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# *Who Pays Taxes on Basic Foodstuffs?: Evidence from Broadening the VAT Base*

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# Who Pays Taxes on Basic Foodstuffs?: Evidence from Broadening the VAT Base

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**Abstract**

We exploit the introduction of a 5% VAT on very essential food products (like fresh milk, coffee, yogurt, cheese) that occurred when an EU member state had to harmonise its VAT legislation with the EU VAT legislation. Preceding this reform, there was a removal of the zero VAT rate and imposition of 5% VAT rate on other food items that were considered less essential (juices, bottled water). We adopt a difference-in-difference approach as the price data support the common trends identifying assumption. On average, the tax was shifted fully to the consumer within the first month after the reform. However, there are differences even across seemingly related goods as some of them experienced overshifting of the pass through effect. The prices of goods in the control group did not change. These estimates are robust to alternative specifications and can be useful to other countries considering to broaden their VAT base by taxing basic groceries.

JEL Classification: H22, H32, D4

Keywords: commodity taxation, tax burden, tax incidence, pass through, tax harmonisation.

# 1 Introduction

Debates on the effects of tax harmonization have to do mostly with the way in which taxes relate to consumer prices and, hence, the distribution of welfare within society. In recent years, in an effort to tackle issues resulting from the sovereign debt crisis, some countries have increased the VAT rate on food while other countries are considering broadening the VAT base by removing the zero rate on food. Adopting the optimal tax approach to evaluate VAT reforms requires to make assumptions about the market structure of food retailing and, hence, the pass through of VAT reforms on food retail prices. The usual assumption, that both officials and academics make for pass-through analysis, is that consumer prices fully reflect taxes. However, taxes may also be over-shifted or undershifted into the prices paid by consumers and the degree of shifting may be different across goods.

The theoretical literature on tax incidence is quite rich but does not provide a clear prediction. If firms in the retail market act as perfect competitors, tax incidence will depend on the relative elasticities of supply and demand. However, the introduction of VAT on food will be fully shifted to retail prices if they face constant marginal cost. In market conditions other than perfect competition, theory predicts a number of possible outcomes, including both over- or under-shifting of taxes to consumer prices (Katz and Rosen, 1985; Stern, 1987; Besley, 1989). Atkinson (2012) noted that the appropriateness of removing the zero rate on food depends on whether the retail market is perfectly competitive. However, the retail sector in most countries is highly concentrated with few supermarkets having most of the market share. Therefore, empirical evidence can play a significant role in guiding policy reforms. The tax incidence on food items has scarcely been studied. To the best of our knowledge, Besley and Rosen (1999) and Politi and Mattos (2011) are most probably the only studies that presented empirical evidence on the incidence of taxes on basic basket food items (milk, bread, bananas). Most empirical studies concentrated on the incidence of taxes on tobacco, gasoline, restaurant, hairdressing and other services, sugar sweetened beverages and clothing.

In this paper, we contribute to the scarce empirical evidence on the causal pass through of VAT increases to retail prices of basic food necessities. We exploit a reform that involved broadening of the VAT base. This policy change occurred when Cyprus became member of the European Union in 2004 and there was a need to harmonise the country's VAT legislation with the EU VAT legislation by imposing the reduced VAT rate of 5% on food products consumed by humans. The experience of this EU country make it a good working laboratory to study the pass through of taxes on the prices

of very basic commodities, which constitute a large share of the expenditure of poor households. While many EU countries impose VAT on food, there are member states that still have the zero VAT rate. For example, Malta has a zero-rate on all foodstuffs and Ireland has zero-rate for some foodstuffs (EC, 2018). The UK also has zero VAT rate on some foodstuffs and the recommendation of the *Mirrlees Review* is that the full rate of VAT be imposed on food in combination with an appropriate package of reforms to address the pass-through effects of the broadening of the VAT base (Mirrlees et al., 2011).

As a first step in harmonising its VAT system, Cyprus changed the VAT rate in 2009 from 0% to 5% on a group of food products that were not considered as primary food necessities, like fruit juices and drinks, bottled water, chocolates. However, the zero VAT rate continued to apply on a group of food products that officials considered primary to the daily diet of citizens, like milk, cheese, coffee, yogurt, macaroni. In the second phase, in January 2011, the government changed the VAT rate on these basic need food products from 0% to 5% as well. This policy change enables us to apply a difference-in-difference approach to identify the causal effect of the VAT tax on the consumer prices of food necessities. The treatment group includes brands of basic food products for which the VAT rate changed from 0% to 5% on 10th January 2011, like milk, traditional coffee, traditional cheese, macaroni, sugar. The control group includes brands of food products, like bottled water and fruit juices, for which the VAT rate was 5% since 19th October 2007 and remained at this level after the 10th January 2011.

The key identifying common (parallel) trends assumption is required to obtain valid difference-in-differences estimates. This assumption is satisfied as in each of the months prior to the reform, the average price of goods in the treatment group moved in parallel to the average price of the goods in the control group. Also, after the reform, the percentage change in the average price of goods in the control group is not significantly different from zero. In contrast, the percentage change in the average price of goods in the treatment group is about 5% within the first month after the reform. However, there are differences even across seemingly related goods with some of them experiencing overshifting within the first quarter after the reform. Our pass through estimates are robust to alternative specifications and estimations. They are important as poor households spend a larger share of their income on food consumption.[1] Overshifting could be due to an imperfectly competitive market structure. It could also be

[1] The poorest 10% of the households spent 35.32% of their mean total expenditure on food (Family Expenditure Survey, 2009).

due to general equilibrium effects that, as pointed out by Benedek, Mooij, Keen and Wingender (2015), might matter when estimating pass-through within a single country. Consequently, in a difference-in-difference framework, using other commodities as a comparison group could over-estimate (under-estimate) the degree of pass-through if the treated and comparison goods are complements (substitutes).

The paper proceeds as follows. Section 2 provides a brief review of some of the existing literature that also forms the basis to understand the empirical findings. Section 3 provides a timeline of the reform and institutional setting and section 4 describes the data and identification strategy. In section 5, we present the econometric method and discusses the empirical findings. Section 6 concludes.

## 2 Background

Kotlikoff and Summers (1987) and Fullerton and Metcalf (2002) provide a review of the theoretical literature on tax incidence. Many factors determine who really pays taxes including market structure (Besley 1989; Dellipala and Keen 1992; Katz and Rosen 1985; Seade 1985; Stern 1987), the responsiveness of supply and demand to changes in prices and degree of product differentiation. Consumer price search can also affect the degree of shifting of taxes to consumer prices (DeCicca, Kenkel and Liu, 2013).

In perfectly competitive markets with free entry and exit, the actor with less elastic responses (in absolute value) will experience most of the price change induced by the commodity tax. With either perfectly elastic supply or perfectly inelastic demand, in equilibrium, the tax is shifted away from suppliers and towards consumers. However, if the market is less than competitive the effect of the tax could be different. Under monopoly, the imposition of a sales tax will increase the price to the consumer by a multiple of the tax depending on the price elasticity of demand. Between the extremes of perfect competition and monopoly is the oligopoly market structure where each firm interacts strategically with the other firms in the market. In this case, it is difficult to make definite predictions about the incidence of the sales tax as it would depend on how each oligopolist behaves. An oligopolist may not change the price if he/she believes that by doing so, other firms will steal his/her market share. However, the opposite occurs if each oligopolist expects that his/her competitors may match his/her price increase. Therefore, taxes could be undershifted, fully shifted or even overshifted if the market is imperfectly competitive because of strategic pricing.

The theoretical literature on tax incidence is quite extensive. In contrast, the em-

pirical literature is scarce and the findings vary. Studies mostly exploited changes in commodity sales taxes over time and/or across states to identify the incidence on consumer prices. Besley and Rosen (1999) used information on the prices of 12 commodities in 155 different US cities from 1982/2-1990/3 to estimate how these prices were affected by different types of sales taxes levied on these commodities at the country, state and local level. Their findings suggested full shifting for several commodities, such as Bic Macs, eggs, kleenex. However, more than half of the commodities exhibited over shifting, like milk, bread, bananas, Crisco, soda and boys underwear. Poterba (1996) also found evidence in favour of overshifting using prices of clothing in US cities over the periods 1925-39 and 1947-77. These findings are consistent with the predictions of certain theoretical models of imperfect competition.

Benedek et al. (2015) estimated the VAT pass through to prices by exploiting a large panel data set and different types of VAT reforms in the Eurozone countries. Specifically, they considered 65 VAT changes between 1999-2013, seven of which were revisions in the reduced rates on basic foodstuffs. They adopted a similar approach as Poterba (1996) and Besley and Rosen (1999) and found that the pass through to prices of changes in the standard rate was 100 percent whereas the pass through of reduced rates was significantly lower (around 30 percent). They also found that the pass through is increasing in the breath of the consumption base that is affected.

Politi and Mattos (2011) studied the pass through to prices of exogenous VAT tax rate increases in ten goods in the Brazilian basic food basket. They used monthly data for sixteen municipalities and their baseline specification suggested tax undershifting for all the Brazilian base basket food items they studied. When they considered only tax rate increases, their findings showed tax full shifting for three products, undershifting for six products and overshifting for one product. When tax rate decreases were also taken into account, their findings indicated undershifting for every good.

More recently, Benzarti, Carloni, Harju and Kosonen (2017) investigated asymmetric responses of prices to VAT changes using reforms with more substantial tax changes and bigger samples. First, they exploited a 14 percentage point decrease in the VAT rate applied to Finnish hairdressing services in January 2007 and a subsequent 14 percentage point increase in the same sector in January 2012. These reforms[2] were part of a VAT experimentation program suggesting that the timing of the reforms and the choice of sector are plausibly exogenous. Their findings suggested that prices responded twice as

[2]Kosonen (2015) exploited the January 2007 VAT cut and found that firms and consumers divided the benefit from the tax reduction roughly equally.

much to the 14 p.p. VAT increase than to the 14 p.p. VAT decrease. Second, they generalised their findings about the asymmetry of the VAT pass through to prices by showing that it is not specific to small labour intensive sectors (such as hairdressers) but holds in most other industries regardless of their size. They conducted their analysis using a similar data set as the one used by Benedek et al. (2015) but covered more years (1996-2015), more EU member states and all sectors of the economy.

There has also been research on the incidence of taxes on other types of services. For example, Carbonier (2007) exploited the 1987-1991 VAT reforms in France regarding housing repair services and the new car market and found evidence of overshifting. Evans, Ringel and Stech (1999) studied the effect of state plus federal excise taxes on tobacco using data from 1985-1996 for all states and the District of Columbia. They compared the prices of states that did change their taxes on tobacco (treatment group) with the prices of states which did not change their tax rates (control group) over time. Their findings suggested that 100% of the increase in the tax rate was passed completely to consumers in the form of higher prices. Brownlee and Perry (1967) also found evidence of full shifting using a reduction in the excise tax in the US in 1965. On the other hand, Johnson (1978) found evidence of over-shifting using data on cigarette prices in the US. More recently other studies found evidence that cigarette excise taxes are overshifted (Keeler et al., 1996; Delipalla and O'Donnell, 2001; Hanson and Sullivan, 2009).

Varying pass through evidence was found with regard to alcohol excise taxes. More recently, Young and Bielinska-Kwapisz (2002), and Kenkel (2005) estimated that alcohol excise taxes are over-shifted. In contrast, Harding, Leibtag, and Lovenheim (2010) use unique transaction-level data and found under shifting for both alcohol and cigarette taxes. Alm, Senoga, and Skidmore (2009) found evidence that in urban states gasoline taxes are fully passed through to prices but gasoline taxes were under-shifted in rural states.

Research also examined the incidence impact of taxes imposed on sugar sweetened beverages in different countries, which aim to discourage consumption for health reasons. The findings again vary. Cawley and Frisvold ( 2016) estimated less than pass through from a first city-level tax on SSBs in the United states in November 2014. In contrast, Grogger (2015) found oveshifting of the tax imposed nationwide on sugar sweetened beverages in Mexico in 2014 since a tax of roughly 9 percent raised the price of caloric soda by 12%. Bergman and Hansen (2010) found evidence suggesting overshifting of tax hikes and undershifting of tax cuts. In the case of the French tax on soda imposed on January 1st 2012, Berardi et. al (2012) estimated full shifting.

# 3 The VAT Reform and Institutional Setting

The Republic of Cyprus has been a member state of the European Union since 2004 and Eurozone since 2008. The attempt of the government to harmonize its VAT legislation with the European acquis began in 1990 when the country faced the prospect of accession in the European Union. By 1st May 2004, when the country became a member of the European Union, the VAT legislation was modified to a large extent and the VAT rate on most basic food products was kept at the zero rate.[3]

On 19th October, 2007, the reduced VAT rate of 5%, was imposed on manufactured fruit drinks, juices, bottled water and confectionery products. Soft drinks and alcoholic drinks, like wine and beer, were subject to the standard rate of 15%. In order to smooth the transition, the government asked for an extension of the period during which food products, considered essential to the daily diet of citizens, would continue to be in the 0% VAT rate category. The permission to do so was granted. However, in order to comply with the European acquis and after a vote on 14th December 2010 in the House of Representatives, on 10th of January of 2011 there was an increase in the VAT rate from 0% to 5% on these group of very basic food necessities, like fresh milk, bread, macaroni, cheese, coffee, sugar, etc. Thus, starting on the 10 January, 2011 the reduced VAT rate of 5% was applicable on all food products suitable for consumption by humans, except alcoholic beverages, beer, wine and soft drinks that continued to be taxed at 15%. This policy change provides us with an exogenous variation in tax rates and the quasi-experimental setting to identify the incidence on retail prices of extending VAT on food necessities. There were no other changes that are expected to have affected the prices of groceries at the time of the reform.

Besides the tax system and preferences, the pass-through of the VAT to prices also depends on the market structure at all levels of the food supply chain. Although the food retail sector in Cyprus is highly concentrated, after the country became member of the EU and Eurozone, there was a substantial decrease in market concentration. As indicated by a European Commission report (2014), the Herfindahl-Hirschman index (HHI) for the food retail sector in Cyprus was 6529, 3572 and 2879 in 2004, 2010 and 2012 respectively.[4] Countries that had higher market concentration in the food

[3]The sales tax legislation was passed and put into effect on 1st July, 1992. By the beginning of 2001, the harmonization of the Cypriot legislation with the European acquis was achieved to a great extent and specific regulations were implemented on 1st February 2002. Details of the Cypriot VAT legislation can be found at the following government website: http://www.mof.gov.cy/mof/VAT/vat.nsf/DMLrates_en/DMLrates_en?OpenDocument.

[4]The Herfindahl-Hirschman index (HHI) is an acceptable measure of market concentration. It is

retail sector than Cyprus in 2012 were Finland, Latvia and Sweden whose HHI indices were 3935, 3443 and 3305 respectively. In general, the food retailing sector is highly concentrated in many countries. For example, in the UK, the top four supermarkets have market share of over 75% (Atkinson, 2012). Hall (1988) found that retail trade is not competitive for the US.

There are also indications that there are competition issues on the production and distribution of food, in particular for dairy products. Based on a report by the European Competition Network (2012), the National Commission for the Protection of Competition (NCA) investigated four cases of infringement in the food sector in Cyprus between 2004-2011. Three out of the four cases of infringement concerned primary production of raw milk or fresh pasteurised cow milk. Other countries with similar issues were Greece, Portugal and the Nordic countries.

# 4 Data and Identification Strategy

The empirical analysis uses monthly retail prices of various brands of very essential food products charged by different supermarkets. These prices are collected by the Price Observatory of the Consumer Protection Service of the Ministry of Industry and Tourism of Cyprus and made available on its website. The aim of the Observatory is to provide consumers with relevant information that supports their choices and economic interests.[5]

The Observatory collects the prices of brand food products, widely consumed by the population, that are charged by a large number of supermarkets easily accessible to consumers and with a high sales turnover. The prices are collected in the middle of every month. Employees of the Observatory visit these supermarkets, look for these products in the store and record the prices. At the time, the prices charged by twelve large supermarket chain stores in different districts were collected.[6] The adopted methodology and online availability of these prices is expected to lead to their careful collection and the minimisation of measurement error.

calculated by squaring the market share of each firm competing in a market, and then summing the resulting numbers. The index can range from close to zero to 10,000 (monopoly).

[5] We do not have evidence which indicate to what extent this additional information affects the salience of the price of these key commodities relative to others. However, the prices posted by the Observatory are sometimes in the news, in particular during big holidays when there are family gatherings and celebrations with food consumption.

[6] The retail stores (supermarkets) include Athienitis, Alphamega, Carrefour, Debenhams, E&S, Kokkinos, Karseras, Metro, Orfanides, Sarris and Stelios.

The usefulness of this particular set of prices for determining overall pass through depends on how much consumers shop at these large supermarket chains vs. small local retail outlets. Official statistics on sales turnover in 2011 show that 79% of retail sales in non-specialised stores with food is attributed to sales in groceries and supermarkets selling a variety of goods, which are the stores whose prices we consider in this paper. The rest of the retail sales in non-specialised stores with food is attributed to sales in mini-markets and kiosks that are smaller outlets. Similar trends apply if we examine retail sales in these stores by number of employees (0-1; 2-9; 10-19; 20+). About 55% of total retail sales is attributed to supermarkets with more that nineteen employees and 62% to supermarkets with more that nine employees in 2011. Similar trends apply for years close to the reform.[7]

We adopt the difference-in-difference methodology to assess the impact of the reform on consumer prices since the reduced VAT rate of 5% on food was introduced gradually on different groups of grocery products. We conduct the estimations using the price information on brand food products of groceries that are part of the daily diet of consumers, fall in the treatment and control groups, sold in all districts and their prices are available in each month. These are items with a barcode, which is expected to minimise measurement error in prices. They are produced, packaged and distributed by leading domestic national manufacturers in all districts of the country, which is expected to minimise heterogeneity in production costs. This also implies that their prices are determined at the national level.[8] We conduct the empirical estimations by averaging the monthly price data for each brand product across all supermarkets and districts. The estimates with the disaggregated data do not alter significantly the empirical findings. This is expected as Cyprus is a small country.

The treatment group includes very basic food groceries like fresh milk, traditional Cypriot cheese (known as halloumi), traditional coffee, traditional sheep yogurt, sugar, macaroni for which the VAT rate changed from 0% to 5% on 10th January 2011. The control group includes brands of manufactured drink products, such as bottled water and orange juices, for which the VAT rate was 5% since 19th October 2007 and remained at this level after 10th January 2011. The usefulness in studying this set of prices depends on whether generic versions of the same goods were available. The three brands of fresh

[7]This information can be found on the website of the Statistical Service of Cyprus: :https://www.mof.gov.cy/Mof/cystaT/STATisTiCS.nsF.

[8]These include the three main dairy companies (Charalambides Ltd, Kristis Ltd and Pittas Dairy Industry Ltd), two main manufacturers of traditional cypriot coffee (G. Charalambous Ltd, Laiko Cosmos Trading Ltd), leading manufacturer of pasta (Mitsides) and main manufacturers of juices and bottled water (Kean Ltd, Lanites Group and Fodiades Group).

milk, whose prices are collected by the Observatory and included in the data set, satisfy almost all the milk market.[9] Official statistics on sales of industrial commodities in 2011 indicate that all milk consumption is produced domestically and there are no imports of milk. Long duration milk was not available at the time. It was introduced in the market in 2013 and is still not popular among consumers. The same applies for other vegetarian substitutes to fresh cow milk, like rice, coconut or almond milk. A substantial part of the market for traditional challoumi cheese is satisfied by the leading domestic dairy manufacturers, whose prices the Observatory collected. Also, the Observatory collected the prices of the two basic players in the market for traditional coffee.[10] With regard to sugar, the Observatory recorded the price of the sugar brand that had the lowest price on the shelf assuming that consumers always buy the brand of common sugar with the lowest price. Sugar is imported and packaged in Cyprus.

We first conduct preliminary descriptive analysis to establish the validity of the difference-in-difference estimates and look at the impact of this specific VAT reform on food product prices. The summary statistics of the average price of the brand products included in the treatment and control groups six months before (June 2010 - December 2010) and after the reform (January 2011 - June 2011) are reported in Table 1 in the Appendix. Compared to the six months before the reform, the average price of products in the treatment group over the six months following the reform was higher by about 5.7%. The corresponding increase in the average price of goods in the control group was 1.2%.

In order to obtain valid difference-in-difference estimates, we need to have a valid control group that requires the common (parallel) trends assumption to hold. This identification assumption implies that the underlying trends in the price of the treatment group are similar to those of the control group before the reform. Hence, in the absence of the reform, the prices of goods in the treatment group would have changed in a similar way as those in the control group. Figures 1 plots the normalised price (with base, the price in the month before the reform) in each of the twelve month before and after the reform. Figure 2 plots the first difference in *ln price* of the goods in the treatment group and control group, which is a very close approximation of the percentage change in the price. This is the dependent variable in the empirical specifications that we estimate since it can directly indicate the tax shifting impact of the reform. Figure 6 in the

[9] The market share for fresh milk of Charalambides and Christis is about 62% and Lanitis about 31%.

[10] G. Charalambous Ltd satisfies about 40% of the market for traditional coffee.

Appendix plots the corresponding average monthly prices. These figures support the identifying common (parallel) trends hypothesis. Also, it is evident that there was a jump in the average price of the treated goods right after the reform. In contrast, we do not observe an increase in the average price of goods in the control group.

The same result is indicated in Table 2 in the Appendix, which shows the average price of goods in the treatment and control groups for each the six months before and after the reform. Also, there was no statistically significant change in the price of goods in the control group in the post reform period. In contrast, it is evident that there was a statistically significant increase in the average price of goods in the treatment group of almost 5% within the first month after the reform. Subsequently, there was no further statistically significant increase in the average price of goods in the treatment group. This immediate and complete pass through of the tax into the prices of the treated goods is in line with the immediate 4.7% increase in the Food Price Index that is also reported in Table 2 in the Appendix. After the reform, we do not observe a statistically significant change in the average price of goods in the control group.

We also group the various treated brand items into product categories (i.e. milk, yogurt, coffee, cheese). Similarly, we group into product categories the various brand items (i.e. orange juice, bottled water). Figure 3 plots the corresponding normalised price of the treated product categories of milk, yogurt, coffee and cheese, which constitute the bulk of the observations. In each of these figures, we also plot the corresponding price of the control group. Figure 7 in the Appendix plots the average monthly prices for four commodity categories. These figures indicate that the common trends hypothesis is satisfied. Also, there was an increase in the price of the treated product categories right after the reform. An exception are the brand items in the cheese category for which the average price increased with a lag. The same result is supported in Table 3 in the Appendix, which presents the average price of products belonging to the different treated commodity categories and control group that constitute the bulk of the observations, for each of the six months before and after the reform. Also, the trends in the prices of the product groups that constitute the control group (i.e. orange juice, bottled water) are similar to the trend exhibited by the average price of the control group. This preliminary evidence suggests an immediate and significant overshifting of the tax within the first month after the introduction of the VAT rate for most categories. An exception is the cheese category for which we observe no immediate significant change. Subsequently, we observe a significant increase. Over the six months following the reform, the cumulative percentage change in the price of traditional cheese was about 5.14%.

# 5 Empirical Specification and Results

We first present a simple framework to motivate the empirical specification and also help us to rationalise the empirical findings later. In the context of a model with the retailers being competitive and constant marginal cost, the price of good $i$ in month $t$ is given by,

$$price_{it} = (1+\tau)MC_{it}, \tag{1}$$

where $\tau$ is the VAT rate and $MC_i$ is the marginal cost of good $i$. All else equal and constant $MC$, the change in the price will be equal to the tax rate.

Under imperfect competition,

$$price_{it} = \lambda_i(1+\tau)MC_{it}, \tag{2}$$

where $\lambda = \eta_i/(\eta_i - 1)$ and is a function of the elasticity of demand of good $i$ ($\eta_i$), which is associated with the residual demand curve and takes into account the firm's perception of the competitors responses to changes in the firm's price.[11] Thus, varying degrees of tax shifting are possible including overshifting, which will be a function of the market structure of the industry, the elasticity of demand, marginal cost and the revision in VAT. Consequently, with constant marginal cost, the price of product $i$ in month $t$ will be equal to its price in the previous month $t-1$ plus the change that may be induced by any revision in the VAT rate.

Thus, we specify the difference-in-difference model by defining the dependent variables as the first difference in the $\ln price$ of brand product $i$, which is a very close approximation of the percentage change in the price. This also makes easier the interpretation of the estimates capturing the pass through of the VAT on goods in the treatment group and not on goods in the control group. We also estimated the model using $ln$ price as the dependent variable and the estimates are the same. The estimates are available upon request.

The empirical specification takes the following form,

$$\begin{aligned} \triangle \ln price_{it} \;=\; & c_0 + \Sigma_t a_t(month\_before_t) + \\ & \Sigma_t g_t(month\_before_t * treatment_i) + \\ & \Sigma_t b_t(month\_after_t) + \\ & \Sigma_t d_t(month\_after_t * treatment_i) + v_i + e_{it}, \end{aligned} \tag{3}$$

[11] In equation (2), the perfectly competitive case is a special case of equation when demand elasticity is infinite.

where $\triangle$ represents the first difference operator. The $treatment_i$ dummy takes a value of one for brand product $i$ for which the zero VAT rate was removed in January 2011 and zero otherwise. The $month\_before_t$ dummy takes the value of one for all observations in month $t$ before the reform and zero otherwise. The dummy $month\_after_t$ takes the value of one for all observations in month $t$ after the reform and zero otherwise. We also include $v_i$ which captures brand product fixed effects. We set as panel variable the brand product code given by the Price Observatory.

From the viewpoint of tax incidence, the causal estimates of interest are $d_t$ that capture the percentage change of the tax inclusive prices of treated brand food products in each of the months after the reform compared to the percentage change in the price of the brand food products in the control group. The parameters $a_t$ capture changes in the prices that are common to all the products in the control and treatment groups that may also result from monthly changes in the costs of producing these goods.[12] The $g_t$ parameter estimates allow for the percentage change in the prices of goods in the treatment group to be different from those in the control group, that may also be due to monthly variation in the costs of producing these goods.

We estimate equation (3) using the price data twelve months before and twelve months after the reform (January 2010 - January 2011), which includes 529 observations and 23 groups. As a robustness check, we also conduct the estimations using a subset of the price data six months before and six months after the reform (June 2010 - June 2011), which includes 276 observations and 23 brand food products. The advantage of this longer time series data set is that we can account for changes in prices that are due to seasonality and not due to the reform. We conduct the estimations using both a standard fixed effects specification and a random effects specification controlling for the effect of time-invariant characteristics of the various products through the treatment and control group dummies. The Hausman test, where the null hypothesis is that the preferred model is random vs the alternative fixed effects model, suggests the estimation of a random effects model. We report the estimates from the fixed effects specification as the Hauseman test is only valid under the assumption of homoskedastic errors. The results from the random effects model are similar and available upon request.

Figure 4 shows the fixed effect estimates of the treatment group parameter estimates for each of the six months before and after the reform, together with the 95% confidence

[12] We also included variables that capture changes in the costs of production of these goods, such as electricity, wages and barley (for macaroni). These variables are highly correlated with monthly dummies and the causal estimates do not change.

interval, based on the longer time series data.[13] Table 4 in the Appendix reports all the estimates, for each of the six months before and after the reform, using both data sets. It is evident from Figure 4 that the average price of the treated goods increased by about 5% within the first month after the reform. In contrast, Table 4 in the Appendix shows that the average price of goods in the control group is not significantly different from zero after the reform. Also, the common (parallel) trends assumption is supported as the estimates show that the percentage change in the average price of goods in the treatment and control groups is not statistically different for each month prior to the reform. The results are similar across the two data sets.

We next examine whether the tax shifting behaviour is different across the various commodity categories that compose the treatment group. We estimate a variant specification of equation (3) which allows the causal estimates to differ across the various treated commodity categories, i.e. milk, yogurt, coffee, cheese, macaroni and sugar. Table 4 in the Appendix reports these estimates, for each of the six months before and after the reform, using both data sets. Before the reform, the estimates of the treatment dummy capture differences in the price of all the brand items in the treatment group relative to the control group. In the post reform period, the estimates of the treatment dummy period capture differences in the price of yogurt, which is the reference treated category, relative to the control group. The results indicate full shifting and, for some commodities overshifting, of the tax within the first month after the reform. Cheese products are an exception as the tax was not shifted to their price within the first month after the reform but we observe a price increase within the first quarter after the reform that is higher than the tax. The price of sugar increased fully one month after the reform but also exhibited a big increase in the second month after the reform. As it is also supported by the estimates of Table 5 in the Appendix that we refer to below, the significant decline in the relative price of some of the treated items in April 2011 seems to be due to an increase in the price of yogurt (the reference product category) in that month. In the case of cheese, it is also due to a decrease in its own price in that month.

We find the same tax shifting behaviour when equation (3) is estimated using subsamples of the price data set. Each subsample includes the treated brand products in each treated product category and all the brand products in the control group. Figure 5 shows the treatment estimates for the milk, yogurt, coffee and cheese product categories

[13] Since the dependent variable is the first difference of ln price, the parameter estimates of the June 2010 monthly dummy cannot be estimated in the case of the shorter time series data and the parameter estimates of the January 2010 monthly dummies cannot be estimated in the case of the longer time series data. The reference month in both data sets is July 2010.

for each of the six months before and after the reform, together with the 95% confidence interval, based on the long time series data. Table 5 in the Appendix presents all the estimates for these commodity categories, for each of the six months before and after the reform, using both data sets. The results are the same if we restrict the control group to include either the brand products in the orange and/or bottled water category(ies), which constitute the bulk of the observations in the control group. All the estimation results can be made available upon request.

Our findings are similar to those of Besley and Rosen (1999) who also considered brand products commonly bought by consumers but used a different identification strategy. They also found that prices react quickly and within the first quarter to a change in the tax rate. In addition, they also found that the shifting patterns across goods are to some extent different. Some of the brand products in our data set belong to the dairy category and are produced by major local manufacturers and made available to consumers through the retail stores (supermarkets). Although it is expected that the change in the price of these products to be similar, since they are all produced with milk and are usually displayed next to each other in retail stores, we find that they are characterised by different tax shifting behaviour. For the milk, yogurt and coffee products there is complete or more than complete and immediate shifting of the tax to the consumer within the first month after the introduction of the tax. In contrast, the retail price of cheese increased within the first quarter after the reform and also exhibited variability. Varying degree of pass through is exhibited by sugar.

Demand for challoumi cheese is expected to be less inelastic than the demand for fresh milk.[14] Thus, differences in the elasticity of demand could explain the differential response in the prices of milk and challoumi cheese products in the first month after the reform. The overshifting in the price of challoumi cheese in the first quarter after the reform, which is not observed for other related dairy products, may be due to an imperfectly competitive structure in the food supply chain. As noted by Besley and Rosen (1999), for commodities whose prices are set at the national level, as is expected to be the case for the grocery products considered in this study, the relevant effects of non-competitive behaviour for pass through are likely to come from the retail market. For commodities that are produced and priced at the local level, the results could be due to non-competitive behaviour at all levels of the food supply chain. Overshifting may also be due to complementarity between each of the treated product category and the control

[14] Other types of cheeses are expected, to some extent, to be substitutes of challoumi cheese. In 2011 per capita consumption of all other cheeses (domestically produced and imported) was double the per capita consumption of challoumi cheese.

group (Benedek et al., 2015). Therefore, consideration of the variation in the level of competition at the upstream and downstream sides of the food supply chain and cross price demand elasticities would aid in assessing what is likely to explain overshifting. Due to lack of relevant information, it is not possible to investigate econometrically the impact of these factors on pass through.

**Further Sensitivity Analysis**

We also address the issue about the validity of the difference-in-difference estimates, in the sense that they capture the impact of the reform and not something else. It may well be the case that in the beginning of every year the prices of the goods in the treatment group are always higher than the prices of the goods in the control group due to other factors related to the time of the year we are conducting our analysis. With the difference-in-difference estimation, it is important to check the same model in the absence of the intervention (Angrist and Krueger 1999). Therefore, we conduct an alternative robustness check using the price data for the corresponding period a year before the reform (June 2009 to June 2010). Table 4 (specifications 5 and 6) in the Appendix reports the estimates. The results indicate that the percentage change in the prices of the goods in the treatment group in January 2010 and for the subsequent months, was not statistically different from the percentage change in the prices of goods in the control group. These results support further that it was the reform that increased the consumer prices of the basic need (food) products and not something else.

# 6 Conclusion

An important question in public finance is who pays commodity and value added taxes that have become an increasingly important part of the tax system of many countries worldwide (Crawford, Keen and Smith, 2010).[15] Theoretical predictions are ambiguous and empirical evidence is scarce.

In this paper, we address this question. We exploit the experience of an EU member country that broadened its VAT base by removing the zero rate on basic foodstuffs like milk, coffee, cheese, yogurt, macaroni, sugar. This policy reform allows us to employ a different identification strategy than the one used by the previous scarce research

[15] Another implication of this type of tax, noted by Atkinson (2012), is that the within household distribution of income may also be affected since this policy change may leave worse off those in the household who do the grocery shopping and, consequently, have an effect on gender equality.

(Besley and Rosen, 1999; Politi and Mattos, 2011). Specifically, we estimate a difference-in-difference model using panel price data on a variety of food products charged by supermarkets.

We find an immediate pass through of the 5% VAT rate, which was introduced, to the prices paid by the consumer for foodstuffs considered by citizens essential to their daily diet. On average, the pass through was immediate and complete within the first month after the reform. This finding is in line with the inelastic demand that is expected to hold for basic necessities. However, there is some variation in the pass through effect even across seemingly related goods, i.e. the dairy products, with some of them experiencing overshifting of the pass through effect. Our findings are robust to alternative specifications and confirm the conclusions reached by other studies, including Leyaro, Morrissey and Owens (2010) and Liberati (2001), that tax reforms regarding food are mostly felt by the poor population.

In general, the VAT pass through estimates are expected to be context specific and depend on market structure, preferences and the tax system. Nevertheless, we can reasonably expect our findings to carry over to other European countries considering to broaden their VAT base to food or increase VAT on basic groceries that have inelastic demand. Although Cyprus differs from other EU countries in terms of population and market size that may affect market structure, the food supply chain is characterised by high market concentration in other EU countries as well (EC, 2014). In particular, the dairy industry is highly concentrated in other Southern European countries but Nordic countries as well (ECN, 2012).

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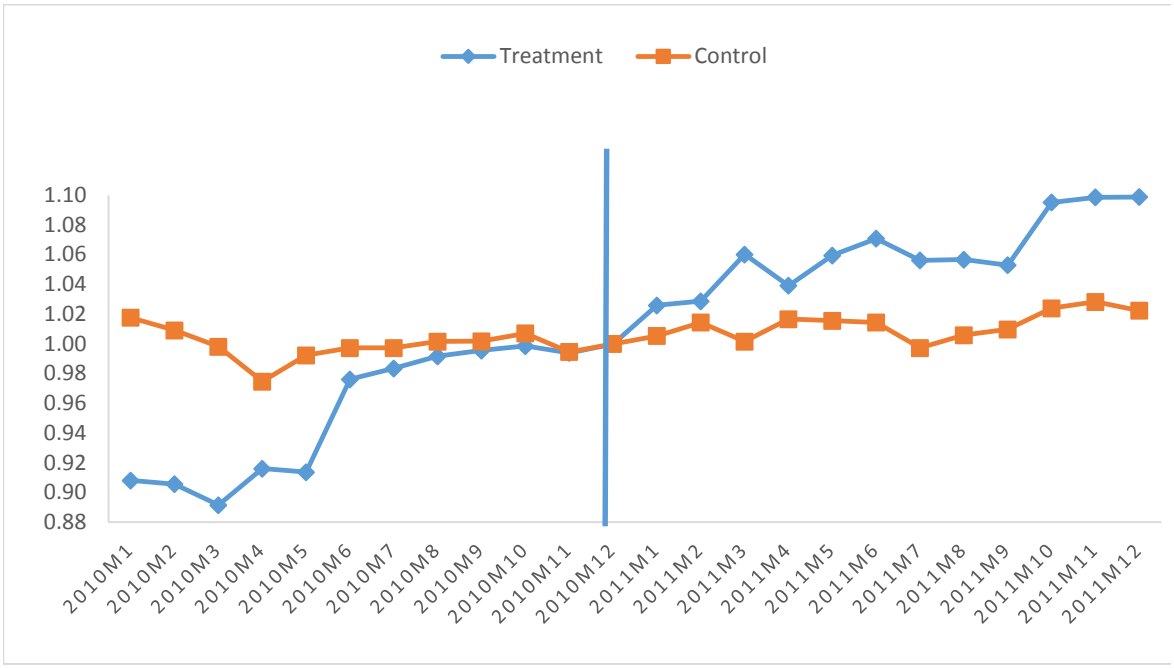
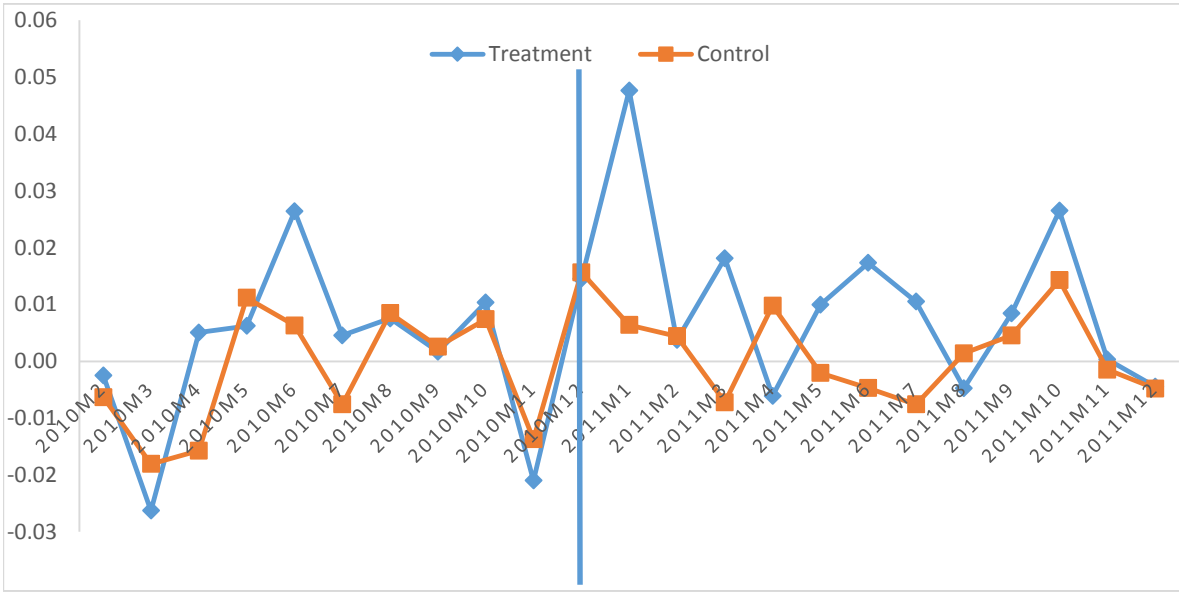
**Figure 1: Normalised Prices (base: Dec 2010)**



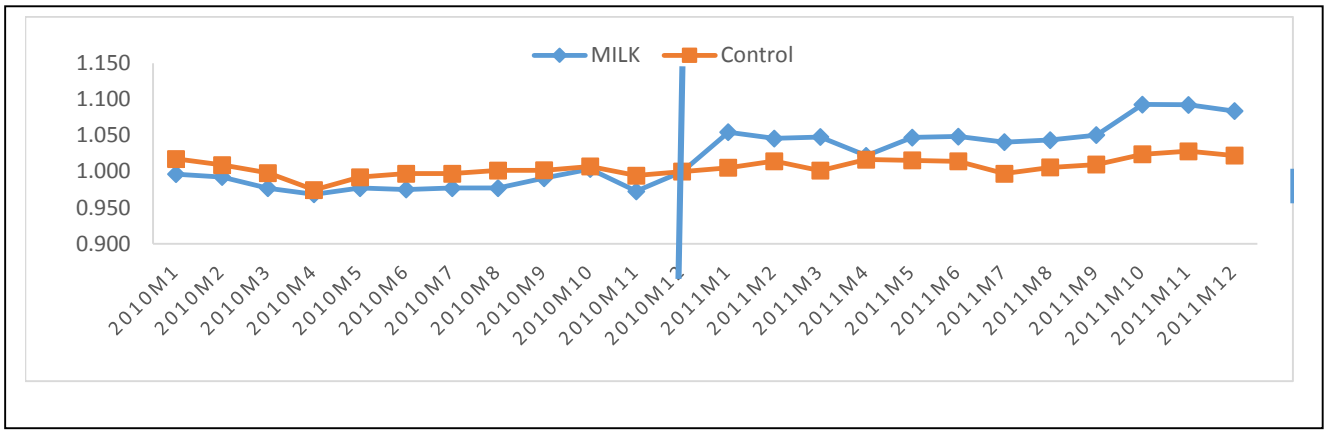

*Note*: January 2011 is the month of the VAT reform of very essential food items.

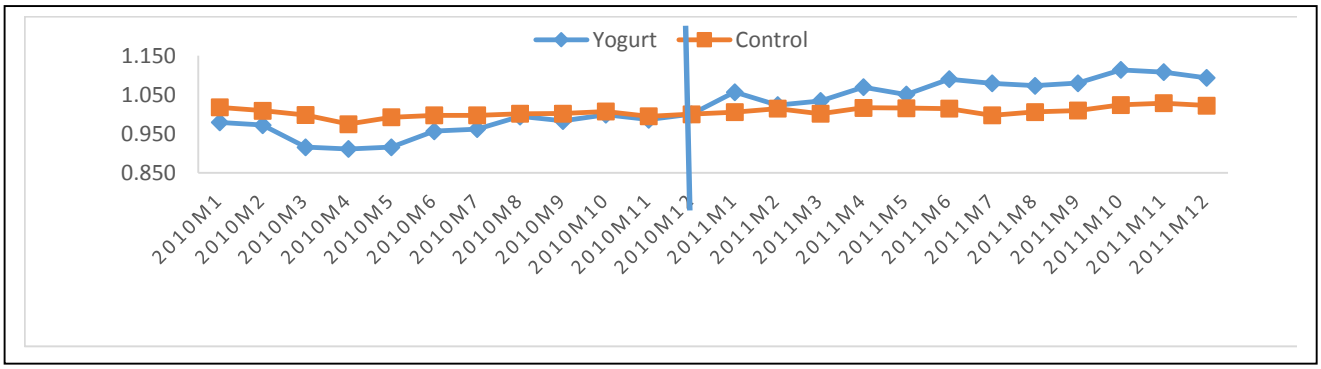
**Figure 2: First Difference in ln Prices**

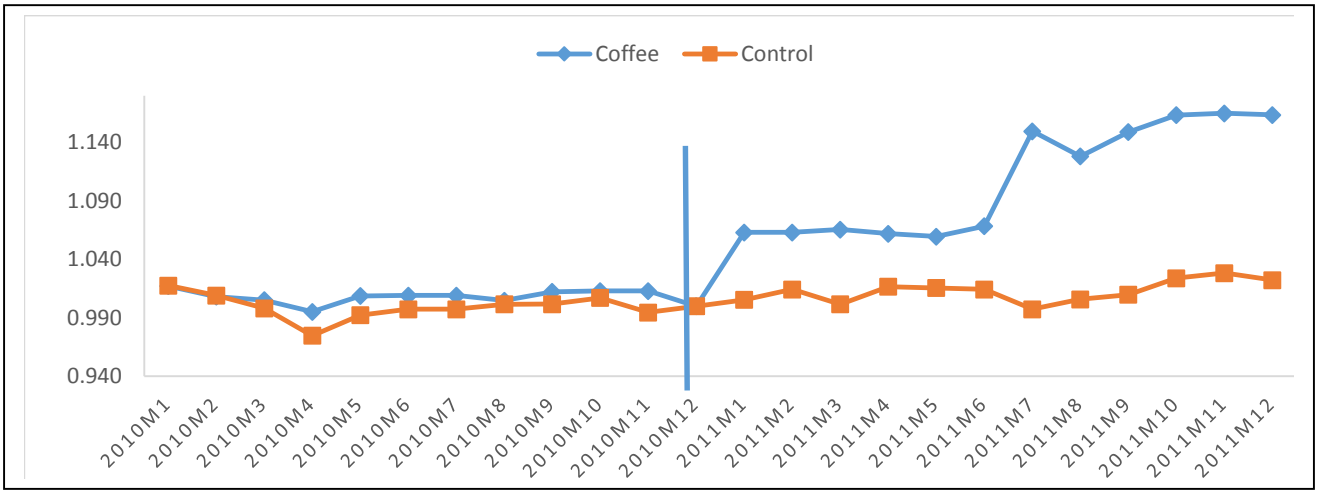


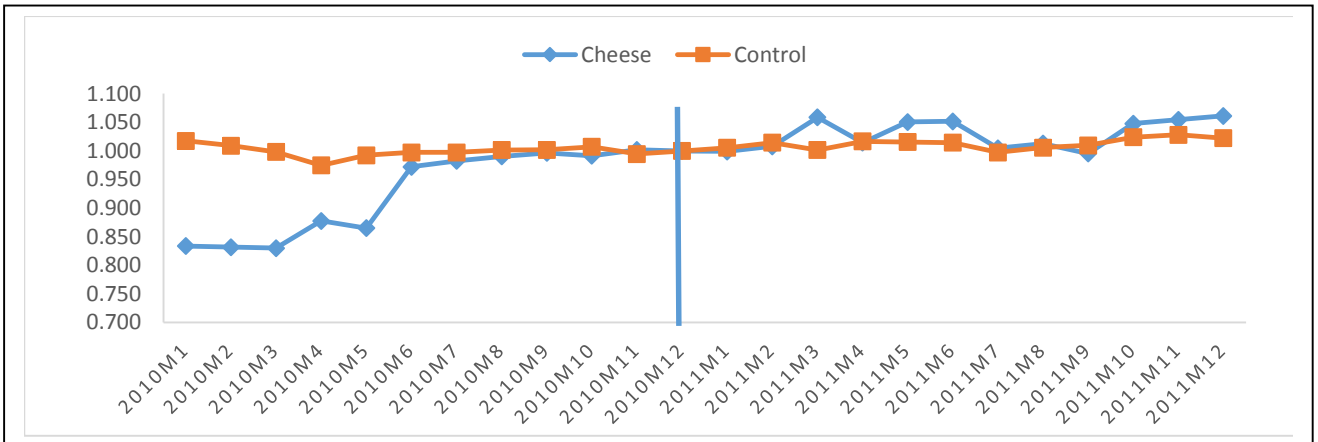

*Note*: January 2011 is the month of the VAT reform of very essential food items.

**Figure 3: Normalised Prices of Treated Product Categories (base: Dec 2010)**



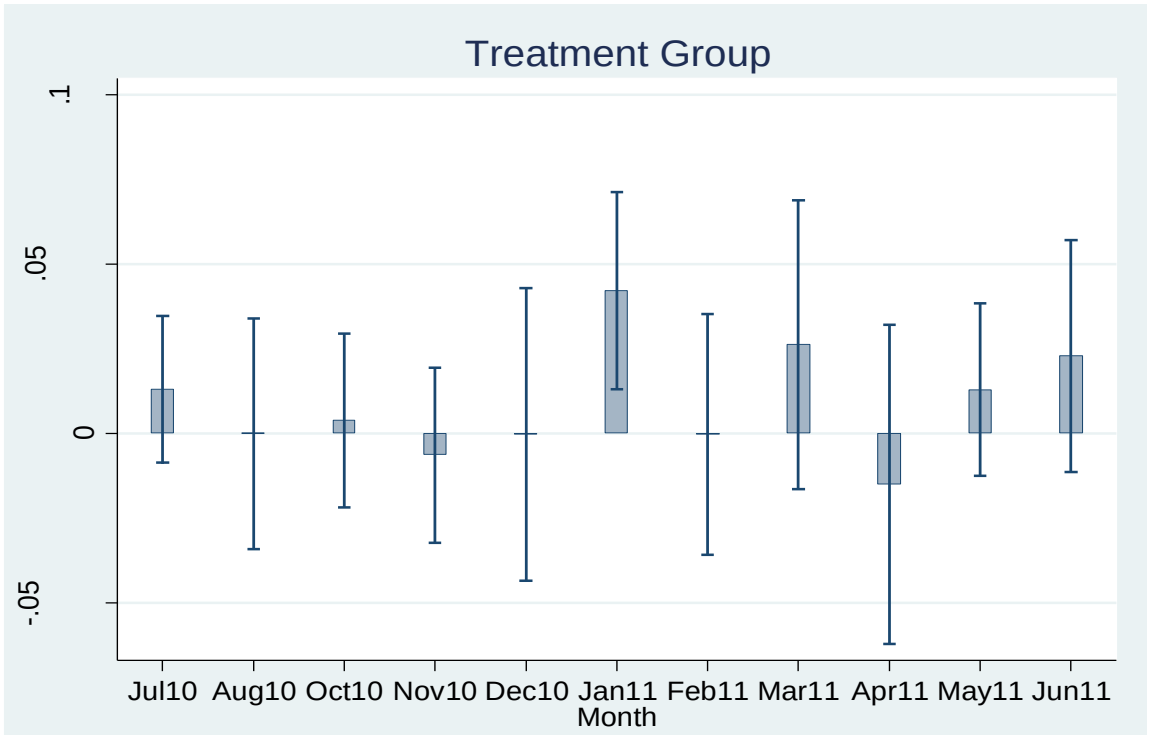



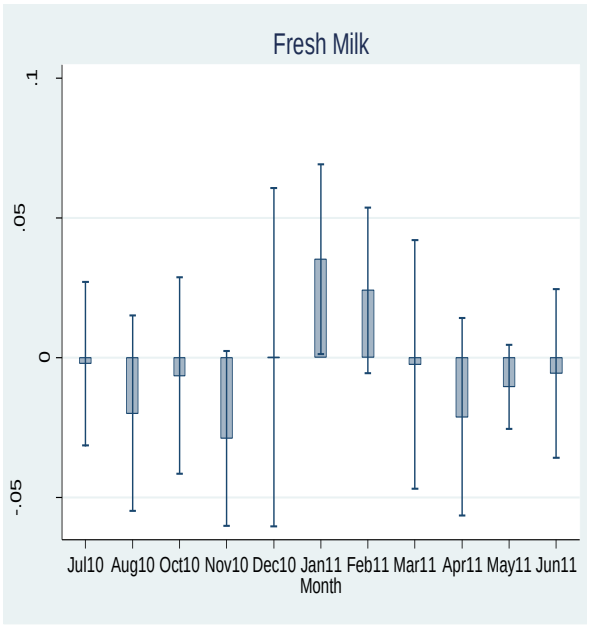

*Note*: January 2011 is the month of the VAT reform of very essential food items.

**Figure 4: Parameter Estimates of Treatment Group**

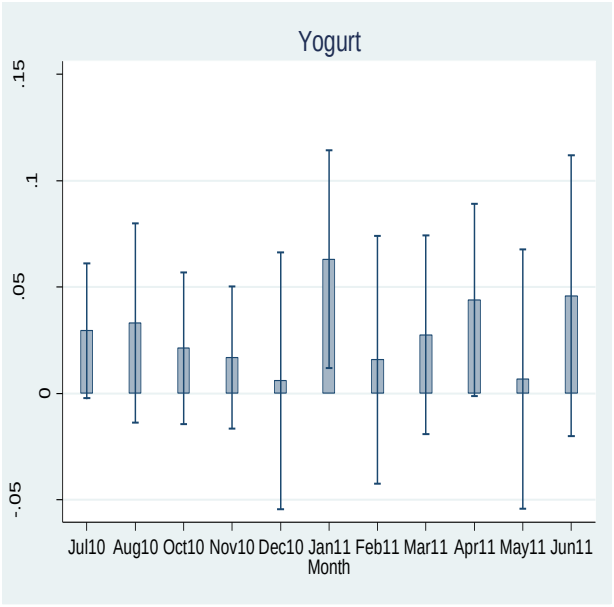



*Note*: January 2011 is the month of the VAT reform of very essential food items. Fixed effect estimates based on the long time series data Jan 2010-Jan 2011.

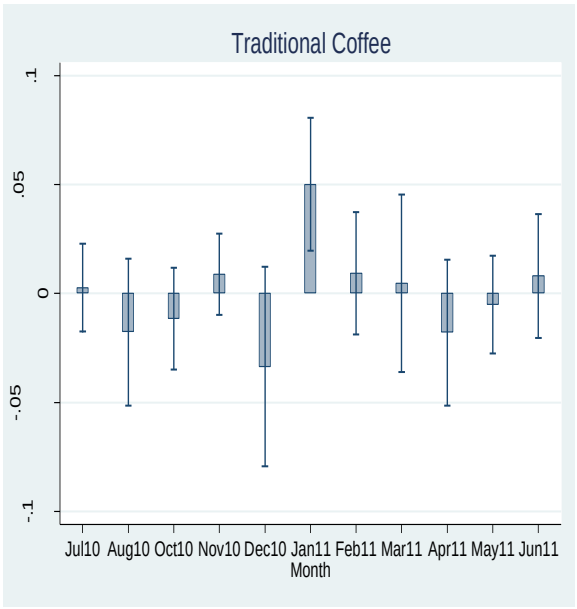
## Figure 5: Fixed Effect Parameter Estimates of Treated Food Categories



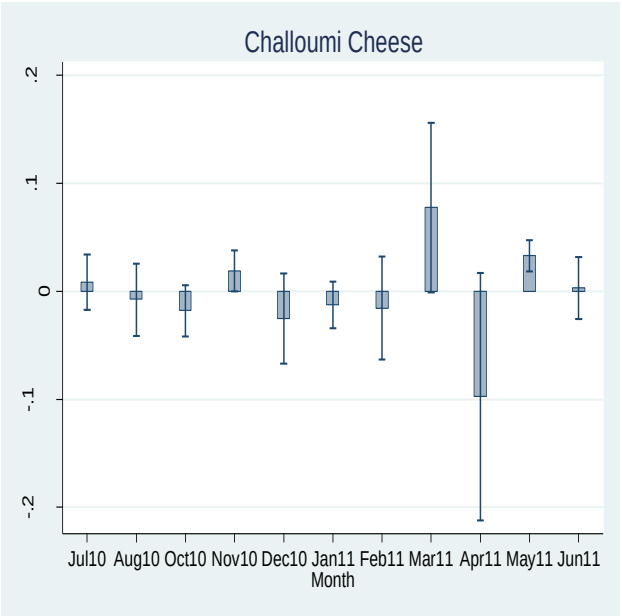

*Note*: January 2011 is the month of the VAT reform of very essential food items. Fixed effect estimates based on the long time series data Jan 2010-Jan 2011.




*Note*: January 2011 is the month of the VAT reform of very essential food items. Fixed effect estimates based on the long time series data Jan 2010-Jan 2011.




*Note*: January 2011 is the month of the VAT reform of very essential food items. Fixed effect estimates based on the long time series data Jan 2010-Jan 2011.




*Note*: January 2011 is the month of the VAT reform of very essential food items. Fixed effect estimates based on the long time series data Jan 2010-Jan 2011.

**Appendix**

## Table 1: Prices of Brand Food Products in Treatment and Control Groups

| | June 2010-June 2011 | TREATMENT GROUP | | | | |
|---|---|---|---|---|---|---|
| | | | Before the Reform | | After the Reform | |
| Product Category | Brand Product | Code | Mean | Std. Dev. | Mean | Std. Dev. |
| Milk | Charalabides Milk, 1L | 1001 | 1.13885 | 0.01410 | 1.21752 | 0.00495 |
| Milk | Lanites Milk, 1L | 1002 | 1.15280 | 0.01555 | 1.21542 | 0.00657 |
| Milk | Christes Milk, 1L | 1003 | 1.18256 | 0.02585 | 1.26507 | 0.00799 |
| Traditional Yogurt | Pittas Sheep Yogurt 100%, 300g | 1017 | 1.32499 | 0.02438 | 1.42191 | 0.01846 |
| Yogurt | Christes Yogurt, 300gr | 1021 | 1.70266 | 0.05579 | 1.80569 | 0.06346 |
| Traditionl Cheese | Pittas Challoumi, 225gr | 1101 | 2.65503 | 0.01141 | 2.78626 | 0.16231 |
| Traditioal Cheese | Cristes Challoumi Light, 1000gr | 1103 | 13.22248 | 0.16565 | 13.72802 | 0.31870 |
| Fresh Cream | Pittas Fresh Cream 200ml | 1122 | 0.87429 | 0.00652 | 0.95647 | 0.04988 |
| Macaroni | Mitsides Pastas | 1203 | 1.13597 | 0.02075 | 1.22819 | 0.03726 |
| Traditional Coffee | Coffee Laikos, 200gr | 1601 | 1.74093 | 0.01607 | 1.84269 | 0.00995 |
| Traditional Coffee | Coffee Charalambous, 200gr | 1602 | 1.77412 | 0.00590 | 1.86372 | 0.01008 |
| Sugar | Sugar, 1Kg | 1614 | 0.89407 | 0.02928 | 1.09557 | 0.09372 |
| No. of Observations | | 156 | | | | |
| Average Price | | | 2.40 | | 2.54 | |
| Percentage Change in Price (%) | | | 5.65 | | | |
| | | | | | | |
| | | CONTROL GROUP | | | | |
| Product Category | Brand Product | Code | Before the Reform | | After the Reform | |
| Orange Juice | Lanites Orange Juice, 1L | 1718 | 1.32479 | 0.03822 | 1.38346 | 0.04227 |
| Orange Juice | Kean Orange Juice, 1L | 1719 | 1.23885 | 0.02224 | 1.22346 | 0.01145 |
| Orange Juice | Ena Orange Juice, 1L | 1720 | 1.31865 | 0.00672 | 1.33303 | 0.05946 |
| Orange Juice | Lanites Orange Juice, 9x250ml | 1721 | 4.24179 | 0.11498 | 4.39157 | 0.14281 |
| Orange Juice | Kean Orange Juice, 9x250ml | 1722 | 4.14838 | 0.02853 | 4.05452 | 0.04667 |
| Squash | Kean Lemon Squash, 1L | 1723 | 1.70506 | 0.02318 | 1.70468 | 0.00937 |
| Squash | Lanites Orange Squash, 1L | 1724 | 1.65815 | 0.11715 | 1.87493 | 0.03855 |
| Lemon Juice | Lanites Lemon Juice, 0,33cl | 1725 | 0.57875 | 0.01077 | 0.62391 | 0.00299 |
| Bottled Water | Agros Water, 6x1.5L | 1726 | 2.42405 | 0.05056 | 2.35559 | 0.01243 |
| Bottled Water | Kykkos Water | 1727 | 2.53552 | 0.05348 | 2.46750 | 0.10007 |
| Bottled Water | HBH Water | 1729 | 3.10463 | 0.02382 | 3.14189 | 0.01249 |
| No. of Observations | | 143 | | | | |
| Average Price | | | 2.21 | | 2.23 | |
| Percentage Change in Price (%) | | | 1.14 | | | |

*Note* : Prices are in euros per unit.

## Table 2: Monthly Prices of Food Products in Treatment and Control Group
## June 2010-June 2011

| | | PRICE (EURO) | | | | FIRST DIFFERENCE IN LN PRICE | | | | % CHANGE | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TREATMENT | | CONTROL | | TREATMENT | | CONTROL | | Food CPI | Overall CPI |
| Year | Month | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | | |
| **Before Reform** | | | | | | | | | | | |
| 2010 | June | 2.36311 | 3.36311 | 2.20129 | 1.21443 | - | - | - | - | - | - |
| 2010 | July | 2.38097 | 3.41095 | 2.20131 | 1.23731 | 0.00456 | 0.01064 | -0.00759 | 0.02549 | 0.00420 | -0.00990 |
| 2010 | August | 2.40071 | 3.44297 | 2.21069 | 1.23324 | 0.00752 | 0.02007 | 0.00845 | 0.02661 | 0.04800 | 0.00820 |
| 2010 | September | 2.41022 | 3.46619 | 2.21118 | 1.21675 | 0.00167 | 0.01361 | 0.00258 | 0.02284 | 0.02800 | -0.00490 |
| 2010 | October | 2.41729 | 3.44392 | 2.22295 | 1.20442 | 0.01036 | 0.01409 | 0.00738 | 0.01653 | -0.01130 | 0.02600 |
| 2010 | November | 2.40607 | 3.49472 | 2.19532 | 1.19979 | -0.02101 | 0.03394 | -0.01372 | 0.01777 | -0.04870 | -0.00370 |
| 2010 | December | 2.42092 | 3.48799 | 2.20712 | 1.15304 | 0.01450 | 0.03439 | 0.01565 | 0.05060 | -0.02370 | -0.00160 |
| **After Reform** | | | | | | | | | | | |
| 2011 | January | 2.48357 | 3.46502 | 2.21916 | 1.16505 | 0.04765 | 0.02760 | 0.00637 | 0.01461 | 0.04710 | -0.00820 |
| 2011 | February | 2.49042 | 3.47034 | 2.23904 | 1.20850 | 0.00373 | 0.03673 | 0.00441 | 0.02262 | 0.01450 | 0.00430 |
| 2011 | March | 2.56644 | 3.60764 | 2.21063 | 1.17781 | 0.01814 | 0.03404 | -0.00723 | 0.04363 | 0.00880 | 0.00980 |
| 2011 | April | 2.51571 | 3.51765 | 2.24392 | 1.21137 | -0.00609 | 0.05401 | 0.00980 | 0.05131 | -0.00370 | 0.01160 |
| 2011 | May | 2.56484 | 3.65468 | 2.24169 | 1.21596 | 0.00996 | 0.03223 | -0.00207 | 0.01822 | 0.00760 | 0.00500 |
| 2011 | June | 2.59228 | 3.64705 | 2.23895 | 1.23303 | 0.01730 | 0.03005 | -0.00471 | 0.02225 | 0.01500 | 0.00500 |
| No. of Observations | | 156 | | 143 | | 144 | | 132 | | | |

*Note* : Unit prices are in euros. The first difference in ln price approximates the percentage change in prices and is the dependent variable in the regressions we estimate.

## Table 3: First Difference in Monthly Price of Product Categories in Treatment and Control Groups June 2010-June 2011

| | | TREATED PRODUCT CATEGORIES | | | | | | | | CONTROL GROUP CATEGORIES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MILK | | YOGURT | | COFFEE | | CHEESE | | ORANGE | | WATER | |
| Year | Month | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| **Before Reform** | | | | | | | | | | | | | |
| 2010 | July | 0.00186 | 0.00784 | 0.00816 | 0.01345 | 0.00000 | 0.00000 | 0.00508 | 0.01194 | -0.01272 | 0.02018 | 0.01370 | 0.02485 |
| 2010 | August | 0.00016 | 0.00027 | 0.02780 | 0.02609 | -0.00435 | 0.00615 | 0.00499 | 0.00599 | 0.01753 | 0.02456 | -0.01871 | 0.02214 |
| 2010 | September | 0.01411 | 0.01274 | -0.01116 | 0.01353 | 0.00743 | 0.00179 | 0.00690 *** | 0.00107 | -0.00143 | 0.02312 | 0.01272 | 0.03253 |
| 2010 | October | 0.01253 | 0.01095 | 0.01491 | 0.01085 | 0.00066 | 0.00093 | -0.00646 ** | 0.00278 | 0.00339 | 0.01467 | 0.01391 | 0.02490 |
| 2010 | November | -0.03097 | 0.03310 | -0.01063 | 0.01439 | 0.00000 | 0.00000 | 0.00957 | 0.00164 | -0.01115 | 0.01545 | -0.01603 | 0.02645 |
| 2010 | December | 0.02740 | 0.02843 | 0.00793 | 0.04886 | -0.01301 | 0.01932 | -0.00543 | 0.00768 | 0.02537 | 0.06678 | -0.00580 | 0.02075 |
| **After Reform** | | | | | | | | | | | | | |
| 2011 | January | 0.05314 *** | 0.01193 | 0.05569 ** | 0.02779 | 0.06139 ** | 0.01608 | -0.00187 | 0.00189 | 0.00549 | 0.01181 | -0.00027 | 0.01148 |
| 2011 | February | -0.00819 | 0.00515 | -0.02521 | 0.03741 | 0.00000 | 0.00000 | 0.02432 | 0.03258 | 0.00705 | 0.03105 | -0.00205 | 0.00475 |
| 2011 | March | 0.00188 | 0.00494 | 0.00660 | 0.02745 | 0.00228 | 0.00056 | 0.07455 | 0.05583 | 0.00366 | 0.04518 | -0.03418 | 0.05378 |
| 2011 | April | 0.00024 | 0.00226 | 0.03999 | 0.03222 | -0.00331 | 0.00172 | -0.08345 | 0.08814 | 0.00274 | 0.06200 | 0.02703 | 0.05414 |
| 2011 | May | -0.00091 | 0.00811 | -0.00903 | 0.04956 | -0.00226 | 0.01235 | 0.03511 *** | 0.00003 | -0.00879 | 0.02168 | 0.00998 | 0.01128 |
| 2011 | June | 0.00128 | 0.00437 | 0.02746 | 0.05184 | 0.00830 | 0.00176 | 0.00270 | 0.00382 | -0.00589 | 0.03102 | -0.00247 | 0.00610 |
| Observations | | 36 | | 36 | | 24 | | 24 | | 60 | | 36 | |

*Note* : *** p<0.01, **p<0.05, * p<0.1.

**Table 4: Parameter Estimates With and Without VAT Policy Reform**

| WITH POLICY INTERVENTION | | | | | WITHOUT POLICY INTERVENTION | | |
|---|---|---|---|---|---|---|---|
| | Jan10-Jan11 | Jun10-Jun11 | Jan10-Jan11 | Jun10-Jun11 | | Jun2009-Jun2010 | |
| VARIABLES | (1) | (2) | (3) | (4) | VARIABLES | (5) | (6) |
| **AFTER VAT REFORM** | | | | | | | |
| Jan 2011 | 0.0140 | 0.0140 | 0.0140 | 0.0140 | Jan 2010 | 0.0219* | 0.0219 |
| | (1.319) | (1.322) | (1.235) | (1.241) | | (1.810) | (1.693) |
| Feb 2011 | 0.0120 | 0.0120 | 0.0120 | 0.0120 | Feb 2010 | 0.00930 | 0.00930 |
| | (1.312) | (1.314) | (1.228) | (1.234) | | (1.071) | (1.002) |
| March 2011 | 0.000363 | 0.000363 | 0.000363 | 0.000363 | Mar 2010 | -0.0116 | -0.0116 |
| | (0.0205) | (0.0205) | (0.0192) | (0.0193) | | (-0.796) | (-0.745) |
| April 2011 | 0.0174 | 0.0174 | 0.0174 | 0.0174 | Apr 2010 | -0.00380 | -0.00380 |
| | (1.079) | (1.081) | (1.010) | (1.014) | | (-0.273) | (-0.255) |
| May 2011 | 0.00551 | 0.00551 | 0.00551 | 0.00551 | May 2010 | 0.0212 | 0.0212 |
| | (0.936) | (0.938) | (0.876) | (0.880) | | (1.496) | (1.399) |
| June 2011 | 0.00288 | 0.00288 | 0.00288 | 0.00288 | Jun 2010 | 0.0178 | 0.0178 |
| | (0.301) | (0.301) | (0.281) | (0.283) | | (1.708) | (1.597) |
| Jan 2011*Treatment | 0.0422*** | 0.0422*** | 0.0526*** | 0.0470** | Jan 2010*Treatment | 0.00876 | 0.0200 |
| | (3.002) | (3.007) | (2.901) | (2.169) | | (0.604) | (0.839) |
| Feb 2011*Treatment | -0.000227 | 0.000227 | 0.0263 | -0.0319 | Feb 2010*Treatment | -0.00320 | -0.00757 |
| | (-0.0132) | (0.0133) | (0.978) | (-1.163) | | (-0.500) | (-0.858) |
| Mar 2011*Treatment | 0.0263 | 0.0263 | 0.0171 | 0.0115 | March 2010*Treatment | -0.00609 | -0.0335 |
| | (1.281) | (1.283) | (0.725) | (0.523) | | (-0.397) | (-1.223) |
| Apr 2011*Treatment | -0.0150 | -0.0150 | 0.0335 | 0.0279 | April 2010*Treatment | 0.0174 | -0.00665 |
| | (-0.660) | (-0.662) | (1.244) | (1.162) | | (0.911) | (-0.146) |
| May 2011*Treatment | 0.0129 | 0.0129 | -0.00364 | -0.00928 | May 2010*Treatment | -0.00637 | -0.0123 |
| | (1.055) | (1.057) | (-0.115) | (-0.305) | | (-0.488) | (-0.440) |
| Jun 2011*Treatment | 0.0229 | 0.0229 | 0.0355 | 0.0298 | Jun 2010*Treatment | 0.0171 | 0.0353 |
| | (1.390) | (1.392) | (1.277) | (1.039) | | (0.928) | (0.729) |
| Jan 2011*Milk | - | - | -0.00284 | -0.000565 | Jan 2010*Milk | - | -0.0189 |
| | | | (-0.195) | (-0.0295) | | | (-0.792) |
| Feb 2011*Milk | - | - | 0.0167 | 0.0190 | Feb 2010*Milk | - | 0.00215 |
| | | | (0.700) | (0.789) | | | (0.213) |
| Mar 2011*Milk | - | - | -0.00500 | -0.00273 | Mar 2010*Milk | - | 0.0376 |
| | | | (-0.313) | (-0.246) | | | (1.470) |
| April 2011*Milk | - | - | -0.0400 | -0.0378* | Apr 2010*Milk | - | 0.00958 |
| | | | (-1.633) | (-1.968) | | | (0.215) |
| May 2011*Milk | - | - | 0.00784 | 0.0101 | May 2010*Milk | - | 0.00824 |
| | | | (0.241) | (0.333) | | | (0.297) |
| June 2011*Milk | - | - | -0.0265 | -0.0242 | June 2010*Milk | - | -0.0471 |
| | | | (-1.121) | (-0.990) | | | (-0.923) |
| Jan 2011*Cheese | - | - | -0.0749*** | -0.0538*** | Jan 2010*Cheese | - | -0.0342 |
| | | | (-5.692) | (-2.985) | | | (-1.509) |
| Feb 2011*Cheese | - | - | 0.0322 | 0.0533 | Feb 2010*Cheese | - | 0.00228 |
| | | | (1.088) | (1.663) | | - | (0.232) |
| March 2011*Cheese | - | - | 0.0506 | 0.0717* | Mar 2010*Cheese | | 0.0449* |
| | | | (1.460) | (1.986) | | - | (1.741) |
| April 2011*Cheese | - | - | -0.141** | -0.120** | Apr 2010*Cheese | | 0.0827* |
| | | | (-2.479) | (-2.346) | | - | (1.857) |
| May 2011*Cheese | - | - | 0.0268 | 0.0479 | May 2010*Cheese | | -0.0114 |
| | | | (0.834) | (1.588) | | - | (-0.410) |
| June 2011*Cheese | - | - | -0.0421* | -0.0210 | Jun 2010*Cheese | | 0.0764 |
| | | | (-1.788) | (-0.847) | | - | (1.485) |
| Jan 2011*Macaroni | - | - | -0.00395 | -0.00186 | Jan 2010*Macaroni | | -0.0226 |
| | | | (-0.304) | (-0.103) | | - | (-1.042) |
| Feb 2011*Macaroni | - | - | 0.0332 | 0.0353 | Feb 2010*Macaroni | | 0.0371*** |
| | | | (1.397) | (1.472) | | - | (3.773) |
| March 2011*Macaroni | - | - | 0.0105 | 0.0126 | Mar 2010*Macaroni | | -0.0137 |
| | | | (0.671) | (1.173) | | - | (-0.544) |

**Table 4: Parameter Estimates With and Without VAT Policy Reform**

| WITH POLICY INTERVENTION | | | | | WITHOUT POLICY INTERVENTION | | |
|---|---|---|---|---|---|---|---|
| | Jan10-Jan11 | Jun10-Jun11 | Jan10-Jan11 | Jun10-Jun11 | | Jun2009-Jun2010 | |
| VARIABLES | (1) | (2) | (3) | (4) | VARIABLES | (5) | (6) |
| April 2011*Macaroni | - | - | -0.0937*** | -0.0916*** | Apr 2010*Macaroni | - | 0.0347 |
| | | | (-3.824) | (-4.779) | | | (0.809) |
| May 2011*Macaroni | - | - | 0.0259 | 0.0280 | May 2010*Macaroni | - | 0.0208 |
| | | | (0.806) | (0.933) | | | (0.767) |
| June 2011*Macaroni | - | - | 0.0411* | 0.0432* | Jun 2010*Macaroni | - | -0.0724 |
| | | | (1.747) | (1.772) | | | (-1.423) |
| Jan 2011*Coffee | - | - | 0.00727 | 0.0134 | Jan 2010*Coffee | - | -0.0102 |
| | | | (0.444) | (0.645) | | | (-0.467) |
| Feb 2011*Coffee | - | - | 0.0268 | 0.0329 | Feb 2010*Coffee | - | -0.00119 |
| | | | (1.126) | (1.371) | | | (-0.110) |
| March 2011*Coffee | - | - | -0.00275 | 0.00339 | Mar 2010*Coffee | - | 0.0515* |
| | | | (-0.175) | (0.313) | | | (2.042) |
| April 2011*Coffee | - | - | -0.0417 | -0.0356* | Apr 2010*Coffee | - | 0.00997 |
| | | | (-1.699) | (-1.844) | | | (0.227) |
| May 2011*Coffee | - | - | 0.00835 | 0.0145 | May 2010*Coffee | - | 0.0141 |
| | | | (0.252) | (0.465) | | | (0.471) |
| June 2011*Coffee | - | - | -0.0176 | -0.0115 | Jun 2010*Coffee | - | -0.0433 |
| | | | (-0.748) | (-0.470) | | | (-0.847) |
| Jan 2011*Sugar | - | - | 0.0224* | 0.0267 | Jan 2010*Sugar | - | 0.0324 |
| | | | (1.721) | (1.486) | | | (1.494) |
| Feb 2011*Sugar | - | - | 0.117*** | 0.121*** | Feb 2010*Sugar | - | 0.00669 |
| | | | (4.926) | (5.065) | | | (0.680) |
| March 2011*Sugar | - | - | 0.0184 | 0.0227** | Mar 2010*Sugar | - | 0.0370 |
| | | | (1.169) | (2.106) | | | (1.471) |
| April 2011*Sugar | - | - | -0.00302 | 0.00129 | Apr 2010*Sugar | - | 0.0403 |
| | | | (-0.123) | (0.0675) | | | (0.940) |
| May 2011*Sugar | - | - | 0.0793** | 0.0836** | May 2010*Sugar | - | 0.0208 |
| | | | (2.467) | (2.784) | | | (0.769) |
| June 2011*Sugar | - | - | 0.00693 | 0.0112 | Jun 2010*Sugar | - | -0.0704 |
| | | | (0.295) | (0.462) | | | (-1.385) |
| **BEFORE VAT REFORM** | | | | | | | |
| Aug 2010 | 0.0160 | 0.0160 | 0.0160 | 0.0160 | Aug 2009 | 0.0223 | 0.0223 |
| | (1.068) | (1.070) | (0.999) | (1.004) | | (1.474) | (1.379) |
| Sep 2010 | 0.0102 | 0.0102 | 0.0102 | 0.0102 | Sept 2009 | 0.0120 | 0.0120 |
| | (1.170) | (1.173) | (1.096) | (1.101) | | (1.420) | (1.328) |
| Oct 2010 | 0.0150 | 0.0150 | 0.0150 | 0.0150 | Oct 2009 | 0.0131 | 0.0131 |
| | (1.454) | (1.457) | (1.361) | (1.368) | | (1.242) | (1.161) |
| Nov 2010 | -0.00613 | -0.00613 | -0.00613 | -0.00613 | Nov 2009 | 0.0153 | 0.0153 |
| | (-0.613) | (-0.614) | (-0.574) | (-0.577) | | (0.679) | (0.635) |
| Dec 2010 | 0.0232 | 0.0232 | 0.0232 | 0.0232 | Dec 2009 | 0.00391 | 0.00391 |
| | (1.057) | (1.059) | (0.990) | (0.994) | | (0.249) | (0.233) |
| Jul 2010*Treatment | 0.0131 | 0.0131 | 0.0131 | 0.0131 | Jul 2009*Treatment | 0.00706 | 0.00706 |
| | (1.252) | (1.255) | (1.172) | (1.178) | | (0.419) | (0.392) |
| Aug 2010*Treatment | -1.79e-05 | -1.79e-05 | -1.79e-05 | -1.79e-05 | Aug 2009*Treatment | -0.0195** | -0.0195* |
| | (-0.00109) | (-0.00109) | (-0.00102) | (-0.00103) | | (-2.141) | (-2.002) |
| Oct 2010*Treatment | 0.00389 | 0.00389 | 0.00389 | 0.00389 | Oct 2009*Treatment | -0.00358 | -0.00358 |
| | (0.315) | (0.315) | (0.294) | (0.296) | | (-0.311) | (-0.291) |
| Nov 2010*Treatment | -0.00637 | -0.00637 | -0.00637 | -0.00637 | Nov 2009*Treatment | -0.0213 | -0.0213 |
| | (-0.511) | (-0.512) | (-0.478) | (-0.480) | | (-1.064) | (-0.995) |
| Dec 2010*Treatment | -0.000245 | -0.000245 | -0.000245 | -0.000245 | Dec 2009*Treatment | -0.00847 | -0.00847 |
| | (-0.0118) | (-0.0118) | (-0.0110) | (-0.0111) | | (-0.510) | (-0.477) |
| Constant | 0.00190 | -0.00806 | -0.0512 | -0.00806 | Constant | -0.00999 | -0.00999 |
| | (0.0390) | (-0.986) | (-0.785) | (-0.944) | | (-1.167) | (-1.100) |
| Observations | 529 | 276 | 529 | 276 | Observations | 262 | 262 |
| R-squared | 0.155 | 0.161 | 0.303 | 0.360 | R-squared | 0.141 | 0.298 |

Note: Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

## Table 5: Parameter Estimates for Different Treated Food Categories

| | JANUARY 2010 - JANUARY 2011 | | | | JUNE 2010 - JUNE 2011 | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | MILK | YOGURT | COFFEE | CHEESE | MILK | YOGURT | COFFEE | CHEESE |
| **AFTER VAT REFORM** | | | | | | | | |
| Jan-11 | 0.0140 | 0.0140 | 0.0140 | 0.0140 | 0.0140 | 0.0140 | 0.0140 | 0.0140 |
| | (1.261) | (1.261) | (1.250) | (1.250) | (1.265) | (1.265) | (1.254) | (1.254) |
| Feb 2011 | 0.0120 | 0.0120 | 0.0120 | 0.0120 | 0.0120 | 0.0120 | 0.0120 | 0.0120 |
| | (1.254) | (1.254) | (1.243) | (1.243) | (1.258) | (1.258) | (1.247) | (1.247) |
| March 2011 | 0.000363 | 0.000363 | 0.000363 | 0.000363 | 0.000363 | 0.000363 | 0.000363 | 0.000363 |
| | (0.0196) | (0.0196) | (0.0194) | (0.0194) | (0.0196) | (0.0196) | (0.0195) | (0.0195) |
| April 2011 | 0.0174 | 0.0174 | 0.0174 | 0.0174 | 0.0174 | 0.0174 | 0.0174 | 0.0174 |
| | (1.031) | (1.031) | (1.022) | (1.022) | (1.034) | (1.034) | (1.025) | (1.025) |
| May 2011 | 0.00551 | 0.00551 | 0.00551 | 0.00551 | 0.00551 | 0.00551 | 0.00551 | 0.00551 |
| | (0.895) | (0.895) | (0.887) | (0.887) | (0.898) | (0.898) | (0.890) | (0.890) |
| June 2011 | 0.00288 | 0.00288 | 0.00288 | 0.00288 | 0.00288 | 0.00288 | 0.00288 | 0.00288 |
| | (0.287) | (0.287) | (0.285) | (0.285) | (0.288) | (0.288) | (0.286) | (0.286) |
| Jan 2011*Treatment | 0.0352** | 0.0631** | 0.0502*** | -0.0126 | 0.0352** | 0.0631** | 0.0502*** | -0.0126 |
| | (2.243) | (2.662) | (3.583) | (-1.274) | (2.250) | (2.670) | (3.595) | (-1.278) |
| Feb 2011*Treatment | 0.0241 | 0.0159 | 0.00927 | -0.0156 | -0.0241 | -0.0159 | -0.00927 | 0.0156 |
| | (1.764) | (0.590) | (0.718) | (-0.711) | (-1.769) | (-0.592) | (-0.721) | (0.713) |
| March 2011*Treatment | -0.00242 | 0.0276 | 0.00465 | 0.0775* | -0.00242 | 0.0276 | 0.00465 | 0.0775* |
| | (-0.118) | (1.276) | (0.248) | (2.146) | (-0.118) | (1.280) | (0.249) | (2.153) |
| April 2011*Treatment | -0.0211 | 0.0439* | -0.0180 | -0.0976* | -0.0211 | 0.0439* | -0.0180 | -0.0976* |
| | (-1.292) | (2.105) | (-1.168) | (-1.857) | (-1.296) | (2.111) | (-1.172) | (-1.863) |
| May 2011*Treatment | -0.0104 | 0.00678 | -0.00504 | 0.0329*** | -0.0104 | 0.00678 | -0.00504 | 0.0329*** |
| | (-1.492) | (0.240) | (-0.489) | (5.003) | (-1.497) | (0.241) | (-0.490) | (5.020) |
| June 2011*Treatment | -0.00555 | 0.0459 | 0.00815 | 0.00308 | -0.00555 | 0.0459 | 0.00815 | 0.00308 |
| | (-0.397) | (1.503) | (0.625) | (0.235) | (-0.399) | (1.508) | (0.627) | (0.235) |
| **BEFORE VAT REFORM** | | | | | | | | |
| Aug 2010 | 0.0160 | 0.0160 | 0.0160 | 0.0160 | 0.0160 | 0.0160 | 0.0160 | 0.0160 |
| | (1.021) | (1.021) | (1.011) | (1.011) | (1.024) | (1.024) | (1.015) | (1.015) |
| Sep 2010 | 0.0102 | 0.0102 | 0.0102 | 0.0102 | 0.0102 | 0.0102 | 0.0102 | 0.0102 |
| | (1.119) | (1.119) | (1.109) | (1.109) | (1.122) | (1.122) | (1.112) | (1.112) |
| Oct 2010 | 0.0150 | 0.0150 | 0.0150 | 0.0150 | 0.0150 | 0.0150 | 0.0150 | 0.0150 |
| | (1.390) | (1.390) | (1.377) | (1.377) | (1.394) | (1.394) | (1.382) | (1.382) |
| Nov 2010 | -0.00613 | -0.00613 | -0.00613 | -0.00613 | -0.00613 | -0.00613 | -0.00613 | -0.00613 |
| | (-0.586) | (-0.586) | (-0.581) | (-0.581) | (-0.588) | (-0.588) | (-0.583) | (-0.583) |
| Dec 2010 | 0.0232 | 0.0232 | 0.0232 | 0.0232 | 0.0232 | 0.0232 | 0.0232 | 0.0232 |
| | (1.011) | (1.011) | (1.002) | (1.002) | (1.014) | (1.014) | (1.005) | (1.005) |
| Jul10 | -0.00208 | 0.0295* | 0.00273 | 0.00835 | -0.00208 | 0.0295* | 0.00273 | 0.00835 |
| | (-0.153) | (2.015) | (0.296) | (0.711) | (-0.154) | (2.021) | (0.297) | (0.713) |
| Aug10 | -0.0198 | 0.0331 | -0.0177 | -0.00778 | -0.0198 | 0.0331 | -0.0177 | -0.00778 |
| | (-1.226) | (1.528) | (-1.142) | (-0.508) | (-1.229) | (1.533) | (-1.146) | (-0.510) |
| Oct10 | -0.00638 | 0.0213 | -0.0116 | -0.0182 | -0.00639 | 0.0213 | -0.0116 | -0.0182 |
| | (-0.393) | (1.286) | (-1.080) | (-1.677) | (-0.394) | (1.290) | (-1.084) | (-1.683) |
| Nov10 | -0.0288* | 0.0168 | 0.00887 | 0.0190** | -0.0288* | 0.0168 | 0.00887 | 0.0190** |
| | (-1.990) | (1.088) | (1.031) | (2.187) | (-1.996) | (1.091) | (1.035) | (2.194) |
| Dec10 | 0.000220 | 0.00602 | -0.0335 | -0.0254 | 0.000221 | 0.00602 | -0.0335 | -0.0254 |
| | (0.00787) | (0.215) | (-1.597) | (-1.326) | (0.00790) | (0.216) | (-1.602) | (-1.330) |
| Constant | -0.0722 | -0.0167 | -0.0402 | 0.0255 | -0.00512 | -0.0105 | -0.00684 | -0.00692 |
| | (-1.412) | (-0.224) | (-0.901) | (0.448) | (-0.609) | (-1.254) | (-0.806) | (-0.815) |
| Observations | 322 | 322 | 299 | 299 | 168 | 168 | 156 | 156 |
| R-squared | 0.162 | 0.179 | 0.161 | 0.280 | 0.166 | 0.169 | 0.133 | 0.237 |

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

**Figure 6: Prices of Treated Product Categories vs. Control Group**

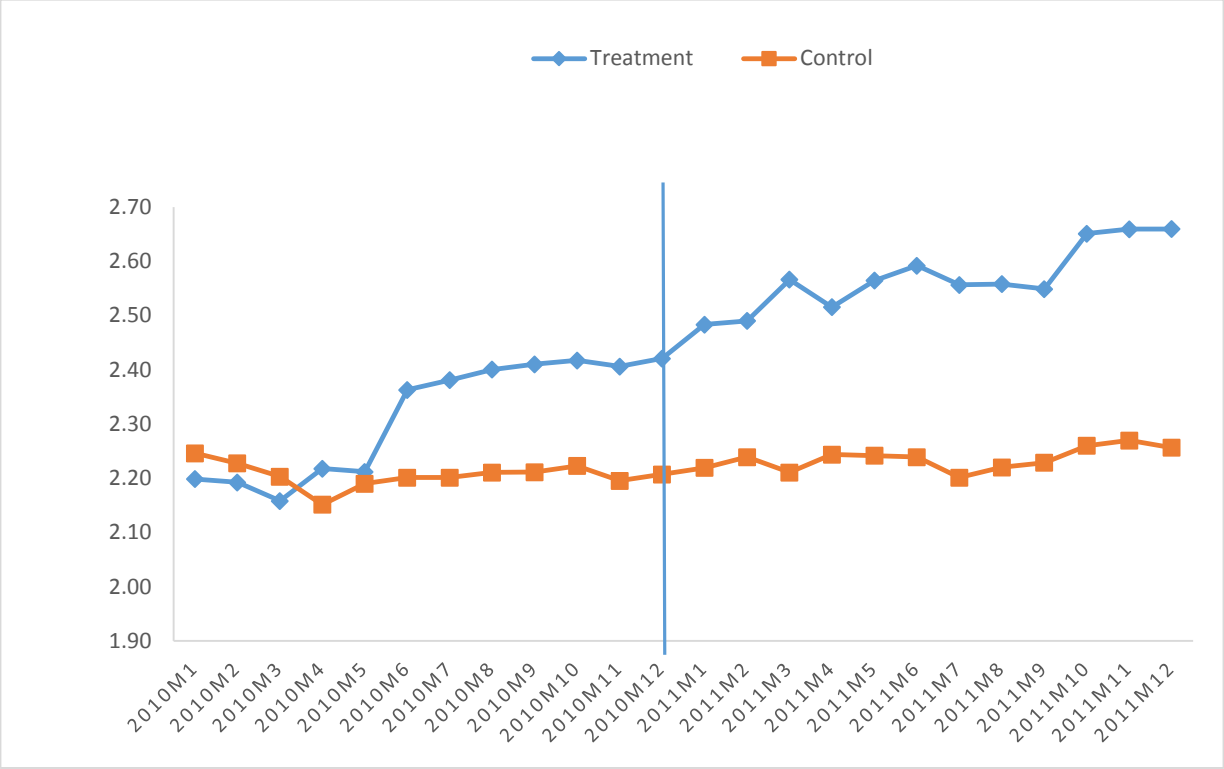


**Figure 7: Prices of Treated Product Categories vs. Control Group**