When the baby cries at night.

Uninformed and hurried buyers in non-competitive markets*

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Abstract

We study the entrance in a retail market of consumers who are less elastic because of hurriedness and lack of information. Theory predicts that firms react by increasing prices to expand surplus extraction, but this effect weakens as market competition increases. High frequency data from Italian pharmacies confirm these predictions. Monthly variation in the number of newborns at the city level generates exogenous changes in the number of less elastic buyers (the parents) who consume a basket of hygiene products demanded by more experienced and elastic consumers as well. We estimate that the number of newborns has a positive effect on the equilibrium price even if marginal costs are decreasing. We exploit exogenous variation in market competition generated by the Italian legislation concerning how many pharmacies should operate in a city as a function of the existing population. Using a Regression Discontinuity design we find that an increase in competition has a significant and negative effect on the capacity of sellers to extract surplus from less elastic buyers.

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1 Introduction

In some periods of their life consumers may face higher opportunity cost of time as, for example, when they become parents of newborns. In such cases they often cannot acquire all the useful information about the best prices in the market and about the relevant products for their needs. They may also have less time to profit from the best deals even if they had all the information necessary to identify them. As a consequence, these consumers are less price sensitive than standard more experienced consumers. Similar kinds of buyers' heterogeneity, in terms of price-elasticity, are likely to be a common feature of most markets, but their consequences on firms' pricing strategies are relatively unexplored.

In this paper we investigate empirically how firms react to the composition of the population of their consumers, when they perceive that the proportion of less elastic buyers changes. Specifically, we provide a novel and clean identification strategy to study what happens to prices when exogenous waves of hurried, less informed, and thus less elastic buyers enter a market. We then estimate how the *composition effect* on prices generated by an increase in the share of these buyers is affected by an exogenous modification in the degree of competition faced by firms.

Our analysis rests on the assumption that immediately after delivery, parents suddenly enter as buyers in the market of the goods that are necessary to raise their babies, but are relatively less informed about prices and children's needs than other consumers of those products, including cohorts of parents of older babies. They are also more likely to be under pressure (... when the kid cries!), being less able to profit from the best offers available in the market.

For each of the 8,092 Italian municipalities (henceforth, cities), we have data on the number of newborn babies at the monthly frequency between January 2006 and December 2010. We have also identified a set of hygiene products demanded by parents of small babies as well as by other consumers and we are able to access monthly data on prices charged for these goods by a large number of pharmacies in these cities, together with the corresponding quantities. Thanks to these unique sets of data, under relatively mild identification assumptions[1], we are able to estimate the elasticity of the equilibrium price with respect to a shock in the monthly number of newborns. Consistently with the theoretical

[1] Controlling for city and time fixed effects, the variation in newborns at the monthly frequency is arguably random.

predictions, we find that an increase in the number of newborns significantly raises the average price at the city level. There are other possible interpretations for this result (most notably increasing marginal costs) but we are able to show that none of these alternative interpretations is consistent with the other available pieces of evidence.

The insights of the theoretical model that guides our analysis invites us to further explore empirically whether the elasticity of the equilibrium price with respects to newborns, that we estimate in the first part of the paper, decreases when competition among sellers increases. To do this, we need exogenous sources of variation in the number of sellers. We find these sources by concentrating the analysis on cities whose maximum population during the last 45 years has been in a neighborhood of the 7500 units threshold. Indeed, the Italian law prescribes, similarly to many other countries, that cities with a population lower than this threshold should have only one pharmacy, while an additional pharmacy should be opened in cities above the threshold. With respect to current population, there is substantial non-compliance with this rule, partly because of geographic reasons[2], but more importantly because during the post-war period, when population grew above the threshold, pharmacies were opened but later they were not closed if population declined under the threshold. Precisely for this reason, *the maximum population size* reached historically by cities generates a fuzzy assignment mechanism for the current number of pharmacies. We exploit this assignment mechanism within a Regression Discontinuity design to study how the number of sellers influences the effect of an increase in the share of less elastic consumers.

Using this identification strategy we show, as expected, that cities immediately above the threshold (in terms of maximum historical population) have, on average, a larger number of pharmacies than cities immediately below. More interestingly, we show that where the number of competing pharmacies is larger for this exogenous reason, the elasticity of equilibrium prices to newborns is significantly smaller. We interpret this finding as evidence that in less competitive environments sellers can exploit to their advantage increases of demand originating from less elastic consumers, as theory predicts. Competition, however, limits severely this sellers' ability to exploit market power.

Although there has been a recent surge of empirical investigations of consumers' heterogeneity, these studies typically do not investigate directly the composition effect on prices which emerges when, for some reasons, the fraction of informed and uninformed consumers

[2] The presence of remote areas or valleys within the city boundaries is the most common motivation for being allowed to have more pharmacies than what the Law would prescribe.

changes. An important exception is Lach (2007) who studies the effect of an unexpected large inflow of immigrants to Israel during 1990. He shows that a one-percentage-point increase in the ratio of immigrants to natives in a city decreases prices of commodity goods by 0.5 percentage points. He explains this finding with immigrants having lower search costs and thus higher price elasticity than the native population. We consider instead a predictable increase in less price-elastic and higher-search costs consumers (the parents of newborns), showing that this increase has a positive effect on prices. Moreover, Lach (2007) does not study how *competition among sellers* modifies the effect of an inflow of buyers characterized by a different price elasticity. We improve on this relevant question with respect to Lach (2007) by showing, in a Regression Discontinuity design, that greater competition reduces the capacity of sellers to extract surplus from less elastic buyers.

The advent of Internet has been seen as one leading factor that has reduced search costs, increased the fraction of more informed consumers, and ultimately induced a reduction of prices. This has been documented, for example, by Brown and Goolsbee (2002) illustrating the effect of Internet comparison shopping sites on the prices of life insurance in the 1990s.

Using scanner data, Aguiar and Hurst (2007) have shown that older individuals, facing a lower opportunity cost, shop more frequently, looking for temporary discounts, and thus paying lower prices than younger ones for exactly the same products. Interestingly for our analysis, they are able to calculate the implicit opportunity cost of time, showing that it is hump shaped with respect to age, with a peak in the early thirties, precisely when most of them are engaged in parental cares, thus rising the opportunity cost of shopping (for given wage). This empirical observation is consistent with our findings but, differently from their paper, we do not take shops' pricing strategies as given and we are rather interested in precisely verifying if and how shops endogenously modify prices when they observe a change in the composition of the population of their customers.

In the mutual funds industry, Hortacsu and Syverson (2004) recover estimates of the search cost distributions for heterogeneous investors and show that the observed large dispersion of fund participation fees (i.e. the price to join a fund) can be explained by the non-negligeable search costs. They also document an upward shift of the estimated search costs distribution that occurred between 1996 and 2000 and suggest, with indirect evidence, that this observation may be the result of entry of novice investors.[3]

[3]However, they say on p. 441: "*We emphasize that our model's implication of such a composition shift is only suggestive–we would need investor-level data to test it definitively*".

Similarly to these papers, we are interested in measuring the *composition effects* in markets with consumers characterized by different levels of elasticities, possibly induced by different available information sets and higher time pressure. However, and differently from these papers, we address this analysis with *a direct measure* of an *exogenous* change in the composition of consumers, offered by the possibility to count explicitly the number of inexperienced newborns' parents entering the market for childcare products. We further qualify this composition effect by interacting it with an exogenous source of variation in the market structure, i.e. the number of pharmacies available to parents as implied by the law.[4]

The rest of the paper is organized as follows. Section 2 provides the theoretical background that guides our empirical exercise. Section 3 describes the data and justifies the identification strategy. Section 4 presents and discusses the econometric results. The effect of newborns on equilibrium price is estimated in Section 4.1. Section 4.2 shows instead how competition affects the elasticities estimated in the previous section. Finally, Section 5 concludes.

2 Theoretical insights

Consider a market with S shops selling a possibly differentiated product to a total of N_t consumers at any period t. Buyers are divided in two groups, the N_t^U "unelastic consumers" with an individual demand q_i^U for shop i and the N_t^E "elastic consumers" who instead have an individual demand q_i^E. The difference between the two groups is that the demand elasticity to price for the products sold at any shop i is lower for types U than for types E.[5]

In particular, our empirical analysis will consider products that are used for various purposes among which, in particular, childcare and that are sold at pharmacies and supermarkets. Parents of newborns are buyers of these products who are typically very pressed and face higher opportunity cost of time. As a consequence, they may have limited information on best price sellers, especially if they are at their first baby and just after delivery,

[4] With this respect the paper is also related to the vast literature on entry, initiated by Bresnahan and Reiss (1991) who showed that the pro-competitive effect of new entrants falls rapidly after 3-5 firms have entered the market. However, we are here considering an environment with regulated entry and we are interested on the composition effect and how it is affected by the actual number of competitors. See Schaumans and Verboven (2008) for an empirical analysis of entry in regulated markets.

[5] The smooth demand functions that we will use in this analysis can be obtained either assuming single-unit consumption with different willingness to pay for consumers within each of the two groups U and E, or assuming multiple-units with homogenous individuals within each group. In the Appendix we illustrate a simple model in the latter class which delivers smooth demand and the desired different price elasticities for the two groups of consumers.

and they may also find it unprofitable to move to shops offering the best deal even if they had the information necessary to identify them. In addition, they may perceive purchases of childcare products at pharmacies as non perfectly substitutable with purchases of the same or equivalent products in supermarkets, due to the value they attach to pharmacists' advice and information. These consumers will then be our unelastic type U buyers. All the others consumers, comprising possibly also parents after some months of experience, will be instead our elastic or experienced type E buyers.[6]

At any period t, we assume that there is an inflow of new consumers of type U which is IID over time. In general, the number of standard consumers of type E at date t may also depend on inflows of types U in previous periods because some of them may have been able to better organize their purchases (after some time parents may become childcare experts) in which case they exit the group of types U consumers and enter in the group of type E. Although for simplicity here we do not explicitly model this transition, we will consider this possibility in our empirical analysis.

For the time being we assume that any shop i has a constant (and time invariant) marginal cost c_i and will consider other possibilities in the sequel.

2.1 Shops' pricing strategies

The presence of two types of consumers opens up the possibility for shops to price discriminate. Assume for simplicity that the two types of consumers are identifiable. In the context of our empirical application, it is possible that pharmacists might identify the parents of newborns when they enter their shops. For example, mothers of newborns have probably shopped at the local pharmacy while pregnant before the birthdate and newborns parents are likely to talk with their pharmacist about the recent change in their family life. In this case first degree price discrimination may take place with associated prices p_i^E and p_i^U.[7] The profit of shop i is[8]

$$\pi_{it} = (p_i^E - c_i)q_i^E N_t^E + (p_i^U - c_i)q_i^U N_t^U \tag{1}$$

[6]Ointments for child skin protection that we will consider in our data are largely used also by sportsmen; shampoos, bath foams, and barrier creams for children are extensively used by adults as well.

[7] What we describe below on the average price, which is our matter of interest, is also valid with second degree price discrimination, i.e. when shops cannot identify groups. Indeed, with quantity discounts they are still able to have consumers in the two groups paying different unitary prices.

[8]To simplify notation we suppress the time-index except for profit and the numbers of consumers.

The associated optimal prices p_i^{*E} and p_i^{*U} are simply obtained by two separate maximizations of profits per-consumer for each of the two types. From standard price discrimination it follows that $p_i^{*E} \leq p_i^{*U}$ so that, the *average price* registered in the unit of time at shop i

$$\frac{p_i^{*E} N_t^E + p_i^{*U} N_t^U}{N_t}$$

is increasing in the fraction N_t^U / N_t of new and unelastic consumers. On the other hand, a proportional increase in the two groups of consumers, thus leaving the ratio N_t^U / N_t constant, would leave the average price unaffected.

Imagine now that shops cannot price discriminate and can only offer a unique (linear) price p_i.[9] The profit then simply becomes

$$\pi_{it} = (p_i - c_i) \left(q_i^E \frac{N_t^E}{N_t} + q_i^U \frac{N_t^U}{N_t} \right) N_t.$$

The inability to price discriminate may induce shops to relay on mixed strategies, if shops' products are sufficiently substitutable. This would be the case, for example as in Varian (1980), when the new consumers U are uninformed about the prices available in the market and consumers E are instead fully informed.

However, for whatever pricing strategy, either deterministic or stochastic, we can still state the following.[10]

Remark 1 *Changes in consumers' demand may generate a scale and a composition effect:*

(i) ***Scale effect****: Any change in the number of consumers that preserves the same composition in the population among unelastic and elastic consumers (i.e. keeps constant N_t^U / N_t^E) leaves unaffected the average price observed in the market.*

(ii) ***Composition effect****: An increase in the proportion of unelastic consumers N_t^U / N_t^E always induces an increase in the average price in the market at date t.*

Intuitively, when the fraction of new and unelastic consumers increases, shops find it optimal to increase their price(s) since the associated demand reduction coming from elastic and standard consumers is more than compensated by the total demand increase coming from the unelastic ones. This is specifically what happens, in the context of our empirical

[9]Given what we say in footnote 7 we are here assuming away the possibility to offer non-linear prices.

[10]In the case of deterministic strategies, results are immediate. For mixed strategies with informed and uninformed consumers they are obtained, among others, in Janssen and Moraga-Gonzalez (2004).

analysis, when the number of standard and elastic consumers remains constant and instead the number of unelastic consumers increases. It is also important to notice that if the U consumers (or at least some of them) effectively become E consumers after some time, i.e. at a future date $t' > t$, the wave of these consumers will induce a reduction of the proportion $N_{t'}^U / N_{t'}^E$ of U consumers at date t', which in turn will determine a reduction of the average price at t'.

We are also interested in studying how the composition effect derived above is affected by the presence of more sellers in the market, and in particular whether the expected price increase due to more unelastic consumers is mitigated when S is large. To our knowledge, in all environments illustrated above it is possible to derive the following:

Remark 2 *The average price increase induced by the entrance of more unelastic consumers in the market is mitigated by competition, i.e. by a larger number of sellers S.*

This remark illustrates how competition (measured by S) affects the *price changes* induced by fluctuations of the fraction of unelastic consumers. We do not consider, instead, how S affects *price levels* directly. This is a well investigated issue on which theoretical models deliver some mixed results. In fact, we know that when sellers set price in pure strategies (such as for example when products are perceived as imperfect substitutes by consumers), then, as expected, prices are reduced by a larger S. Janssen and Moraga-Gonzalez (2004) have instead shown that, with perfect substitutability and informed / uninformed consumers, more sellers induce a larger expected price (unless uninformed consumers optimally randomize between buying or not buying which is optimal for them if S is large).

We are however less interested in this issue both because it has been well debated in the empirical and theoretical literature and also because our data do not allow us to measure the degree of substitutability of the products that we consider, and are therefore not particularly useful to study the potentially ambiguous effect of competition on price levels.[11] We think instead that our data may provide a more significant value added if used to measure the *composition effect* highlighted in Remark 1 and how it changes at different levels of competition between sellers (Remark 2). This will therefore be the main focus of our empirical

[11] Our empirical evidence on this issue, that we do not report here given the different focus of this paper, but that is available upon request, suggests a close to zero overall effect of competition on the *level* of prices and quantities. This result probably hides the two opposite effects mentioned in the text related to the coexistence of consumers for whom products in different pharmacies are substitutable with consumers for whom instead they are not.

analysis, but before moving to it we need to consider the possibility of a more conventional explanations for the effect of a demand shock on prices.

2.2 Non-constant marginal costs

It is clear that if marginal costs are increasing, then a larger number of consumers trivially implies an upward pressure on prices, independently of any composition of demand. From this viewpoint, a significant component of the marginal costs faced by sellers is determined by the wholesale contracts that they are able to sign with their suppliers. Indeed, quantity discounts may induce decreasing marginal cost while quantity premia may instead induce increasing marginal costs. In what follows, we will investigate these possibilities and show that for the type of products that we are considering in the empirical analysis, pharmacies are actually offered quantity discounts. Hence, it is not possible to attribute the price increases observed in our data to the type of wholesale contracts signed by pharmacies. Actually, these wholesale contracts should, if anything, mitigate the price increase.

Alternatively, increasing marginal costs could be the consequence of congestion in the shop both directly (it is proportionally more costly to serve more consumers) and indirectly (having customers queueing in the shop may discourage future visits thus inducing lower future demand). Again, we will explore empirically this possibility and show that the change in demand that we observe generated by the increase of new unelastic consumers is too small to imply any significant congestion.

Related to congestion, we finally mention the possible effects of capacity constraints and the risk for shops of running out of stock. We will explain that wholesalers promptly supply pharmacies so that this possibility is unlikely to occur in our data. Moreover, the effect of limited product availability on prices is ambiguous. Indeed, with highly substitutable products and informed / uninformed consumers, Lester (2010) has shown that an increase of uninformed (hence unelastic) consumers may actually decrease prices when shops are capacity constrained.[12] This again may mitigate the composition effect described in Remarks 1 and 2, which is the object of interest in the empirical analysis that follows.

[12]Limited products availability makes the shops posting the lowest prices less interesting for the informed consumers since they know they risk not being served. This competition among informed consumer, which is increased by the presence of more uninformed consumers, may thus relax competition among shops and reduce prices when there are more uninformed.

3 The data and the empirical strategy

We use information on a large sample of Italian pharmacies collected by "Pharma" (the name is fictitious for confidentiality reasons), a consultancy company for pharmacies and pharmaceutical firms. With the consent of its clients, we were given access to the details of every item sold by each pharmacy in the Pharma database for the period from January 2007 to December 2010. The dataset originates from each single sale receipt. During the period under study, Pharma collected data from 3,331 Italian pharmacies, corresponding to 18.6% of the universe of pharmacies in Italy. For 60% of them, we have complete information for the entire period; for 28.7% we have information starting from January 2009; and for the remaining 11.26% data is available only for the period January 2007-December 2008. The pharmacies in the Pharma database are located in almost all the Italian regions (with the exception of Basilicata), but their concentration is higher in the North since the company is located near Milan.[13]

Our goal is to use this dataset to test the theoretical predictions of Section 2, summarized in Remarks 1 and 2, concerning how, in a market, prices and quantities are affected by a demand shock deriving from a change in the number of new and unelastic consumers. We argue that a measure of this kind of shock for a subset of products sold by these pharmacies is represented by changes at the monthly frequency in the number of newborns in the neighborhood where a pharmacy is located. Monthly data on newborns are obtained at the city level from the National Statistical Office (ISTAT). The left panel of Figure 1 plots the temporal evolution of the number of newborns in the cities where the pharmacies of the Pharma sample operate. There is a significant seasonality in newborns: the most relevant peaks are typically in the summer, while the lowest levels are more frequent in the winter. The right panel of the figure plots the residuals of a regression of (log) newborns on city fixed effects. These residuals show a substantial within-city and over time variability in the number of newborns.

Ideally we would like to measure the monthly number of newborns in some neighborhood of each pharmacy, but we can only measure it at the level of a city. Therefore in the empirical analysis we aggregate all the pharmacies of the Pharma data set in each municipality and consider as a unit of observation the average price and the average quantity of these

[13] Specifically 19% of these pharmacies are in the north east of Italy, 45% in the north west, 9% in the center, 16% in the south and 11% in the islands.

pharmacies in each city. Note that unfortunately we do not observe the quantity and the price of the pharmacies that, within each city, are not in the Pharma sample. This drawback of our dataset is in principle problematic, but we will report results restricted to cities in which we observe all the existing pharmacies (i.e. cities in which Pharma has a full market coverage), to show that our tests of the theoretical predictions remain unaffected.

We select child hygiene products as the ones for which changes in newborns may be considered as a proxy of exogenous demand shocks originating from variations in the composition of elastic and unelastic consumers in the market. With respect to these products the parents of newborns, like type U consumers of the theoretical models described in Section 2, are less informed, more pressed and thus less elastic than other buyers in the same market. For this reason we focus on a set of 2925 hygiene products that are used for children immediately *after* birth and then extensively during the first years of their life. This set includes items like: bath foams and shampoos for babies; cleansers for babies; cold and barrier creams and oils for babies; baby wipes; talcum and other after-bath products for babies. Table 1 describes a sample of items in this basket: the upper panel shows the five products sold in largest quantity during the period 2007-2010, while the lower panel shows the ones that featured the highest unit price over the same period. For each item, we have the quantity sold by each pharmacy in each month and the price charged (in Euros).[14]

Moreover, these products are consumed also by other customers, like for example bikers and runners, to prevent skin rash. While these customers can be seen as experienced and elastic buyers of these products, newborns' parents (unless they are themselves bikers, runners or experienced parents) are new in this market. Information about prices is available to them through costly trips to pharmacies.[15] They are likely to be under pressure when buying for their babies and they probably lack experience in the evaluation of the newborns' real needs, which makes the advice of a pharmacist highly appreciated. All these ingredients, as emphasized above, make parents of newborns unelastic consumers compared to the other consumers like sports-persons although they all buy the same set of products. Of course parents may learn relevant information after some months of purchases and may be able to

[14]For items that have not been sold for an entire month, the price imputed is the price reported by the pharmacy in the Pharma software database. Instead, when the sold quantity is positive, the monthly price is the weighted average of the (possibly) different prices actually charged over the month, with weights equal to the number of items sold at each price level.

[15]In principle, consumers may use the internet to learn the expected price. However, even the acquisition of information from the internet is far from being costless. Moreover, in the Italian context, very few pharmacies have a website.

smooth out their organization of parental activities, thus becoming less pressed. So, after a while, they are likely to join the stock of elastic consumers.

Note that our theoretical results require the existence of both elastic and unelastic consumers, and focuses precisely on the effect of changes in their proportions (demand composition). Other items may be characterized by more homogeneous consumers and are therefore less suitable for the purposes of this study. For these products, the fraction of standard and elastic buyers would be severely restricted (possibly to zero) if parents are slow in learning about the market and by the fact that, when children grow, parents leave the market perhaps precisely when they have become elastic consumers.

To show that the set of hygiene products on which we focus is indeed demanded by both types of consumers we regress the total number of units sold in each city by the pharmacies under study, on the number of newborns and on time and city fixed effects.[16] This regression allows us to decompose the variability of the number of sold boxes in the part attributable to newborns (plus time and city effects to be conservative) and the residual part that can be attributed to other customers. This decomposition indicates that 88% of the variability in the number of boxes sold from month to month is generated by consumers other than newborns.[17]

We model the number of the elastic buyers of child hygiene products as a specific characteristic of each city and month of the year, that can be captured by city and time fixed effects. Our identification strategy therefore hinges on the assumption that *at the monthly frequency and controlling for city and time fixed effects* a change in the number of newborns is a random event not correlated with other city characteristics.

For the basket of products that is relevant for our study, we constructed Laspeyres indexes of prices and quantities. Denoting with $h \in 1, \ldots, H$ each product in the basket, the price and quantity indexes (hereafter, price and quantity) for pharmacy i in month t are defined by:

$$p_{it} = \frac{\sum_h p_{iht}\bar{q}_h}{\sum_h \bar{p}_h\bar{q}_h} \tag{2}$$

$$q_{it} = \frac{\sum_h \bar{p}_h q_{iht}}{\sum_h \bar{p}_h\bar{q}_h} \tag{3}$$

[16] Later we will construct Laspeyeres quantity and price indexes for the basket of goods in which we are interested, but for the purpose of assessing whether these goods are demanded by other customers beyond newborns, we can focus now on the actual total number of “boxes” sold in a month for each item.

[17] Using the quantity index described below, the decomposition shows that around 85% of the variability can be attribued to customers other than newborns.

where $\bar{q}_h$ and $\bar{p}_h$ are the quantity and the price for product h, respectively sold and charged on average by all pharmacies in all months. In other words, p_{it} is the weighted average price charged by pharmacy i in month t for the entire basket, where the weights are based on the quantities of each item sold on average in the entire market over all months. So this price index is independent of the quantities sold by pharmacy i and changes over time (and with respect to any pharmacy j) if and only if the price of at least one item changes in pharmacy i (or j). The quantity index q_{it} is instead the weighted average quantity sold by pharmacy i in month t for the entire basket, where the weights are based on the prices of each item charged on average in the entire market over all months. So this quantity index is independent of the prices charged by pharmacy i and changes over time (and with respect to any pharmacy j) only if the quantity of at least one item changes in pharmacy i (or j).

The temporal evolutions of these two indexes for the pharmacies in the Pharma dataset are plotted in the left panels of Figure 2. Quantities are characterized by seasonality (with the most relevant peaks during the summer) and by a weak downward trend. Conversely, prices are characterized by a more robust upward trend. Our empirical strategy exploits within pharmacy variability of both these variables. The right panels plot the residuals of a regression of (log) quantity and (log) price on city fixed effects. These residuals show that both the quantity and the price change substantially over time at the intra-pharmacy level. Although the intra-pharmacy variability of quantity index is larger, there is substantial variability also in the price index.

We are also interested in the effects of changes in the degree of competition between sellers for the market under study. To study these effects we need an exogenous source of variation in the number of pharmacies. Here, we exploit the rules that regulate the Italian pharmacy market. In Italy, entry in and exit from this market are regulated by the Law 475/1968. This Law establishes (as in many other countries) the so-called "demographic criterion" to define the number of pharmacies authorized to operate in each city. Specifically, the law generates a set of population thresholds at which the number of existing pharmacies that should operate in a city changes discontinuously. Leaving the details to Section 4.2, for our purposes this law generates a Regression Discontinuity design that allows for the possibility to estimate the causal effect of a change in the number of competing pharmacies at each threshold.

Descriptive statistics for the variables used in the econometric analyses are displayed in Table 2.

4 Effects of changes in the proportion of unelastic consumers in a market

We exploit the data described in the previous section to estimate, with different empirical models, the parameters of the following linear regression, which allows us to test the predictions of the theory:

$$p_{ct} = \alpha + \beta S_c + \delta N^U_{ct} + \Lambda(N^U_{ct-\tau}) + \phi_c + \mu_t + \varepsilon_{ct} \tag{4}$$

where $c \in \{1, \ldots, C\}$ denotes cities and $t \in \{1, \ldots, T\}$ denotes months. p_{ct} is the (log) price index charged by the S_c pharmacies in city c at time t. N^U_{ct} is the (log) number of newborns in city c at time t. $\Lambda(N^U_{ct-\tau})$ is a polynomial in the lags of the number of newborns. ϕ_c and μ_t are city and month fixed-effects which capture relevant characteristics of city markets, like the distance between pharmacies, or of calendar months, like seasonal effects.

As explained in Section 3, our identifying assumption requires also that these fixed effects capture the (log) number of elastic consumers N^E_{ct}. Therefore, by measuring the effect of N^U_{ct} controlling for ϕ_c and μ_t we are effectively measuring the composition effect of the ratio $\frac{N^U_{ct}}{N^E_{ct}}$ described in Remark 1. ε_{ct} is an error term, which is allowed to display heteroskedasticity and serial correlation at the city level. This, however, is not a threat for our identification strategy, since it does not affect the randomness of the number of newborns N^U_{ct} and of its lags.

4.1 The elasticity of price to the proportion of unelastic consumer

We first exploit within-city variation of newborns for the estimation of the following standard fixed-effect model:

$$p_{ct} = \alpha + \delta N^U_{ct} + \Lambda(N^U_{ct-\tau}) + h_c + \mu_t + \varepsilon_{ct} \tag{5}$$

where, given equation 4, $h_c = \beta S_c + \phi_c$. Note that if our identifying assumptions are valid, N^U_{ct} is randomly assigned conditioning on city and time fixed effects. Thus, the parameter δ, that captures the *composition effect* derived in Remark 1 of Section 2.1, can be interpreted as a causal parameter and its OLS estimate is consistent. Similarly, the coefficients of the polynomial in the lags of the number of newborns, $\Lambda(N^U_{ct-\tau})$, measure the extent to which the *composition effect* fades away with time, while newborns' parents become more experienced buyers.

Table 3 reports estimates of equation 5. Let's first assume that marginal costs are constant or decreasing. Under this assumption, if parents of newborns are less elastic than other consumers we expect a positive estimate for δ. If instead, newborns' parents are as elastic as other consumers, the effect on price should be nil (or negative in case of decreasing marginal costs). Thus, a positive parameter δ should signal the presence of less elastic consumers and measure the associated *composition effect* discussed in our theoretical analysis (see Remark 1).

The first row of Table 3 reports estimates of δ that are positive and highly significant. In the first column the entire sample is considered, while in the second column the estimate is based on the restricted sample of cities in which Pharma has full coverage. Since the estimate in the first column may be confounded by the fact that we do not observe the pharmacies not covered by the Pharma dataset, it is reassuring to see that results are essentially unchanged (actually, if anything larger) in the second column.

To help the interpretation of their size, we have standardized coefficients and standard errors by the standard deviation of the correspondent variable. The estimate in the first row and first column, for example, indicates that a 100% increase in newborns (which corresponds to one quarter of a standard deviation of this variable) causes an increase of 1.6% of a standard deviation of the (log) price. This indicates that when pharmacists note a (standard) increase in the number of newborns in a given month, the average price at which they sell in that month increases substantially and, as explained in section 2, this effects prevails independently of the pharmacists' ability to price discriminate.[18]

The remaining rows of Table 3 report estimates for the first 11 monthly lags of the number of newborns. The regression actually includes all the 23 lags for which we have information in our dataset (see Section 3), but only the first 10 lags (except the second one) are statistically different from zero. The 11th (reported in the last row of the table) and all the remaining ones (not reported to save on space) are statistically insignificant. The estimated coefficients do not decline monotonically, as one would have expected if they captured the learning process of parents, but it should be noted that the differences between them are not statistically significant. Although we do not know exactly if, how and when parents of newborn enter the pool of the more elastic consumers, these estimates indicate

[18] In case of price discrimination, it is not necessarily the case that pharmacists ask higher prices to the parents of newborns. They may equivalently offer higher discounts to more experienced and thus less loyal consumers.

that they remain relatively less elastic than experienced buyers for almost one year after delivery.

However, before concluding that the estimates for δ of Table 3 are positive because the parents of newborns are relatively unelastic consumers, it is necessary to dismiss the possibility that this finding is driven instead by the alternative explanations discussed in Section 2.2. A positive estimate for δ could be the consequence of increasing marginal costs even if all customers were equally and fully informed. We present three pieces of evidence that exclude this possibility.

First, it may be marginally more costly for a pharmacy to sell larger quantities if wholesalers charged higher prices for larger orders, in which case an increase in newborns may obviously translate into higher prices for consumers. The evidence, however, points in the opposite direction. From "InfoSystem"(fictitious name for confidentiality reasons), a software house specialized in managing information systems for pharmacies in Italy, we obtained the pricing schedule adopted by a large Italian wholesaler in the period 2010-2011. This wholesaler sells 727 child hygiene products (24.8% of our basket) to pharmacies. For none of them the wholesale price schedule, as a function of quantity, is increasing. Figure 3 shows the average price charged by the wholesaler for different quantities of the four main categories of child hygiene products (bath foam and shampoo, after bath products, barrier creams, wipes). What emerges is a clear decreasing pattern supporting the theoretical assumption of non-increasing marginal costs. If anything, the presence of these quantity discounts should have reduced the composition effect that we document in Table 3.

Second, we can also exclude that problems of congestion, caused by the increase of newborns, indirectly raise pharmacies' marginal costs. If the increase of newborns has the potential to generate a queue of hurried parents in the pharmacy and if expected revenues from them are lower than the ones that can be expected from other consumers (of any product), the pharmacist may react by increasing prices on child hygiene products in order to reduce the undesired queue of newborns' parent. This possibility is extremely unlikely in our environment because child hygiene products represent on average a tiny percentage of the monthly transactions of a pharmacy: evidence from till receipts issued by the pharmacies in our sample show that those containing at least one child hygiene product are on average less than 2.2% of all monthly till receipts (i.e. around 130 over a total of 5,800). A 100% increase in monthly sales of child hygiene products would thus yield an increase of around 2.2% of total demand, which would not be enough to generate substantial queueing in the pharmacy.

Third, pharmacies in our dataset can receive supplies from wholesalers more than once a day so that there is basically no effective shortage of inventories that might be binding for more than few hours.

We can therefore conclude with sufficient confidence, that the positive effect of the number of newborns on prices estimated in Table 3 is evidence that the parents of newborns are more hurried and less informed, thus relatively less elastic, than other consumers of child hygiene products and that pharmacies are capable to exploit their inability to substitute. We now can explore whether this capacity to extract surplus from the less elastic consumers changes according to different levels of competition faced by pharmacies in this market.

Before doing so a word should be said concerning quantities. As explained in Section 2 we expect that an increase in the number of newborns raises the quantity sold by pharmacies. This result, however, is less interesting from the viewpoint of this paper because it does not contain specific information concerning the capacity of firms to extract surplus from unelastic consumers, which is our main focus. It is nevertheless reassuring to see that this expectation is confirmed by our evidence. We do not report results in tables to save on space, but our evidence indicates that a 100% increase in newborns (which corresponds to one quarter of a standard deviation of this variable) causes an increase of 3% of a standard deviation of the (log) quantity. Also in the case of quantities results are confirmed when the analysis is restricted to cities in which Pharma has full coverage of the existing pharmacies.

4.2 Can competition limit the capacity of pharmacies to extract surplus from unelastic consumers?

As previously discussed, entry and exit in the pharmacy market is regulated by law 475/1968 which establishes how many pharmacies should operate in a city as a function of the existing population. Below 7500 inhabitants there should be only one pharmacy. From 7500 to 12500 there should be two pharmacies. Above this threshold a new pharmacy should be added every 4000 inhabitants. Compliance with this theoretical rule is however imperfect for at least two reasons. First, cities that are composed by differentiated and land locked geographical areas with difficult transport connections (e.g. because of mountain ridges or rivers), are allowed to have more pharmacies than what would be implied by a strict application of the law. Second, the evidence suggests that it is easier to open a pharmacy than to close one, probably because of the difficulty of "deciding" who should exit the market when pharmacies are too many (the law being silent on this issue). In some rare occasions market forces induce the bankruptcy of the weakest pharmacy in a city in which demand is no longer sufficient to sustain positive profits for all the existing ones. But otherwise, the evidence suggests that, given the rents that a pharmacy probably grants to its owners in a highly regulated market like the Italian one, new sellers enter immediately whenever possible, but very few later exit if and when the city population declines.

This historical asymmetry in the likelihood that pharmacies are opened or closed, generates, nevertheless, an exogenous source of variation in the current number of pharmacies based not on the current population but on the population peak reached since 1971.[19] Consider the threshold of 7,500 inhabitants at which the number of existing pharmacies should theoretically increase from 1 to 2, according to the law. The left panel of Figure 4 shows local polynomial smoothing (LPS) regression estimates of the number of pharmacies as a function of the current city population, together with the 95% confidence intervals.[20] No discontinuity in the number of competitors can be appreciated. The right panel of the same Figure shows instead analogous LPS regression estimates of the number of pharmacies against the maximum level reached by the city population since 1971. Here the discontinuity is large and statistically significant.

As it can be seen, there are cities in which the population never went above 7500 units since 1971 and nevertheless have more than one pharmacy for the already mentioned historical or geographic reasons. Similarly, on the right of the threshold, the average number of pharmacies is larger than two, in contrast with what the law would require. But even in the presence of this generalized "upward non-compliance", a significant discontinuity of approximately half a pharmacy emerges at the threshold.

Table 4 reports estimates of the equation

$$S_c = \omega + \varphi K_c + g(|Pop_c - \kappa|) + \zeta_c \tag{6}$$

where c denotes a city, S_c is the number of pharmacies in a city; Pop_c is the maximum historical population in a city; $K_c = 1(Pop_c \geq \kappa)$ is a dummy taking value 1 for cities on the right hand side of the $k-$threshold. The parameter φ in this equation measures the

[19]The 1971 Census is the first reliable population measure at the city level after the date of enactment of Law 475/1968.

[20]For municipalities in which pharmacies are observed since January 2007, current population is measured at December 31, 2006; for municipalities in which pharmacies are observed since January 2009, current population is measured at December 31, 2008.

discontinuity at the threshold. Independently of the specification of the polynomial $g(.)$, the first panel of Table 4 confirms the visual impression of Figure 4, suggesting an even larger discontinuity at the threshold (we report local linear and polynomial regressions for different population windows around the threshold, from $\pm 1,500$ to $\pm 4,000$ inhabitants). The same happens in Panel B of the same table in which the analysis is restricted to the cities with a 100% Pharma coverage and in Panel C where observable controls are included in the specification to improve efficiency.[21]

At higher thresholds, involving larger cities with more pharmacies, even the compliance with the rule based on the population peak is more blurred, so that we are forced to use only the first threshold of 7500 units for our analysis. This however is enough to test in a clean way the theoretical predictions concerning the effects of competition in this market.[22]

Having shown that the number of pharmacies effectively changes discontinuously at this threshold, we now have to provide evidence supporting the identifying assumption for a RD design, requiring that nothing else relevant changes discontinuously at the same threshold. Figure 5 shows the local polynomial smoothing (LPS) regressions of four observable pre-treatment factors on the maximum historical population since 1971: the average monthly number of newborns, a dummy taking value 1 if the city is in a urban area, a dummy taking value 1 if the city is in Northern Italy and per capita disposable income (measured in 2008) at the city level. For none of these variables a quantitatively or statistically significant discontinuity should be observed at the threshold and this is precisely the evidence emerging from the figure.[23] Nonetheless, in some empirical specifications we include these variables as regressors to increase efficiency.

Since the conditions for a RD design are satisfied we can now describe what we learn from estimates based on it, concerning the effect of competition on the ability of firms to extract surplus from unelastic consumers. To this end, we test whether the *composition*

[21] The included controls are: the average monthly number of newborns, a dummy taking value 1 if the city is in a urban area, a dummy taking value 1 if the city is in Northern Italy, and per capita disposable income at the city level.

[22] It would instead not be enough for a complete policy design since we only have insights concerning changes from approximately 1 to approximately 2 pharmacies in relatively small cities.

[23] We have also tested the existence of discontinuity at the threshold for these variables using local linear and polynomial regressions for different windows around the threshold (as suggested by Imbens and Lemieux (2008)). Results uniformly fail to identify any significant discontinuity. Additional covariates for which the unconfoundedness hypothesis has been tested include the population growth rate since 1971, per capita consumption, per capita expenditure on pharmaceuticals, the number of convenience-stores allowed to sell drugs ('parafarmacie'), and the number of grocery stores, all at the city level. The expected values of all these variables do not show any significant discontinuity at the threshold. Results are available upon request.

effect on prices of an increase in the number of unelastic consumers is different at different levels of competition between pharmacies. In other words, we are now interested in the interaction between N^U_{ct} and S_c. The theoretical model in fact suggests that when competition is tougher, an inflow of type U consumers should have a less positive effect on prices than when competition is weaker. To gather evidence on this prediction we proceed in three steps.

1. We regress the price and the number of newborns at t on newborns' lags, city and time fixed effects to partial out these variables. That is, we estimate the following model for the set of dependent variables $H_{ct} = \{N^U_{ct}, p_{ct}\}$:

$$H_{ct} = \Lambda(N^U_{ct-\tau}) + \phi_c + \mu_t + \eta_{ct}, \tag{7}$$

   and we retrieve the residuals for each dependent variable that we denote as: $\tilde{H}_{ct}$.

2. *Separately for each city*, we regress the residual price on the residual newborns' number obtained from step 1. That is, we run a total of C regressions like:

$$\tilde{p}_{ct} = \alpha_c + \delta_c \tilde{N}^U_{ct} + \tilde{\varepsilon}_{ct} \tag{8}$$

   Each regression yields a city specific estimate $\hat{\delta}_c$ of the elasticity of the price p_{ct} to the contemporaneous number of newborns.

3. We then use the RD design, to test whether these city-specific elasticities differ on the two sides of the population threshold $\kappa = 7500$, keeping in mind that on the left of this threshold the number of pharmacies is significantly lower than on the right. Therefore we estimate the following equation restricting the analysis to cities in a neighborhood of the threshold:

$$\hat{\delta}_c = \omega + \gamma K_c + g(|Pop_c - \kappa|) + \eta_c \tag{9}$$

   where $K_c = 1(Pop \geq \kappa)$ is a dummy equal to 1 on the right of the threshold.

A negative estimate for γ in the RD regression (9) would confirm the prediction of the theoretical Section 2.1 (Remark 2), according to which an increase in the number of competitors should reduce the *composition effect*, i.e. the capacity of pharmacies to extract surplus from less elastic consumers and therefore that it should reduce the positive effect of newborns on prices.

Figures 6 plots the LPS regression estimates of the elasticity of price with respect to the number of newborns on the two sides of the threshold. In line with the theoretical model we see that the elasticity of price to newborns declines down to zero when competition increases, suggesting that pharmacies facing higher competition are less able to extract surplus from uninformed consumers.

Table 5 reports estimates of the coefficient γ in equation (9), confirming the visual impression of Figure 6.[24] In the first four columns we find a significant effect of the number of competitors on the elasticity of price with respect to newborns, independently of the specification of the polynomial in the distance from the threshold and of the window around the threshold. Indeed, this elasticity is always significantly lower on the right of the threshold than on the left. This finding is consistent with the theoretical analysis that predicts that an increase in the number of competitors reduces the *composition effect*, i.e. the capacity of firms to extract surplus from unelastic buyers.

Column 5 of Table 5 shows that these results are robust with respect to the failure of observing all the pharmacies in a city. Estimates are in fact qualitatively and quantitatively similar when we restrict the analysis to cities with a 100% Pharma coverage.[25] Column 6 of Table 5 reports, instead, results obtained controlling for observables to increase efficiency.[26] As expected, point estimates remain practically unchanged.

Finally, our setting allow us to use also Instrumental Variable methods for the purpose of measuring the effect of competition on the pharmacies' ability to extract surplus from uninformed consumers. We estimate the equation

$$\hat{\delta}_c = \chi + \psi s_c + g(|Pop_c - \kappa|) + \nu_c \tag{10}$$

using the threshold dummy $K_c = 1(Pop_c \geq \kappa)$ as an instrument for the number of competitors perceived by a pharmacy, which is given by $s_c = S_c - 1$. Therefore, the measure of competition used in this regression is the number S_c of pharmacies in the market minus 1. In this way, *near the threshold* where $Pop_c \approx \kappa$, the constant captures what happens when in a city there is only one monopolist pharmacy. Table 6 reports estimates of the effect ψ

[24] In Table 5 inference is based on heteroskedasticity-robust standard errors. Alternatively, standard errors have been bootstrapped: results, available upon request, show unaffected statistical significance.

[25] Note, however, that focusing on this subsample reduces the number of observations, so that we have to enlarge the window up to 4,000 inhabitants and rely on lower order polynomials to obtain precise estimates.

[26] These controls are, again, the average monthly number of newborns, a dummy taking value 1 if the city is in a urban area, a dummy taking value 1 if the city is in Northern Italy and per capita disposable income (measured in 2008) at the city level.

of the real number of competitors (*Treatment Effect*) on the elasticity of price to newborns, as opposed to estimates of the effect of their theoretical number (*Intention to Treat Effect*), which were reported in Table 5. Here, controls have been added to increase efficiency. The four columns use different windows around the threshold up to ± 4,000 inhabitants and report the F-statistics of the excluded instrument. This set of estimates shows that, near the threshold, when there is just one pharmacy in the market (i.e. a pharmacy with $s_c = 0$ competitors), the elasticity of equilibrium price to the number of newborn is positive and significant.[27] The presence of an additional competitor, however, annihilates this elasticity.

5 Conclusions

In this paper we have provided new evidence on the role of consumers' heterogeneity in terms of elasticity for the retail sector, and on its interplay with competition among sellers. Theory predicts that an inflow of less informed and more hurried, thus less elastic, consumers should have a positive effect on the average price charged by sellers. This composition effect (generated by sellers being able to extract larger rents from unelastic consumers through higher prices) should also decline as the number of competitors increases.

We gather data for a large sample of Italian pharmacies and estimate the effect of a positive shock in the number of newborns (at the monthly frequency and controlling for city and time fixed effects) on the average price at the city level, for a basket of child hygiene products. We argue that parents of newborns are less informed and more hurried than other consumers of the same set of products and that an increase of newborns is thus a source of exogenous variation in the number of relatively unelastic consumers. Consistently with the theoretical prediction, an increase in newborns has a positive effect on price. We provide evidence allowing us to exclude that this positive effect might be driven by increasing marginal costs and/or by congestion at the pharmacy level.

To study the effect of competition on the elasticity of price to the presence of unelastic consumers, we exploit a legislative feature of the Italian pharmacy market that is common to many countries and based on a demographic criterion. In Italy the law imposes that municipalities under 7,500 inhabitants should have a single pharmacy, while those right above this threshold should have two. Despite the presence of non-compliance with this

[27] The value of the constant has been measured at the mean value of the covariates included, that are a dummy equal to 1 in Northern Italy, the municipal area, and the number of 'parafarmacie'(i.e. special convenience-stores allowed to sell drugs).

law, we are able to exploit it within a Regression Discontinuity design and show that the elasticity of prices to the number of newborns declines to zero in cities where the number of pharmacies is higher. These results confirm the theoretical prediction that competition reduces the capacity of firms to extract surplus from less elastic buyers.

Appendix: A simple model with new and regular consumers

Each consumer has a local shop "around the corner" indexed with l. The utility of a consumer purchasing in any given shop is $u(q) - pq$ for q units at price p. The marginal utility of consumption is decreasing. Consumers may decide to delay consumption of some or all units to future dates (in discrete time), in which case she can purchase also at distant shops, otherwise she can only buy from the local one. Let the time-discount factor be denoted with δ^j for consumer of type $j = U$, E with $\delta^U \leq \delta^E$. The parameter δ^j measure the opportunity cost of delaying consumption and thus, indirectly, of time. Suppose all consumers are informed of prices and let p_d be the lowest available price in the market amongst the distant shops and p_l be the price of the local shop available to the consumer at hand. Consumer j when deciding if and how much to buy from the local shop solves the following problems

$$\max_{q_l, q_d} \{u(q_l) - p_l q_l + \delta^j [u(q_l + q_d) - u(q_l) - p_d q_d]\}.$$

If $q_d = 0$ the consumer only purchases from the local shop. If $q_l = 0$ she prefers to completely delay consumption. In all other cases she buys (and consumes) the first q_l units from the local shop and then buys the additional q_d units from the distant shop tomorrow with an increment in utility corresponding to $u(q_l + q_d) - u(q_l)$.

Think for example to a parent of a newborn who has an absolute necessity to procure some minimal amount of childcare products so as to cope with immediate needs. Even knowing that the local shop has higher prices, she may procure the minimal amount (i.e. the units generating the largest marginal utility) locally and then postpone the additional units, not strictly necessary for today, to tomorrow's purchase in the least costly distant shop. The drawback of waiting is that consumption is discounted.

Clearly if $p_d \geq p_l$ then $q_d = 0$ for any $\delta^j > 0$. The interesting case is instead the one in which $p_l > p_d$. Straightforward calculations show that more impatient consumers of type U, i.e. with a lower discount factor, purchase more from the local shop $q_l^U \geq q_l^E$ and, for a price increase in the local shop, their demand reduction is less strong than that of consumers with a larger discount factor, i.e. $\frac{\partial q_l^U}{\partial p_l} \leq \frac{\partial q_l^E}{\partial p_l}$.

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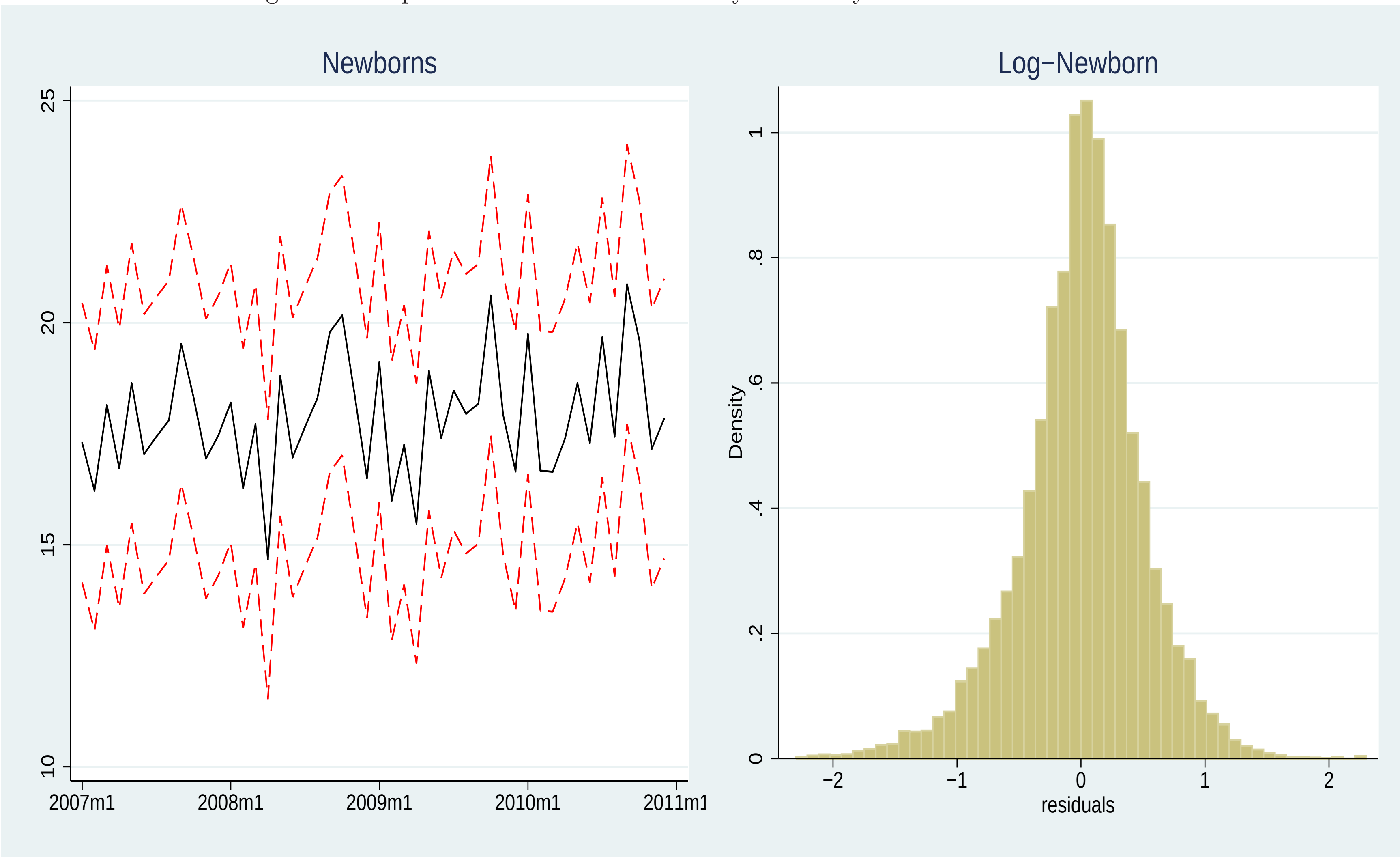
Figure 1: Temporal evolution and within city variability of the number of newborns



Notes: Temporal evolution of the average number newborns per city (left panel), and histograms of the residuals of a regression of log-newborns on city fixed effects (right panel). Dashed lines delimit the 95% confidence interval.

Table 1: Top items in the basket of hygiene products

Name	Description	Price	Quantity
Top-5 by Sold Quantity			
Salviette Assorbello	Hygienic Towels	2.04	39.94
GP Baby Pasta all'Ossido di Zinco	Zinc-Oxyde Paste	4.91	23.3
Bluedermin Pasta BB 100ml	Diaper Change Ointment	5.83	17.21
Trudi Baby Care Salviettine	Hygienic Towels	2.07	16.53
GP Baby Detergente	Cleansing Cream	5.02	15.3
Top-5 by Price			
Soin de Fee 24-Hour Baby Cream 50ml	Barrier Cream	45	0.21
Vidermina 3 Soluzione 1000ml	Cleansing Cream	40.32	0.01
Buba Shampoo e Bagno	Shampoo and Bath Foam	37.61	0.04
Unilen Gel 15ml	Barrier Cream	36.06	0.11
Protezione Solare Bambini Vichy	Suntan Cream	30.9	0.02

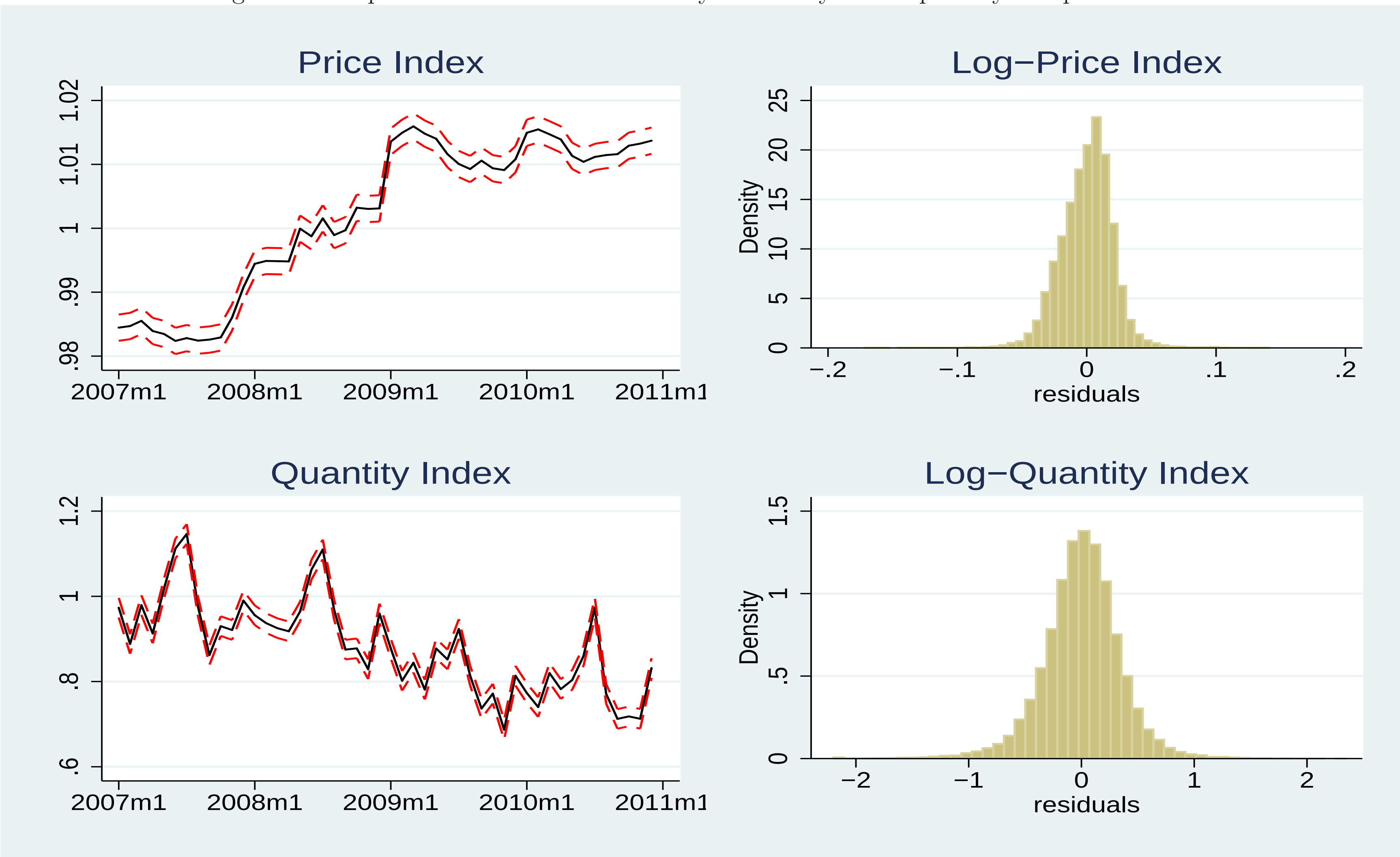
Notes: Our calculations based on the Pharma database. Prices are in Euros

Table 2: Descriptive statistics of the variables used in the econometric analysis

	Mean	Standard deviation	Minimum	Maximum	Number of Observations
Price Index	1	0.03	0.8	1.15	63432
Quantity Index	1	0.52	0.003	7.2	63432
Sold boxes of hygiene products	72	68	0	992	63432
Number of newborns in t	19	79	0	4048	63432
Number of pharmacies per city	7	28	1	709	63432

Notes: Price and quantity information concerns 2925 hygiene products sold by the 3331 pharmacies in the Pharma dataset. Information on newborns refers to the 1565 cities in which the pharmacies of the Pharma dataset operate. One observation is a city in a month.

Figure 2: Temporal evolution and within city variability of the quantity and price indexes



Notes: Temporal evolution of the average quantity and price indexes of hygiene products (left panels), and histograms of the residuals of a regression of the (log) quantity and (log) price indexes on city fixed effects (right panels). Dashed lines delimit the 95% confidence interval.

Table 3: Effect of the monthly number of newborns on the equilibrium price

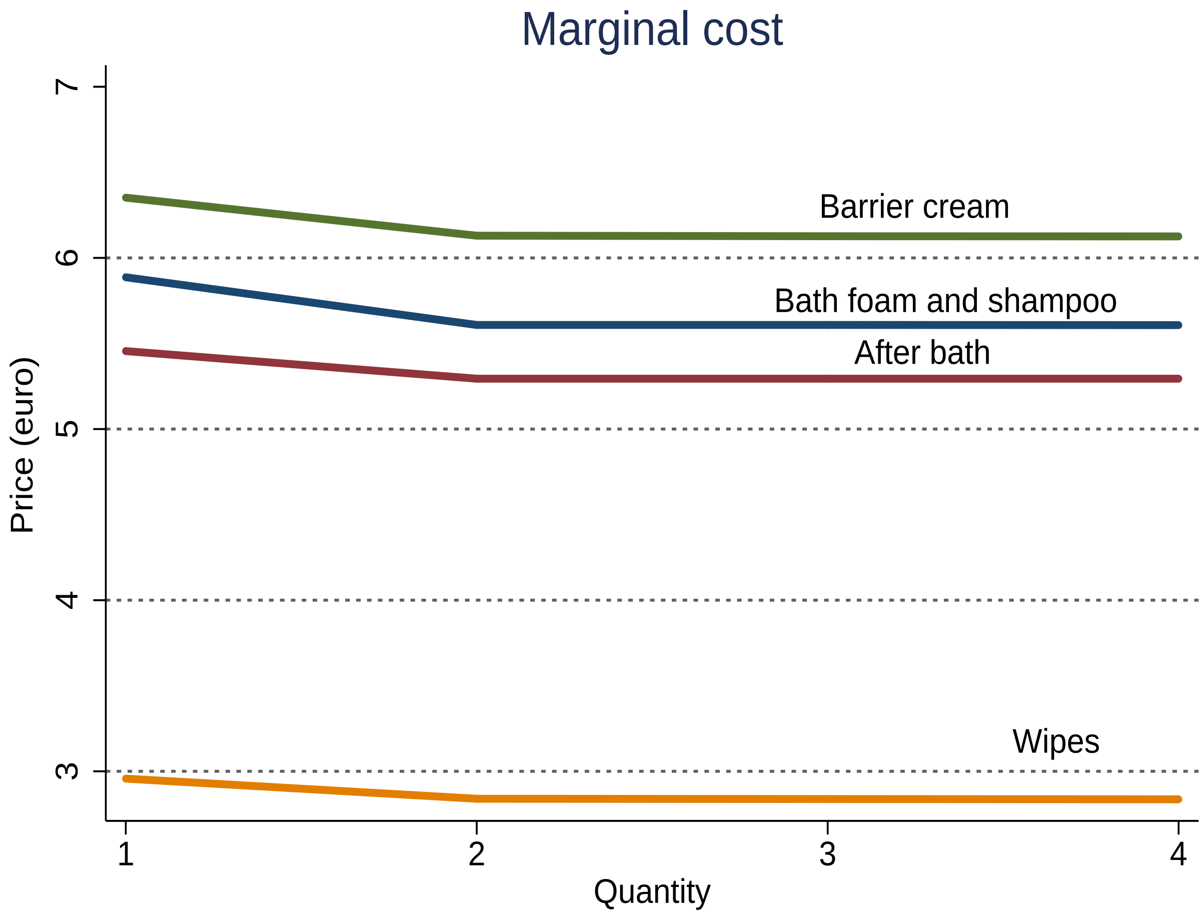
	All cities	100% Pharma Coverage
Log Newborns	0.0158	0.0193
	(0.0053)***	(0.0056)***
Log Newborns (t-1)	0.0138	0.0155
	(0.0053)***	(0.0056)***
Log Newborns (t-2)	0.0084	0.0094
	(0.0053)	(0.0056)
Log Newborns (t-3)	0.0129	0.0116
	(0.0056)**	(0.006)*
Log Newborns (t-4)	0.0153	0.0122
	(0.0056)***	(0.006)**
Log Newborns (t-5)	0.0213	0.0162
	(0.006)***	(0.006)***
Log Newborns (t-6)	0.0245	0.0182
	(0.006)***	(0.0063)***
Log Newborns (t-7)	0.0228	0.0170
	(0.0066)***	(0.0066)**
Log Newborns (t-8)	0.0236	0.0163
	(0.0066)***	(0.0063)**
Log Newborns (t-9)	0.0125	0.0100
	(0.0066)***	(0.0063)
Log Newborns (t-10)	0.0068	0.0049
	(0.0066)**	(0.0063)
Log Newborns (t-11)	0.0055	0.0003
	(0.0066)	(0.0063)
Time effects	Yes	Yes
City effects	Yes	Yes
Number of observations	63432	25967
Number of cities	1565	699

Notes: OLS estimates of the regression

$$p_{ct} = \alpha + \delta N^U_{ct} + \Lambda(N^U_{ct-\tau}) + h_c + \mu_t + \varepsilon_{ct}$$

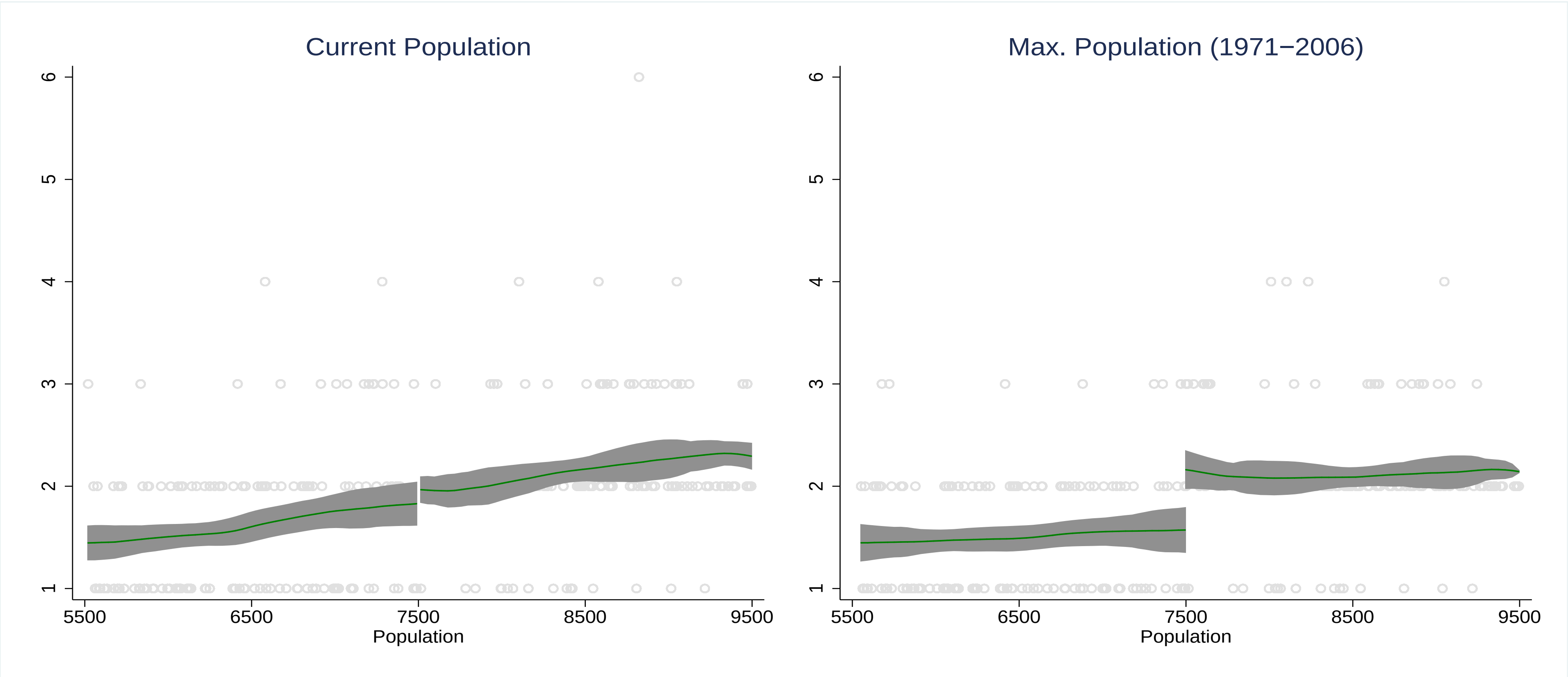
where all variables are in logs, c denotes a city, t a month, p_{ct} is the equilibrium (log) price and N^U_{ct} is the (log) number of newborns, $\Lambda(N^U_{ct-\tau})$ is a polynomial in the lags of the number of newborns, h_c and μ_t are respectively city and time fixed effects. The specification includes 23 lags, although only the first 10 have a significant effect. The remaining insignificant lags are omitted to save on space. Robust standard error, clustered at the city level, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Reported coefficients and standard errors have been standardized by the standard deviation of the correspondent variable. To evaluate the size of the estimates note that a standard deviation is ≈ 1.8 for the (log) number of newborns at different lags and to 0.03 for the (log) price.

Figure 3: Marginal cost faced by pharmacies for child hygiene products.



Source: Authors' calculations on data from InfoSystem

Figure 4: Current population, maximum population and competition at the threshold



Notes: Scatter plot and local polynomial smoothing regressions (bandwith = 300) of the number of pharmacies with respect to current and maximum historical population. Current population is measured at 12-31-2006 for municipalities observed since January 2007, at 12-31-2008 for municipalities observed since January 2009.

Table 4: Competing pharmacies on the two sides of the maximum hystorical population threshold.

	Local linear ± 1,500 inhabs.	Polynom. $2^n d$ ± 2,000 inhabs.	Polynom. $3^r d$ ± 3,000 inhabs.	Polynom. $4^t h$ ± 4,000 inhabs.
Panel A: All cities				
Right side of the threshold	0.518	0.605	0.774	0.843
	(0.195)***	(0.247)**	(0.260)***	(0.281)***
Constant	0.619	0.644	0.584	0.574
	(0.136)***	(0.184)***	(0.193)***	(0.206)***
No. of Obs.	209	269	417	569
Panel B: 100% Pharma coverage				
Right side of the threshold	0.484	0.699	0.807	0.668
	(0.212)**	(0.244)***	(0.273)***	(0.264)**
Constant	0.090	0.067	0.047	0.051
	(0.084)	(0.103)	(0.102)	(0.103)
No. of Obs.	85	110	185	282
Panel C: Controls included				
Right side of the threshold	0.450	0.587	0.754	0.849
	(0.178)**	(0.224)**	(0.235)***	(0.253)***
Constant	1.795	1.832	1.765	1.584
	(0.336)***	(0.330)***	(0.282)***	(0.278)***
No. of Obs.	209	269	417	569

Notes: OLS estimates of the regression:

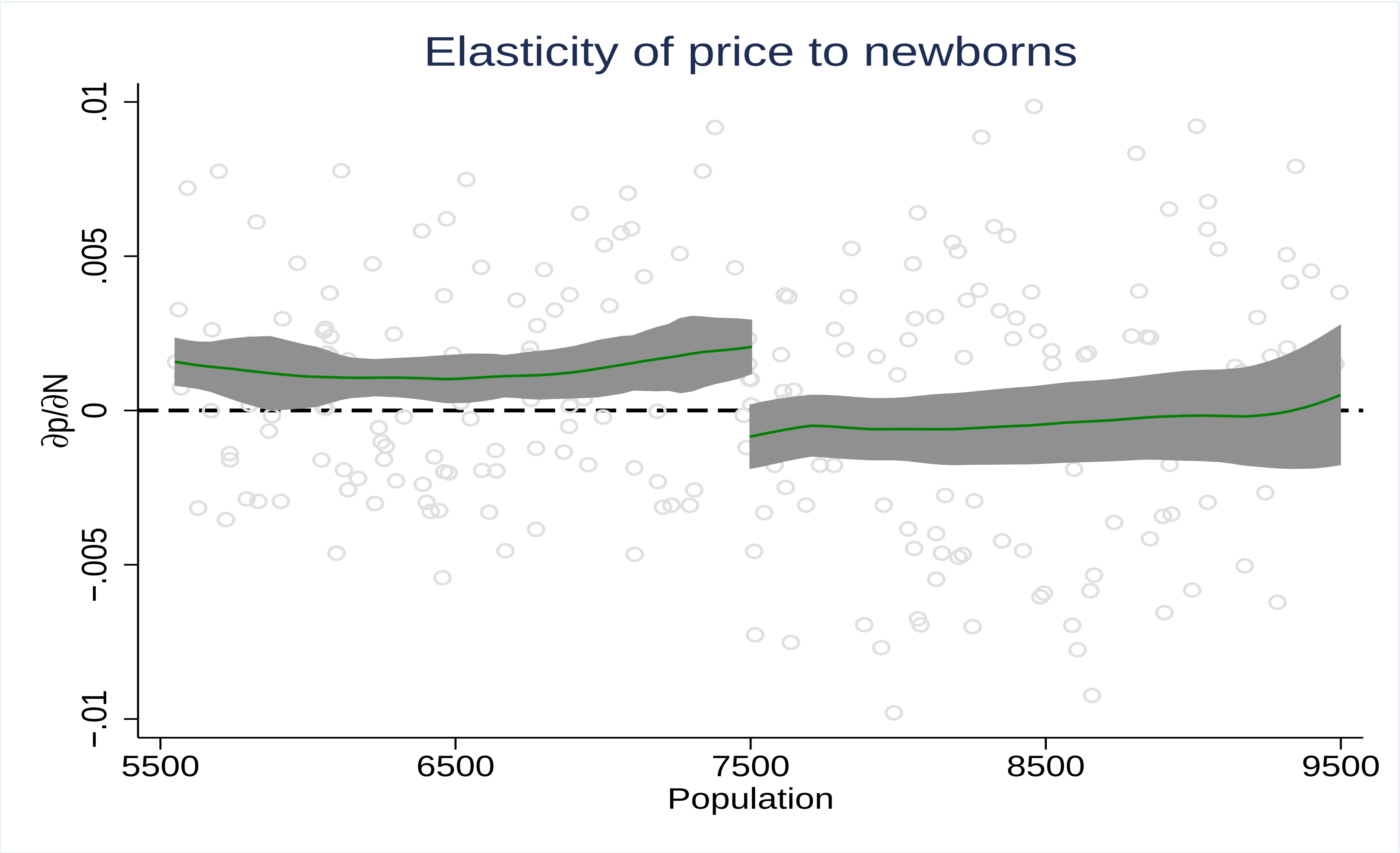
$$S_c = \omega + \varphi K_c + g(|Pop_c - \kappa|) + \zeta_c$$

where c denotes a city, S_c is the number of pharmacies in a city; Pop_c is the maximum historical population in a city; $K_c = 1(Pop_c >= \kappa)$ is a dummy taking value 1 for cities on the right side of the threshold. Robust standard errors, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Panel B includes cities in which Pharma has a 100% coverage on pharmacies. Regressions in Panel C includes the average monthly number of newborns, a dummy taking value 1 if the city is in a urban area, a dummy taking value 1 if the city is in Northern Italy and per capita disposable income at the city level as controls.

Figure 5: Continuity tests for covariates

Notes: Scatter plot and local polynomial smoothing regressions (bandwith = 300) of four observable "pre-treatment" city characteris with respect to maximum historical population. The four characteristics are: the average monthly number of newborns, a dummy taking value 1 if the city is in a urban area, a dummy taking value 1 if the city is in Northern Italy and per capita disposable income in the city.

Figure 6: The composition effect on the two sides of the threshold



Notes: Scatter plot and local polynomial smoothing regressions (bandwith = 300) of the city specific elasticity of price $\hat{\delta}_c$ with respect to the monthly number of newborns.

Table 5: Elasticity of the price index with respect to the monthly number of newborns on the two sides of the threshold.

	Local Linear Reg. ± 1,500 inhabs. All Sample	Polynom. 2^{nd} ± 2,000 inhabs. All Sample	Polynom. 3^{rd} ± 3,000 inhabs. All Sample	Polynom. 4^{th} ± 4,000 inhabs. All Sample	Local Linear Reg. ± 4,000 inhabs. 100% NL Coverage	Polynom. 4^{th} ± 4,000 inhabs. All Sample
	1	2	3	4	5	6
Higher competition	-0.003	-0.004	-0.003	-0.004	-0.003	-0.004
	(0.001)**	(0.001)***	(0.001)**	(0.002)**	(0.001)**	(0.002)**
Constant	0.002	0.003	0.002	0.002	0.002	0.003
	(0.001)***	(0.001)***	(0.001)**	(0.001)**	(0.001)***	(0.002)
Controls	N	N	N	N	N	Y
No. of Obs.	209	269	417	569	185	417

Notes: OLS estimates of the regression

$$\hat{\delta}_c = \omega + \gamma K_c + g(|Pop_c - \kappa|) + \eta_c$$

where c denots a city; Pop_c is the maximum historical population in a city; $K_c = 1(Pop_c >= \kappa)$ is a dummy taking value 1 for cities on the right side of the threshold. The dependent variable δ_c is obtained in two steps: first we regress p_{ct} and N_{ct} on lag newborns, city and time fixed effects and retrieve the residuals; then we regress the residuals of price on the residuals of newborns separately for each city, exploiting the within city time variability. Column 5 includes cities in which Pharma has a 100% coverage on pharmacies. Column 6 includes the average monthly number of newborns, a dummy taking value 1 if the city is in a municipal area, a dummy taking value 1 if the city is in Northern Italy, and per capita disposable income at the city level as controls. Robust standard errors are in parentheses with *** p<0.01, ** p<0.05, * p<0.1.

Table 6: IV estimates of the effect of a change in the number of competitors on the elasticities of price with respect to the number of newborns.

	Local Linear Reg. $\pm$ 1,500 inhabs. 1	Polynom. 2^{nd} $\pm$ 2,000 inhabs. 2	Polynom. 3^{rd} $\pm$ 3,000 inhabs. 3	Polynom. 4^{th} $\pm$ 4,000 inhabs. 4
Number of competitors	-0.005	-0.007	-0.005	-0.004
	(0.002)**	(0.003)**	(0.002)**	(0.002)**
Const. (1 pharmacy, 0 competitors)	0.006	0.004	0.004	0.003
	(0.002)***	(0.002)**	(0.002)**	(0.002)**
Controls	Y	Y	Y	Y
No. of Obs.	209	269	417	569
F-stat of excluded instrument	12.37	10.86	13.16	13.72

Notes: IV estimates of the regression

$$\hat{\delta}_c = \omega + \gamma s_c + g(|Pop_c - \kappa|) + \eta_c$$

where c denotes a city; s_c is the number of competitors (equal to the number S_c of pharmacies in a city minus 1) and is instrumented with $K_c = 1(Pop_c > \kappa)$; Pop_c is the maximum historical population in a city; $K_c = 1(Pop_c >= \kappa)$ is a dummy taking value 1 for cities on the right side of the threshold. The dependent variable δ_c is obtained in two steps: first we regress p_{ct} and N_{ct} on lag newborns, city and time fixed effects and retrieve the residuals; then we regress the residuals of price on the residuals of newborns separately for each city, exploiting the within city time variability. All regressions include the following controls: a dummy taking value 1 if the city is in Northern Italy, municipal area, and number of 'parafarmacie'. Robust standard errors are in parentheses with *** p<0.01, ** p<0.05, * p<0.1.