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EXPLORING THE LONG-TERM IMPACT OF MAXIMUM MARKUP DEREGULATION[***]

Do product market reforms have a lasting impact on the market? How does the adjustment path to the new equilibrium look once these reforms are implemented? Does it matter whether reforms are conducted under weak macroeconomic conditions? We examine pricing equilibrium, three and five years after the repeal of the maximum wholesale and retail markup regulation, in an oligopolistic and vertically non-integrated market in Greece, at the beginning of its economic crisis. Using a difference-in-difference framework, we show that market liberalization led to a significant decrease in both retail and wholesale prices and a shift to the left of the whole price distribution five years after the change, corresponding to approximately €212 million of added consumer welfare per year, or €1.06 billion in total over five years.

Key words: *Markup regulation. – Focal point. – Collusion. – Ex-post policy evaluation. – Long-term impact.*

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1. INTRODUCTION

Given the secular decline in productivity growth and the weakness of the economic recovery after the financial crisis in many advanced economies, increased attention is being paid to the potential role of structural reforms as a way of restoring economic growth. While structural reforms can take many forms, advanced countries have particularly focused on product market reforms (OECD 2015). Yet, despite the consensus that structural reforms boost employment and productivity in the long run, very little is known about the adjustment path to the new equilibrium once these reforms are implemented (Gal, Hijzen 2016). Moreover, there is natural concern and debate as to whether such reforms may have adverse short-run impact, especially if conducted under weak macroeconomic conditions (Caldera, de Serres, Yashiro 2016). Given the growing interest and increased concerns, robust ex-post policy evaluation is needed to measure short-term, but also med– and long-term, economic impact of product market reforms.

In this paper, we provide a detailed analysis of a product market reform by estimating the impact of the repeal of maximum markup regulation in the fresh fruit and vegetable market in Greece. First implemented right after the Second World War, markup regulation was hastily repealed in June 2011 with the objective of reducing unnecessary regulation of the Greek economy. Regulation consisted of maximum wholesale and retail markups on virtually all fruits and vegetables. Nonetheless, five products — apples, lemons, mandarins, oranges, and pears — were exempt from regulation. To identify the impact of deregulation on prices, we compare prices of products affected by regulation before and after the policy change, using unregulated products as a control group. After accounting for product and store characteristics, time trends and yearly price cycles (typical of fruit and vegetable products), deregulation provides some plausibly exogenous variation that allows us to estimate the causal impact of regulation. Moreover, this product market reform took place against the background of the Greek economy at the start of the longest recession of any advanced capitalist economy to date.

Building on Genakos *et al.* (2018), which studied the immediate impact of this deregulation, we extend their original dataset adding more products over a longer period of time, with the aim of examining the short-term (one year), medium-term (three years) and long-term (five years) effect of this reform (January 2010–June 2016). We use two main datasets: the first is weekly store level retail prices for each fruit and vegetable product category, both for supermarkets and street markets in Athens, Greece; the second are the three times per week median wholesale fruit and vegetable prices from the Athens Wholesale Central Market (henceforth Central Market).

Using the difference-in-difference methodology, we find that abolishing markup regulation led to a 5 percent average long-term retail price decrease. In aggregate, this decrease corresponds to savings of almost €212 million per year, or €1.06 billion in total over those five years. In line with Genakos *et al.* (2018), we find that deregulation had a direct effect on wholesalers and only indirectly affected retailers, who adjusted their prices in reaction to the lower wholesale prices. We also find that the drop in average prices is driven by a price drop for the majority of products and that price dispersion increased (particularly at the bottom of the distribution) in the retail and wholesale markets, as a consequence of deregulation. Finally, we confirm that the main channel through which this effect operates is that maximum markups were used as focal points for coordination in the Central Market. We traced back the causal channel and showed that the same transmission mechanism persists in the medium and long run.

This paper contributes to the existing literature in several ways. First, it adds to the growing literature of ex-post evaluation of product market reforms and their impact on efficiency along the adjustment path (see, for example, Djankov *et al.* 2002; Bertrand, Kramatrz 2002; Scarpetta, Tressel 2002; Carranza *et al.* 2015; Knittel, Stango 2003). Second, it informs the debate on recent investigations by the competition authorities (European Competition Network 2012) into suspected vertical and horizontal agreements in the food market. Finally, it adds to the growing literature looking at the causes of the crisis in Greece and the lessons to be learned (see, for example, Pelagidis, Mitsopoulos 2014; Meghir *et al.* 2017; Katsoulacos *et al.* 2017).

The remainder of this paper is organized as follows. Section 2 discusses the fruit and vegetable market and the background of the legislation in Greece. Section 3 presents data and some descriptive statistics. Section 4 provides the empirical methodology used, while Section 5 reports the results of markup deregulation on prices. Finally, Section 6 concludes.

2. BACKGROUND ON THE GREEK FRUIT AND VEGETABLE MARKET AND THE POLICY CHANGE

The Greek fruit and vegetable market consists of three layers. The first is the production layer, where the market is fragmented, compared to other EU countries.[1] The second layer is the wholesale market, which is significantly more concentrated, with the Central Market operating as a

[1] The average Greek producer cultivates just 47,000 m^2 (470 a) vs. the EU average of 126,000 m^2 (1,260 a). Moreover, around 50 percent of Greek producers own less than 20,000 m^2 (200 a) of land.

closed market in which only licensed sellers can operate. Wholesalers mainly sell to retailers (supermarkets being their largest customers), but also to street market sellers, grocery stores, and restaurants. Finally, the third layer is the retail market, which consists of supermarkets, street vendors, and grocery stores or other corner shops. Supermarkets (and grocery or corner shops) typically buy from the wholesale market. Street vendors either buy from the Central Market or they are producers themselves.

The history of regulation for fruits and vegetables dates back to the end of Second World War. After the war, the Greek government imposed various market regulations on prices and markups for essential and scarce products such as bread, meat, fruits and vegetables, and pharmaceutical products. Some years later (Law No. 3475/1955) the government created the (state-owned) Central Market, where the wholesale trade of raw agricultural products was required to take place. These policies had multiple objectives. In an economy plagued by scarcity of essential goods, they were designed to prevent wholesalers and retailers from making excessive profits. However, they were also aimed at setting specific standards of food safety and hygiene, and facilitating the monitoring of prices and markups by the competent authorities.

Markup regulation initially covered all fruits and vegetables. By 1977, however, five products (apples, lemons, mandarins, oranges, and pears) had been exempted from the application of maximum markup regulations, as they were considered available in sufficiently large supply. No change in the list of excluded products has occurred since. Maximum markup regulation remained in place for all other fruits and vegetables until 2011, although the initial conditions of scarcity had long ceased to exist. The production, trade, and consumption of these products is now widespread throughout the country.

Products exempted from markup regulation are not the output of any specific region or any identifiable set of producers, and they are statistically indistinguishable from unregulated products in terms of mean cultivation area, production quantity, and yield. Until 2011, the law provided for product-specific maximum markups ranging between 8 and 12 percent for the wholesale market, 20 and 35 percent for supermarkets, and 17 and 32 percent for street markets and grocery stores (see Table A1 in the Appendix for details). Following the 1977 reform of markup regulations, steps were gradually taken towards liberalizing the fruit and vegetable market. By the 1990s, only maximum markups were still in place.

The repeal of the maximum markup regulation was the outcome of mounting international pressure to liberalize the Greek economy in an attempt to limit red tape and government intervention in various markets.

Reactions, as reported in the newspapers at the time, were mixed and somewhat contradictory, with some expecting no change in prices to take place and others forecasting price increases. The process leading to deregulation was quick. The policy was implemented on 23 June 2011, about three weeks after the government first announced it. It is worthwhile noting that this product market liberalization took place against a background of the Greek economy entering a long and severe recession. The Greek crisis started in late 2009, triggered by the turmoil of the worldwide financial crisis, structural weaknesses in the Greek economy, and lack of monetary policy flexibility stemming from membership in the Eurozone. The crisis led to a loss of confidence in the Greek economy, indicated by a widening of bond yield spreads and the rising cost of risk insurance on credit default swaps compared to the other Eurozone countries. The government enacted twelve rounds of tax increases, spending cuts, and reforms between 2010 and 2016, which at times triggered local riots and nationwide protests. Despite these efforts, the country required bailout loans in 2010, 2012, and 2015, from the International Monetary Fund, Eurogroup, and European Central Bank, and negotiated a 50% "haircut" on debt owed to private banks in 2011, which amounted to a €100 bn debt relief. Hence, it is even more interesting, from an international perspective, to study the impact of this product market reform as it was taking place against one of the most severe economy-wide recessions.

3. DATA AND EMPIRICAL METHODOLOGY

3.1. Data Construction

We matched two different data sources for our analysis. First, we obtained weekly store-level retail prices for fruits and vegetables in Athens[2] from the Ministry of Development and Competitiveness. The data contained information on 36 products, further divided into 72 varieties, from 28 supermarkets and 28 street markets, and covered the period from 4 January 2010 to 6 June 2016. Products and varieties are reported in Table A2 in the Appendix.

Second, we also obtained the three times per week wholesale median, minimum and maximum prices of fruits and vegetables from the administration of the Central Market, for the same period. The wholesale data consisted of 44 products and 72 product varieties (of which 59 are common to the retail ones). Given that the change in regulation took

[2] We focused on Athens, as it is by far the biggest market in Greece, is well-documented in our supermarket sample, and provides reliable information on wholesale prices.

place in June 2011, we defined the period one year after the change (2010–2012) as "short term", equivalently three years after the change (2010–2014) as "medium term", and five years after the change (2010–2016) as "long term".

Figure 1 plots the time series of year-month average log prices of fruits and vegetables for the retail sector. The dashed black line shows products affected by regulation (treatment group), while the dashed grey line shows the five products not affected by regulation (control group). The average price of products not affected by the regulation (the solid grey line) practically does not change during the period following the policy change. Instead, the average price of products affected by regulation (the solid black line) shows a large drop, indicating a significant reduction in the price of these products. Figure 2 plots the corresponding figure for the wholesale market. As in the case of the retail market, the average price of products affected by the regulation significantly drops, whereas, the average price of products in the control group remains at the same level.

Figure 3 reports the distribution of retail prices for products affected by the policy change, before it (the black line), in the short run (the blue line), in the medium run (the green line), and in the long run (the red line), following its implementation. The figure shows a substantial change in distribution after the reform, with a decrease of the mean and an increase in the standard deviation, which is particularly strong in the left tail.

Almost the same picture emerges in Figure 4 for wholesale prices, where the mean price declined and variance increased. Here we see a much clearer shift of the entire distribution of prices to the left, with both the left and right tails moving significantly over time.

3.2. Empirical Methodology and Identification

We identified the impact of the policy change using a difference-in-difference empirical framework. Denoted by P_{ijt} is the retail price of product variety i, in store j, during week t. The baseline empirical specification is of the form:

$$\ln (P_{ijt}) = b_0 + b_1 Post_t + b_2 Treat_i + b_3 Post_t \times Treat_i + X_{ijt}\, d + e_{ijt} \qquad (1)$$

where $Post_t$ is an indicator variable equal to one after deregulation, $Treat_i$ is an indicator variable equal to one for products affected by the regulation (treatment group), $Post_t$ x $Treat_i$ denotes their interaction, X_{ijt} is a matrix of control variables and e_{ijt} is a random shock with E (e_{ijt}/ $Post_t$, $Treat_i$, X_{ijt}) = 0. b_3 is the parameter of interest, since it captures the impact of the policy change.

The key identifying assumption is that price trends are the same (conditional on covariates) for the treatment and control groups without any changes in regulation. This assumption became increasingly credible as we progressively added more controls in X_{ijt}. First, we controlled for changes in the VAT rates.[3] Second, we included in X_{ijt} the month indicator variables, 53 store indicator variables, and 109 product variety-specific indicator variables. We then added the interaction of month and product fixed effects, capturing the yearly price cycle of each product (we assumed that varieties of the same product follow the same cycle). Finally, we included a quadratic trend (measured in months). This captures the overall changes in the average price of fruit and vegetable products during the sample period (due, for example, to the economic recession). The analysis of wholesale prices uses the same empirical specification, with the caveat that only median (as well as the minimum and maximum) wholesale prices at a weekly frequency are available for each product variety.

4. SHORT, MEDIUM, AND LONG-TERM IMPACT OF DEREGULATION ON PRICES

Table 1 reports the results of the analysis of the retail data alone. The simple difference-in-difference estimator without any additional controls (column 1) shows a 10.1 percent decrease in the average price of the treatment group one year after the deregulation (short-term impact), in line with the results in Genakos *et al.* (2018). The impact seems to get stronger in column 2, where we enlarge the time window after deregulation to three years (medium-term impact). The positive and significant impact also seems to hold in column 3, even five years after the change in regulations (long-term impact). These conclusions seem to be robust to the inclusion of store and product × month fixed effects and a linear and quadratic trend in columns 4–6. The estimated impact five years after the regulation seems to be a robust 4.9 percent reduction on average prices.

The economic magnitude of this result is significant. A 4.9 percent decrease corresponds to yearly savings of €19 per person.[4] Aggregately, this indicates that the long-term savings from deregulation amount to €212 million per year, i.e. €1.06 billion in total over those five years.

Table 2 reports the results when we analyzed the wholesale market alone. Columns 1–3 report the difference-in-difference estimator without

[3] During our sample period, there were three changes in VAT rates, which potentially affected both regulated and unregulated products: from 9% to 10% on 15 March 2010, from 10% to 11% on 1 July 2010, and from 11% to 13% on 1 January 2011.

[4] A 4.9 percent decrease of the prices of fruits and vegetables illustrates a 0.82 percent decrease in the price of food for the typical household in Greece and a corresponding decrease of 0.13 percent of the price index. The average household in Greece consists of 2.6 persons.

any additional controls. The impact on the wholesale market seems to monotonically decrease in value from 10.8 percent after one year (column 1), to 9.9 percent after three years (column 2), and to 6.8 percent after five years (column 3). The same pattern holds true in columns 4–6 when we add all the additional controls. Column 4 shows a 10.2 percent decrease just one year after the change, which becomes 11.2 percent in column 5, three years after the deregulation. Column 6 shows that even after five years we can detect a significant and sizable 9.2 percent decrease in wholesale prices. Hence, the average prices for products affected by the reform decreased in both markets. They are greater in magnitude in the medium run and smaller in the long run, compared with the short-run effect.

4.1. The Impact on the Distribution of Prices

As we saw earlier in Figures 3 and 4, deregulation seemed to have had an effect on the entire price distribution. After deregulation, the distributions shifted to the left and became more dispersed. In Table 3 we used quantile regressions to measure the impact of markup regulation on the distribution of retail price residuals. The results indicate that although the short-term effect was mainly concentrated in the middle and left parts of the distribution, the long-term effect seems to also manifest in the right tail, hence moving the entire price distribution to the left. A similar picture emerges in Table 4, which presents the results of the quantile regressions for the wholesale market. Although initially it was the middle and left parts of the distribution that were most affected, over time all parts had a negative coefficient again indicating a shift of the entire distribution to the left.

As a robustness exercise for the wholesale market, we also looked at the changes using the minimum and maximum wholesale prices for each product. With this information, we computed the monthly relative wholesale price range for each product, $(max_{it} - min_{it})/min_{it}$. Table 5 reports the results of the difference-in-difference regressions on price range. Wholesale price variability significantly increased as a result of the reform both in the short (column 1), but also in the medium (column 2) and long run (column 3). Looking at the minimum (columns 4–6) vs. maximum prices (columns 7–9), we can see that minimum prices significantly decreased, while maximum prices were largely unaffected by the reform. Hence, the increase in price variability can be attributed to a shift of the left tail of the wholesale price distribution. Therefore, both quantile and price variability analyses show that deregulation had a permanent effect on the market by shifting the entire price distribution to the left and lowering average prices.

4.2. Product Specific Effects

The estimated impact of the reform, presented in Tables 1 and 2, is the average effect across products in the treatment group. However, we can exploit the richness of the data and estimate the impact of the reform separately for each product, while keeping the same control group. This allows us also to examine whether the benefits of the reform were concentrated on a few products or whether they were more widely spread and hence easier to pass through to final consumers.

Table 6 reports the product-specific coefficients of the interaction of $Post_t$ x $Treat_i$ in equation (1) with product-specific indicator variables, columns 1–3 refer to the retail market, whereas columns 4–6 refer to the wholesale one. While there is significant variability across products, the negative effect of deregulation is not specific to one or a small set of products: wholesale results indicate that 34 out of 39 products[5] show a negative coefficient and 30 out of 39 are statistically significant at the 5 percent confidence level in the medium-term. Comparing these results with the short run, it is apparent that the effect of policy change is stronger, since it indicates a 20 percent in the medium run increase on products with statistically significant coefficients, and a 16 percent increase in the long run. Similar results emerged in the analysis of the retail market: the drop in average prices is driven by the fall in the majority of products and this effect holds over time.

4.3. Examining the Channels of the Deregulation Impact

Our results on the negative impact of deregulation on the mean retail and wholesale prices are not consistent with the view that the sole effect of the regulation was the constraining of firms with high markups. While some firms might have been constrained by the markup regulation, another effect must have played a significant role. Genakos *et al.* (2018) shows that the main alternative explanation is that regulation facilitated collusive behavior. The economic intuition underlying this idea is that (unconstrained) firms used the maximum markup as the focal point for coordination, leading to increases in average prices. Repeal of the law destroyed these focal points and led to significant price decreases. Genakos *et al.* (2018) provides evidence that the source of collusion was the Central Market. In the rest of this paper we trace back the same causal channel and examine whether the same transmission mechanism persisted in the medium and long term.

Table 7 depicts the impact of the policy change on retail prices using pass-through regressions, which allow us to disentangle the direct

[5] There are eight more products in the wholesale market together with data availability for the watermelon. Data for watermelon is limited for the retail market, therefore it is excluded.

impact of the policy on the distribution of retail prices from the indirect impact through the effect on the wholesale price distribution. We merged the retail with the wholesale price data, excluding the varieties not included in the wholesale data set. Column 1 shows the results from our benchmark specification where, in addition to store, variety-specific fixed effects, product-specific yearly cycles and quadratic trends, we also controlled for wholesale prices. The effect of the policy now becomes statistically insignificant. Deregulation affected retail prices indirectly through wholesale prices, but there is no evidence of a direct effect of deregulation on retail prices. Hence, pass-through regressions clearly point towards collusion in the wholesale market as the cause of the overall fall in prices after the reform. The same is true for the medium (column 2) and long run (column 3).

4.4. The Heterogeneous Impact of the Reform in Supermarkets and Street Markets

The fact that the effect of the reform on prices originated in the wholesale market is also supported by the differential effect of deregulation in supermarkets and street markets. As discussed in Section 2, supermarkets typically buy all their grocery products from the wholesale market (Hellenic Competition Commission 2013). Street vendors, on the other hand, have access to a variety of small producers, or are producers themselves. Hence, collusion at the wholesale level is more likely to have a higher impact on prices in supermarkets than at street markets.

In Table 8, column 1, we find that the policy change indeed had a large and significant impact (-10.8 percent) on supermarkets, whereas street markets were relatively unaffected. The same phenomenon persists both in the medium (column 2) and long run (column 3), with the supermarkets being the main channel of transmission of lower prices.

To further confirm the key role played by the wholesale market, we analyze the differential impact of the policy change on specific products sold at street markets. In fact, even street vendors have to rely on wholesalers for their supply of some specific products. Based on information drawn from the Hellenic Competition Commission report (2013), street vendors almost never buy lettuce from wholesalers, but rely on them heavily for peaches. Hence, we could test whether the policy had a different impact on the street market price of these two products.

Table 8, column 4, reports the results of our benchmark specification using the same control group as before, but this time including only lettuce (classified as “low”) and peaches (“high”) in the treatment group interacted, with indicators for supermarkets or street markets. Column 4 shows that at street markets, deregulation had no significant impact on the price of lettuce ($Low_i \times Street\ market_j$), but had a negative impact on

the price of peaches ($High_i \times Street\ market_j$). By contrast, in supermarkets, both lettuce and peaches were affected by the policy. Hence, the decrease in prices is only evident when the wholesale market plays an important role. Remarkably, this differential effect can be traced back even three (column 5) and five (column 6) years after the original deregulation.

5. CONCLUSIONS

In this paper, we presented systematic evidence of the short-term (one year), medium-term (three years) and long-term (five years) impact of a change in maximum markup regulation on prices. The results indicate that the abolishment of markup regulation led to a significant price decrease, corresponding to an estimated €212 million in yearly consumer savings at the national level. We also provide evidence that the long-term impact of deregulation was to move the entire price distribution to the left and it was observed for most products on the market. Finally, we were able to trace back the original channel of the breakdown of the collusion in the Central Wholesale Market and examine the persistency of the transmission mechanism over time. Overall, the results of our ex-post policy evaluation highlight that deregulation in this case had a positive and unexpected effect, making the fruit and vegetable market in Greece more competitive and efficient, not just in the long run but throughout the adjustment path, against the background of an economy in severe recession. We very much hope that our findings will add an interesting case to the debate on product market reforms and whether market liberalization raises competitiveness and boosts economic growth in an equitable way across the society.

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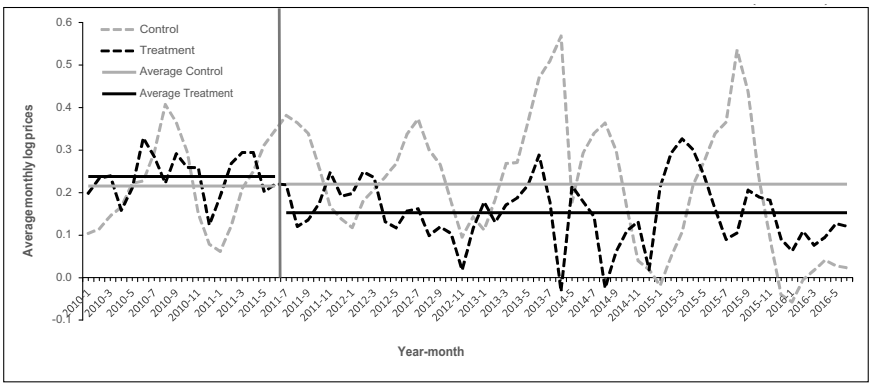
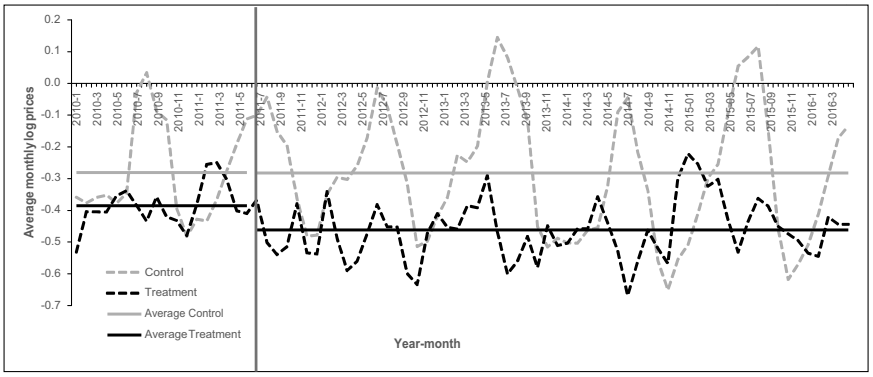
FIGURE 1: AVERAGE RETAIL PRICES OF REGULATED AND UNREGULATED PRODUCTS (2010–2016)



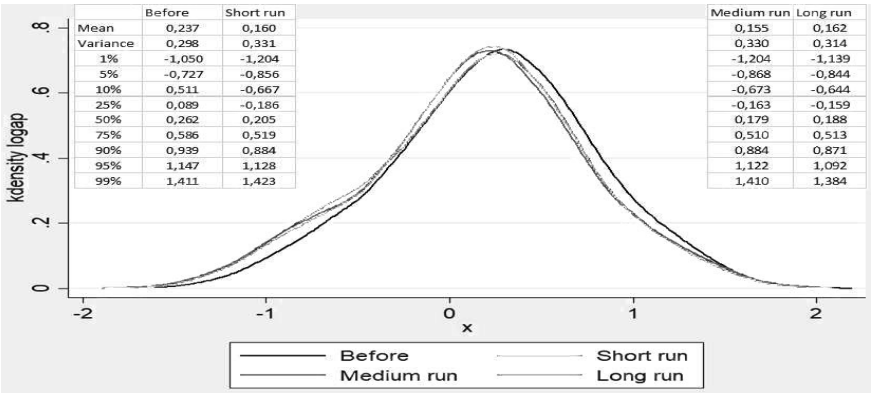
Note: The figure reports the monthly average of the logarithm of fruits and vegetables products' prices affected by the markup regulation (treatment group, black dashed line) and not affected by regulation (control group, grey dashed line) and their averages (black solid line for the treatment group and grey solid line for the control group) before and after deregulation.
Source: Authors' calculations based on data from the Greek Ministry of Development.

FIGURE 2: AVERAGE WHOLESALE PRICES OF REGULATED AND UNREGULATED PRODUCTS (2010–2016)



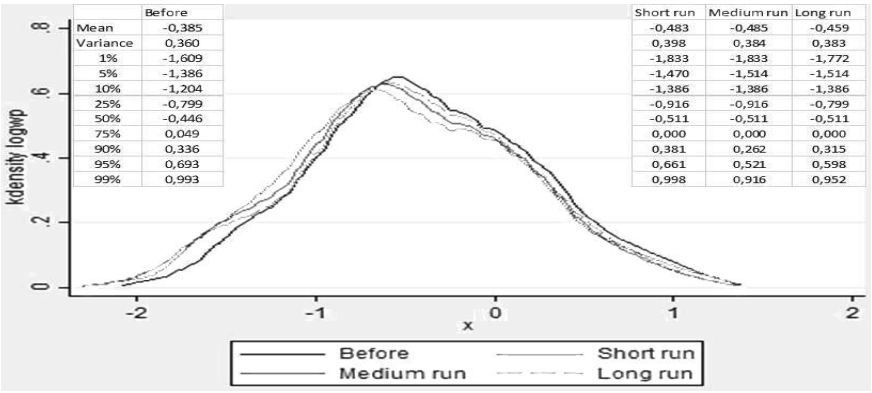
Note: The figure reports the monthly average of the logarithm of fruits and vegetables products' prices affected by the markup regulation (treatment group, black dashed line) and not affected by regulation (control group, grey dashed line) and their averages (black solid line for the treatment group and grey solid line for the control group) before and after deregulation.
Source: Authors' calculations based on data from the Central Market.

FIGURE 3: THE DISTRIBUTION OF RETAIL PRICES BEFORE AND AFTER DEREGULATION



Note: The figure plots the distribution of log retail prices of fruits and vegetable products in the treatment group one and a half years before ("Before"), one and a half years after ("Short run"), three and a half years after ("Medium run") and five years after ("Long run") the policy change. Sample statistics are reported in the top corners.
Source: Authors' calculations based on data from the Greek Ministry of Development.

FIGURE 4: THE DISTRIBUTION OF WHOLESALE PRICES BEFORE AND AFTER DEREGULATION



Note: The figure plots the distribution of log wholesale prices of fruits and vegetable products in the treatment group one and a half years before ("Before"), one and a half years after ("Short run"), three and a half years after ("Medium run") and five years after ("Long run") the policy change. Sample statistics are reported in the top corners.
Source: Authors' calculations based on data from the Central Market.

TABLE 1 – THE IMPACT OF DEREGULATION ON RETAIL PRICES

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	OLS	OLS	FE	FE	FE
Dependent variable	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$
Sample	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment
Time period	2010-2012	2010-2014	2010-2016	2010-2012	2010-2014	2010-2016
$\text{Treat}_i \times \text{Post}_t$	-0.101**	-0.121**	-0.077**	-0.064***	-0.082***	-0.049***
	(0.045)	(0.054)	(0.036)	(0.023)	(0.021)	(0.017)
Post_t	0.024	0.039	0.002	0.005	0.019	-0.028
dummy=1 after 22 June 2011	(0.036)	(0.047)	(0.028)	(0.021)	(0.027)	(0.022)
Treat_i	0.028	0.028	0.028			
	(0.117)	(0.117)	(0.117)			
Observations	56,523	82,858	112,534	56,523	82,858	112,534
Adjusted R^2	0.005	0.006	0.003	0.859	0.858	0.845
Clusters	72	72	72	72	72	72
Store FE				yes	yes	yes
Product variety FE				yes	yes	yes
Month × Product FE				yes	yes	yes
Year-month trend and square				yes	yes	yes

Note: The dependent variable is the logarithm of the retail price of product variety *i*, in store *j*, and day *t*. All regressions include binary indicators for the changes in VAT rates. Standard errors clustered at the product variety level are reported in parenthesis below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.
Source: Authors' calculations based on data from the Greek Ministry of Development.

TABLE 2 – THE IMPACT OF DEREGULATION ON WHOLESALE PRICES

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	OLS	OLS	FE	FE	FE
Dependent variable	$\ln(\text{Wholesale Price})_{it}$	$\ln(\text{Wholesale Price})_{it}$	$\ln(\text{Wholesale Price})_{it}$	$\ln(\text{Wholesale Price})_{it}$	$\ln(\text{Wholesale Price})_{it}$	$\ln(\text{Wholesale Price})_{it}$
Sample	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment
Time period	2010-2012	2010-2014	2010-2016	2010-2012	2010-2014	2010-2016
$\text{Treat}_i \times \text{Post}_t$	-0.108*	-0.099*	-0.068	-0.102***	-0.112***	-0.092***
	(0.059)	(0.052)	(0.050)	(0.034)	(0.024)	(0.030)
Post_t	0.009	-0.001	-0.006	-0.055	-0.014	-0.029
dummy=1 after 22 June 2011	(0.047)	(0.041)	(0.041)	(0.036)	(0.038)	(0.035)
Treat_i	-0.086	-0.086	-0.086			
	(0.134)	(0.134)	(0.134)			
Observations	12.294	20,783	28,686	12.294	20,783	28,686
Adjusted R^2	0.014	0.016	0.011	0.882	0.868	0.851
Clusters	72	72	72	72	72	72
Product variety FE				yes	yes	yes
Month × Product FE				yes	yes	yes
Year-month trend and square				yes	yes	yes

Note: The dependent variable is the logarithm of the wholesale price of product variety *i* in day *t*. All regressions include binary indicators for the changes in VAT rates. Standard errors clustered at the product variety level are reported in parenthesis below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.
Source: Authors' calculations based on data from the Central Market.

TABLE 3 – THE IMPACT OF DEREGULATION ON RETAIL PRICES (QUANTILE REGRESSIONS)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable	residuals	residuals	residuals	residuals	residuals	residuals	residuals
		1th percentile	5th percentile	25th percentile	50th percentile	75th percentile	95th percentile	99th percentile
2010-2012	$Treat_i \times Post_t$	-0.087*	-0.067*	-0.052**	-0.063***	-0.066***	-0.038*	-0.032
		(0.044)	(0.037)	(0.020)	(0.018)	(0.019)	(0.023)	(0.053)
	Observations	56,523	56,523	56,523	56,523	56,523	56,523	56,523
2010-2014	$Treat_i \times Post_t$	-0.102***	-0.072**	-0.066***	-0.080***	-0.084***	-0.076***	-0.114***
		(0.031)	(0.029)	(0.020)	(0.017)	(0.021)	(0.027)	(0.041)
	Observations	82,858	82,858	82,858	82,858	82,858	82,858	82,858
2010-2016	$Treat_i \times Post_t$	-0.053	-0.026	-0.038*	-0.041**	-0.052***	-0.070**	-0.120**
		(0.043)	(0.039)	(0.019)	(0.017)	(0.020)	(0.030)	(0.052)
	Observations	112,534	112,534	112,534	112,534	112,534	112,534	112,534

Note: The dependent variable is the residuals of a regression of the logarithm of the retail price of product variety *i,* in store *j,* and day *t* on store, product variety, month × product fixed effects and a linear and quadratic trend measured in months including binary indicators for the changes in VAT rates. Standard errors clustered at the product variety level are reported in parenthesis below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.
Source: Authors' calculations based on data from the Greek Ministry of Development.

TABLE 4 – THE IMPACT OF DEREGULATION ON WHOLESALE PRICES (QUANTILE REGRESSIONS)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable	residuals	residuals	residuals	residuals	residuals	residuals	residuals
		1th percentile	5th percentile	25th percentile	50th percentile	75th percentile	95th percentile	99th percentile
2010-2012	$Treat_i \times Post_t$	-0.273***	-0.197***	-0.144***	-0.103***	-0.128***	0.031	0.385***
		(0.036)	(0.056)	(0.040)	(0.036)	(0.048)	(0.053)	(0.037)
	Observations	12,294	12,294	12,294	12,294	12,294	12,294	12,294
2010-2014	$Treat_i \times Post_t$	-0.050	-0.098*	-0.084***	-0.074**	-0.083***	-0.079**	-0.269***
		(0.047)	(0.051)	(0.025)	(0.030)	(0.031)	(0.036)	(0.047)
	Observations	20,783	20,783	20,783	20,783	20,783	20,783	20,783
2010-2016	$Treat_i \times Post_t$	-0.078	-0.092	-0.072**	-0.049*	-0.068**	-0.077	-0.151
		(0.115)	(0.100)	(0.033)	(0.028)	(0.027)	(0.092)	(0.111)
	Observations	28,686	28,686	28,686	28,686	28,686	28,686	28,686

Note: The dependent variable is the residuals of a regression of the logarithm of the wholesale price of product variety *i,* in day *t* on product variety, month × product fixed effects and a linear and quadratic trend measured in months including binary indicators for the changes in VAT rates. Standard errors clustered at the product variety level are reported in parenthesis below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.
Source: Authors' calculations based on data from the Central Market.

TABLE 5 – THE IMPACT OF DEREGULATION ON WHOLESALE PRICES RANGE, MINIMUM & MAXIMUM

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Estimation method	FE	FE	FE	FE	FE	FE		FE	FE
Dependent variable	Wholesale Price Range$_{it}$	Wholesale Price Range$_{it}$	Wholesale Price Range$_{it}$	ln(Wholesale Min Price)$_{it}$	ln(Wholesale Min Price)$_{it}$	ln(Wholesale Min Price)$_{it}$	ln(Wholesale Max Price)$_{it}$	ln(Wholesale Max Price)$_{it}$	ln(Wholesale Max Price)$_{it}$
Sample	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment	Control & Treatment
Time period	2010-2012	2010-2014	2010-2016	2010-2012	2010-2014	2010-2016	2010-2014	2010-2014	2010-2016
Treat$_i$ × Post$_t$	0.239***	0.220***	0.215***	-0.176***	-0.184***	-0.159***	-0.048	-0.070**	-0.050
	(0.061)	(0.071)	(0.072)	(0.037)	(0.029)	(0.026)	(0.030)	(0.028)	(0.038)
Observations	12,294	20,783	28,686	12,294	20,783	28,686	12,294	20,783	28,686
Adjusted R^2	0.471	0.398	0.371	0.850	0.836	0.816	0.895	0.882	0.867
Clusters	72	72	72	72	72	72	72	72	72
Product FE	yes	yes	yes	Yes	yes	yes	yes	yes	yes
Month × Product FE	yes	yes	yes	Yes	yes	yes	yes	yes	yes
Year-month trend and square	yes	yes	yes	Yes	yes	yes	yes	yes	yes

Notes: The dependent variable (Columns 1, 2 and 3) is the wholesale price range divided by the minimum price, $(max - min)/min$ for product variety *i* in day *t*. The depentent variable Columns 4, 5 and 6 (Columns 7, 8 and 9) is the logarithm of the minimum (maximum) wholesale price of product variety *i* in day *t.* All regressions include binary indicators for the changes in VAT rates. Standard errors clustered at the product variety level are reported in parenthesis below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

Source: Authors' calculations based on data from the Central Market.

TABLE 6 – THE IMPACT OF DEREGULATION ON RETAIL AND WHOLESALE PRICES BY PRODUCT

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	FE	FE	FE	FE	FE	FE
Dependent variable	ln(Retail Price)$_{ijt}$	ln(Retail Price)$_{ijt}$	ln(Retail Price)$_{ijt}$	ln(Wholesale Price)$_{it}$	ln(Wholesale Price)$_{it}$	ln(Wholesale Price)$_{it}$
Time period	Short run	Medium run	Long run	Short run	Medium run	Long run
Apricot	-0.271***	-0.208***	-0.154***	-0.284***	-0.201***	-0.162***
	(0.023)	(0.035)	(0.046)	(0.027)	(0.045)	(0.046)
Artichoke	-0.028	-0.073***	0.035*	-0.146***	-0.162***	-0.063*
	(0.017)	(0.015)	(0.017)	(0.033)	(0.022)	(0.034)
Banana	-0.010	-0.030	-0.001	0.049*	0.052***	0.057**
	(0.020)	(0.020)	(0.015)	(0.028)	(0.017)	(0.021)
Beans	-0.058*	-0.075**	-0.061**	0.012	-0.043	-0.046
	(0.031)	(0.028)	(0.023)	(0.030)	(0.036)	(0.035)
Beetroot	-0.023	-0.056**	-0.002	-0.019	-0.030*	0.024
	(0.019)	(0.020)	(0.015)	(0.029)	(0.018)	(0.026)
Broccoli	-0.121***	-0.123***	-0.041**	-0.124***	-0.154***	-0.109***
	(0.019)	(0.016)	(0.017)	(0.029)	(0.018)	(0.025)
Cabbage	-0.180***	-0.194***	-0.076***	-0.136***	-0.180***	-0.059**
	(0.019)	(0.018)	(0.014)	(0.030)	(0.018)	(0.025)
Carrot	-0.110***	-0.085***	-0.042**	-0.054*	-0.006	0.026
	(0.020)	(0.020)	(0.014)	(0.029)	(0.017)	(0.021)
Cauliflower	-0.157***	-0.125***	-0.021	-0.202***	-0.181***	-0.090***
	(0.020)	(0.017)	(0.014)	(0.029)	(0.018)	(0.024)
Cherry	-0.011	-0.063**	-0.086***	-0.010	-0.109***	-0.154***
	(0.021)	(0.026)	(0.018)	(0.027)	(0.028)	(0.026)
Cucumber	0.041	-0.009	0.002	0.000	-0.036**	-0.031
	(0.027)	(0.021)	(0.015)	(0.027)	(0.017)	(0.021)
Eggplant	-0.037*	-0.066***	-0.050***	-0.048	-0.065***	-0.066**
	(0.020)	(0.019)	(0.014)	(0.030)	(0.023)	(0.030)
Fresh onion	0.012	-0.047**	0.010	0.044	-0.136***	-0.069**
	(0.019)	(0.020)	(0.015)	(0.028)	(0.018)	(0.027)
Grapes	0.014	-0.013	-0.007	0.038	-0.082	-0.053
	(0.030)	(0.031)	(0.020)	(0.046)	(0.053)	(0.044)
Greens	-0.080***	0.005	0.050***	0.151***	0.041**	0.082***
	(0.019)	(0.020)	(0.015)	(0.028)	(0.017)	(0.021)
Kiwi	-0.029	0.005	0.012	-0.105***	-0.004	-0.069**
	(0.074)	(0.075)	(0.073)	(0.030)	(0.019)	(0.031)
Leek	-0.033*	-0.081***	0.012	-0.087***	-0.111***	-0.042
	(0.019)	(0.017)	(0.015)	(0.028)	(0.018)	(0.028)
Lettuce	-0.093***	-0.098***	-0.081***	-0.163***	-0.176***	-0.150***
	(0.020)	(0.020)	(0.015)	(0.028)	(0.017)	(0.021)
Mellon	-0.167***	-0.166***	-0.155***	-0.162***	-0.201***	-0.180***
	(0.055)	(0.052)	(0.052)	(0.035)	(0.019)	(0.015)
Nectarine	-0.191***	-0.213***	-0.228***	-0.122***	-0.159***	-0.161***
	(0.026)	(0.030)	(0.020)	(0.034)	(0.019)	(0.013)
Okra	-0.057*	-0.096***	-0.077***	0.181***	0.120***	0.147***
	(0.029)	(0.033)	(0.021)	(0.047)	(0.023)	(0.015)
Onion	-0.179***	-0.222***	-0.127***	-0.218***	-0.202***	-0.111***
	(0.020)	(0.020)	(0.015)	(0.029)	(0.017)	(0.021)

	(1)	(2)	(3)	(4)	(5)	(6)
Peach	-0.172***	-0.221***	-0.251***	-0.090	-0.176***	-0.221***
	(0.025)	(0.029)	(0.019)	(0.056)	(0.026)	(0.024)
Peas	-0.151***	-0.144***	-0.120***	-0.263***	-0.412***	-0.407***
	(0.021)	(0.018)	(0.018)	(0.033)	(0.022)	(0.037)
Pepper	-0.104***	-0.123***	-0.102***	-0.068**	-0.074***	-0.062*
	(0.027)	(0.025)	(0.023)	(0.028)	(0.020)	(0.031)
Potato	-0.129***	-0.074***	-0.064***	-0.191***	-0.120**	-0.139**
	(0.024)	(0.019)	(0.020)	(0.063)	(0.047)	(0.051)
Spinach	-0.027	-0.046**	0.020	-0.013	-0.002	0.060**
	(0.019)	(0.018)	(0.014)	(0.029)	(0.017)	(0.026)
Strawberry	0.023	-0.094***	-0.037*	-0.063*	-0.116***	-0.099**
	(0.019)	(0.017)	(0.018)	(0.032)	(0.020)	(0.037)
Tomato	-0.060***	-0.074***	-0.068***	-0.221***	-0.201***	-0.167***
	(0.020)	(0.020)	(0.015)	(0.027)	(0.017)	(0.023)
Zucchini	-0.070***	-0.127***	-0.124***	-0.109***	-0.148***	-0.126***
	(0.020)	(0.020)	(0.015)	(0.027)	(0.017)	(0.021)
Watermelon				-0.094***	-0.118***	-0.085***
				(0.029)	(0.016)	(0.018)
Vlita				-0.076**	-0.074***	-0.041**
				(0.029)	(0.017)	(0.017)
Dill & parsley				-0.110***	-0.151***	-0.160***
				(0.028)	(0.017)	(0.021)
Pomegranate				-0.223***	-0.282***	-0.311***
				(0.035)	(0.022)	(0.013)
Quince				-0.075**	-0.135***	-0.151***
				(0.032)	(0.021)	(0.014)
Damson				-0.268***	-0.264***	-0.242***
				(0.036)	(0.016)	(0.027)
Fig				0.124**	-0.079***	-0.143***
				(0.046)	(0.024)	(0.016)
Loquat				-0.229***	-0.259***	-0.216***
				(0.032)	(0.018)	(0.035)
Sour cherry				0.359***	0.065***	-0.032*
				(0.047)	(0.047)	(0.015)
Store FE	yes	Yes	Yes			
Product variety FE	yes	Yes	Yes	yes	yes	yes
Month × Product FE	yes	Yes	Yes	yes	yes	yes
Year-month trend and square	yes	Yes	yes	yes	yes	yes

Note: The dependent variable in columns 1, 2, and 3 is the logarithm of the retail price of product variety *i*, in store *j*, and week *t*. The dependent variable in columns 4, 5, and 6 is the logarithm of the wholesale price of product variety *i* in month *t*. All regressions include binary indicators for the changes in VAT rates. Standard errors clustered at the product variety level are reported in parenthesis below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

Source: Authors' calculations based on data from the Greek Ministry of Development and the Central Market.

TABLE 7 – THE IMPACT OF PASS-THROUGH ON RETAIL PRICES

	(1)	(2)	(3)
Estimation method	FE	FE	FE
Dependent variable	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$
Sample	Merged Retail & Wholesale data	Merged Retail & Wholesale data	Merged Retail & Wholesale data
Time period	2010-2012	2010-2014	2010-2016
$\text{Treat}_i \times \text{Post}_t$	-0.016	-0.026*	-0.010
	(0.013)	(0.013)	(0.010)
$\ln(\text{Wholesale Price})_{it}$	0.431***	0.440***	0.460***
	(0.021)	(0.026)	(0.025)
Post_t	0.009	0.005	-0.016
dummy=1 after 22 June 2011	(0.013)	(0.016)	(0.014)
Observations	49,286	73,688	101,108
Adjusted R^2	0.884	0.885	0.880
Clusters	59	59	59
Store FE	yes	yes	yes
Product variety FE	yes	yes	yes
Month × Product FE	yes	yes	yes
Year-month trend and square	yes	yes	yes

Note: The dependent variable is the logarithm of the retail price of product variety *i,* in store *j,* and day *t*. All regressions include binary indicators for the changes in VAT rates. Standard errors clustered at the product variety level are reported in parenthesis below coefficients: *significant at 10%; **significant at 5%;
***significant at 1%.
Source: Authors' calculations based on data from the Greek Ministry of Development and the Cetntral Market.

TABLE 8 – THE IMPACT OF DEREGULATION ON RETAIL PRICES (SELECTED PRODUCTS)

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	FE	FE	FE	FE	FE	FE
Dependent variable	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$	$\ln(\text{Retail Price})_{ijt}$
Sample	Merged Retail & Wholesale data	Merged Retail & Wholesale data	Merged Retail & Wholesale data	Retail data	Retail data	Retail data
Time period	2010-2012	2010-2014	2010-2016	2010-2012	2010-2014	2010-2016
$\text{Treat}_i \times \text{Post}_t \times \text{Street market}_j$	-0.028	-0.040*	-0.009			
	(0.024)	(0.023)	(0.020)			
$\text{Treat}_i \times \text{Post}_t \times \text{Super market}_j$	-0.108***	-0.107***	-0.065**			
	(0.037)	(0.034)	(0.025)			
$\text{Treat}_i \times \text{Post}_t \times \text{Low}_i \times \text{Super market}_j$				-0.250***	-0.220***	-0.186***
				(0.031)	(0.026)	(0.017)
$\text{Treat}_i \times \text{Post}_t \times \text{High}_i \times \text{Super market}_j$				-0.238***	-0.295***	-0.333***
				(0.036)	(0.035)	(0.022)
$\text{Treat}_i \times \text{Post}_t \times \text{Low}_i \times \text{Street market}_j$				0.006	-0.014	-0.004
				(0.018)	(0.020)	(0.018)
$\text{Treat}_i \times \text{Post}_t \times \text{High}_i \times \text{Street market}_j$				-0.136***	-0.170***	-0.194***
				(0.021)	(0.027)	(0.019)
Post_t	-0.008	-0.003	-0.055**	-0.003	-0.066*	-0.061**
dummy=1 after 22 June 2011	(0.022)	(0.029)	(0.023)	(0.038)	(0.032)	(0.028)
Observations	49,286	73,688	101,108	14,075	20,521	27,667
Adjusted R^2	0.861	0.859	0.846	0.879	0.877	0.862
Clusters	59	59	59	19	19	19
Store FE	yes	yes	yes	yes	yes	yes
Product variety FE	yes	yes	yes	yes	yes	yes
Month × Product FE	yes	yes	yes	yes	yes	yes
Year-month trend and square	yes	yes	yes	yes	yes	yes

Note: The dependent variable is the logarithm of the retail price of product variety *i,* in store *j,* and day *t*. In Columns 1–3, the sample includes the 59 product varieties which are common for the retail and wholesale market. In Columns 4–6, the sample includes all the products assigned to the control group (see Table A2) but only lettuces ("Low") and peaches ("High") in the tretment group. All regressions include binary indicators for the changes in VAT rates. Standard errors clustered at the product variety level are reported in parenthesis below coefficients: *significant at 10%; **significant at 5%; ***significant at 1%.

Source: Authors' calculations based on data from the Greek Ministry of Development.

TABLE A1 – MAXIMUM WHOLESALE AND RETAIL MARKUPS

Product	Wholesale maximum markup	Retail maximum markup (supermarkets and grocery stores)	Retail maximum markup (street markets)
Potato	8%	25%	23%
Dry onions	10%	20%	17%
Artichoke, cucumber, tomatoes, vlitta*, drill & parsley*	10%	25%	22%
Zucchini, cauliflower, beetroot, lettuce, spinach, cabbage, broccoli, greens, leek, peas, carrots, fresh onions, peppers, okra, eggplant.	12%	35%	32%
Apricot	10%	35%	32%
Peach	10%	35%	30%
Grapes, beans.	12%	28%	25%
Strawberry	12%	40%	35%
Bananas	12%	30%	27%
Other fruits i.e.: cherry*, damson*, fig*, kiwi*, loquat*, mellon*, nectarine*, pomgranate*, quince*, sour cherry*, watermellon*.	10%	30%	27%

Note: Products with a star (*) did not exist in Genakos *et al* (2018) paper.
Source: Ministerial decision A2–1045 (Gazette B' 1502/22–6–2011).

TABLE A2– PRODUCT CLASSIFICATION

Treatment Group	Control Group
Apricot	**Apple**
Apricot (Diamantopoulou)*	Apple (Golden)*
Apricot (common)*	Apple (Golden-imported)*
Artichoke	Apple (Grand Smith)*
Artichoke (common)*	Apple (Grand Smith-imported)*
Artichoke (imported)	Apple (Starkin)*
Banana	Apple (Starkin-imported)*
Beans	**Lemon**
Bean Barbouni*	Lemon (common)*
Bean Barbouni (imported)	Lemon (imported)*
Bean Tsaouli*	**Mandarins**
Beetroot	Clementin mandarin*
Broccoli	Clementin mandarin (imported)
Broccoli (common)*	Mandarin (common)*
Broccoli (imported)	Mandarin (satsoumes)**
Cabbage	**Orange**
Carrot	Valencia orange*
Cauliflower	Orange (navalines-merlin)*
Cauliflower (common)*	**Pear**
Cauliflower (imported)	Pear (imported)*
Cherry	Pear Krystali*
Cherry (petrokeraso)*	Pear Krystali (imported)
Cherry (crisp)*	Pear (kontoules)**
Cucumber	Pear (kossia)**
Cucumber small*	Pear (santa maria)**
Cucumber large*	
Damson**	
Dill & Parsley**	
Eggplant	
Tsakonian eggplant*	
Eggplant (common)*	
Eggplant (imported)	
Fig**	
Fresh onion	

Treatment Group	Control Group
Grapes	
Grape (common)*	
Sultana grapes (raisin)*	
Greens	
Kiwi	
Kiwi (common)*	
Kiwi (imported)	
Leek	
Lettuce	
Lettuce (common)*	
Lettuce (kg)	
Loquat**	
Melon	
Melon (common)*	
Melon (Argitis)*	
Melon (Thrace)*	
Nectarine	
Okra	
Thick okra	
Fine okra*	
Onion	
Onion (common)*	
Onion (imported)	
Peach	
Peach (common)*	
Peach (white-pulp)**	
Peas	
Pepper	
Pepper (longish)*	
Florinis peppers*	
Green pepper (large)*	
Green pepper (large-imported)	
Pomegranate**	

Treatment Group	Control Group
Potato	
Potato (common)*	
French potato*	
Potato (imported)*	
Potato Cyprus	
Quince**	
Sour cherry**	
Spinach	
Strawberry	
Tomato	
Tomato (common)*	
Tomato (imported)*	
Vlitta**	
Watermelon*	
Zucchini	
Zucchini*	
Zucchini (imported)	

Notes: The table reports information on the classification of all the products (and their varieties) used in the estimation. A star (*) indicates the product varieties matched in the wholesale data. Two stars (**) indicates the products or product varieties appear only in the wholesale data.