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A single espresso, please! Rationalizing espresso price dispersion across Italian cities

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Abstract

This paper aims at providing an explanation of the observed espresso price dispersion across major Italian cities. The empirical evidence suggests a positive relationships between the average espresso price in a city and the number of coffee shops (normalized for the adult population) operating in that city. This finding is shown to be robust after controlling for GDP per capita and consumers' price index. We provide an interpretation of the empirical findings relying on a model of price competition delivering a continuum of Nash equilibria, where firms adjust the mark-up to offset the negative effect of any increase in their number.

Keywords: price dispersion, espresso prices, market competition.

JEL Classification: L11, L13, L66.

1 Introduction

For the average Italian adult, drinking an espresso is not only a ritual, but it is most often a repeated ritual during the day. According to anecdotical evidence, espresso is the second most drunk beverage in Italy (water being first), dozens million cups being consumed daily.

A discerning consumer travelling from Northern to Southern Italian cities would probably notice a non-negligible fall in espresso prices. Actually, in major Italian cities espresso cups are priced in bars very similarly within cities and very differently across cities.[1] For instance, in 2001 the average price[2] charged in Milano was 0.78 euros, it declines to 0.62 in Roma and even more in Palermo, 0.56. In 2011, the last year in our sample, the dispersion across cities did not change much as it ranged from 1.01 euros in Bologna to 0.79 in Roma and 0.71 in Bari.

Since the standard espresso drunk at the bar is a fairly homogeneous good, except for location, broad price differences look surprising. Moreover, descriptives suggest a large variance in the average number of consumers per bar across cities. In particular, it turns out that higher prices are associated to lower number of clients (proxied by adult inhabitants) per bar. These facts give rise to interesting questions: why prices are so high in some cities and not in others? do consumers per bar play a role in explaining these large

[1] In what follows we refer to "bar" to indicate a plethora of establishments selling coffee (coffee shops, cafeterias, pubs...), excluding restaurants. More details are provided in Appendix A.1 describing the dataset.

[2] By *average price* we mean the price charged for a cup of single espresso drunk standing at the counter. Unlike many other countries, this is the standard way Italians consume espresso. Hence, the sample excludes the service surcharge applied by cafeterias to the price of espresso when customers sit down.

differences in prices? High levels of price are compatible with several different explanations. The first and well known relies upon explicit collusion.[3] A second interpretation may be based on tacit collusion in a repeated game. However, there are at least two characteristics of the espresso market that are hardly compatible with the two above classical explanations. First, the number of bars/firms is large in all cities. Second, in many cities demand is seasonally fluctuating because of tourists' flows and the discontinuous presence of students. Both factors are known as obstacles to implement and sustain collusive agreements.

However, there is a third approach that does not need to invoke either implicit or explicit collusion. Such an approach is based upon Dastidar's (1995, 2001) model of one-shot price competition with homogeneous goods under convex costs. According to the Dastidar model a price equilibrium outcome mimicking joint profit maximization may indeed emerge as a non-cooperative equilibrium without repetition. We will show that our empirical findings fit better Dastidar's conclusion than the two traditional approaches mentioned above. The empirical evidence suggests a positive relationships between the average espresso price in a city and the number of bars, or conversely, higher prices tend to prevail in cities with a lower number of clients per bar, which is consistent with the comparative statics properties of Dastidar's model.

We perform a simple empirical analysis on the distribution of espresso prices in the 20 Italian regional capitals, a sample including the most populated Italian cities, between 2001 and 2011. A glance to the basic descriptive

[3] Italian bars are usually members of professional associations. It is not rare for these associations to suggest "focal" price levels for espresso. This could be a factor facilitating collusion or, at least, coordination of price levels across bars.

statistics reveals a negative correlation between espresso prices and the average number of customers per bar. For instance, in 2011, the upper limit of one euro is the price approached when the number of clients falls below 400. Using data available for four years (2001, 2005, 2009, 2011) within the period, we estimate a Linear Probability Model Fixed Effects Regression and show that increasing the average number of customers per bar (or decreasing the number of bars with respect to the population) has a negative and significant impact on espresso price. The result is obtained controlling for both GDP per capita and city price indices. This evidence is then rationalized within Dastidar's model, by means of some comparative statics.

The paper is organized as follows. In section 2 we illustrate the statistical evidence and develop our simple empirical analysis. The detailed description of data set is in the Appendix. Section 3 illustrates how the basic empirical findings may be derived within Dastidar model of price competition. Section 4 concludes by bridging the empirical analysis and theoretical predictions.

2 Empirical analysis

2.1 Data

We aim to perform an empirical analysis on the distribution of espresso prices in Italy. The lack of data available on the sector studied constitutes an important constraint to our analysis. In Appendix A.1 we provide a detailed account of how we constructed the sample. Generally, our analysis focuses on the capital cities of the 20 Italian regions in the years 2001, 2005, 2009 and 2011, for a total of about 80 observations. The espresso prices are collected by Italian National Institute of Statistics (henceforth ISTAT). For each city, we also have information about the number of bars, the total adult population,[4] the consumers price index (ISTAT) and the GDP per capita (Eurostat). From the previous sources, we compute the average number of clients per bar in each city. The descriptives of the sample are summarized in Table 1.

Table 1. Descriptive statistics

	Obs	Mean	Std Dev	Min	Max
Coffee Price	78	0.78075	0.11517	0.56	1.012
Clients per bar	80	537.777	188.702	294.529	1239.579
GDP per capita	80	25400	7035.102	13800	46600
Price Index	77	113.6266	9.4284	101.8	130.9

2.2 Empirical results

Observing the raw data we detect the presence of a negative relationship between the price of the espresso and the average number of clients per bar. The scatter plot of clients per bar and espresso prices displays a downward pattern that approaches the average price of 1 euro when clients per bar are less than 400. The relationship is confirmed by the correlation coefficient of -0.6292.

[4] The total adult population is officially defined by ISTAT as residents of 15 years of age or above.

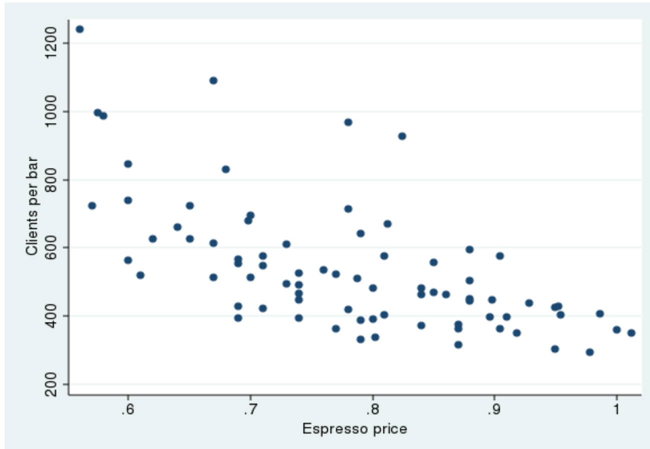

Fig. 1 Clients per bar and espresso prices.

The previous descriptive evidence is not sufficient to explain the observed pattern of espresso prices in Italy. For a better understanding of the price dispersion, we need at least to control for a number of other factors. In particular, price dispersion is likely to be explained by variables like cities' GDP per capita and general consumers' price indices. Common sense would suggest that richer cities should experience higher price levels, including higher espresso prices.[5]

Given the panel structure of our dataset, we estimate a Linear Probability Model with Fixed Effects using the following specification:

$$\text{Espresso price}_{it} = \kappa_{it} + \alpha\text{Clients}_{it} + \beta\text{GDPpc} + \gamma\text{PriceIndex}_{it} + \varepsilon_{it} \qquad (1)$$

where t indicates the year, i the city and κ_{it} represents the city fixed effects. For ease of interpretation of the following results, the variable Clients is measured in hundred clients per bar and GDPpc in thousands of euros.

[5]Intuition may suggest that richer areas entail higher espresso prices. However, this maybe misleading: *within* the same city, for example Bologna, espresso prices are basically flat across districts, despite very large differences in income per capita across city districts (Bologna City Council, 2014).

Table 2 presents our main results.

Table 2. Espresso price dispersion: a linear probability model

	Espresso price
Clients	−0.06275***
	(0.01333)
GDPpc	0.020878***
	(0.006672)
Price Index	−0.0003536
	(0.0003424)
Const	0.618089**
	(0.239975)
R^2	0.4916
Obs	75

First and fairly surprisingly, city consumers' price levels are not statistically significant in explaining espresso prices.[6] Whereas we could *a priori* think that the price index may capture, for example, the impact of tourism on the price of an espresso cup, our regression analysis suggests instead no role for this regressor. Second, the GDP per capita has a statistically significant role in explaining the espresso price dispersion. A thousand euros increase in the GDP per capita has an estimated positive impact of 2 cents on the price of a cup. Last but not least, controlling for fixed effects, evidence shows that increasing the average number of clients per bar has a significant and negative effect on the price of espresso. In particular, an extra hundred clients per each bar is estimated to lead to an average *decrease* of 6.2 cents in

[6]We included both GDP per capita and consumers' price levels among the regressors as they are not highly collinear.

the price of espresso.[7] The latter finding is rather counterintuitive. There are two ways of thinking about it: either increasing demand per bar yields a fall in espresso prices or increasing the number of sellers for a given population of consumers increases espresso prices. This finding calls for a theoretical investigation.

3 A suggested interpretation

To rationalize our empirical findings, we rely upon Dastidar (1995). His model is important for the analysis of market competition under price-setting behavior because it allows proving the existence of a continuum of pure-strategy Nash equilibria in the price space under regular demand and convex variable costs. We shall focus on a linear-quadratic version of his original model.

The market is supplied by a population of $n \geq 1$ identical firms. The product is homogeneous and its demand function is $p = a - Q$, where $Q = \Sigma_{i=1}^{n} q_i$ is aggregate output p is price and a is a positive parameter proxying the size of the market. All firms produce with the same technology, to which a cost function $C_i = bq_i + cq_i^2/2$ is associated, where c is a positive parameter, and $b \in [0, a)$. The profit function of firm i is then

$$\pi_i = \left(p - b - \frac{cq_i}{2}\right) q_i = \left(a - q_i - Q_{-i} - b - \frac{cq_i}{2}\right) q_i \tag{2}$$

where $Q_{-i} = \Sigma_{j \neq i} q_j$.

The non-cooperative one-shot game takes place under complete, symmetric and imperfect information. The solution concept is the Nash equilibrium, which here involves all firms setting the same price $p^* \in [p^{avc}, p^u]$. At the

[7] Appendix A.2 provides a robustness check of our conclusions.

lower bound p^{avc}, equilibrium price equals average variable costs, so that firms are indifferent between producing or not. At the upper bound p^u, the equilibrium price is such that firms would be indifferent between playing p^u or marginally undercutting it in order to capture the entire market demand.

The continuum of price equilibria is[8]

$$p^{BN} = \frac{ac + 2b(n-\alpha)}{c + 2(n-\alpha)} \tag{3}$$

where BN stands for Bertrand-Nash, and α is a parameter whose range is $\alpha \in [0, n^2/(1+n)]$. In particular:

- if $\alpha = 0$, the equilibrium price equals average variable cost;
- at $\alpha = n/2$, marginal cost pricing obtains;
- if $\alpha = n^2/(1+n)$, p^{BN} reaches the highest level above which undercutting takes place.

Taking the partial derivatives of (3) w.r.t. n (treated as a continuous variable) and α, we get

$$\frac{\partial p^{BN}}{\partial n} = -\frac{2(a-b)c}{[c+2(n-\alpha)]^2} < 0 \tag{4}$$

$$\frac{\partial p^{BN}}{\partial \alpha} = -\frac{\partial p^{BN}}{\partial n} = \frac{2(a-b)c}{[c+2(n-\alpha)]^2} > 0 \tag{5}$$

The partial derivative (4) tells that, in the Bertrand-Nash equilibrium, an increase in the number of firms unambiguously decrease market price. Partial derivative (5) reveals that the equilibrium price increases with α at the same rate with which price decreases w.r.t. the number of firms. Therefore, the

[8]See Dastidar (1995, pp. 27-28), Gori *et al.* (2014, pp. 373-75) and Delbono and Lambertini (2015).

isoprice curve in the space (n, α) is a straight line increasing at 45°. This amounts to saying that the price-setting firms may compensate the negative effect of an increase in their number by increasing α. If the latter increases more than proportionately w.r.t. n, the equilibrium price increases.

4 Bridging evidence and theory

In our context, the assumption of cost convexity appears a sound one. Indeed, according to a recent professional association report (FIPE, 2013), in the average Italian bar, labor costs account for about 60% of the total espresso cost, whereas raw coffee weights 22% and rents and other costs account for 18%. Hence, the incidence of labor costs makes the hypothesis of convex variable costs plausible. Moreover, different rents likely account for the midl dispersion of espresso prices within each city.

Our linear probability model with fixed effects explains espresso prices using three variables: GDP per capita, consumers' price level and the average number of clients per bar. As for the GDP, it clearly affects positively the espresso price. In our formulation of Dastidar's model, GDP is proxied by parameter a, any increase in which obviously causes an increase in equilibrium price. The effect of a change in the consumers' price level, which could perhaps be captured by a variation in the cost parameters b and c appearing in the cost function, is not statistically significant.

Finally, notice that a decrease in the average number of clients per bar is equivalent to an increase in the number of bars for any given size of consumers' population. The empirical finding is that an increase in the number of bars (firms) significantly increases espresso prices. The theoretical counterpart of this finding is that firms react to the pro-competitive impact of an increase in their population by drifting away from both average and marginal cost pricing through α. If firms overreact to a decrease in industry concentration by increasing α more than proportionally, then price increases.

Our rationalization of what happens in Italian cities can then be summarized as follows. In those cities in which the number of bars is large with respect to the population of customers, or conversely the average number of clients per bar is small, espresso prices tend to be high as firms/bars behave in a way consistent with the prediction of the theoretical model.

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A Appendix

A.1 Construction of the dataset

The lack of data on bars selling espresso constitutes a serious obstacle to the statistical analysis in this study. We outline here the strategy adopted to construct a workable dataset. The units of analysis are the 20 regional capital cities of Italy. The following are the original data sources available. ISTAT has data about the price of espresso but these are available only for years 2005 and 2009. Data from the Italian Census, also published by ISTAT, provide us with the number of eating and drinking establishments in each city for years 2001 and 2011. For year 2011 the exact number of bars is also available. Data on GDP per capita at current prices (Eurostat)[9] and on the Consumers' Price Index and the Total Adult Population (ISTAT) are available for all the years in the study.

On the basis of these original sources, we do two exercises. First, we need to estimate the number of bars. For 2001 we use the proportion of

[9]Eurostat provides data on GDP at province levels. In the Eurostat taxonomy, the Italian provinces correspond to NUTS3.

bar over the total number of eating and drinking establishments in 2011. For the remaining years, 2005 and 2009, we calculate the number of bars by interpolating the original data on establishments in 2001 and 2011 and then using again the 2011 proportion to estimate the number of bars in those years. The underlying assumption is that the proportion of bars over the total number of establishments has not changed throughout the 2001-2011 period. In other words, the data-generation process relies upon the conjecture that the number of bars were not subject to any technological, demand or supply shock in the ten years time span considered: given the characteristics of the sector (very homogeneous product, very low technology, very customary clients) our conjecture and the resulting constant rate appears justified.

Second, we need to estimate the price of espresso for years 2001 and 2011. A very similar reasoning was adopted. Given the original 2005 and 2009 data, we interpolate them linearly to calculate the estimated espresso prices for years 2001 and 2011.

A.2 Robustness checks

In the light of the difficulties faced in constructing the dataset for the analysis, it is extremely important to check the robustness of them. To do so, in this section we test two alternative specifications. The first specification includes only the years for which we have original information on the number of eating and drinking establishments, i.e. 2001 and 2011. The second specification includes only the years for which original data on espresso prices are available, i.e. 2005 and 2009.

Table A.1 reports the results for these two specifications in columns (1) and (2) respectively. Column (1) shows that our results are extremely robust to the first of our new, reduced specifications.

Table A1. Espresso price: robustness checks

	(1)	(2)
Clients	−0.061702***	0.005125
	(0.013277)	(0.021477)
GDPpc	0.022716***	−0.034596
	(0.006977)	(0.0050634)
PriceIndex	−0.000632	0.009313***
	(0.000342)	(0.001617)
Const	0.599450**	−0.264686
	(0.213104)	(0.276885)
	2001-2011 only	2005-2009 only
R^2	0.4916	0.0058
Obs	38	37

The signs and significance are comparable and even the magnitude of the effects is almost unaffected. The results are less encouraging when focusing on Column (2). In that specification, covering years 2005 and 2009, the number of clients per bar has a positive effect on espresso prices. The effect, however, has a very small magnitude and it is not statistically significant (p-value$\simeq$ 0.81). GDP per capita is also not significant and all the effects seem to be captured by the consumers' price level, that is highly significant. A look at the descriptives for years 2005 and 2009, however, seems to confirm the evidence provided in the main text. Figure 2 shows a weaker but negative relationship between the price of espresso and the clients per bar. On top of that the correlation coefficient between these two variables is still −0.6262. The regression results in (2), instead, might be affected by the reduced number of observations when focusing only on two years.

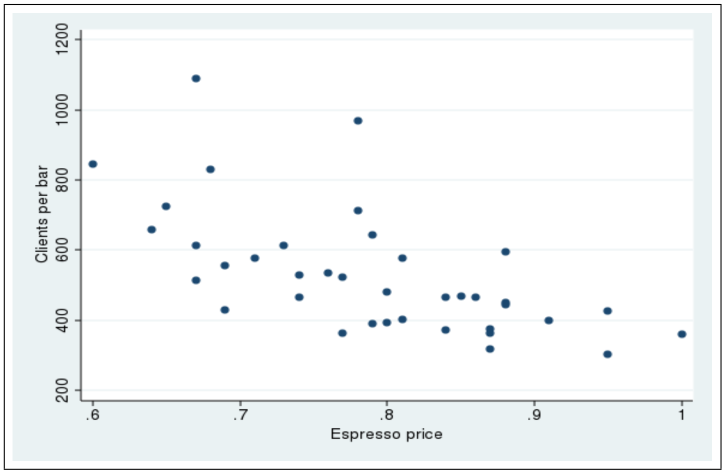

Fig. 2 Clients per bar and espresso prices, 2005-2009.

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