Targeted Price Controls on Supermarket Products [‡§]

Diego Aparicio
MIT

Alberto Cavallo
HBS & NBER

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Abstract

We study the impact of targeted price controls on supermarket products in Argentina between 2007 and 2015. Using web-scraping methods, we collected daily prices for controlled and non-controlled goods and examined the differential effects of the policy on inflation, product availability, entry and exit, and price dispersion. We first show that price controls have only a temporary effect on inflation. Second, contrary to common beliefs, we find that controlled goods are consistently available for sale. Third, firms compensate for price controls by introducing new product varieties at higher prices, increasing price dispersion within narrow categories.

JEL Codes: E31, D22, L11, L81

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[§]Aparicio: dapa AT mit.edu. Massachusetts Institute of Technology, Department of Economics. Cavallo: acavallo AT hbs.edu. Harvard Business School.

1 Introduction

Governments often consider some form of price controls when inflation rise. In some cases, these price controls are imposed across-the-board, affecting all goods and causing widespread shortages.[1] But most of the times, governments prefer to implement a more subtle form of "targeted" price controls on a limited number of selected goods.[2] Traditionally, these targeted controls were limited to easy-to-regulate sectors, such as pharmaceuticals, utilities, or gas prices.[3] More recently, the availability of online data, mobile phone apps, and electronic records has dramatically increased the ability of governments to implement, monitor, and enforce targeted price controls in all kinds of consumer goods. In particular, developing countries such as Argentina, Ecuador, Israel, and Panama have had in the recent years some form of targeted price controls for food and grocery products.[4]

Despite the increased interest in the use of targeted price controls, there is little empirical research documenting their economic effects. Are these controls binding? Do they affect prices and inflation of related goods? Can they avoid shortages associated with more generalized controls? What strategies do firms employ to deal with potentially lower profits and better enforcement?

In this paper, we answer some of these questions by studying the rich and volatile experience with price controls in Argentina from 2007 to 2015. These were targeted controls, affecting a selected set of consumer products with detailed characteristics (e.g. whole milk, 1 liter, brand X). To help with the visibility and enforcement programs, the government required retailers to display labels identifying individual goods as being under a "government

[1]Venezuela is a particularly troubling recent case of across-the-board price controls. The armed forces are in charge of strict price controls and a food supply program. The country had over 250% inflation in 2016 and is experiencing an unprecedented economic crisis with massive food shortages. See New York Times (2015a); Financial Times (2016); Wall Street Journal (2016). In May 2017, President Maduro announced that he was considering a complete freeze of prices that would be enforced by "people in the streets" (El Nacional (2015)).

[2]Targeted controls are also referred to as "selective controls" in the literature (Rockoff (2004)).

[3]For example, developed countries such as Australia, Canada, and Switzerland currently have targeted price control programs for pharmaceutical drugs. Visit http://www.pbs.gov.au/pbs/home in Australia; http://www.pmprb-cepmb.gc.ca/home in Canada. In the US, the main candidates in the recent presidential election suggested they would push for legislation to control drug prices. See, for example, Bloomberg (2016); New York Times (2015b); Forbes (2017).

[4]Visit http://www.consumers.org.il/category/Price-monitoring in Israel; see El Pais (2013).

agreement", both in the offline and online stores. We used web-scraping methods to identify these price-controlled goods and track their prices on a daily basis between October 2007 to May 2015. Our data include more than 50 thousand products sold by one of the largest supermarkets, including approximately 1.4 thousand goods that were under a price control at some point during this period. These price controls were imposed on goods that have significant weights in the CPI basket and for varieties sold by leading brands, consistent with the results in Cox (1980), who argues that focusing on products with high CPI weight and on concentrated industries maximizes the impact on CPI inflation as well as the ability of the government to enforce the controls.

With this high-frequency panel of controlled and non-controlled goods, we examine the before-and-after impact of price controls on inflation, product availability, and price dispersion. Our main results can be summarized as follows.

First, the impact of targeted price controls on aggregate inflation is temporary and small. Controlled goods are sold at "government agreement" prices, which are on average 3.3% lower than before the control. This lower price is usually compensated by a similar increase in prices as soon as the controls are relaxed.

Second, contrary to common beliefs, we find that controlled goods are seldom discontinued and that their general availability is similar to that of non-controlled goods. They have a higher probability of going temporarily out of stock, but stockouts are short-lived and goods are only occasionally discontinued. One likely explanation is that the government's enforcement of both prices and stocks was aided by new technologies, including a mobile app allowing consumers to scan product barcodes in the stores, check "government agreement" prices, and send online complaints to an enforcement agency in cases of price discrepancies or stockouts.

Third, given that price controls are binding in prices and availability, we study how firms might offset lower profit margins. Consistent with the predictions of a standard vertical differentiation model in the presence of price controls, we find evidence that firms expanded their product line with new varieties at higher prices. We further show how this strategy increased price dispersion within controlled categories, which implies an additional welfare cost from search frictions. Using average-price indices, we find that there is more inflation when we account for the introduction price of non-controlled varieties, but in contrast to some reports in the Argentine media, we find no evidence suggesting that firms reduced package sizes or that per-gram and per-liter inflation was higher.

Our results are relevant for different areas of research. We build on an extensive literature on price controls from a macroeconomic perspective, most of which focuses on the US price and wage controls program during Richard Nixon's presidency in the 1970s.[5] The Argentine experience is more closely related to Israel's, where the government has often controlled the price of subsets of basic food products, fuel, and public transportation (Cukierman and Leiderman (1984)). We contribute to this literature by using micro data and comparing inflation rates for both controlled and non-controlled goods within narrow categories.

Our work is also related to the literature that studies price controls from a micro or industrial organization perspective. Fershtman and Fishman (1994) and Rauh (2001) study the relationship between price controls and consumer search behavior. Kyle (2007) finds that price controls in one market affect entry strategies and the introduction of new products in other markets. Leffler (1982) provides a model where firms decrease quality until shortages from binding maximum prices are eliminated. Besanko, Donnenfeld, and White (1987) and Besanko, Donnenfeld, and White (1988) find that maximum price regulation can counteract the quality distortion in a monopoly price setting, and that firms may deteriorate quality for lower willingness-to-pay consumers. Raymon (1983) argues that binding price ceilings can decrease quality and consumer welfare in competitive markets.

[5] Rockoff (2004) provides an excellent overview of the history of price controls in the United States, ranging from the Revolutionary War to the Vietnam War. Galbraith (1952), Friedman (1966), and Solow (1966), provide early formal treatments on the subject. Helpman (1988) shows that the macroeconomic effects of price controls depend on the market structure. Other papers include U.S. Council of Economic Advisers (1973), Gordon (1973), Gordon (1975), Gordon (1977), Schultze (1975), Darby (1976a), McGuire (1976), Oi (1976), Cox (1980), and Blinder and Newton (1981).

Finally, our work also relates to a growing number of papers that use online good-level data to study retailer pricing behaviors. For example, scraped online prices are being used in consumer search and online elasticities (Ellison and Ellison (2009)), synchronization and pass-through (Gorodnichenko and Talavera (2017)), retail pricing dynamics (Cavallo (2018)), and price transparency (Ater and Rigbi (2017)). Our results suggest that while the Internet may have increased the ability of governments to monitor and enforce price controls, these targeted programs have limited effects on aggregate inflation and can cause potentially welfare-reducing effects through higher price dispersion and average prices.

The remainder of the paper is as follows. Section 2 describes the price controls in Argentina from 2007 to 2015. Section 3 describes the web-scraping technology and the micro dataset. Section 4 discusses the impact of price controls on inflation and product availability. Section 5 presents evidence of firms' behavior in the presence of controls. Section 6 concludes.

2 Price controls in Argentina

Argentina has a long history of price controls. In 1939, Congress passed a law to prevent stockouts during the Second World War. And although originally conceived as a temporary mean to lower inflation, subsequent governments have continued to rely on various forms of price controls.[6]

We study the recent 2007–2015 period, during which the government experimented with various types of targeted price controls in supermarket products. These price controls were meant to curb inflation, which rose from 10% in 2006 to over 35% in 2016 (according to unofficial estimates).[7] These controls focused on food and beverages, which constitute nearly 40% of the CPI basket. Despite the fact that they did not appear to have much of an impact on the inflation rate, these programs were popular with voters, which explains why they persist today. According to recent consulting and media surveys, 60% of Argentines supported price

[6]See FIEL (1990) for a review of price controls prior to 1990.

[7]In addition to price controls, Argentina's main strategy to deal with inflation was to manipulate the official inflation statistics. See Cavallo (2013) for more details.

control policies, and 25% of consumers bought price-controlled goods, which accounted for up to 20% of retailers' revenues in supermarkets.[8]

This period of price controls can be divided into four stages, as shown in Figure 1. Stages 1, 3, and 4 are examples of targeted price controls, and Stage 2 was a temporary freeze of all goods sold by large supermarkets. In all cases, the control price applies to the retail price inclusive of VAT taxes. Section A.5 in the Appendix shows descriptive statistics for each of these Stages.

Figure 1 about here

The first stage lasted six years, from 2007 to 2013, and was characterized by confidential ad-hoc price agreements with major supermarkets, which had to freeze prices temporarily for selected goods. There were no official press releases or announcements that disclosed the specific products being controlled, but some retailers showed a "government agreement" label next to the product. We use this label to identify controlled products through scraping technologies. News articles throughout the period reported that this policy resulted in major shortages (e.g., Bloomberg (2007)), but we find no evidence of consistent shortages in our data, as we discuss later.

The second stage started in February 2013, when unofficial inflation reached 25%. The government announced that it had reached a new agreement with the largest retailers in Argentina to freeze prices of all products for 60 days, and later extended it for another 60 days until May 31st (Bloomberg (2013)). The number of products available for sale fell significantly around this time, as discussed in Section 4.2. Prices remained stable for a few weeks but soon started to rise again.

Figure 2 about here

A third stage started in June 2013, when the government lifted the general freeze on all but 500 products. In this instance the government released to the public the names and

[8]The new government elected in 2015 continued the "Precios Cuidados" program. More details can be found in the official government website: `https://www.argentina.gob.ar/precios-cuidados`. For evidence on their popularity, see Telam (2014b); Pagina 12 (2014); El Cronista (2015); Clarin (2016).

"government agreement" prices for those 500 products, which included food (fresh produce and packaged), beverages, cleaning, and health and personal care items. It first targeted major retailers in Buenos Aires and then expanded throughout the country. Because not all retailers sold the same brands or categories, each supermarket had its own list of 500 products whose prices had to stay constant for six months. This price agreement was formalized under the name "Mirar para Cuidar" (*Look to Care*). The government increased the program enforcement as well as its advertising in public media. A political organization with close ties to the President, "La Campora", developed a web and mobile phone app that allowed "militants" to help monitor and enforce the price controls. Several store locations were temporarily closed or fined due to shortages.[9]

Figure 2 shows how the government increased the intensity of the price controls starting in 2013, relative to the first stage of targeted controls. Although the types of products and categories remained similar over time, the number of distinct retailer categories (URLs) that had controlled goods during the same month increased significantly. So did the duration of the price control period: the median time product remained under price controls increased from 70 days in the first stage to 183 days in the third stage (Appendix A.5).[10] For example, in July 2013, the retailer had at least one controlled-good in 50 CPI categories. As shown in Section 4.2, the ups and downs of price controls intensity are not related to data-scraping problems.

In December 2013, amid significant changes in cabinet, the government announced a new stage of price controls called "Precios Cuidados" (*Protected Prices*).[11] Launched in January 2014, it drastically reduced the product list to 100 different goods (194 varieties in total) that were by then common in all major retailers. In an attempt to facilitate the diffusion

[9]See Clarin (2013); Wall Street Journal (2013). These efforts can be interpreted as a new form of bottom-up monitoring technologies (e.g., Olken (2007)).

[10]Although price controls were supposed to be widespread during the second stage, retailers kept identifying a specific set of goods as being under a "government agreement". Our algorithm, described in Section 3, identified these goods as "controlled products", and therefore the intensity index is relatively stable during these weeks.

[11]Several high-ranking government officials left around that time, including the Secretary of Commerce, the Minister of Economy, and the Central Bank President. See La Nacion (2013b).

of price lists, the new program started with fewer categories and varieties that steadily increased over time. *Protected Prices* also required producers to inform the government of new product introductions that resembled those under control. This clause was added amid criticism that, in previous controls, firms launched similar products or varieties to circumvent maximum prices.[12] We discuss evidence of that strategy in Section 5.

The government also increased the firms' costs of violating the agreements and implemented tighter and more sophisticated monitoring strategies.[13] The government developed a website with all product lists and prices, and made the information accessible with a mobile phone app that allowed consumers to scan product barcodes and report stockouts or incorrect prices. Militant groups close to the government posted pictures of CEOs and owners of supermarket chains in the streets and encouraged people to help monitor prices. These strategies were extensively advertised in public media, including radio, television, newspapers, and official press releases.[14][15]

As of the time of writing, *Protected Prices* remains active, with new products and maximum prices announced on a quarterly basis.[16] Price controls remain popular with consumers in Argentina, which is consistent with the experience in the 1970s in the Unites States (Nixon (1978), Blinder (1979)) and in Sweden (Jonung (1990)).

[12]See La Nacion (2013c,a); Clarin (2015).

[13]The government monitored the retailers for stockouts, wrong labeling, incorrect prices, incorrect product weight. The agreements also stipulated that retailers should not limit purchases of controlled goods per household. Companies and supermarket chains could be subject to temporary store closures and large monetary fines. For evidence on retailers receiving fines see Buenos Aires Herald (2014); Telam (2014a); La Nacion (2015a, 2017).

[14]See La Nacion (2014a,b).

[15]The Israeli government has also faced challenges to enforce targeted price controls. See Globes (2017).

[16]The product list can be found at `https://www.argentina.gob.ar/precios-cuidados`. Opposition leader President Mauricio Macri, who took office after former President Cristina Fernandez de Kirchner in December 2015, broadened the program's scope. See Telam (2016).

3 Scraped online prices

We use online prices from thousands of products sold online each day from 2007 to 2015 by one of the largest retailers in Argentina in terms of market share.[17] The data were scraped off the Internet by The Billion Prices Project, an academic initiative at HBS and MIT Sloan that collects online prices from hundreds of retailers around the world (Cavallo and Rigobon (2016)).

The scraping software is designed to search the HyperText Markup Language (HTML) public code of a retailer's website and to automatically store the pricing data of all goods on a daily basis. The retailer assigns a unique ID to each product sold online. In the days when the scraping fails (due to software failures or webpage maintenance) prices are assumed to remain constant until the goods are back online. Goods that do not reappear on the website are considered to be discontinued. See Aparicio and Rigobon (2018) for additional details on web-scraping and classifiers to categorize product-level data.

We identified price-controlled goods in two ways. First, from 2007 to 2015, the scraping algorithm read a special HTML (ID-specific) tag next to each controlled good sold online. This method accounts for about 75% of the controlled goods in our database. Second, after the government started publishing lists of controlled goods in 2013, we manually identified each of these goods in our database.[18]

3.1 Data description

Table 1 provides summary statistics of the data coverage. We have daily prices for more than 50,000 distinct products from 2007 to 2015, and a yearly average of about 14,000 distinct goods. The supermarket scraped data covers categories such as food, beverages, electronics, household appliances, kitchen utensils, and health and personal care items, which collectively account for about 45% of the CPI weights.

[17]The same retailer is also used in Cavallo (2013) and Cavallo (2018). Online prices and availability for this retailer are estimated to be identical across locations.

[18]Figure 9 in the Appendix illustrates a screenshot of the government website.

Table 1 about here

We label products as controlled if they were affected by a price control at least one day during the scraping period.[19] This results in 1,460 controlled goods, which is about 3% of the total products in the database. Although a relatively small set, these goods have a significantly higher weight in the CPI basket, as seen in Table 1.[20]

On average, goods were controlled for six months, with a median of two and a half months. About 25% of the controlled goods had price controls lasting more than 7 months; and if a product price was controlled more than once, there were usually no gaps in between. Controlled goods were under price controls about 23% of their time available online. And a stable subset of items consistently remained under price controls throughout the scraping period.[21] Price controls were generally imposed at the existing price level, but in about a third of the cases, the new price was set lower. On average, the price change was -3.3%.

4 Aggregate impact of price controls

In this section we study the impact on inflation and product availability.

4.1 Aggregate inflation

We first construct a price index using a weighted arithmetic average of category indices. Each category index is a Jevons geometric average of all products sold online. If an item is out of stock we assume constant prices. And if an item is discontinued, then it no longer impacts the index. Products that are out-of-stock are momentarily unavailable for online purchase,

[19]This implies that controlled and non-controlled products do not switch sample groups. A similar strategy is used in Cavallo (2013) and Rockoff (2004). Controlled-goods in stage 2 are only identified through the HTML flag, although the government tried to impose a generalized freeze (Section 2).

[20]In Appendix A.1 we expand on some of the key determinants of price controls, and find that for a unit increase in the CPI weight (i.e. 1 percentage point) the odds of a control increase by 24%. Price controls are less likely in less concentrated or homogeneous markets, as approximated with the number of brands, products, and varieties within the category-URL (i.e. narrow sub-categories). These findings are consistent with the predictions in Cox (1980), who describes the policymakers' problem as maximizing the impact on the price index while reducing enforcement or deadweight costs.

[21]For visual evidence on the duration of price controls, see the histogram in Figure 10 in the Appendix.

while discontinued products were no longer offered online until the end of our scraping period. Price changes are weighed using Argentina's National Statistics Office (INDEC) official weights by CPI category. See Cavallo (2013) and Aparicio and Bertolotto (2016) for evidence that online price indices closely track and forecast official CPIs.

The impact of price controls on aggregate inflation is small and temporary. This can be seen in Figure 3, where we shot the price indices and the annual and monthly inflation rates for three samples: all goods, controlled goods, and non-controlled goods.

Figure 3 about here

From 2007 to 2015, all price indices had recorded about 400% accumulated inflation. There are periods when the inflation rate of controlled goods appears significantly different than that of non-controlled varieties, as shown in the volatility of the monthly inflation rate in panel (c). These periods are associated with weak or strong periods of price agreements, but the difference was never large enough to have a significant impact on the aggregate inflation rate for all items, as shown in panel (b). Because weights for individual goods do not exist within subcategories, it is possible that the government chose specific varieties based on their perception as "leading brands". But regardless of the magnitude, the impact was temporary. Periods of low inflation in controlled goods were quickly followed by higher inflation for those same goods. In particular, controlled goods had lower inflation until 2009 and then much higher inflation in 2010 and 2011.[22]

Table 2 about here

Table 2 show the micro impact of price controls using product-specific regressions.

[22]A body of literature argues that price controls can indirectly benefit the inflationary process through inflation expectations. See Galbraith (1952), Friedman (1974), Blinder and Newton (1981), Rockoff (2004). Interestingly, inflation expectations remained relatively flat even around key price controls announcements. Figure 11 in the Appendix shows annual inflation rates, inflation expectations, and monetary policy. See also Figure 12 in the Appendix for visual evidence of higher volatility of controlled-goods' annual inflation rate, as well as a measure of "excess" inflation relative to non-controlled sectors.

We calculate the monthly average price for each product, and run regressions of the form:

$$\pi_t^{i,j} = a + \beta D_t^i + \gamma_t + \mu^j + e_t^i \tag{1}$$

where $\pi_t^{i,j}$ is the percent change in monthly price of product i from category j at time t; γ_t and μ^j are time and category fixed effects, respectively; and D_t^i are product and time specific indicators.

In column (1) we define an indicator that takes value 1 if the product experienced a price control during month t. The estimate suggests that products have 0.84% lower inflation during the month of price controls. In column (2) we include an indicator if a non-controlled product has a competitor under price controls (defined as in the same narrow category). The point estimate suggests that non-controlled products experience about 0.17% higher inflation when a competitor is under price controls. These results combined suggest that, while controlled-goods experience lower inflation while under price controls, retailers compensate increasing prices of non-controlled related goods.

The effect on inflation is temporary, with prices rising as soon as the price control is lifted. This can be seen in column (3), where we show the coefficient of an indicator variable that takes a value of one if the product experienced a price control at month $t-1$ but not at t. The estimate suggests that as soon as price controls are lifted monthly inflation increases by an additional 4.9 percentage points in a single month. We next explore whether the effect varies with the duration of the control. We include an indicator that takes value 1 if the product experienced price controls during at least three consecutive months (but not on month t). Controls that lasted less than three months cause an increase of 1.8 percentage points, while those that last more than 3 months lead to an increase of approximately 5.9 percentage points (adding both coefficients).

Overall, these results suggest that price controls have a temporary effect on the inflation of controlled products, while non-controlled products experience more inflation while competitors are under price controls. These regressions cover both sporadic as well as more intense control periods, summarized at the monthly level, and include results from goods that may have been under price controls multiple times, allowing the firms to act strategically with their pricing. In the next section we explore high-frequency pricing reactions using an event study that focuses exclusively on the first time each product was affected by a price control.

4.1.1 Effect on non-controlled goods

We now use high-frequency price data on the first time each controlled-good experienced its price control. This allows to capture the effect that is driven by the surprise of a price control.

In order to determine if firms increased the price of related goods after price controls were imposed, we split the sample of non-controlled goods into two: "related" and "unrelated". Related non-controlled goods are sold in subcategories that have goods under price controls at the same time. One example of a subcategory could be 'cereals'. Unrelated non-controlled goods are sold in subcategories that had no price controls at all.

The related sample is constructed as follows. Each time an item is controlled for the first time, we randomly select another product from the same subcategory such that: (i) is in stock that day, (ii) is not controlled during the scraping period, and (iii) has not already been selected as related to another good (i.e., draws without replacement). The unrelated sample is constructed in a similar way but from non-controlled categories. The controlled, related, and unrelated samples comprise 1,460, 1,321, and 1,400 distinct items, respectively.

For each good, we keep prices for 90 days before and after it received the first price control.[23] This method produces a balanced panel for each sample (except for some censored observations in some price spells for discontinued goods). We then compute the 30-day rolling inflation at the good-level and average it across goods each day. This generates an approximation of the average monthly inflation, shown in Figure 4 for a 90-day window around the day the control is first introduced.

[23]We focus on the first event to avoid picking up behaviors that are connected to previous controls, but the results are similar if we make no distinctions for repeated controls.

Figure 4 about here

This figure highlights three findings. First, consistent with the previous discussion, there were temporary effects on controlled-goods prices. The monthly inflation rate falls to -5% immediately after the control is imposed, and 30 days later the monthly inflation is close to 0% (indicating that prices remain fixed). However after two months, the inflation rate jumps to +5%, compensating for previous declines.

Second, non-controlled goods in related categories do not have higher inflation rates after the control. Their behavior is similar to non-controlled goods in unrelated categories, suggesting that, at least immediately after the first event, firms were not compensating for the controls by increasing prices of related goods. In some cases, the government explicitly monitored the behavior of related goods, which likely limited firms' ability to compensate through the prices of existing varieties.

Third, related goods do have higher inflation *before* the controls are imposed. Their prices start to rise faster 60 days before the control, and the inflation difference peaks 15 days before the control is imposed. Goods that will later be under a price control, and those in unrelated categories, do not experience similar price increases. One possible explanation is that firms increased prices of some varieties to make potential candidates for a price control appear relatively cheap. Overpricing varieties that were less likely to be under a price control could be a strategy to negotiate a higher price ceiling on the cheap variety.[24]

In summary, price controls on specific goods did not seem to have a downward effect on the inflation rate of related goods in the same categories. In Section 5 we explore whether targeted price controls affected the price of new varieties introduced after a price control takes place.

[24] See also Blinder (1979) on related overpricing strategies during price controls in the Unites States.

4.2 Product availability

Price controls are typically expected to produce shortages. But can better monitoring tools prevent them? In order to answer this we compute a measure of "product availability", defined as the number of items available for sale online on a given day.[25] Panel (a) in Figure 5 shows that the retailer sold over 13,000 products per day, of which about 700 were controlled-goods. The flat line between late 2009 and early 2010 is due to a partial scraping failure in our algorithm. Scraping failures are otherwise only occasional and do not affect the data.

Figure 5 about here

The availability of controlled goods was surprisingly stable over time, at around 700 items per day. Although newspapers claimed that price controls produced major stockouts, we found no such evidence in our data. We also simulated online purchases on several occasions and found no shipping delays nor limits on the number of units that could be purchased.[26]

The only major drop in availability occurred when the government imposed a total price freeze (shaded region). About 100 goods were discontinued during that period, and another 200 disappeared when controls ended. Once the programs became targeted again, in Stage 3, the availability of controlled goods stabilized, though at a much lower level. It is possible that as intensity and duration of price controls increased, retailers decided to discontinue products that were previously controlled.[27]

[25] Cavallo (2018) shows that in Argentina, close to 100% of the goods found offline are also available online and have similar prices.

[26] A potential explanation is that price ceilings were being set above the intersection of demand and marginal cost curves in non-competitive industries (Darby (1976b), Helpman (1988)), so profits margins could be smaller but still positive.

[27] These discontinuities explain why availability did not recover. It is also possible that, as a new stringent targeted program developed, firms preferred not to re-introduce controlled products for fear these would be the target of price controls again. In Figure 13 in the Appendix we plot product introductions and discontinuities over time, and show that these were more pervasive when the government increased the intensity of price controls.

4.3 Temporary stockouts

Even if the government can prevent retailers from discontinuing goods, we expect controlled goods to experience more frequent stockouts. In this section, we use survival analysis to study the risk of stockouts across samples.

The onset of risk, or t_0, is defined as the day each good received its first price control during the scraping period from 2007 to 2015. The end date, or failure event, is the day of the first stockout after the control is imposed. If the scraping package fails, no price observations are recorded for that date. We control for these cases and for right-censored observations (i.e., controlled goods that did not go out of stock by the end of the scraping period).

Panel (a) in Figure 6 shows a histogram of the number of days until the first stockout, that is, we compute the number of days between t_0 and the failure event for each good. We find that controlled goods do experience a relatively faster stockout: one and a half months after the first price control more than 50% of the goods have gone out of stock, compared to 40% in the related non-controlled varieties. Vertical lines depict average days for each sample.

Figure 6 about here

We also estimate the survival function $S(t)$, defined as the survival probability (or in-stock probability) past time t, i.e. the probability of failing after t, for both controlled and related goods. We use the non-parametric algorithm from Kaplan and Meier (1958):

$$\hat{S}(t) = \prod_{j|t_j \leq t} \left(\frac{n_j - d_j}{n_n} \right)$$

Where n_j is the number of goods at time t_j and d_j is the number of stock-out events at time t_j, and where the product is computed over all observed failure times until time t.

Panel (b) in Figure 6 shows the estimated survival function for both controlled and related goods.[28] Although survival functions exhibit similar shapes, the probability of being

[28]Results remain robust to alternative functions, such as the non-parametric Nelson–Aalen cumulative

in stock is about 15% higher for (related) non-controlled goods a month after controls were imposed.

5 New Varieties and Price Dispersion

The previous sections show that targeted controls in Argentina, while do not significantly affect the aggregate inflation rate, they do force some firms to sell goods at lower prices and keep them in stock most of the time. So how do firms cope with price controls?[29] Although we find no evidence that firms consistently increased prices of existing goods, we find that firms introduced new varieties at higher prices, which in turn increased price dispersion within controlled categories. In Appendix A.2 we introduce a vertical differentiation model that motivates theoretical predictions of targeted price controls on firms' pricing behavior.

For targeted price controls, an effective strategy might be to introduce new varieties at higher prices.[30] For example, in January 2014, the government controlled the popular kids' dessert *Chocolate Vanilla Shimy* and *Dulce de Leche Vanilla Shimy*. Several days after the first control, the firm introduced the new variety *Vanilla Chocolate Shimy* at a 50% higher price. In June 2013, Royal's *Dulce de Leche, 65 grams* cake powder was controlled; the same week Royal introduced *Light Dulce de Leche, 40 grams* at a -24% lower price (but bulk-adjusted represented a 23% increase). Examples like these are numerous and easy to find.

Traditional matched-model price indices, such as those used in Section 4.1, are unable to capture the impact of new varieties. The reason is that they are based on the price changes of goods that are present in two time periods. The prices of new product varieties are therefore ignored and do not affect the price index.

hazard function (Kaplan and Meier (1958)).

[29]Some firms actually benefited from the price agreements by gaining market share. In principle, these price agreements provided advertising and facilitated product distribution to major retailers throughout the country. For example, an Argentine firm producer of vinegar, mayonnaise, and other dressings, reported that 27% of its 2014 sales could be attributed to the *Protected Prices* program, and that these products exhibited a 28% increase in gross sales. Participating in the price agreements allowed the firm to access new retailers and supermarket chains in segments that were previously restricted to major brands. See La Nacion (2015b); Telam (2015).

[30]See Bourne (1919), Darby (1976a), Jonung (1990), Rockoff (2004).

A simple way of detecting the introduction of higher priced varieties is by constructing *average-price* indices, which are based on average prices for all varieties sold each day in a narrowly defined category.[31] To measure the impact of new and exiting varieties, we first compute average-price indices for both controlled and non-controlled goods in the same subcategories, and then build aggregate price indices using official CPI category weights. Our data are well suited for this analysis, because the web-scraping algorithm adds goods to our sample on the first day they appear on the store.

As Figure 7 panel (a) shows, the inflation rate for non-controlled goods is higher once we account for the price levels of new varieties at the time of introduction. The average-price index has more inflation than the corresponding matched-model (chained) index that uses only price changes, and significantly more inflation than the average-price index for controlled goods. We also find that the average price index for controlled goods is lower than its corresponding chained index (shown in Figure 3), widening the gap in inflation with non-controlled goods.

Figure 7 about here

Finally, we document that the number of non-controlled varieties increases after price controls are introduced. We run regressions at the category-URL and month level:

$$Varieties_t^j = a + \beta D_t^j + \gamma_t + \mu^j + e_t^i \tag{2}$$

where $Varieties_t^j$ is the number of non-controlled varieties (in logs) in category-URL j at month t; γ_t and μ^j are time and category fixed effects, respectively; and D_t^j is an indicator that takes value 1 when category-URL j has at least one product under price controls at month t. The main estimate in column (2) of Table 3 indicates that narrow categories subject to price controls experience a 33.7% increase in new non-controlled varieties.[32]

[31] Parsing out the product description string into grams and liters amounts per item, we find no evidence that firms systematically reduced package sizes to cope with price controls. However, if they did, the results would be stronger (a smaller size would increase the per-unit price of the new product).

[32] See also visual evidence of increased activity of product introductions and discontinuities in Figures 13

Table 3 about here

We can also detect higher-priced varieties by looking at price dispersion before and after controls are introduced. This can be seen in Figure 7 panel (b), which plots the price dispersion within subcategories for all goods and the subset of "continuing" goods.[33] Panel (b) shows that price dispersion increases by around 14% during the first weeks post-control. Furthermore, dispersion is primarily driven by new goods following price ceilings and does not revert to its initial levels. In both cases, price dispersion rises a few days before the price control is introduced, but in the sample that includes new varieties (all goods), the dispersion continues to rise after the control is in place.

We formalize the visual evidence of price dispersion using a similar regression to equation (2). In this case, the dependent variable is the category-URL price dispersion, which is defined as the coefficient of variation. The coefficient in column (4) in Table 3 indicates that, relative to the average price dispersion across all narrow categories, targeted price controls lead to 17.7% higher price dispersion.

5.1 Robustness across Stages

In Table 4 we replicate the main empirical analyses for each of the price control stages. The main results can be summarized as follows.

Table 4 about here

First, stage 2 was useful to bring aggregate inflation down but led to an increase in the product-level inflation rate for those products which experienced targeted price controls at some point. This suggests that the retailers utilized the "freeze" as an opportunity to anticipate (and possibly obfuscate) price increases in those goods that they expected to be controlled in the near term.

and 14 in the Appendix.

[33]We compute price dispersion as the coefficient of variation, i.e. standard deviation of prices over average prices, per week and URL. We then averaged these URL-level time series for each week, 6 months before and after the first control.

Second, stage 3 was the most successful in terms of reducing the inflation rate of controlled goods and limiting temporary stockouts; but this was also the period where a large fraction of goods were discontinued. These are likely related to the novelty of a "targeted" program combined with a tight monitoring and enforcement policy.

Finally, stage 4 appears to be the least successful, suggesting that the ability to enforce price controls had fallen dramatically by this time. However, this period also coincides with a new president in office, changes to the basket of controlled products, and potential right-censoring for controlled products introduced towards the end of the data collection.

6 Conclusions

During the past ten years, Argentina has experienced various forms of targeted price controls in which the government set price ceilings for specific supermarket goods. We use web-scraping technologies to collect online prices from one of the largest retailers in the country and construct a detailed micro panel dataset with more than 50,000 goods, which we use to evaluate the impact of price controls.

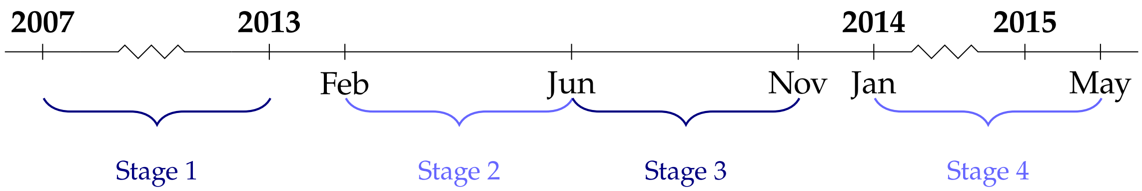
We show that, although price controls targeted goods with high CPI weight, they had minor and temporary effects on inflation. Price controls were binding, both in price and availability, but we find evidence that firms introduced new varieties at higher prices to compensate for reduced profit margins. This increased price dispersion within narrow categories of controlled goods.

Our results suggest that new technologies, such as the Internet and mobile phones, may allow governments to better enforce targeted price controls programs. Still, this does not make price controls an effective policy to reduce aggregate inflation, because the effects are short-lived and do not spill over to non-controlled goods. Furthermore, firms adjust to targeted price controls by using strategies that may obfuscate consumer options and increase price dispersion.

Future research should weigh the temporary income effects from price ceilings against the welfare losses associated with search frictions from price transparency and price dispersion, administrative enforcement costs, and investments in the retail industry.

Figures

Figure 1: Timeline



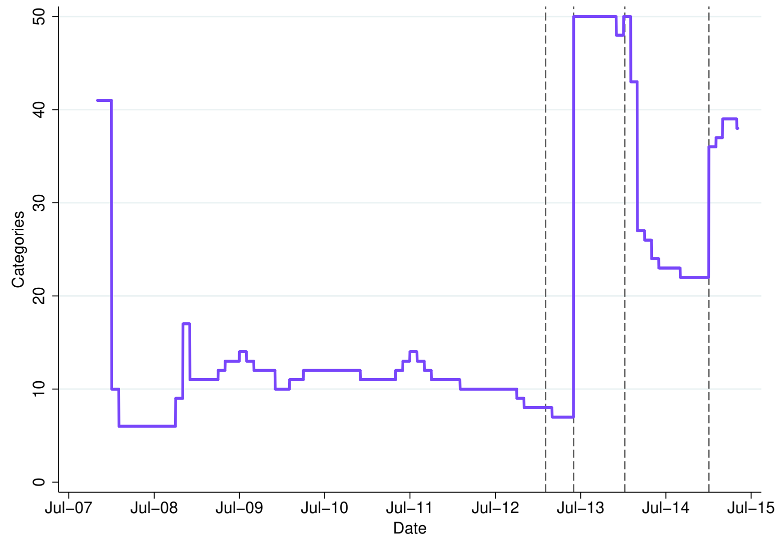
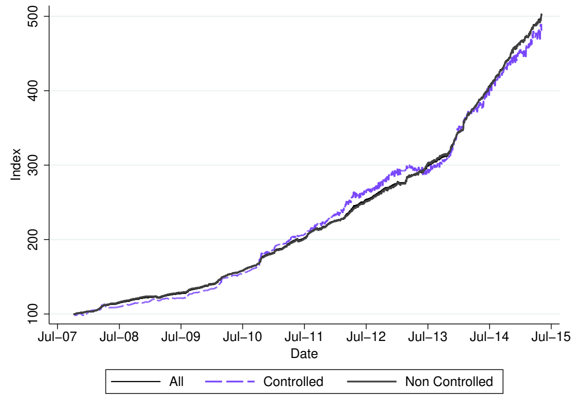
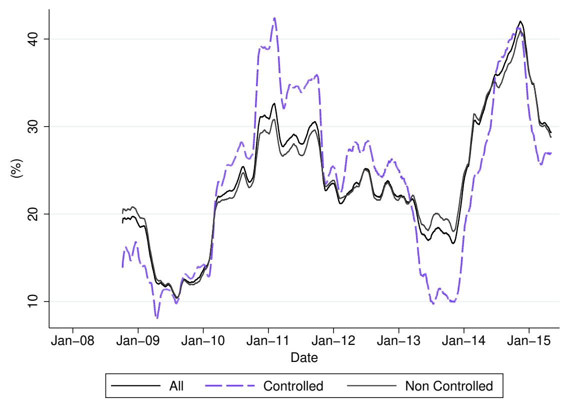


Figure 2: Intensity Index

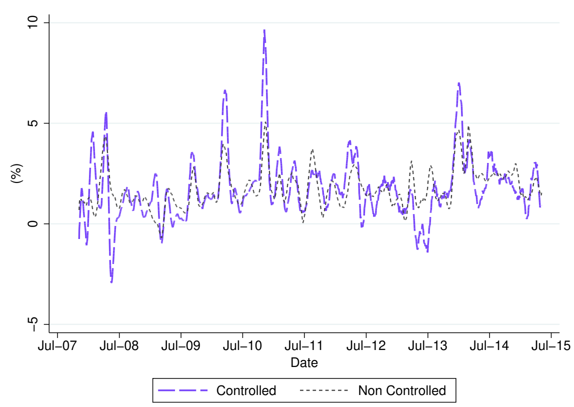
Notes: Retailer's narrow categories under price controls. Vertical notes denote the four main events in the timeline as described in the main text.



(a) Price Index



(b) Annual Inflation Rate



(c) Monthly Inflation Rate

Figure 3: Price Index and Inflation Rates for Different Samples

Notes: The price index is calculated using official weights by CPI categories and unweighted geometric averages of price changes for subcategories without official weights. The annual and monthly inflation rates are computed using a 30-day moving average of the price index.

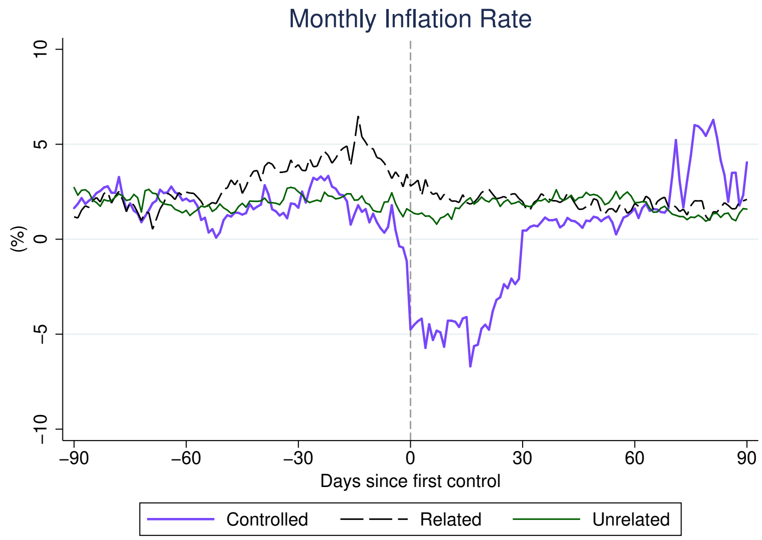
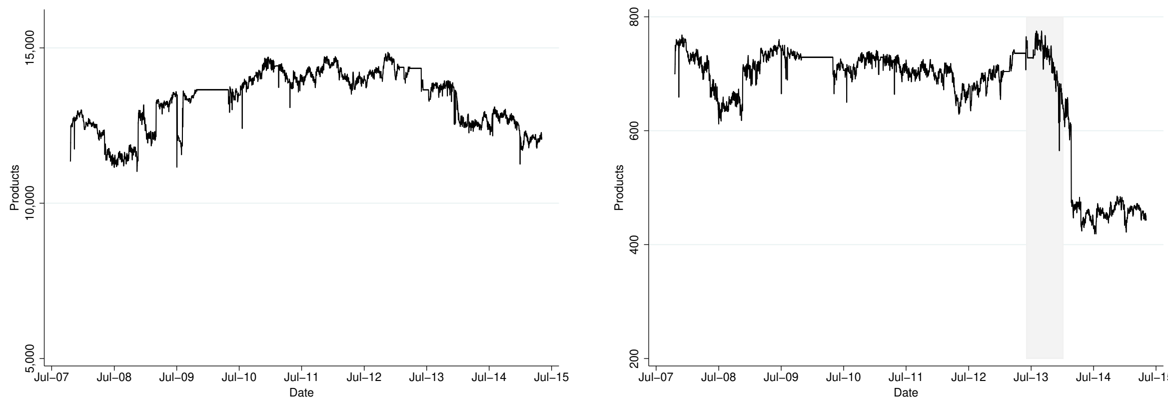
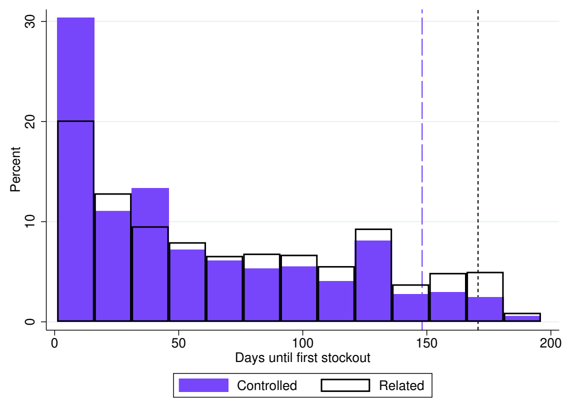


Figure 4: 90-day window before and after the first price control

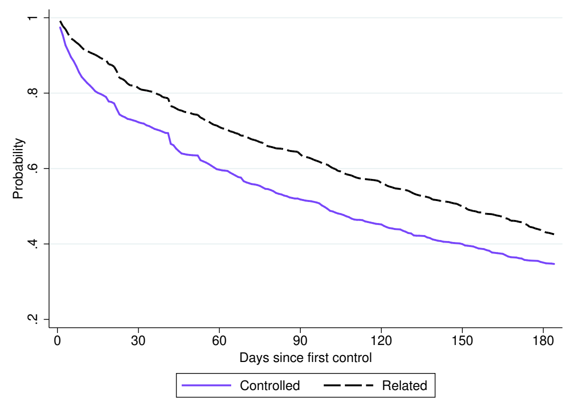


(a) All Goods (b) Controlled Goods

Figure 5: Product Availability



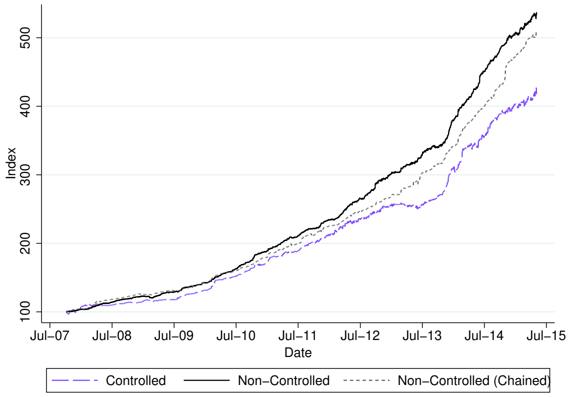
(a) Days Until the First Stockout



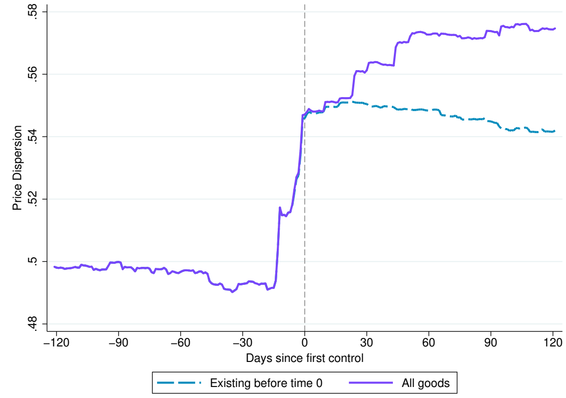
(b) Probability of Being In-Stock

Figure 6: Stockout behavior

Notes: Histogram computed for less than six months for better visualization. Average days until first stockout in vertical lines. Kaplan-Meier survival function is computed for all months, but axis is also restricted to six months.



(a) Price index using average prices



(b) Price dispersion

Figure 7: Price Index and Price Dispersion

Notes: In Panel (a), "Controlled" and "Non-Controlled" are average price indices as described in the text; "Non-Controlled (Chained)" is a standard chained or matched-model price index.

7 Tables

Table 1: Summary Statistics

		All Goods	Non-Controlled	Controlled Goods
(i)	Time period	October 2007 to May 2015	October 2007 to May 2015	October 2007 to May 2015
(ii)	Observations (with price)	15,796,787	15,139,656	657,131
(iii)	Distinct goods	51,779	50,319	1,460
(iv)	Distinct brands	3,518	3,466	438
(vi)	Retailer's categories[a]	964	963	302
(vi)	CPI categories	75	75	54
(vii)	Total CPI weight	44.6	44.6	39.7
(viii)	Average CPI weight per category	0.859	0.802	0.923
(ix)	Average CPI weight per product	0.860	0.853	1.094
(x)	Average CPI weight per product[b]	0.001	0.001	0.034
(xi)	Median control time	-	-	75 days
(xii)	Median control events[c]	-	-	2 times
(xiii)	Percent of time under control[d]	-	-	23%
(xiv)	First control at higher price[e]	-	-	6%
(xv)	First control at lower price	-	-	32%
(xvi)	First control at same price	-	-	51%
(xvii)	Average price change at control[f]	-	-	-3.3%

Notes: [a] Website retail categories (e.g. dairy), which are broader than URL-based retail sub-categories (e.g. yogurt). [b]Weighted by number of products in each category (e.g., if a category weights 3 and there are 10 products, then each product's weight is 0.3), then averaged across all goods. [c]Number of (non-consecutive) times a product received price controls, and then median across controlled goods. [d]Calculated using non-missing observations (in stock for sale). [f]Fraction of controlled goods whose first control was set at a higher price, relative to its last available price without controls. Similarly for (xv) and (xvi). The remaining fraction are new items and have no price change available. [e]Based on the average price ten days before and after the first control.

Table 2: Effect of price controls on product-specific monthly inflation

	Product Inflation			
	(1)	(2)	(3)	(4)
Product controlled	-0.837***	-0.793***		
	(0.073)	(0.073)		
Product w. controlled competitor		0.165***		
		(0.024)		
Control lifted			4.904***	1.802***
			(0.334)	(0.452)
Extended control lifted				4.052***
				(0.608)
Category FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	1,546,383	1,546,383	1,546,383	1,546,383

Notes: Observations are aggregated to the product and month level. Dependent variable is the percent change in the product-specific monthly average price. Estimates remain quantitatively similar if covariates are added sequentially or all together. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Effect of price controls on non-controlled varieties and price dispersion

	NC Varieties		Price Dispersion	
	(1)	(2)	(3)	(4)
$\mathbb{1}\{\textit{Controlled this month}\}$	0.418***	0.337***	0.052***	0.083***
	(0.0866)	(0.0708)	(0.018)	(0.019)
π_t				-0.002
				(0.003)
Constant	2.497***	1.404***	0.466***	0.750***
	(0.0313)	(0.0154)	(0.010)	(0.004)
Category FE	NO	YES	NO	YES
Time FE	NO	YES	NO	YES
Observations	65,276	65,021	68,077	67,771

Notes: Observations are aggregated to the category-URL and month level. In columns (1) and (2) the dependent variable is the log number of distinct (non-missing) non-controlled goods. In columns (3) and (4) the dependent variable is the coefficient of variation. We let $\mathbb{1}\{\textit{Controlled this month}\}$ take 1 when a price ceiling affects any good on a certain URL-month. π is the online-measured monthly inflation rate. Coefficient remains similar if we control for inflation volatility and exchange rate depreciation. Categories are CPI sub-categories. Standard errors clustered at the URL level in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Inflation, Stockout, and New Varieties By Stage

		Isolated Controls	General Freeze	*Look to Care*	*Protected Prices*	
		Stage 1	Stage 2	Stage 3	Stage 4	All Stages
A - Monthly inflation:[a]						
(i)	Products controlled	-0.78	2.37	-1.96	-0.43	-0.84
B - Probability of stockout:[b]						
(ii)	30 days after	0.27	0.23	0.20	0.42	0.28
C - New varieties:[c]						
(iii)	Products controlled	0.32	-0.28	0.49	0.51	0.34

Notes: [a]Coefficient from the regression of product-specific monthly inflation rate (in percentage) on an indicator that takes 1 if the product received a price control during month t. Sample restricted to each stage period. The regression follows equation (1) in the main text, which includes category and time fixed effects. All coefficients are statistically significant at the 1% level. Complete estimates for the entire period are shown in Table 2. [b]Kaplan-Meier inverse probability of survival. This reproduces the survival analysis in Panel (b) of Figure 6. [c]Coefficient from the regression of category-URL non-controlled varieties (in logs) on an indicator that takes 1 if the product received a price control during month t. Sample restricted to each stage period. The regression follows equation (2) in the main text, which includes category and time fixed effects. All coefficients are statistically significant at the 1% level (except the coefficient from stage 2 which is not statistically significant).

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Targeted Price Controls on Supermarket Products
Diego Aparicio and Alberto Cavallo

A Online Appendix

A.1 Determinants of price controls

We expand on some of the key determinants of price controls. In relation to the price-wage control in the United States, Cox (1980) argues that policymakers balance between two forces: control industries with higher weight on the price index, while minimizing enforcement or inefficiency costs. One might expect that the degree of price controls is increasing in: the CPI weight of a given good, elastic demand or inelastic supply, industry concentration, or more homogenous goods. See also Galbraith (1952). The scraping technology applied to the selective program in Argentina offers an attractive setting to test for these determinants.

We formalize the analysis as follows. For each good sold online by the retailer, we manually matched each URL-based category with the official CPI categories from Argentina's NSO. This allows to obtain good-level weights. Industry concentration is approximated by the number of distinct available brands (or products) per URL, and homogenous goods are approximated by the average number of varieties per brand-URL. A good's brand is recognized by parsing out the scraped product description and keeping a string of letters with special font.[34] We then run simple Logit binary regressions of the controlled dummy on a series of covariates.[35]

Table 5 shows the results. *Controlled* is a dummy variable equal to 1 if the good had a price control; *CPI Weight* is a good's CPI weight, which in our sample ranges from

[34]Once we obtain the number of brands (products), varieties, and good-level weights, we collapse the panel data into a cross-section by taking the average over time at the good level. One observation per ID is appropriate in our case since these variables tend to be stable over time. Controlled-goods use only information through the first price control to take into account that the number of varieties or products are affected once firms receive price controls. See Section 5.

[35]Results remain very similar under probit or OLS regressions, as well as using pooled category-level data. Table 6 shows the results for the OLS specification.

0.03% to 6%; *Products*, *Brands*, and *Varieties* are the number of distinct goods, brands, and varieties (in tens) per subcategory.

Coefficients are expressed in terms of the odds ratio. Consider for instance the specification in column (3). For a unit increase in the CPI weight (i.e. 1 percentage point), the odds of a control increase by 24%. The sign is consistent with the statistics in Section 3 showing that controlled-goods have a higher CPI weight relative to the other goods. The estimates also suggest that if the number of products in the URL increase by 10, i.e. a more competitive industry, the odds of a control decrease by over 7%. Price controls are also less likely the more varieties of the good.

Table 5: Determinants of price controls

	(1)	(2)	(3)	(4)	(5)	(6)
Controlled						
CPI Weight	1.232**	1.242**	1.237**	1.222*	1.280**	1.260**
	(0.120)	(0.132)	(0.129)	(0.127)	(0.133)	(0.127)
Products			0.929***			
			(0.0224)			
Brands				0.799***		0.778***
				(0.0639)		(0.0646)
Varieties					0.575***	0.522***
					(0.123)	(0.107)
Sector FE	NO	YES	YES	YES	YES	YES
Observations	38,908	38,908	38,908	38,908	38,908	38,908

Notes: Coefficients from Logit regressions expressed as odds-ratio. Dependent variable is an indicator that takes 1 if the product received a price control. Sectors are CPI broad categories. Standard errors clustered at the URL level in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Determinants of price controls

	(1)	(2)	(3)	(4)	(5)
Controlled					
CPI Weight	0.00876*	0.00764	0.00821*	0.00938*	0.00890*
	(0.00488)	(0.00498)	(0.00487)	(0.00486)	(0.00485)
Products		-0.00159***			
		(0.000490)			
Brands			-0.00475***		-0.00545***
			(0.00152)		(0.00169)
Varieties				-0.0136***	-0.0167***
				(0.00486)	(0.00499)
Sector FE	YES	YES	YES	YES	YES
Observations	38,908	38,908	38,908	38,908	38,908

Notes: Dependent variable is an indicator that takes 1 if the product received a price control. Standard errors clustered at the URL level in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

A.2 A model of price controls

We introduce a simple model to motivate the effects of targeted price controls on firms' pricing behavior. See Section 5 in the main text for the empirical evidence.

We assume consumers have unit demands per unit of time and preferences separable in quality and price (i.e. no income effects).[36] The indirect utility from consuming good i is given by

$$U(\theta, s_i, p_i) = \theta s_i - p_i \tag{3}$$

And zero if no good is purchased. Where s and θ stand for quality level and willingness-to-pay for quality. Consumers have heterogenous tastes over quality. We assume θ is uniformly distributed over the interval $[\underline{\theta}, \bar{\theta}]$ and a density of 1. For simplicity we report results for $\underline{\theta} = 0$ and $\bar{\theta} = 1$.

[36]Vertical differentiation models have become a standard framework in industrial organization since Mussa and Rosen (1978), Gabszewicz and Thisse (1979), Shaked and Sutton (1982), and Tirole (1988). See also Moorthy (1988), and Cheng and Peng (2014).

Although the monopolist cannot observe θ and perfectly discriminate, she can supply combinations of quality and price given the distribution of tastes and the market size.[37] We assume the monopolist supplies one good, and faces a fixed cost f_i per good and variable quadratic costs of quality improvement $C(s)$, with $C'(s) > 0$ and $C''(s) > 0$. We assume the standard form $C(s) = \alpha s^2$.

The firm's problem can be described as a two-stage game: the monopolist chooses quality in the first stage and prices in the second. This sequence of decisions makes sense in our micro context. Once the retailer introduces good i, a salient quality attribute s is presumably fixed throughout the life of a good, whereas the price can more easily be updated.

In the absence of price controls, the optimal monopolist quality and price are $s^m = \frac{1}{3\alpha}$ and $p^m = \frac{2}{9\alpha}$.[38] Relative to a social planner who maximizes aggregate surplus, the monopolist supplies the same quality but serves half the market. Specifically, the social planner chooses $p^{sp} = \frac{1}{9\alpha}$ and thus $\hat{\theta}^{sp} = 1/3$, while $\hat{\theta}^m = 2/3$.

Now imagine that, with the intention of reducing prices to increase the pool of consumers for an essential good, the government imposes a binding price ceiling $\bar{p} = \tau p^m$, with $0 < \tau < 1$. We assume that firms are subject to capacity constraints. In other words, if $\bar{p}$ is set too low, the firm cannot possibly serve the entire demand. We thus let $D(s^m, \bar{p}) > \tilde{D} \equiv D(s^m, p^m)\gamma$, with $\gamma > 1$, be an upper bound to the aggregate demand that can be satisfied. To offset its impact, a firm could readjust quality or introduce a new good. These results are explained in the following Remarks.

Remark 1. *If price $\bar{p} < p^m$ is fixed but quality s is flexible, the monopolist downgrades quality regardless of the cost of quality improvement α.*

Proof. See Section A.3.2. □

[37]Note that θ can be reinterpreted as the inverse of the marginal rate of substitution between income and quality (Tirole (1988)). Therefore the above preferences can reflect consumers with identical tastes but heterogenous income (a higher θ denotes a lower marginal utility of income).

[38]See proof in Section A.3.1.

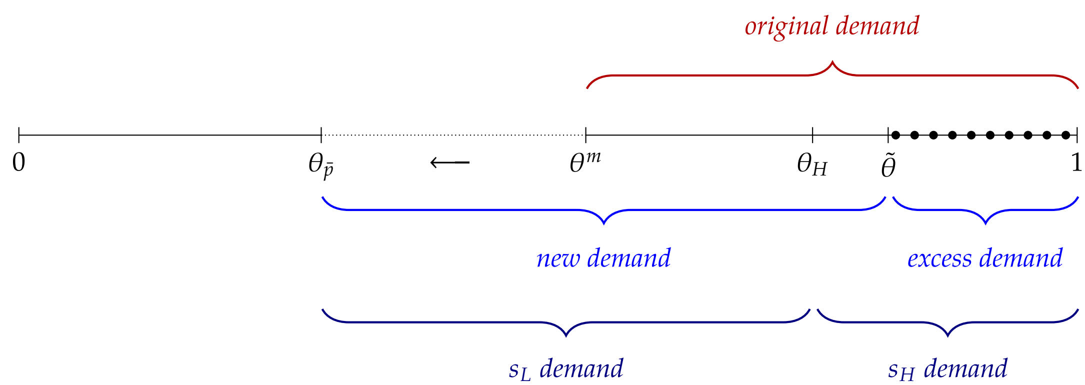
Remark 2. *The monopolist benefits from introducing a new, higher price-quality variety. A new good also deters a rival firm from entering the market to steal excess demand.*

Proof. See Section A.3.3. □

The monopolist can reduce the price-ceiling burden by introducing a new and more expensive variety. This strategy results in higher profits relative to a wait-and-see (continue selling one good), and it prevents a rival firm from entering and exploiting a distorted product line. Let $\bar{p}_L$, s_L, and θ_L stand for the incumbent's price, quality, and marginal consumer for the (original) low-quality good. Then an entrant could introduce a better-quality good, H, and set p_H and s_H such that $\theta_H = \theta_L$, and steal the entire market. Where $\theta_H = \frac{\Delta p}{\Delta s}$ and $\theta_L = \frac{p_L}{s_L}$. Recall that $p_H > p_L = \bar{p}$ is possible, because price ceilings affect a subset of goods.[39]

Depending on the price ceiling, the capacity constraint, and the cost advantages, the monopolist can optimally crowd the product line, relative to an entrant that needs to position a new product. Moreover, that a monopolist may attenuate the impact of price controls through new products can be related to an extensive literature on brand proliferation and entry deterrence.[40]

Figure 8: Marginal consumers



[39]The monopolist would prefer to discontinue the controlled good and introduce a similar variety. Alternatively, she could introduce a second good and, once controls are removed, discontinue the controlled good. We abstract from dynamic considerations but note that a richer model might consider strategic responses that depend on the expected duration of price controls and the probability of getting caught cheating. See Section A.4.

[40]See Caves and Porter (1977), Schmalensee (1982), and Urban, Carter, Gaskin, and Mucha (1986) on the advantages of pioneering brands, and Lutz (1997) on the monopolist's ability to deter (or accommodate) entry under vertical differentiation. See Hay (1976) and Schmalensee (1978) on brand proliferation.

Figure 8 illustrates the main intuitions from the model. Initially, the firm sells a single good at price p^m, and demand is $1 - \theta^m$. A price ceiling $\bar{p} < p^m$ lowers the marginal consumer for the (original) low-priced s_L good from θ^m to $\theta_{\bar{p}}$. A sufficiently low price ceiling binds the capacity constraint and generates excess demand $(1 - \tilde{\theta})$ for the controlled good. To deter entry and benefit from the high willingness-to-pay consumers, the monopolist is incentivized to segment the market with a new and more expensive good s_H. This increases price dispersion within controlled categories. Introducing a new good is Subgame Perfect Nash Equilibrium (SPNE): it is only after the price control that the firm is better off supplying a second good. Interestingly, that price controls can increase market share is consistent with anecdotical evidence reported in the news.[41]

A.3 Proofs

A.3.1 Single-Product Monopolist

In the single product case with an uncovered market, demand is given by $\bar{\theta} - \hat{\theta}$, where $\hat{\theta}$ stands for the marginal consumer for which $\theta s - p \geq 0$. In stage two, price is set to maximize profits given quality, i.e. $p^*(s) = \frac{s(1+\alpha s)}{2} = \arg\max \left\{ \left(1 - \frac{p}{s}\right) \left(p - \alpha s^2\right) \right\}$. In stage one, quality is chosen to maximize $\pi \left(p^*(s), s\right)$. This yields $p^m = \frac{2}{9\alpha}$ and $s^m = \frac{1}{3\alpha}$. (The alternative solution $p^m = \frac{1}{\alpha}$ and $s^m = \frac{1}{\alpha}$ does not satisfy the second order conditions) Then $\hat{\theta} = \frac{2}{3}$. Fixed costs f_1 and f_2 are such that the firm decides to introduce one good. This holds as long as $f_2 > \frac{1}{\alpha}\frac{2}{675}$.[42]

A social planner who maximizes aggregate surplus would set a price such that $\max_p \int_{p/s}^{1} \left(\theta s - \alpha s^2\right) d\theta$. And then choose quality to maximize $AS\left(p(s), s\right)$. This yields $p^s = \frac{1}{9\alpha}$ and $s^s = \frac{1}{3\alpha}$, and thus $\hat{\theta} = \frac{1}{3}$. (The alternative solution $p^s = p^s = \frac{1}{\alpha}$ does not satisfy the second order conditions)

[41] See footnote 29 in the main text for an example describing how price controls provide free advertising and facilitate access to new markets. In this model we assume consumers are perfectly informed about the attributes of the good; however, one might also think of advertising as a new margin to attract consumers under product differentiation (Grossman and Shapiro (1984)).

[42] We assume costs take the standard form $C(s) = \alpha s^2$, and that are independent of the quantity supplied. Convex quality costs are common in the literature (e.g., Mussa and Rosen (1978), Besanko, Donnenfeld, and White (1987)).

A.3.2 Proof of Remark 1

When $\bar{p}$ is fixed and exogenously set below p^m, the new optimal $\tilde{s}^m$ is lower than s^m. Let $\pi\Big(\bar{p}(\tau,\alpha),s\Big)-\pi\Big(\bar{p}(\tau,\alpha),s^m\Big)$ be the extra profit when s can be re-optimized. Replace $s^m=\frac{1}{3\alpha}$, $\bar{p}=\frac{2}{9\alpha}\tau$, and $s=\frac{1}{3\alpha}x$, where x is positive but finite. Then it can be shown that the profit difference is negative when $x>1$, and does not depend on the cost α. Alternatively, one can think of the profit function $\pi(\tau,\alpha,s)$ in terms of monotone comparative statics. $\pi(\tau,\alpha,s)$ is a twice continuously differentiable function in (τ,s), and $\mathcal{T}$ and S can be thought of as convex. Then it can be shown that $\pi(\tau,\alpha,s)$ has increasing differences in (τ,s). In other words, the extra benefit of increasing s (quality) is higher when τ is higher.

Under the new price $\bar{p}$, the firm would like to set a lower quality $\tilde{s}<s^m$ regardless of cost α. The price is fixed, exogenously set by the government, and the product must be supplied. For instance, when $\tau=0.9$, the new quality is about 7% lower. Although we cannot empirically measure quality, it is worth noting that quality downgrades substituting for price increases were common in past experiences. For instance, see Bourne (1919) on France in the years following the French Revolution, Darby (1976a) on the 1970s U.S. wage-price controls, Rockoff (2004) on the US during the World World II, or Moon and Stotsky (1993) on rent control programs in the US. However, downgrading quality, particularly in essential goods, can be costly in terms of reputation and fines.

A.3.3 Proof of Remark 2

When the firm waits-and-sees, i.e. sit tight and wait until the price control is over, she obtains a profit equal to $\pi=D(\bar{p},\tau,\gamma)\left(\frac{1}{9\alpha}\right)(2\tau-1)-f_1$. Where $D(\bar{p},\tau,\gamma)=\min\left\{\left(1-\frac{2}{3}\tau\right),(1-2/3)\gamma\right\}$ to account for possible capacity constraints. However, wait-and-see is not SPNE, because a potential entrant has now extra incentives to serve the higher willingness-to-pay for quality consumers. In particular, the entrant would like to set s_H and p_H such that $\theta_H=\frac{\Delta p}{\Delta s}=\theta_L$, while also satisfying (1) $s_H>s_L$, (2) $p_H>p_L=\bar{p}$, (3) $\theta_H<1$, and therefore steal the entire market. The extent to which an entrant can enter depends on α, τ, and the fixed cost differential across firms.

However, if τ or f_2 are low enough, the monopolist is better off introducing a new higher price-quality good.[43] This allows to capture the excess demand via market segmentation, i.e. discriminate between different θ-tastes for quality consumers. Let s_L and $p_L = \bar{p}$ denote the original's single-product optimal quality and afterwards controlled price, respectively. And then let s_H and p_H be the second product's optimal quality and price. The demand for good L and H are given by the marginal consumers θ_L and θ_H, namely $D_L = \frac{\Delta p}{\Delta s} - \frac{p_L}{s_L}$ and $D_H = \bar{\theta} - \frac{\Delta p}{\Delta s}$.

Formally, the firm's problem can be stated as follows[44]: $\max_{s_H} \pi\left(s_H, p_H^*(s_H), \tau, \alpha, \gamma\right)$ subject to the constraints (1) $p_L = \bar{p}_L$, (2) $s_L = s^m$, (3) $p_H > p_L$, (4) $s_H > s_L$, and (5) $\underline{\theta} < \theta_L < \theta_H < \tilde{\theta}(\gamma) < \bar{\theta}$. Where we set $\underline{\theta} = 0$ and $\bar{\theta} = 1$. The firm's response is SPNE in the sense that introduces a new good that, in the absence of price controls, decided not to introduce.

A.4 Multi-product monopolist

We briefly mention the case of a multi-product monopolist. Consider a two-good monopolist that supplies a low quality good s_L at price p_L, and a high quality good s_H good at price p_H. In the absence of price controls, it can be shown that the optimal prices and qualities are $p_L = \frac{3}{25\alpha}$, $s_L = \frac{1}{5\alpha}$, and $p_H = \frac{7}{25\alpha}$, $s_H = \frac{2}{5\alpha}$. Now consider a price ceiling $\bar{p}_L < p_L$ on the low-priced good. Intuitively, the response depends on the trade-off between extra profits from introducing a third good, the magnitudes of fixed costs and quality costs, the lost excess demand from capacity constraints, and harshness of the price ceiling. The firm may want to re-adjust s_H and p_H, possibly through a price decrease and quality downgrade, wait-and-see

[43]Our model differs from previous work which focus on across-the-board price controls, e.g. Raymon (1983), Besanko, Donnenfeld, and White (1987), Besanko, Donnenfeld, and White (1988). For instance in Besanko, Donnenfeld, and White (1987) the monopolist offers a continuous quality array, and $p(\theta) < \bar{p}, \forall \theta$. The price controls that we study are only binding for a subset of goods.

[44]For simplicity it is assumed that the firm does not leave "holes" in the demand line when introducing a new good, i.e. no excess demand between θ_L and θ_H. Where $\tilde{\theta}$ stands for the maximum willing-to-pay consumer that can be supplied under binding capacity constraints. The same condition is used in A.4 for the multi-product monopolist.

if she is compelled to serve the excess demand, or finally introduce a third variety resulting in higher average non-controlled prices.

Formally, that the monopolist may want to decrease p_H leaving s_H constant follows from the first-order condition for p_H in the two-goods' problem: $p_H = \bar{p}_L + \frac{\Delta s}{2} + \frac{\alpha(s_H^2 - s_L^2)}{2}$. The first-order condition for s_H does not depend on p_L. If changing prices are subject to no product holes (serve excess demand), depending on the harshness of $\bar{p}_L$, costs α and f_i, and the degree of capacity constraints, the firm could either wait-and-see, i.e. ration supply for controlled-good s_L with no price changes, or introduce a third variety, possibly resulting in higher average quality at the expense of higher non-controlled price dispersion and higher average prices.

The constrained three-goods problem can be stated as follows: $\max_{s_M, s_H}(\frac{\Delta p_M(s)}{\Delta s_M} - \frac{p_L}{s_L})(p_L - \alpha s_L^2) + (\frac{\Delta p_H(s)}{\Delta s_H} - \frac{\Delta p_M(s)}{\Delta s_M})(p_M(s) - \alpha s_M^2) + (\bar{\theta} - \frac{\Delta p_H(s)}{\Delta s_H})(p_H(s) - \alpha s_H^2) - f_1 - f_2 - f_3$ subject to (1) $p_L = \bar{p}_L$, (2) $s_L = s_L^m = \frac{1}{5\alpha}$, (3) $\bar{p}_L < p_M < p_H$, (4) $s_L < s_M < s_H$, and (5) $\underline{\theta} < \theta_L < \theta_M < \tilde{\theta}(\gamma) < \theta_H < \bar{\theta}$. We set $\underline{\theta} = 0$ and $\bar{\theta} = 1$.

The firm's problem with targeted price ceilings could be extended in several ways. A multi-firm problem would be better addressed using both horizontal and vertical differentiation, i.e. consumers have heterogeneous preferences over brands and quality, respectively. From stylized demands for differentiated products, where $q_L = a_L - b_L p_L + c p_H$ and $q_H = a_H - b_H p_H + c p_L$, one notes that the effects of price controls are not straightforward. The effects depend on price or quantity competition, strategic complements or substitutes, and the capacity constraints. Other domains to enhance the analysis are, for example, the effects of advertising, costly consumer search, consumer switching costs, anticipated and unanticipated price ceilings, and overshooting from costly price changes or stickiness. Aggressive price ceilings, even below marginal costs, can be related to an interesting literature on loss-leaders (Lal and Matutes (1994)).

A.5 Stages of Price Controls

Table 7: Summary Statistics By Stage

		Isolated Controls Stage 1	*Look to Care* Stage 3	*Protected Prices* Stage 4
(i)	Period	Oct 2007 to Feb 2013	June 2013 to Nov 2013	Jan 2014 to May 2015[c]
(ii)	Public Information	No	Yes	Yes
(iii)	Same Goods all Retailers	No	No	Yes
(iv)	Target Number of Products	–	500	100
Information obtained from our data:				
(iv)	Goods Identified	651	599	660
(v)	CPI Categories	47	50	50
(vi)	Retailer's Categories	203	205	217
(vii)	Average CPI Weight per Product	1.24	1.0	1.1
(viii)	Total CPI Weight	34.6	37.3	38.1
(xiv)	Median Days Controlled[a]	70	183	35
(x)	Average Days Controlled[a]	207	134	104
(ix)	Percent of Time Under Controls[b]	22%	83%	44%

Notes: Stage 2 is excluded because it was a targeted program; the government aimed to freeze all goods and did not officially disclose the identifiers of controlled products. [a]Median and average days under price controls is computed during the stage-specific period (row (i)). [b]Percent of time under price controls is computed during the stage-specific period and non-missing observations (in stock for sale). [c]Our data ends in May 2015, but the *Protected Prices* program continued after that. Details about the programs are in Section 2 in the main text.

A.6 Appendix Figures

A.6.1 Price Controls' Government Website

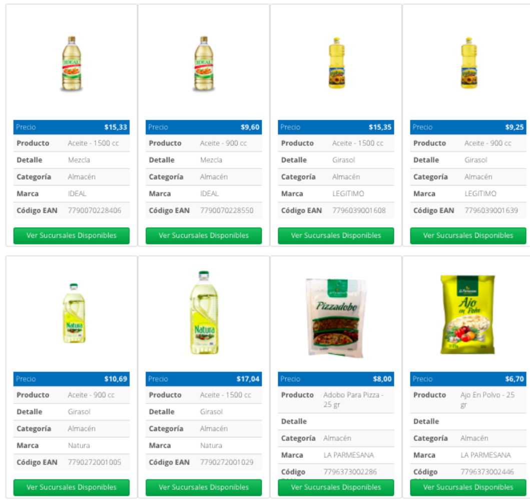


Figure 9: Example of controlled-goods in the City of Buenos Aires

Notes: Screenshot from the official government website on the targeted price control program. The list of controlled-goods include product details, price, and a sample picture. This allows a unique match against the online scraped database. Source: http://precioscuidados.gob.ar. Retrieved on July 14th, 2015.

A.6.2 Histogram Price Control Days

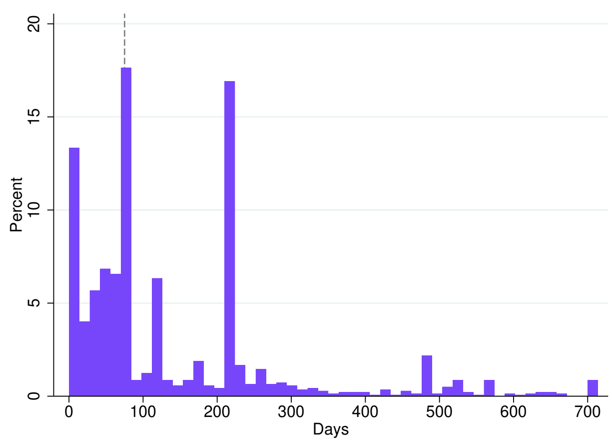


Figure 10: Histogram of Price Control Time

Notes: Axis restricted to two years for better visualization. Vertical line depicts a median control time of 75 days (average close to 120 days). Note that the estimates from this measure are subject to right-censoring, in particular for the most recent price control programs. Our scraping period stops in May 2015 but hundreds of products are still being controlled. The spike around 220 control days is driven by controlled-goods from stage 3.

A.6.3 Annual Inflation Rate and Monetary Policy

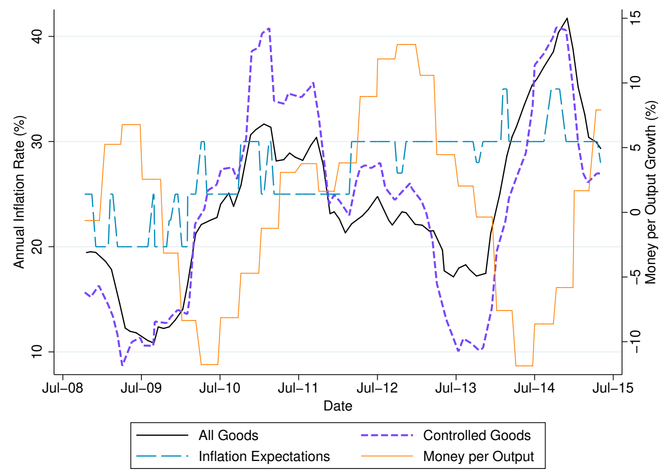


Figure 11: Price Controls and Money per Output

Notes: Median inflation expectations (next 12 months) surveyed by Universidad Torcuato Di Tella. Money per output calculated as the ratio of M2 to GDP. M2 is obtained from the Ministry of Finance and GDP from INDEC. Price indices computed as described in the text.

A.6.4 "Excess" Annual Inflation Rate

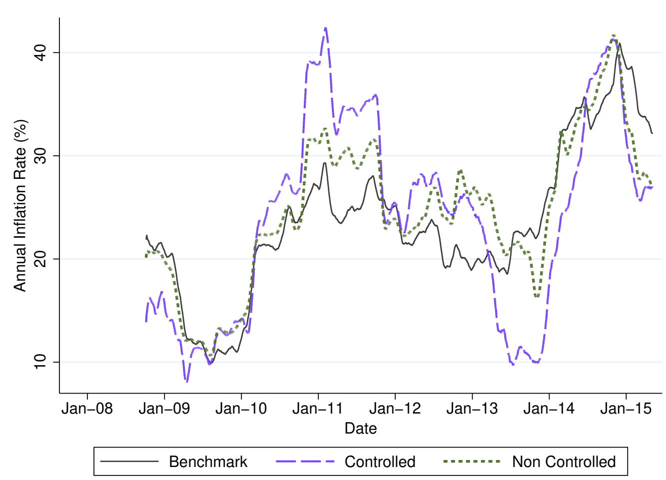


Figure 12: Excess Inflation

Notes: This figure shows larger inflation volatility for controlled-products. This is larger both relative to non-controlled products as well as a benchmark. Online price indices for controlled and non-controlled products are computed restricting the sample to controlled category-URLs. A benchmark price index is computed using non-controlled category-URLs. This provides a measure of "excess" inflation relative to categories that never received targeted price controls. Price indices are weighted using official weights by CPI categories.

A.6.5 Product Introductions and Discontinuities

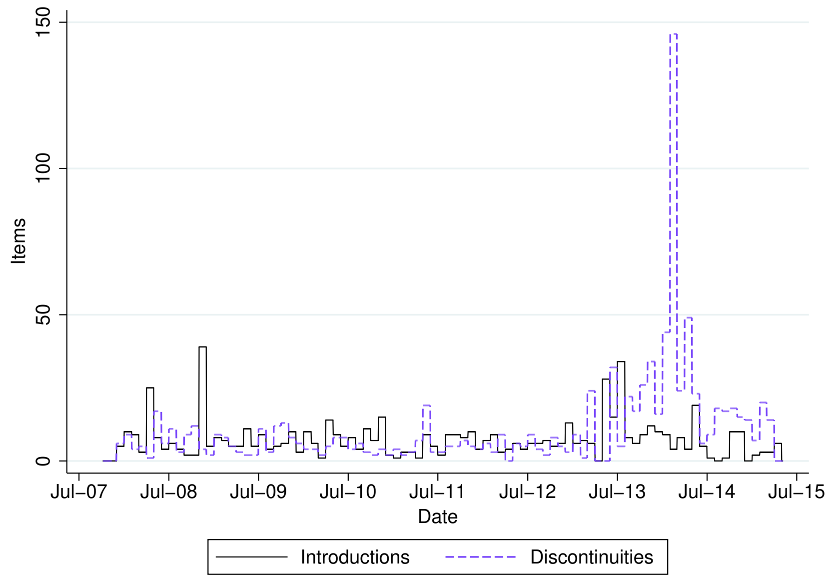


Figure 13: Introductions and Discontinuities

Notes: Calculated at the monthly level for controlled-goods.

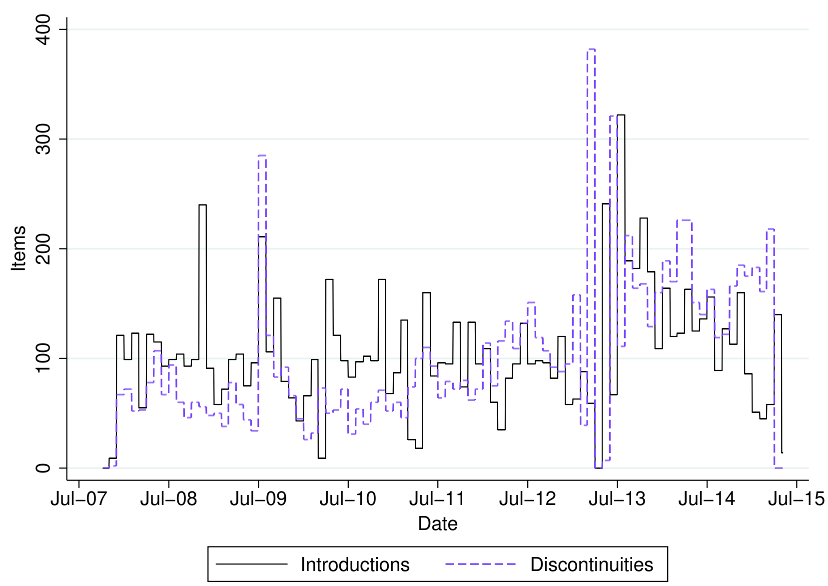


Figure 14: Introductions and Discontinuities

Notes: Calculated at the monthly level for non-controlled goods, restricting the sample to the same brands and retailer's categories that received price controls.