analysis will include separate controls for age for each appliance category.

Second, there is significant heterogeneity in the level of sales of different appliance products in our data. In our data, more than 14,000 appliances (defined by a unique SKU) are introduced during our sample period. Most of these appliances, however, have a very small number of unit sales. Very small differences in product type generate a unique SKU, e.g., a product's color. It could be that some minor variants of an appliance have small sales (more than 93 percent of dryers are white). Alternatively some small volume SKUs may not be real products, but instead the result of a coding error, e.g., an erroneously entered SKU number. To minimize this type of measurement error we focus attention on models that have a relatively high volume of sales. For the smaller appliance categories, freezers, ovens, and cooktops, we restrict attention to appliances that have at least 100 unit sales within the product's first 13 months on the market.¹⁹ Refrigerators, dishwashers, clothes dryers,

¹⁹ Total unit sales of all cooktops, freezers, and ovens in their first 13 months on the market are 65,738; 445,886; and 61,085 respectively in our data. These models account for 66 percent of cooktop sales, 99 percent of freezer sales, and 66 percent of oven sales.

TABLE 1—PRE-MERGER MARKET SHARES FOR MARKETS WITH LARGEST CHANGE IN CONCENTRATION FOLLOWING WHIRLPOOL-MAYTAG

Dishwashers		Clothes dryers	
Manufacturer	Revenue share	Manufacturer	Revenue share
Bosch	6.2%	Bosch	1.9%
Electrolux	25.1%	Electrolux	8.9%
Fisher-Paykel	2.4%	Fisher-Paykel	1.8%
GE	12.47%	GE	12.2%
LG	1.6%	LG	9.6%
Maytag	11.4%	Maytag	16.6%
Miele	1.3%	Whirlpool	48.8%
Whirlpool	38.6%	Other	0.1%
Other	0.9%	Pre-merger HHI	2,983
Pre-merger HHI	2,453	Change in HHI	1,620
Change in HHI	880		
Refrigerators		Clothes washers	
Manufacturer	Revenue share	Manufacturer	Revenue share
Electrolux	24.1%	Bosch	2.4%
GE	10.9%	Electrolux	13.8%
LG	6.1%	Fisher Paykel	2.1%
Maytag	9.2%	GE	10.5%
Samsung	4.2%	LG	10.2%
Sub-Zero	2.4%	Maytag	16.8%
Whirlpool	41.8%	Whirlpool	44.0%
Other	1.4%	Other	0.3%
Pre-merger HHI	2,595	Pre-merger HHI	2,632
Change in HHI	770	Change in HHI	1,478

washing machines, and ranges are higher volume products, so we restrict our sample to models having 1,000 unit sales in the first 13 months on the market.²⁰

III. Price Effects of the Merger

The major issue faced by any study attempting to estimate the effect of a merger on consumer prices is to develop a reasonable estimate of the counterfactual change in prices had the merger not occurred. Simply comparing the merging firms' average prices after the merger to their average prices beforehand assumes this counterfactual change is zero, and this simple time difference will be biased if something unrelated but concurrent in timing to the merger also affected prices. For example, an increase in the price of steel, coincident with the merger, would bias a simple time difference estimator of the merger's effect on prices upwards. On the other hand, a decline in demand due to the housing crisis would bias the time difference estimator of the merger's effect downwards. In order to avoid this assumption, we follow the literature and estimate the price effects by comparing the change in pricing to that of a comparison group. For this approach to be valid, it must be the case that the change

²⁰Total unit sales of all refrigerator, dishwasher, clothes dryer, range, and clothes dryer sales in their 13 months on the market are 3.9 million, 1.9 million, 3.4 million, 2.4 million, and 4 million in our data. These models account for 90 percent of refrigerator sales, 92 percent of dishwasher sales, 98 percent of clothes dryer sales, 90 percent of range sales, and 99 percent of clothes washer sales.

TABLE 2—PRE-MERGER MARKET SHARES FOR MARKETS WITH SMALLER OR NO CHANGE IN CONCENTRATION FOLLOWING WHIRLPOOL-MAYTAG

Cooktop		Freezer	
Manufacturer revenue	Share	Manufacturer revenue	Share
Bosch	8.4%	Avanti Pro	1.4%
Dacor	1.9%	Electrolux	81.3%
Electrolux	19.1%	Haier	12.8%
Fisher-Paykel	1.4%	Other	2.0%
GE	20.8%	Sub-Zero	1.5%
Maytag	9.5%	Wood	1.0%
Miele	1.1%	Pre-merger HHI	6,789
Other	0.00%	Change in HHI	0
Sub-Zero	8.2%		
Viking	7.6%		
Whirlpool	22.0%		
Pre-merger HHI	1,571		
Change in HHI	416		

Oven		Range	
Manufacturer	Revenue share	Manufacturer	Revenue share
Bosch	10.1%	Bosch	1.2%
Dacor	1.9%	Electrolux	37.6%
Electrolux	10.5%	GE	25.3%
Fisher-Paykel	1.6%	Maytag	5.2%
GE	23.1%	Other	1.0%
Maytag	6.3%	Premier	1.7%
Miele	2.3%	Sub-Zero	1.8%
Other	0.00%	Viking	1.7%
Sub-Zero	7.9%	Whirlpool	24.7%
Viking	3.8%	Pre-merger HHI	2,703
Whirlpool	32.5%	Change in HHI	256
Pre-merger HHI	1,929		
Change in HHI	412		

in price of the comparison group is the counterfactual change in price that would have occurred for the brands owned by the merging firms, had the merger not occurred.

Major appliances are highly durable goods that are frequently purchased in conjunction with new home building or home remodeling. A natural control product for our study would be a major appliance category unaffected by the merger. Prior to the merger both Maytag and Whirlpool sold products in seven of the eight major appliance categories for which we have data. The degree of pre-merger competition between Maytag and Whirlpool, however, likely varied across product categories. Maytag and Whirlpool were major competitors in four appliance categories: dishwashers, refrigerators, clothes washers, and clothes dryers (see Table 1 for revenue shares by manufacturer for these appliance markets). In each of these categories, the markets appear to be highly concentrated with Whirlpool typically having about 40 percent of sales and Maytag having a share between 9 percent and 16 percent in these categories.

In contrast, the degree of competition between Maytag and Whirlpool, as suggested by revenue shares, appears less substantial in the cooktop, freezer, oven, and range product categories. In our data, neither Whirlpool nor Maytag had a presence in the freezer market prior to the merger's consummation. While the range market has a similar level of pre-merger concentration as the markets shown in

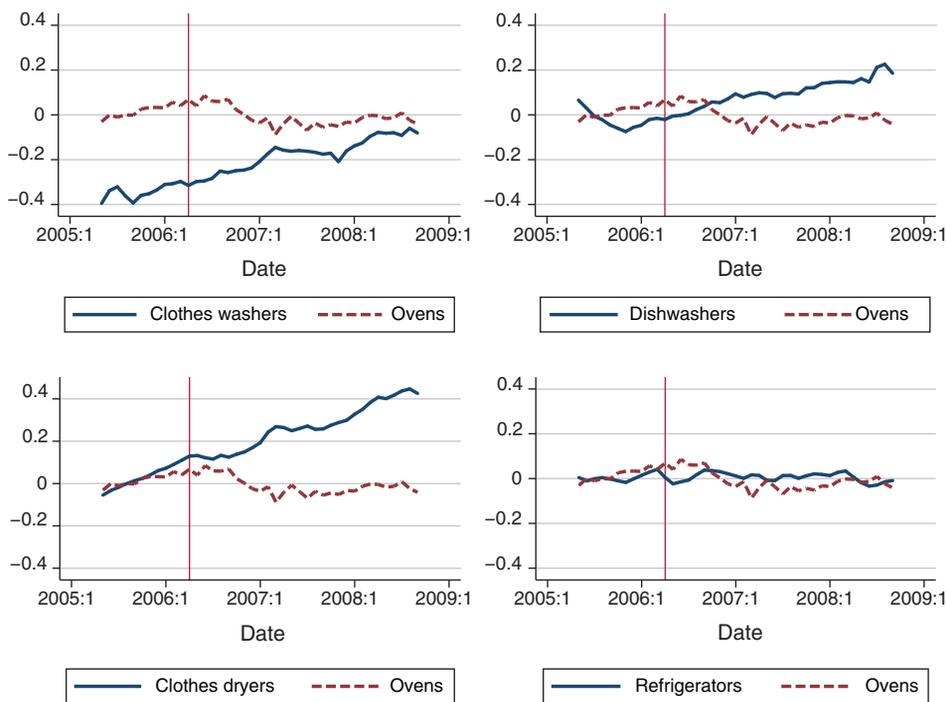


FIGURE 3. CHANGE IN AVERAGE OF LOG PRICE CONDITIONAL ON PRODUCT CHARACTERISTICS AND AGE DUMMIES: OVEN COMPARISON

Notes: Solid line is age and characteristic adjusted average log price of either Maytag and Whirlpool dishwashers, clothes dryers, clothes washers, and refrigerators. Dashed line is age and characteristic adjusted average log price of ovens. The plot spans May of 2005–September of 2008. All products were born within the sample period. The vertical line corresponds to the merger’s consummation date, March 30, 2006. The merger was consummated on March 30, 2006.

Table 1, Maytag’s market share was relatively small at 5.1 percent. Maytag’s pre-merger share is somewhat larger in the cooktop and oven markets at 9.2 percent and 6.2 percent, respectively. However, the level of pre-merger concentration is significantly lower than in dishwashers, refrigerators, clothes washers, and dryers. For this reason, and the fact that these categories were not mentioned in public accounts of DOJ’s investigation, we use cooktops, freezers, ovens, and ranges as comparison groups. Further, in Baker and Shapiro’s (2008) account of the merger, only clothes dryers and washers were explicitly mentioned as areas of concern. To further reduce the possibility that these comparison products experienced a price increase related to the merger, we restrict the comparison group to brands not produced by Maytag or Whirlpool. While the Bertrand model of Deneckere and Davidson (1985) predicts that rivals will increase prices after the merger for most demand systems, they will do so by a smaller amount than the merging firms.

A. Graphical Evidence

To determine if the merger increased appliance prices, we start by plotting average (log) prices of Maytag and Whirlpool appliances in the markets where concentration

changed the most: dishwashers; clothes dryers and washers; and refrigerators. For comparison, we also plot average prices of ovens, an appliance category where the merger should have had little if any effect. Because the composition of appliances varies over the sample period, we condition on observable characteristics and age before constructing the figures. This was done by first fitting the following equation to the data with OLS separately for each of the appliance categories:

$$(3) \quad \log(p_{it}) = \sum_j \delta_j x_{ij} + \sum_{k=3}^{13} \theta_k \text{Age}_{it} + \sum_{l=2}^{43} \gamma_l \text{TimePeriod}_t^l + \epsilon_{it},$$

where x_{ij} is characteristic j of product i , the Age_{it} are age dummies, and the TimePeriod_t^l are month dummies. The omitted month dummy corresponds to the first month in the data. We then plot the $\hat{\gamma}_l$ against the corresponding time period, where $\hat{\gamma}_l$ measure the difference in the average log price between period l and the first month in the data conditional on age and product characteristics. Recall that in order to avoid selection issues associated with left censoring, we restricted our sample to products first introduced during the time period spanned by our data. This restriction causes our sample size to be very small in the first few months of our sample. As a result our estimates of the monthly average log price during the first few months of our data are noisy. Therefore, when constructing the figures we exclude the first four months of data and take the starting point to be June of 2005.

The results are in Figure 3. The vertical lines indicate the first month following the merger's consummation, April of 2006.²¹ Two features are apparent. First, there is no obvious differential trend between the comparison ovens and the four "treatment" appliance categories prior to the merger. Second, the prices of dryers, dishwashers, and clothes washers increase relative to ovens. In the next section, we explore whether there are important differences in the price effects for products introduced before and after the merger date, and then test whether any increases were statistically significant.

B. Regression Estimates

We carry out inference by estimating how the prices of washers, dryers, dishwashers, and refrigerators changed before and after the merger relative to four comparison groups: freezers, ranges, cooktops, and ovens. A natural starting point fits the following equation to the data using OLS separately for each "treatment"/"comparison" pair:

$$(4) \quad \begin{aligned} \log(p_{it}) = & \beta_1 \times \text{Maytag}_i \times \text{PostMerger}_t \\ & + \beta_2 \times \text{Whirlpool}_i \times \text{PostMerger}_t \\ & + \sum_{k=3}^{13} \theta_k^T \text{Age}_{it}^T + \sum_{k=3}^{13} \theta_k^C \text{Age}_{it}^C \\ & + \sum_{l=2}^{43} \delta_l \text{TimePeriod}_{it}^l + \alpha_i + \epsilon_{it}, \end{aligned}$$

²¹The exact date was March 30, 2006.

where p_{it} is the average price of SKU i in month t .²² α_i is an SKU-specific fixed effect, and $TimePeriod_{it}^l$ is a time indicator that allows for a common monthly change in log prices in month l . Age_{it}^C and Age_{it}^T are a series of age indicators corresponding to the appliance's age in months for the comparison and treatment category, respectively. The key parameters are β_1 and β_2 , which measure the change in the log price of Maytag and Whirlpool products relative to the change in log price of each comparison appliance category.²³

The presence of the SKU specific fixed effects α_i in equation (4) implies that the price effects are identified from products that existed both before and after the merger occurred. It is impossible to identify the effect using products that did not exist both before and after the merger, as for these products the $Maytag_i \times PostMerger_t$ and $Whirlpool_i \times PostMerger_t$ are perfectly collinear with the SKU fixed effects. This shortcoming is potentially important: most products in the markets affected by the merger have short lifetimes, roughly a year. The price effect of the merger could be systematically different for products existing prior to the merger relative to those introduced after the merger. For example, the merged firm might maintain its prices on products introduced prior to the merger (on average, six months from the end of their life cycle), and increase the price of products introduced following the merger. To explore this possibility, we replace the SKU fixed effects with a linear combination of observable characteristics such as brand dummies, a stainless steel indicator, and product size.²⁴ We estimate the following equation using OLS:

$$\begin{aligned}
 (5) \quad \log(p_{it}) = & \sum_j \delta_j^T \times x_{ij}^T + \sum_h \delta_h^C \times x_{ih}^C + \sum_{l=2}^{43} \theta_l^C TimePeriod_{it}^l \\
 & + \beta_1 \times Maytag_i \times PostMerger_t \\
 & + \beta_2 \times Whirlpool_i \times PostMerger_t \\
 & + \sum_{k=3}^{13} \theta_k^T Age_{it}^T + \sum_{k=3}^{13} \theta_k^C Age_{it}^C + \epsilon_{it}.
 \end{aligned}$$

The x_{ij}^T include characteristics and brand dummies for Whirlpool/Maytag appliances and x_{ih}^C include characteristics and brand dummies of the comparison appliances.²⁵ Standard errors are clustered by SKU.

²² Most merger retrospectives estimate some variation of this equation. See Weinberg (2008) for a review and description of the various comparison markets and products that have been used.

²³ Allowing separate time dummies for each month is more flexible than controlling only for common pre- and post-merger difference and allowing for SKU specific fixed effects is more flexible than allowing for only a time invariant difference in the conditional mean between Maytag/Whirlpool and other brands. Of course, one cannot control for both a post merger dummy and monthly time effects nor both SKU fixed effects and a Maytag or Whirlpool dummy.

²⁴ A list of product specific characteristics (all specifications include brand dummies) used for each type of appliance is located in the online Appendix. Measuring a product's quality using observed product characteristics is a common approach used in the matching of new and discontinued products in price measurement. The US Bureau of Labor Statistics, for example, estimates hedonic regressions to estimate the value of new product characteristics to control for changes in product quality.

²⁵ Note x_{ij}^T are nonzero only if the SKU is a Maytag or Whirlpool appliance, and x_{ih}^C are nonzero only if the SKU is a comparison appliance.

While specification 5 has the advantage that it can be used to estimate separate price effects for products introduced after the merger was consummated, a potential drawback is that if there are unobservable characteristics that systematically changed after the merger occurred, the OLS estimator of 5 will be biased. To explore the efficacy of using characteristics to control for product heterogeneity we estimate both equations (4) and (5) on the sample of SKU's introduced prior to one year of the merger's consummation date, March 30, 2006. If unobservable product characteristics result in bias of the OLS estimator of 5, we would expect the estimates of β_1 and β_2 to be different when estimated in specification 4 than in specification 5.

The estimated price effects are shown in Tables 1–4 of the online Appendix, where each table corresponds to a different comparison group. Online Appendix Table 1, for example, presents the estimated price effects for the four most affected appliance markets using cooktops as the comparison group. The first two columns show that the estimated price effects for dishwashers using either product fixed effects (column 1) or product characteristics (column 2) are virtually identical, about 4 percent for Whirlpool and 3 percent for Maytag. The estimated price effects for the other appliance markets in online Appendix Table 1 are remarkably similar (typically within 0.1 percent) when using either fixed effects or product characteristics to control for an SKU's quality. This pattern holds not only when cooktops are used as a comparison category, but also when freezers, ovens, or ranges are used for comparison (see online Appendix Tables 2–4, respectively). This finding suggests that unobserved time-invariant product characteristics, within a SKU, are not correlated with the post-merger dummies, conditional on observable characteristics. Because of the potential importance of pricing differences for products introduced after the merger, and because the specifications with fixed effects and product characteristic controls yield virtually identical merger effects, we use measured product characteristics to control for product quality in the remainder of this paper.

As a final specification check, we conduct two tests to determine if the prices of “treatment” appliances move with comparison appliances prior to the merger. Our first test uses an estimating equation that is very similar to that used to conduct inference. We estimate the following equation:

$$\begin{aligned}
 (6) \quad \log(p_{it}) = & \sum_j \delta_j^T \times x_{ij}^T + \sum_h \delta_h^C \times x_{ih}^C \\
 & + \sum_{l=2}^{43} \beta_l \text{TimePeriod}_{it}^l \\
 & + \sum_{l=2}^{43} \gamma_l \text{TimePeriod}_{it}^l \times \text{Maytag/Whirlpool}_i \\
 & + \sum_{k=3}^{13} \theta_k^T \text{Age}_{it}^T + \sum_{k=3}^{13} \theta_k^C \text{Age}_{it}^C + \epsilon_{it},
 \end{aligned}$$

where $\text{Maytag/Whirlpool}_i$ is a dummy variable equal to one if the SKU is produced by Maytag or Whirlpool. We then test the null hypothesis that the $\hat{\gamma}_l$ are equal to zero

in the pre-merger time periods, both jointly and marginally.²⁶ These tests provide some statistical support for the validity of our comparison categories. For ovens, in no case were we able to reject the null that the coefficients were jointly equal to zero at the 0.05 level, and none of the individual estimates were significantly different from zero at the 0.05 level, regardless of treatment category. The tests using cooktops or freezers as comparisons were mixed, and the F -tests reject for each treatment category relative to ranges (partially due to the larger number of SKU's in this category).²⁷ However, in the six months immediately preceding the merger the trends appear to be parallel across each treatment/comparison pair.²⁸

Second, we conduct a more powerful test to examine if the treatment and comparison groups products' prices trend similarly in the pre-merger period for each treatment/comparison pair. This was done by replacing the $TimePeriod^l_{it}$ and $TimePeriod^l_{it} \times Maytag/Whirlpool_i$ variables in equation (6) with the variables $t \times PreMerger_i$, $t \times PreMerger_i \times Maytag/Whirlpool_i$, $t \times PostMerger_i$, and $t \times PostMerger_i \times Maytag/Whirlpool_i$. The test of differential pre-merger trending is that the coefficient on the pre-merger interaction term $t \times PreMerger_i \times Maytag/Whirlpool_i$ is zero. While we find that in 8 of the 16 specifications we reject the hypothesis at the 5 percent level, in no case is the interaction term economically significant. The largest estimated coefficient on the interaction between the time trend and Maytag/Whirlpool dummy was 0.0006, corresponding to an average monthly change in Maytag/Whirlpool price of 0.06 percent more than the comparison category price. Thus, while there is some systematic differential trending in the treatment and comparison groups, it is very small.

In order to explore heterogeneity in the price effects, we use a slight variation of specification 5 that allows the Maytag and Whirlpool interactions with the post-merger dummy to vary by whether the product was introduced before or after the merger date. This allows us to examine whether the merged manufacturer changed pricing differently for products introduced after the merger date. We estimate the price effects on an expanded sample including all products that were born within our sample period. Adding products that did not exist both before and after the merger increases the sample size by between 35 and 57 percent, depending on the appliance category.²⁹

Tables 3–6 present the estimated price effects for dryers, dishwashers, refrigerators, and clothes washers relative to each of the four comparison appliance categories. In summary, we find systematic price increases for Whirlpool dryers and Maytag dishwashers introduced after the merger. When measured relative to ovens, we estimate that Whirlpool dryers increased by approximately 17 percent and Maytag dishwashers increased by about 7 percent (Table 3). These estimates are robust across comparison groups, the estimate for Whirlpool dryers varies between

²⁶To increase the power of our test, we do not include the hypothesis that $\hat{\gamma}_2 = 0$ in the joint test because that parameter was estimated with little data. Instead, we test the null that $\hat{\gamma}_3 = \hat{\gamma}_4 = \dots = \hat{\gamma}_{13} = 0$.

²⁷ p -values for the F -test of the null that the interactions were zero were 0 for washers and cooktops, 0.17 for dryers and cooktops, 0.01 for fridges and cooktops, and 0.03 for dishwashers and cooktops. They were 0 for washers and freezers, 0.05 for dryers and freezers, 0.09 for fridges and freezers, and 0.11 for dishwashers and freezers.

²⁸Figures available upon request.

²⁹We also estimated all of the models using the level of prices as the dependent variable instead of the log of price, and find qualitatively similar results. These results are available upon request.

TABLE 3—PRICE EFFECTS RELATIVE TO OVENS

	Appliance category			
	Dishwashers	Dryers	Refrigerators	Washers
Post × Old × Whirlpool	-0.00769 (0.0168)	-0.0654 (0.0218)	-0.0465 (0.0240)	-0.0556 (0.0273)
Post × Old × Maytag	-0.00919 (0.0188)	-0.0102 (0.0153)	-0.0506 (0.0286)	-0.0117 (0.0195)
Post × New × Whirlpool	0.00463 (0.0151)	0.171 (0.0471)	0.0389 (0.0145)	-0.0150 (0.0176)
Post × New × Maytag	0.0711 (0.0200)	0.0574 (0.0623)	0.0157 (0.0200)	0.0223 (0.0180)
Observations	2,202	2,563	3,440	2,170
Number of SKU	201	240	349	208

Notes: Standard errors in parentheses allow for arbitrary serial correlation and heteroskedasticity within SKU. Product characteristics included in all specifications. Calculated on data from April 2005 through September 2008.

TABLE 4—PRICE EFFECTS RELATIVE TO COOKTOPS

	Appliance category			
	Dishwashers	Dryers	Refrigerators	Washers
Post × Old × Whirlpool	0.0325 (0.0135)	-0.0172 (0.0198)	-0.0213 (0.0227)	-0.00856 (0.0256)
Post × Old × Maytag	0.0275 (0.0161)	0.0437 (0.0132)	-0.0266 (0.0267)	0.0383 (0.0177)
Post × New × Whirlpool	-0.00127 (0.0157)	0.133 (0.0653)	0.0388 (0.0159)	-0.0175 (0.0171)
Post × New × Maytag	0.0662 (0.0206)	0.00486 (0.0864)	0.00602 (0.0212)	0.0157 (0.0179)
Observations	2,296	2,657	3,534	2,264
Number of SKU	211	250	359	218

Notes: Standard errors in parentheses allow for arbitrary serial correlation and heteroskedasticity within SKU. Product characteristics included in all specifications. Calculated on data from April 2005 through September 2008.

TABLE 5—PRICE EFFECTS RELATIVE TO FREEZERS

	Appliance category			
	Dishwashers	Dryers	Refrigerators	Washers
Post × Old × Whirlpool	0.0855 (0.0307)	0.0291 (0.0347)	0.0455 (0.0341)	0.0341 (0.0373)
Post × Old × Maytag	0.0826 (0.0310)	0.0903 (0.0310)	0.0370 (0.0363)	0.0848 (0.0318)
Post × New × Whirlpool	-0.0160 (0.0161)	0.140 (0.0479)	0.0194 (0.0164)	-0.0409 (0.0175)
Post × New × Maytag	0.0480 (0.0200)	0.0113 (0.0622)	-0.00641 (0.0229)	-0.00743 (0.0179)
Observations	1,845	2,206	3,083	1,813
Number of SKU	186	225	334	193

Notes: Standard errors in parentheses allow for arbitrary serial correlation and heteroskedasticity within SKU. Product characteristics included in all specifications. Calculated on data from April 2005 through September 2008.

TABLE 6—PRICE EFFECTS RELATIVE TO RANGES

	Appliance category			
	Dishwashers	Dryers	Refrigerators	Washers
Post × Old × Whirlpool	0.0124 (0.00739)	−0.0602 (0.0176)	−0.0221 (0.0202)	−0.0431 (0.0231)
Post × Old × Maytag	0.0100 (0.0107)	0.000473 (0.00671)	−0.0254 (0.0251)	0.00310 (0.0127)
Post × New × Whirlpool	0.00115 (0.00684)	0.144 (0.0542)	0.0210 (0.00951)	−0.0202 (0.0106)
Post × New × Maytag	0.0743 (0.0163)	0.0318 (0.0757)	0.00960 (0.0164)	0.0171 (0.0111)
Observations	4,068	4,429	5,306	4,036
Number of SKU	364	403	512	371

Notes: Standard errors in parentheses allow for arbitrary serial correlation and heteroskedasticity within SKU. Product characteristics included in all specifications. Calculated on data from April 2005 through September 2008.

approximately 13 and 17 percent and Maytag dishwashers varies between approximately 5 and 7 percent. Despite experiencing a large change in market structure similar to the dryer market, we do not observe evidence of a price increase for clothes washers. The results for refrigerators are more mixed. There is some evidence of a small price increase, 2–4 percent, for Whirlpool refrigerators. However, this price effect is imprecisely estimated and not as robust as the findings for clothes dryers or dishwashers. The results for products introduced before the merger occurred are less robust to the choice of comparison group. When measured relative to cooktops or freezers, appliance prices appear to have increased while the price effects are much smaller (and sometimes negative) when measured relative to ranges and ovens. We cannot reach a conclusion as to how the merger affected pricing for these products.

As an additional test, we compare the change in Maytag and Whirlpool appliance prices relative to rivals' prices within each appliance category. To calculate these price effects, we estimate the following variant of equation (5) separately for each appliance category:

$$\begin{aligned}
 (7) \log(p_{it}) = & \sum_j \delta_j \times x_{ij} + \sum_{k=3}^{13} \theta_k \times Age_{it} + \sum_{l=2}^{43} \delta_l \times TimePeriod_{it} \\
 & + \beta_1 \times Maytag_i \times PostMerger_t \times PreMergerProduct_i \\
 & + \beta_2 \times Whirlpool_i \times PostMerger_t \times PreMergerProduct_i \\
 & + \beta_3 \times Maytag_i \times PostMerger_t \times PostMergerProduct_i \\
 & + \beta_2 \times Whirlpool_i \times PostMerger_t \times PostMergerProduct_i + \epsilon_{it},
 \end{aligned}$$

where x_{ij} are appliance characteristics and the other variables are defined as above. To the extent that the merger increased Maytag/Whirlpool prices, rivals may have increased prices in the post-merger equilibrium as well. This would be true in the differentiated product Bertrand model commonly used to simulate mergers and studied

TABLE 7—PRICE EFFECTS OF MERGING PARTY APPLIANCES RELATIVE TO RIVALS

	Appliance Type			
	Dishwashers	Refrigerators	Dryers	Washers
Post × Old × Whirlpool	0.024 (0.008)	−0.044 (0.021)	−0.055 (0.018)	−0.040 (0.027)
Post × Old × Maytag	0.030 (0.011)	−0.045 (0.025)	0.008 (0.008)	0.006 (0.017)
Post × New × Whirlpool	0.014 (0.007)	0.008 (0.009)	0.073 (0.030)	−0.047 (0.013)
Post × New × Maytag	0.082 (0.015)	−0.026 (0.017)	−0.002 (0.040)	−0.014 (0.014)
Observations	2,895	5,902	3,088	2,456
Number of SKU	257	605	284	232

Notes: Standard errors in parentheses allow for arbitrary serial correlation and heteroskedasticity within SKU. Product characteristics included in all specifications. Calculated on data from April 2005 through September 2008.

in Deneckere and Davidson (1985). In this model, the extent to which rivals increase price depends on how quickly the absolute value of demand elasticities increase as prices increase (Crooke et al. 1999). However, for a large class of demand systems Deneckere and Davidson show that the merging firms will increase price by more than rivals. Therefore, if this model describes pricing well, and if the merging firm's products are important substitutes for other appliances in the same category, then the estimated price effects from equation (6) will be biased down but of correct sign.

The results appear in Table 7. The estimated price effects are generally consistent with the findings from the other comparison groups. Starting with column 1 we see that dishwashers introduced prior to the merger by Maytag and Whirlpool increased slightly more than other manufacturers' dishwashers. This is within the range seen in column 1 of Tables 3–6 for the other comparison groups. Similarly, we found that Maytag dishwashers introduced after the merger had a relatively large price increase of 8 percent relative to other manufacturers' dishwashers. We also estimate a large price increase for Whirlpool dryers introduced following the merger, roughly 7 percent relative to other manufacturers' dryers. Finally, consistent with the other comparison groups, the relative price of Maytag's and Whirlpool's refrigerators do not appear to have changed much relative to the prices of other firms' refrigerators. Whirlpool's clothes washer prices, however, appear to have decreased relative to prices of rival clothes washers.

Given Maytag and Whirlpool's very similar pre-merger market share in the clothes washer and dryer markets, we find it somewhat surprising to observe a price increase only for dryers. One difference between the washer and dryer markets is that the US washer market is experiencing a change in technology. Consumers are switching from traditional top-loading washing machines, where Maytag and Whirlpool were most successful, to more expensive but more efficient front-loading machines. In this segment, Whirlpool and Maytag were less successful and faced strong competition from imports (such as Samsung and LG). In contrast, the dryer market is not undergoing a similar change. In its public discussion of its decision to allow the merger, DOJ cited a number of competitive factors, particularly recent

TABLE 8—CHANGE IN WHIRLPOOL/MAYTAG'S MARKET SHARE AND PRODUCT OFFERINGS FOLLOWING THE MERGER

Product	Change in share ^a		Absolute change in products offered ^b	Relative change in products offered ^c
	Revenue share	Volume share		
Dishwasher	-0.046 (0.010)	-0.043 (0.011)	-1.067 (1.862)	-0.219 (0.044)
Clothes dryer	-0.095 (0.009)	-0.068 (0.008)	-9.767 (2.690)	-0.527 (0.046)
Refrigerator	-0.086 (0.011)	-0.110 (0.013)	-12.500 (5.392)	-0.266 (0.050)
Clothes washer	-0.073 (0.008)	-0.053 (0.007)	-10.367 (2.613)	-0.527 (0.050)
Observations	45	45	45	90

^aRegression of market share on merger indicator.

^bRegression of the number of SKU's with more than 100 unit sales in a month on merger indicator.

^cRegression of the log of the number of SKU's with more than 100 unit sales in a month on merger indicator, Whirlpool/Maytag indicator, and their interaction. Standard errors in parentheses. Calculated on data from April 2005 through September 2008.

successful entry by Samsung and LG, which may have played an important role in maintaining washer pricing.³⁰

C. Market Shares and Product Variety

The focus of our study is to determine if the acquisition of Maytag by Whirlpool increased consumer prices. While the results vary somewhat with the choice of comparison appliance category, overall we interpret our findings as indicating an increase in the price of Maytag dishwashers and Whirlpool clothes dryers. We next examine whether the combined Whirlpool/Maytag's output falls in response to the price increases we observed. We conduct this test by examining how the market share (either revenue or unit sales) of the merged firm changed following the merger in each appliance market.

We estimate the change in the merging parties' average monthly market share with a simple regression of Whirlpool/Maytag's monthly market share on a merger dummy. The results for volume shares are in column 1 of Table 8 and the results

³⁰In contrast to most allowed mergers (where the government states nothing about its reason for allowing the merger), the Department of Justice provided a somewhat detailed justification for its decision to allow the merger to proceed. The Justice Department stated that its investigation focused on laundry products (washers and dryers) and that within this sector three factors led them to conclude that any attempt to raise prices would likely be unsuccessful. First, the two largest domestic manufacturers (Electrolux and GE) had substantial excess capacity and could expand output. Moreover, recent successful foreign entrants (LG and Samsung) could import more products into the US in response to an anticompetitive price increase. Second, sales of the majority of appliances are made by a small number of large retailers (Sears, Best Buy, Lowes, and Home Depot) who "have alternatives available to help them resist an attempt by the merged entity to raise price." Third, "the parties (Maytag/Whirlpool) substantiated large cost savings and other efficiencies that should benefit consumers." Department of Justice closing statement, dated March 29, 2006, available at <http://www.justice.give/atr/public/pressreleases/2006/215326.htm>. In total, however, the factors cited by the DOJ do not appear to have been sufficient to maintain pre-merger price levels for either clothes dryers or dishwashers.

for revenue shares are in column 2. Volume and revenue shares fell significantly in each product category following the merger, and not just those experiencing a relative price increase. Average revenue shares for refrigerators and clothes washers, for example, fell by an estimated 8.6 and 7.3 share points following the merger.

Why should Whirlpool/Maytag's share of these categories have fallen so much following the merger? One possibility is that the merged firm changed its product offerings. We next explore whether Whirlpool/Maytag changed the number of items it sells. To do this, we first identify distinct items (SKUs) that were sold in each time period. As noted earlier, many SKUs in our dataset have very few sales. For this reason, we limit our attention to relatively high volume SKUs sold by appliance manufacturers. Specifically, we calculate the number of SKUs with at least 100 unit sales sold by Whirlpool/Maytag and all other appliance manufacturers for each month in our sample, and examine how the number of items available for sale each month changed following the merger.³¹ We first plot the number of SKUs offered each month by Whirlpool/Maytag, and all other manufacturers, in Figure 4. The plots show a systematic drop in the relative number of Whirlpool/Maytag SKUs offered for sale following the merger in each of the four most affected appliance categories. The changes are most pronounced for clothes washers and dryers, where the combined Whirlpool accounted for the majority of items offered pre-merger and a minority of items post-merger. Regressions of the monthly count of distinct Whirlpool/Maytag SKUs on a post-merger dummy are reported in column 3 of Table 8. The average monthly number of different products sold fell across appliance categories in absolute terms, by about ten units per month for dryers and washers, and by about 12 SKUs for refrigerators. The absolute reduction in SKUs was quite small for dishwashers: roughly 1 SKU.

To further explore the effect of the merger on our simple measure of product variety, we also estimate the relative change in the number of products sold by Whirlpool/Maytag, to account for the possibility that appliance manufacturers may have changed the number of product offerings in response to either changes in demand or cost, e.g., an increased or decreased demand for variety. We do this by estimating the following equation:

$$(8) \quad \log SKU_{it} = \alpha + \beta \times Whirlpool/Maytag_i + \gamma Merger_t \\ + \delta Whirlpool/Maytag_i \times Merger_t + \epsilon_{it},$$

where the dependent variable is the log of the number of high volume SKUs sold in month t (by either Maytag/Whirlpool or all other appliance manufacturers), $Whirlpool/Maytag_i$ is an indicator for Whirlpool/Maytag, and $Merger_t$ is an indicator for the post-merger period. We interpret the coefficient on the interaction term, δ , as the relative proportional change in the number of appliances offered by Whirlpool/Maytag following the merger. The results are in column 4 of Table 8.

³¹ SKUs with at least 100 monthly sales account for the overwhelming majority of unit sales in the most affected markets: 98 percent of clothes washers, 97 percent of clothes dryers, 93 percent of dishwashers, and 91 percent of refrigerators.

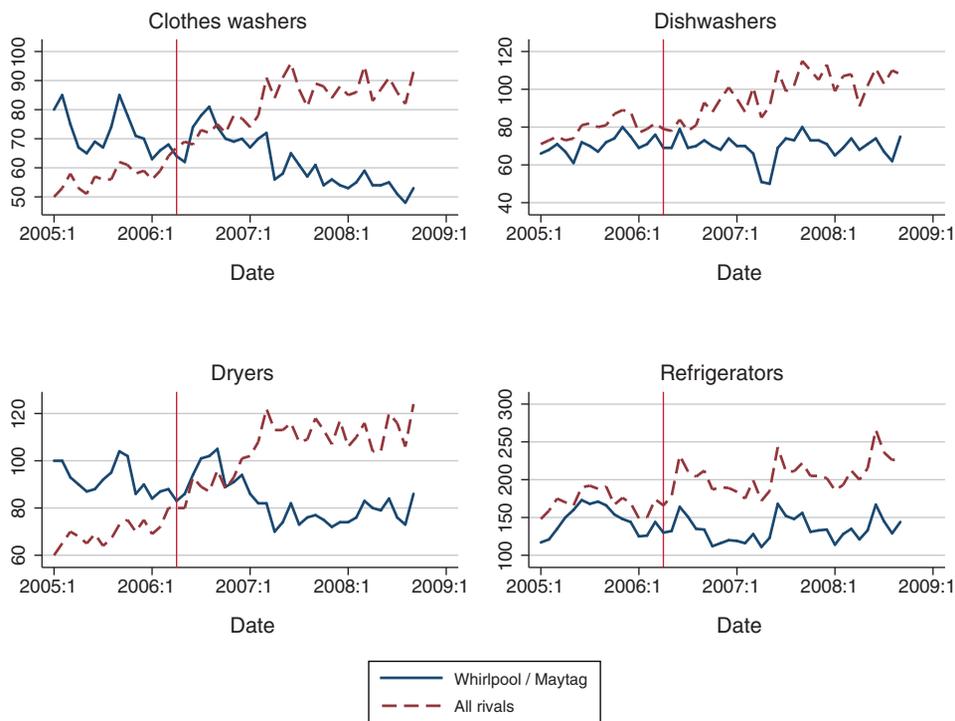


FIGURE 4. SKU COUNTS

Notes: Solid lines are the count of Whirlpool/Maytag SKUs with at least 100 unit sales. Dashed line is the count for all other manufacturers. The plot spans January of 2005–September of 2008. The vertical line corresponds to the merger's consummation date, March 30, 2006.

In relative terms, the reduction in variety is substantial for all four product categories. This implies rival manufacturers were increasing the number of products offered in these appliance markets, while Whirlpool/Maytag was reducing its product offerings. The effect of this reduction of appliance models on consumer welfare is ambiguous. Empirical work shows that mergers can affect a firm's optimal product selection (see, e.g., Sweeting 2010 and Berry and Waldfogel 2001), and that reductions in variety induced by merger can significantly reduce consumer welfare (Draganska, Mazzeo, and Seim 2010). If the reduction in SKU's resulted in a substantial reduction in product variety, this finding suggests that the merger may have reduced consumer surplus through this channel as well as through price increases.

IV. Conclusions

Merger analysis is inherently prospective: the government must quickly make predictions about how large discrete changes in market structure will affect markets. Forecasting how changes in market structure will change consumer prices, costs, and incentives to innovate is extraordinarily difficult. In the roughly 30 years since the passage of the Hart-Scott-Rodino Act (which essentially started federal review of prospective mergers), the antitrust agencies and the federal courts have developed

methodologies, expertise, and expectations about the types of information that will be probative in determining if mergers are likely to harm consumers. Only by estimating the price effects of consummated mergers, however, can we learn if the decision-making process used by the courts and antitrust agencies is successful in identifying and blocking mergers that raise consumer prices. We have estimated the price effects of Whirlpool's acquisition of Maytag, because the decision to not challenge this merger appears to be a break with previous government decision making. The merger greatly increased concentration in several appliance markets that were already concentrated. Both the popular press and academic economists stated that the merger would have been challenged in the previous administration. Therefore, this merger provides a relatively unique opportunity to examine if more lenient treatment of mergers results in competitive harm.

Our findings suggest that the merger of Maytag and Whirlpool harmed US consumers. We estimate large price increases for Whirlpool clothes dryers and Maytag dishwashers, and we find no consistent evidence of merger-induced price reductions for the other affected appliance categories. It is unlikely, however, that these price increases were the only, or even the primary, motivation for the transaction. Whirlpool paid nearly \$500 million more than the second highest bidder, Haier, offered for Maytag.³² We have performed a simple back-of-the-envelope estimate of the change in profits generated by the price increases, which suggests that the observed price increases may have increased Maytag/Whirlpool's annual profits by \$4.1 million to \$9 million.³³ While our estimate of the profit increase is rough and sensitive to the assumed pre-merger margin, even the largest estimate implies an increase in firm value of less than \$100 million.³⁴

Factors other than the merger-related price increase likely played a role in Whirlpool's decision to offer so much more for Maytag than Haier. We have two potential (and not-mutually exclusive) suggestions. First, Whirlpool may have anticipated large cost savings as a result of the merger. Whirlpool and Maytag produced a large number of very similar appliances particularly in the washer and dryer markets. Following the merger, the combined Maytag/Whirlpool dramatically reduced the number of washer and dryer models (SKUs) it sold, which likely resulted in a reduction in its fixed costs. Second, Whirlpool's decision to purchase Maytag may have been taken to deter Haier's entry into the major US home appliance markets. As noted above, Haier planned to move production of Maytag appliances to China while maintaining Maytag's brand name and distribution network. Thus, Whirlpool's purchase of Maytag can be viewed as effectively halting Haier's entry into the major

³²This assumes that the maximum Haier was willing to pay was \$1.3 billion. If Haier dropped out of the bidding for non-economic reasons (concerns that its proposed purchase of Maytag would have been impossible independent of price), then \$1.3 billion may be an underestimate of the value of Maytag to Haier.

³³Our calculations follow the general approach of Shapiro (1996) in estimating the change in profits resulting from a unilateral price increase. To implement Shapiro's (1996) method, we use estimates of retail margins, market size, and retail prices. We assume manufacturer margins and we assume diversion between the merging firms is proportional to pre-merger volume share. We then estimate that the merging firms profits increased by \$4.1 million, \$9 million, and \$7.8 million, with assumed pre-merger manufacturer margins of 0.4, 0.5, and 0.6, respectively. Details of these calculations are available from the authors on request.

³⁴We observed prices increase roughly one year after the merger was consummated. If the increase in profits were permanent, and the discount rate was 10 percent, then a \$9 million dollar annual increase in profits would correspond to a present value of \$90 million.

US appliance markets. To date, virtually all entry into the major US appliance markets we have studied has come from firms selling high-end appliances.

The ability to use the findings of any one case study to comment on US horizontal merger policy, more generally, is clearly limited. However, by conducting a large number of case studies, economists can credibly determine if horizontal merger enforcement is being properly enforced. While the ability to generalize from the published literature is somewhat limited due to the small fraction of consummated mergers that have been studied, the results of our study are consistent with the findings of this literature: mergers that are on the enforcement margin have, on average, resulted in consumer price increases.

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