Essays on Market Structure and Competition.

Thesis

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To my parents

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Finally, I would like to thank the Department of Economics at the University of Warwick.

The first topic has been presented at the University of Warwick and the Business School of Middlesex University. A version of the second topic has been presented at the University of Warwick, Royal Economic Society Autumn School (September 2011), RES 201 and at SMYE 2012. Comments received from the participants are also appreciated.

Declarations

I Declare:
The thesis is my own work and it has not been submitted to another university for a degree.

Abstract

My thesis consists of two relatively independent topics. In the first topic I empirically investigate the factors that determine the presence of the independent coffee shops in the market of Central London. In the second topic I present a theory of cartel detection. The common feature of these topics is that I investigate the demand side effects on market structure and its impact on competition.

To be more specific, in the first topic I build a simple theoretical model of product differentiation in adjacent markets, based on Mazzeo (2002). For the empirical estimation I have constructed a unique dataset of coffee shops in Central London. I further manage to identify differences on demand characteristics across markets by utilizing data on people's mobility from the tube stations and provide evidence for the existence of product differentiation. It is found that residential areas with high employment, areas with *small* business density and leisure areas increase the profitability of the independent coffee shops. A counterfactual analysis is also presented.

In the second topic I investigate the cartel's strategies and likelihood of collusion when the buyers of the cartel are able to report its existence to the anti-trust authority. I characterize the cartel's optimal behavior when the buyers are actively monitoring the cartel's members and are able to report a cartel to an anti-trust authority[1]. I present a simple static model and I show that the likelihood of collusion increases as the willingness of the buyers to report increases (cost of reporting decreases). Furthermore, it is shown that it is optimal for an anti-trust authority to decrease the cost of reporting (a trade-off between price reductions in existing cartels and increased likelihood of cartel formation is identified). Finally, alternative cartel strategies are also explored in this topic. As for the last point, I show that the threat of exclusion (foreclosure) and price discrimination are robust strategies that prevent

[1]This is an element of market structure since the buyers are exogenously informed or assumed that they actively engage in the cartel's detection. The next task is to investigate whether competition fails and identify factors that prevent cartel formation.

buyers from reporting.

Introduction

My thesis is divided into two topics. The first topic includes six chapters and investigates the factors that determine the exit decision of the independent coffee shops in Central London. The first chapter of this topic includes an introduction and the literature review. The second chapter presents the theoretical model. In the third chapter the data is presented and the relative market is defined. In the fourth chapter the empirical investigation is provided. The fifth chapter is a concluding chapter but also includes the appendix of the topic. In the last chapter the bibliography is reported.

The title of the second topic is buyers reporting a cartel. This topic is divided into five chapters. In the first chapter (chapter 7) I present a detailed introduction of the topic but I also include the literature review. In the second chapter (chapter 8) I present the theoretical model and the social welfare implications. In the third chapter (chapter 9) I investigate alternative cartel mechanisms and characterize the optimal private enforcement strategy. In the fourth chapter (chapter 10) I conclude and provide the mathematical appendix. In the last chapter I report the relevant bibliography.

Topic I: David vs. Goliath; Product Differentiation and Chain Stores' effects on Independents

In the first topic I present an empirical investigation of the coffee shops market in Central London. I utilize a unique dataset of coffee shops in Central London to explore the importance of chain stores' behavior towards the presence of independents in the market. A simple theoretical model that links exit with entry of firms and introduces product differentiation in concentrated markets is constructed. The model predicts that product differentiation and market specific demand characteristics are key factors to ensure the survival of the independent firms. The high quality dataset addresses common problems in investigating metropolitan areas. The most innovative part of this topic is the use of tube stations' data to estimate the importance of demand characteristics to the likelihood of an independent coffee shop to exit. An additional important finding of the empirical estimation is that within group (independents) competition is more important than between groups (chain stores vs. independents) competition. The intuition for this finding is the existence of product differentiation which safeguards the independents from the chain stores' effects. Furthermore, the importance of product differentiation for the buyers is estimated and, in contrast to most of the literature, the importance of the demand characteristics in the exit decision of an independent coffee shop is quantified. A counterfactual analysis of city planning policies and their impact on market concentration is presented.

There are six chapters in this topic. In the first one I discuss my motivation and my research questions. I also present the most important findings and the framework used. I then discuss the relevant literature. In the second chapter I present the theoretical model and in the third chapter I present the data and discuss how I define the relevant market. In the fourth chapter I present the empirical results and the counterfactual analysis. In the fifth chapter I conclude the topic and include the relevant appendix. In the last chapter I present the bibliography used.

Chapter 1

David vs. Goliath: Introduction and Literature Review

In the first chapter I discuss the motivation of this research project. I also present my research questions and the framework used. In addition I briefly present the data sources used to identify market specific demand effects and the significance of product differentiation. The most important findings are also being discussed. Finally, in the last section I present the relevant literature.

1.1 Introduction

In the UK there has been a long discussion[1] about the "clone towns" effect[2] and whether the chain stores expansion should be restricted. As lobbyists against chain stores expansion argue, the cities are being homogenized, the local identity is lost[3] and highly concentrated markets are generated. In the case of coffee shops within Central London sub-markets I observe the independent firms (independents) enjoying a large market share, on average corresponding to approximately 60%, which remains constant across time. However, a "clone town" effect is also present, since in some cases the chain stores dominate with shares larger than 70%[4]. Hence, the coffee shops' industry in Central London is an ideal market to examine the factors that facilitate the presence of independents in markets and highlight the effects of chain stores' (hereafter denoted as C-Ss) behavior in the market[5].

In chapter 2 I present a simple theoretical model extending Mazzeo's (2002) model by introducing an exit stage, as with Bresnahan and Reiss (1994), and introducing neighbourhood effects, as with Seim (2006). The entry and exit multiplicity issue is tackled by assuming that the entrants need to bid for their right to enter the market, through an English Auction setting[6]. The unique equilibrium defines both the number and the identity of the entrants, predicting that the most profitable enter. At the exit stage the incentives of the entrants

[1]See the following websites for illustration $http://news.bbc.co.uk/1/hi/magazine/4602953.stm$, $http://www.guardian.co.uk/business/2012/oct/28/totnes-costa-coffee-high-street?INTCMP=SRCH$ and $http://www.independent.co.uk/news/uk/this-britain/cambridge-beats-exeter-for-title-as-uks-ultimate-clone-town-2079476.html$.

[2]Where "clone towns" refers to the dominance of chain stores across city centres' in UK towns and the displacement of independents.

[3]See for example, New Economics Foundation (NEF) website ($http://www.neweconomics.org/publications/reimagining-the-high-street$).

[4]A map is provided in the appendix with the market shares of subgroups across submarkets in Central London.

[5]Investigating if the "clone towns" effect exists in the market of coffee shops.

[6]This assumption was motivated by the fact that available retail space in Central London are scarce and the entrants will need to compete, bid against each other in order to enter.

to replace[7] an unprofitable incumbent combined with the assumption that entrants need to bid for their right to enter, guarantee a unique equilibrium as well. Moreover, the model provides a link between entrants and incumbents. To be more specific, the model predicts that displacement and replacement, which rationalize entry in satiated markets, can be an equilibrium behavior.

Most importantly, this model predicts that product differentiation and market specific effects will safeguard the independents since it increases their profitability and offsets any cost advantages that the C-Ss may enjoy. I further identify a non-strategic fringe, independent incumbents, for which the market structure is given when taking exit decisions. In addition, the C-Ss behavior does not depend on an individual independent's probability of exit but rather on the market structure[8]. As a consequence, a simple estimation procedure can be used in order to examine the independent's likelihood of exit[9]. Furthermore, the model developed here can also be applied to other industries characterized by variation on both entry and exit and a satiated market, where the total number of firms remains unchanged. Industries where the assumption that entrants need to compete for the right to enter include the airlines, the shipping and the retail industries in metropolitan areas.

In the empirical estimation the predictions of the theoretical model are tested and in contrast to most of the existing literature[10], with exception to Mazzeo (2002) and Smith and Gorman (2008), demand factors that influence the market's profitability are investigated. A unique panel data-set of 1900 coffee shops covering the period between 2000 to 2009 is employed including entries and exits of both independents and C-Ss in the coffee shops' market

[7] This is also a consequence of the location scarcity assumption.

[8] In my view, the C-Ss decisions should not be influenced by the behavior of a particular independent but rather from the overall market structure.

[9] Notice that an independent entrant is behaving strategically but conditional on entry an independent incumbent is a non-strategic player. Therefore, a simple exit rule is constructed and estimated through a random-effects probit model.

[10] The literature has mainly focused on supply side effects such as sunk and fixed costs, suppliers' strategic behavior and economies of scope.

of Central London. Most importantly, product differentiation is present in the data-set[11] as well as a large variation on the independents' market shares across Central London subareas. Data on commuting are included, i.e. on people's traveling through tube stations, to estimate the demand characteristics. The latter has been an unexplored source which tackles the issue of demand effects' estimation in metropolitan areas. The tube stations' data reveal the demand characteristics of each area[12]. In this topic people's entry in the morning rush hours is utilized to estimate the effect of residential employment on the independent's profitability. Another variable is constructed to estimate the effect of high business density by using counts of the number of people that exit a tube station during the morning rush hours[13]. The third variable is the number of people that visit a tube station during the weekend. This variable should capture the demand for product differentiation[14]. The last variable constructed from the tube station data is the total number of people that commute through a particular tube station (both entries and exits). This variable captures the total demand for coffee, while the previous three variables estimate demand characteristics. Furthermore, if the tube station data is used properly it can be a source to investigate a wider range of questions (such as city planning to decrease market concentration[15]) and a number of other industries within metropolitan areas.

A random-effects probit model is applied in order to estimate the determinants of the independent incumbents' likelihood of exit. Even though the theoretical model is richer

[11]The independents' group can be categorized into four different subgroups; coffee shops, delicatessens, patisseries and sandwich bars. Furthermore, coffee is differentiated as a product as well. Some examples are: Cappuccino, Latte, Americano, Macchiato, Espresso and filter coffee.

[12]The demand in Metropolitan areas is mainly defined by the number of people that visit a subarea and not its local population. As a result benchmark data sources like the local demographics will fail to estimate the importance of demand.

[13]Exit from a tube station is someone's destination and I believe that during these hours the destination of people is most likely to be their work place.

[14]It is more likely for people's destination during the weekend to be leisure areas and I assume that at leisure areas people are more likely to consume a differentiated coffee product.

[15]Other uses for the data-set are to investigate the determinants of real estates values in Metropolitan areas, safety issues in Central London, businesses agglomeration, determinants of city planning and employment in Metropolitan areas as well as counterfactual analysis.

in structure, I do not investigate C-Ss entry - exit decisions or the entry decision of the independents since it is not in the scope of this topic to examine market evolution[16]. The most important finding of the empirical investigation is that within groups competition is found to be more important than between groups suggesting the existence of product differentiation. It is further shown that in the coffee shops' market of Central London there is no effect on the independents' profitability resulting from the C-Ss' presence or expansion. It is found that the independents' exit depends mainly on the number of independent incumbents and entrants. Furthermore, the significance of product differentiation on the independents' profitability is estimated and specific market demand effects are identified. An additional finding is that an independent coffee shop located in a leisure area, an area with a small density of businesses and a residential area with high employment, will be more profitable. The last result suggests that preferences in different areas determine the structure of the industry.

Finally, a counterfactual analysis, incorporating two scenarios, presents an example of investigating city planning policies in Metropolitan areas and their effect on market structure and concentration. In the first scenario we place a uniform (the same across subgroups) cap on the number of entrants. This scenario was motivated by a planning regulation that took place in 1996 in the UKs groceries market. We show that under this scenario the number of independent incumbents will decrease and that the independents will be influenced the most. In the second scenario we restrict the number of C-Ss entrants to zero if their market shares are larger than a threshold point. This approach, liquidation of assets or growth constraints, is usually taken by anti-trust authorities when they trace presence and abuse of market power in an industry. The second scenario successfully increases the number of independents and decreases the C-Ss market share.

[16]The construction of an entry - exit model, a more general model, was necessary since it defines how entry influences exit in satiated markets. Investigating market evolution in the coffee shops market of Central London is left for future research.

1.2 Literature

The theoretical part of this topic builds on Mazzeo (2002). Mazzeo uses the framework proposed by Bresnahan and Reiss (1991) and Berry (1992). The latter authors provide a framework to investigate the effect of entry and strategic behavior on market concentration. Furthermore, Bresnahan and Reiss (1991), estimate threshold points required for an additional competitor to enter. Additionally, Bresnahan and Reiss (1994) investigate the importance of sunk and fixed costs in their effort to estimate their effects on the intensity of competition. Their estimation is based on the observation that when entering firms endure sunk costs and when exiting they face a scrap cost. The approach taken was to compare the exit and entry thresholds in order to estimate the fixed costs of an industry. In chapter 2 I extend Mazzeo's (2002) paper to allow for an exit stage as with Bresnahan and Reiss (1994). In contrast to both papers, I formally shown that entry and exit is feasible in satiated markets. I also suggest a new assumption, auction game prior entry (the entrants need to bid for the right to enter the market), which solves the multiplicity issue.

Mazzeo (2002) is the first researcher that endogenizes the choice of the entrants to locate themselves in the product space, introducing product differentiation. In a similar paper S. Greenstein and M. Mazzeo (2006) test the role of product differentiation in entry decisions, in the telecommunications industry. However, in this model the types of the groups, Chain-Stores (denoted by C-S) and independents (denoted by y), are predetermined and they may choose whether to enter heterogeneous markets. Hence, in the chapters of this topic the type of the entrant is not endogenized but the choice to enter depends on their type in the product space[17]. My approach also allows for the investigation of between and within groups competition effects on the independents' profitability, as with Mazzeo (2002). Furthermore, the task to investigate a metropolitan area, Central London, introduces spatial correlation

[17] This will be further explained in the theoretical model.

that needs to be tackled, something that is not considered by Mazzeo. In addition and with respect to product differentiation, Smith and O'Gorman (2008) also consider the importance of product differentiation when estimating lower and upper bounds of the Radio Industry fixed costs but they do not aim to identify specific demand market effects and demand taste parameters[18].

Seim's (2006) work is the first paper which endogenizes entry in adjacent markets. Adjacent markets are present in this data, markets within Central London, and as a result Seim's work will be relevant to the chapters of this topic. Seim's technique is employed as a control for spatial correlation in the empirical estimation. However, her theoretical model generates a nested algorithm which defines the entry rule in adjacent markets is not extended, since I believe that this should be a straightforward extension of Seim's model and for the exit decisions the adjacent markets are not a strategic element[19]. Notice, though, that the main difference of the theoretical model chapter of this topic with Seim's work is the introduction of both product differentiation and exit stage.

The fact that both entry and exit is investigated, generates a model of market evolution. There are a number of other papers that also examine market evolution. B. Jovanovic's (1982) seminal paper proposes a theory of selection where the most efficient grow and survive. A similar paper that examines the firms' life cycle is S. Klepper (1996)[20] who presents a model where product innovation determines the life cycle of the industry. Klepper (2002) empirically tests this hypothesis. He shows that pre and post experience matters through R&D for firms' survival, in four distinct industries. Klebber's model is built on a series of papers that examine the product innovation hypothesis. See for example, J. M. Utterback and W. J. Abernathy (1975) and B. Jovanovic and G. M. MacDonald (1994). However, in the coffee shops' industry

[18]I show in the empirical estimation chapter that there is a morning hours effect on the profitability of the independent coffee shops. This suggests the presence of a strong preference to consume coffee in the morning.

[19]The independent's do not choose to exit from adjacent market A or B since by definition they are 1 store firms.

[20]Who builds on the work of B. Jovanovic (1982).

and for the time period examined (2000-2009), product innovation is not relevant and as a result it is not anticipated that it can explain the industry's evolution. My model differs from this literature since I examine product differentiation[21] as a factor that determines the market evolution[22].

The theoretical chapter of this topic examines replacement and displacement of the incumbents, which links entry with exit and explains why we observe this behavior in a satiated market. Displacement, as far as I know, has only been examined in an empirical study by D. Shapiro and R.S. Khemani (1987) who found evidence that the entrants displace the incumbents.

In a similar strand of literature, R. Ericson and A. Pakes (1995) examine the dynamics of industry evolution. The firms are assumed to choose between entry, investment and exit. These choices are influenced by expectations on the evolution of competition. A number of papers have enriched this framework. V. Aguirregabiria and P. Mira (2007) propose a framework that allows for multiple equilibria in dynamic discreet games. A. Pakes, M. Ostrovsky and S. Berry (2007) present an approach to estimate the sunk costs. J. H. Abbring and J. R. Cambell (2010) extend Bresnahan and Reiss (1990) model by assuming last in, first out behavior that guarantees a unique Markov perfect equilibrium in order to estimate the sunk costs. N. Yang (2011) applies a dynamic framework that uses refinements of Markov perfect equilibria to overcome multiplicity issues. My theoretical chapter considers both entry and exit but in contrast to the above papers I abstract from endogeneity and dynamic concerns[23]. This is mainly because I focus on providing a simple model that introduces product differentiation and market specific effects, in such a setting (with both entry and exit), in order to investigate whether demand effects can explain the persistence of independents in

[21] The availability of differentiated products is defined by the taste parameters of the consumers. In other words, the demand of differentiated products will allow for the suppliers (firms) to become product differentiated.

[22] The framework used is also different.

[23] I further explain this issue in both the theoretical chapter and the empirical chapter of this topic.

the markets.[24]. I manage to do that by identifying a non-strategic fringe where endogeneity (influencing the market structure as well as being influenced by the market structure of the industry) and dynamic concerns are not an issue.

In the entry in concentrated markets literature there are a number of papers that examine the effects of C-Ss behavior (entry and strategic behavior) on the market structure of an industry. This part of the literature is the most relevant to this topic. To be more specific, O. Toivanen and M. Waterson (2005) are the first, to my knowledge, that present an analysis of C-Ss strategic behavior. They find support on market learning effects, a result that I wish to investigate further. They focus entirely on competition within C-Ss rather than between C-Ss and independents. J. Holmes (2011) and P. Jia (2008) also examine C-Ss. The former identifies economies of scopes which can explain the growth of a C-S. The latter investigates the impact of the C-Ss entrance on the independents (this is also the closest paper with respect to the research question examined[25]) in a model in which firms choose to enter and exit. However, her model lacks differentiation and abstracts from metropolitan areas.

With respect to the coffee shops' industry, as far as I know there are only two other papers that investigate this market; McManus (2007) and D. Durevall (2007). More particularly, McManus examines non-linear pricing and finds evidence that distortions decrease, in the coffee market, as the willingness of buyers to pay increases. Hence, even though McManus investigates the market of coffee shops, he uses a different context and investigates a different research question from the one presented in this topic. Durevall examines the coffee industry in a different context as well. He investigates whether market power is present in the coffee shops market in Sweden and whether downstream prices are high.

Finally, the entry and exit literature has mainly abstracted from metropolitan areas.

[24]Extending the empirical approach to incorporate dynamics will definitely be an improvement, but this is left for future research.

[25]She investigates what happens to the independents when a C-S enters while I examine both the C-Ss effect and the demand effects (and I show that the latter is more significant in the coffee shops market).

The main reasons for that are either the lack of micro level data of the population or the nature of demand in these areas. To be more specific, for some industries (retail) the main bulk of revenues is generated from the population that visits an area (footfall) rather than the residents of that area. The only exception to this literature is the paper by Bresnahan and Reiss (1994) who investigate the market of dentists. However, the feasibility of this study was based on the local attribute of this industry (it is less likely for people to travel a great distance to visit a dentist, except on rare cases where specialized work is required and in the case of a "star" dentist). Hence, there was no need to estimate the demand charateristics of the industry based on footfall variables.

1.3 Conclusion

This chapter has presented the motivation, the research questions, the framework, the data sources and the literature of the first topic. The motivation comes from a long discussion in UK about the "clone cities" effect. The research question is why do we observe in some markets within Central London the C-Ss displacing the independent coffee shops and in some other markets the fail to do so. Furthermore, I am interested to investigate what determines the exit decision of the independent coffee shops in Central London. I first, construct a theoretical model that specifies the exit decision of the independents. The data sources used are the Yellow and White pages, the tube station data and neighborhood statistics from the Office of National Statistics. The empirically investigation suggest that product differentiation and market specific effects are important factors to the independent coffee shops exit decision. A counterfactual analysis is also presented in this topic.

My research on this topic is relevant to the entry in concentrated markets literature. To be more specific, I built my theoretical model based on Bresnahan and Reiss (1994) and Mazzeo (2002). Notice that the most relevant papers are the ones by Toivanen and Waterson

(2005), Jia (2008) and Holmes (2011) who investigate entry of C-Ss in concentrated markets.

Chapter 2

Theoretical Model

In this chapter a simple model is presented, which introduces replacement and displacement of the incumbents when product differentiation is present. The model actually extends Mazzeo (2002) to allow for an exit stage, as with Bresnahan and Reiss (1994), and controls for adjacent market effects as with Seim (2006). To be more specific, I utilize Bresnahan and Reiss' (1994) approach to define a structure on the profit functions for entry and exit. The Bresnahan and Reiss paper provides an empirical and theoretical framework which allows the estimating of the fixed costs of an industry. I show that entrants might replace or displace an incumbent. I also assume location competition prior entry which solves for multiple equilibria. Finally, the exit decision of an independent coffee shop is characterized.

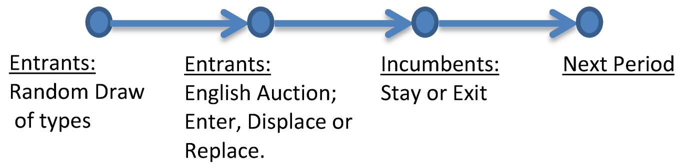

Figure 2.1: Timing: David vs Goliath

2.1 Theory

I assume a game of two stages. In the first stage the potential entrants receive their fixed cost draw, this will be repeated at each time period for the entrants but not for the incumbents. The entrants then decide where (within a market) and whether to enter. Then the entrants decide how to enter; either by displacing or replacing an incumbent. In the last case I will assume that the entrants will need to buy their right to enter the market (this under some conditions will generate displacement) or buyout the incumbent (replacement). In either case this will be accomplished through an English auction setting (if there is more than one potential entrant). In the second stage the incumbent observes the changes on the market; the number and the identities of the new entrants as well as their highest bid. The incumbent will then decide whether to accept a bid from the entrants and exit, or exit in any case (even if the incumbent has not received a bid) or stay in the market. The first two cases will generate the scrap value for the incumbents which will be denoted as h_i[1]. The timeline is given in figure 2.1.

For a more formal definition of the timing please see the appendix. Let me now define the profit function for the three different states that a firm may encounter. The profit functions following Bresnahan and Reiss (1994) are:

$$\text{Entrant: } \Pi_{i,j,t} = d(Z)\alpha_{i,j,t}S(Y) - f_{i,j,t} - F_{i,j,t} \tag{2.1}$$

[1]The scrap value can be positive or negative, since it includes the bid of the entrants (if the incumbent is replaced) and the cost of shutting down a business.

$$\text{Incumbent: } \Pi_{i,j,t} = d(Z)\alpha_{i,j,t}S(Y) - f_{i,j,t} \tag{2.2}$$

$$\text{Exit: } \Pi_{i,j,t} = h_{i,j,t} \tag{2.3}$$

Where subscript i refers to an individual coffee shop, j to the market and t to time. Where $d(Z)$ is population demographics and $\alpha_{i,j,t}$ is the residual demand parameter, a parameter that will capture product differentiation by decomposing the market structure into different subgroups. This is the approach that Mazzeo (2002) uses in the entrants' profit function. Furthermore, $S(Y)$ is for the size of the market, $f_{i,j,t}$ is the fixed cost, $F_{i,j,t}$ is for the sunk cost and $h_{i,j,t}$ is the scrap value of the incumbent that exits. Notice that the main difference between the profit function of the entrant and that of the incumbent is the existence of the sunk cost ($F_{i,j,t}$), a cost that an entrant needs to sunk. Additionally, I have normalized the marginal cost and set it equal to zero. This assumption was mainly motivated from B. McManus (2007) finding that the marginal cost of a cup of coffee is approximately \$0.04-\$0.06, a negligible amount.

Let me assume two kinds of entrants, a C-S and the independents. The entrants differ on fixed costs f_k, where $k \in \{c-s, y\}$ and y is the notation for the independents. I will assume that there is only one type of C-Ss in the market[2] while there are N_I potential independents. Additionally, it is assumed that the fixed cost of a C-S entrant is generated by an i.i.d. distribution $\Phi(f)$ with support $[0,\bar{\mathrm{f}}_{c-s}]$. On the other hand, it is assumed that the pool of independent entrants draw each time period a type for their fixed cost from an i.i.d. distribution $\Phi(f)$ with minimum support $\bar{\mathrm{f}}_{c-s}$ and maximum $\bar{\mathrm{f}}_y$. As a result, the fixed cost

[2] I am going to show that this assumption will not influence the results. Moreover, I do not separate the C-Ss into the two categories (other C-Ss and C-Ss) in order to keep the analysis as simple as possible. However, extending the model into three subcategories should be straightforward and the results should remain unchanged as well.

of the C-S is always going to be smaller than the independents, $f_{c-s} < f_y$. In this way, it is allowed for the C-S to enjoy a cost advantage. To be more specific, $Pr(f_y < f_{c-s}) = 0$ where Pr is the notation for probability. Whether this is a result of economies of scope or higher productivity will not be examined. Notice that Abbring and Cambell (2010) have assumed that the firms of the industry have only drawn their types at the birth of the industry (no re-drawing of types) and they solve the equilibrium multiplicity issue at the exit stage and entry stage by assuming a first in, last out strategy followed by all the firms. However, if entrants redraw their types then the above strategy cannot hold, as it is not necessarily a first in, last out result. Furthermore and with respect to the coffee shops data, this assumption cannot be utilized since I observe both replacement and displacement of incumbents, while entrants remain in the market[3]. In addition in the coffee shops market of Central London it is possible for the fixed costs (which are of immense importance for this industry) of the entrants to be smaller than the incumbents (thus indicating a redraw of fixed cost type).

In order to capture the demand for differentiated products I am going to assume that the two types of entrants are faced with a different stream of revenues within a market. To be more specific, I assume that the C-S will be able to capture a portion of the population of the market, $\alpha_{c-s} * S$, while the independents will capture $\alpha_y * S$, where S is for the total number of buyers (size of the market). The two demand parameters need to sum up to one, $\alpha_y + \alpha_{c-s} = 1$[4]. Notice that $\alpha_y * S$ is the aggregate demand share for the independents. Therefore, that parameter can be decomposed to $\alpha_{i,j,t}$, as used in equations (2.1) and (2.2), to capture the residual demand for an independent coffee shop. In other words, the residual demand, parameter $a_{i,j,t}$ as defined by equation (2.1) and (2.2) belongs to the demand share of a subgroup ($\sum_{i=1}^{I} a_{i,j,t} = a_{y,j,t}$). Notice that in contrast to Mazzeo (2002) the product dif-

[3]The first one that should have exited according to Abbring and Cambell (2010) framework.

[4]Notice that I decompose the incumbents as with P. Jia (2008) and M. Slade (1992). The latter paper, is the first one to my knowledge that has decomposed the participants of the market in such a way; investigated C-Ss and independents behavior in a different context (investigating the competition of the retail gasoline stations).

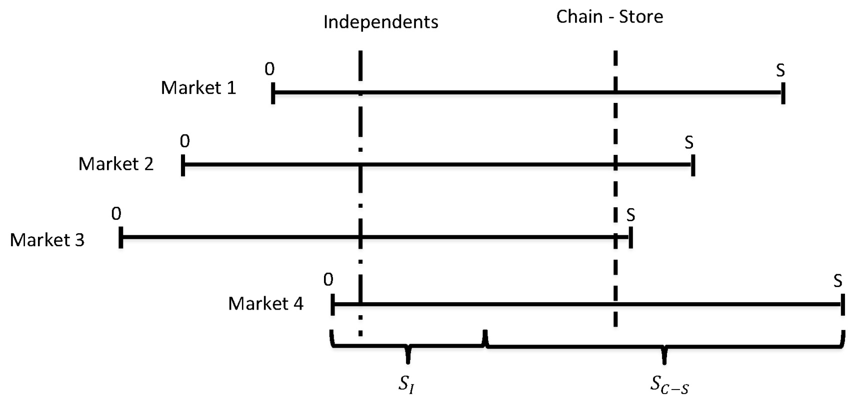

Figure 2.2: Entry Decisions

ferentiation is not endogenously decided by the entrants (the entrants cannot decide between becoming independent or C-S). Therefore, in this model I allow for product differentiation to exogenously determine the behavior of firms[5]. However, the entry decision is not endogenized since I assume that the entrants choose the market they enter. To be more specific, in this model the firms do not choose locations but rather choose markets, given their product range, which generate the higher stream of revenues. This approach is equivalent to choosing a market from a finite set of different markets (adjacent markets) given that a firm needs to locate either left or right in the linear city model. The idea is presented in graph 2.2.

I have fixed the location of independents and C-S and drawn a vertical line across four different markets. The markets differ with respect to buyers' preferences[6]. For example, in the fourth market there is little demand for the independents but this is not the case in the third market. Actually an independent will find it more profitable to enter in the third market than in any other, assuming that fixed costs are unchanged across adjacent markets. At the same time a C-S might find it more profitable to enter the fourth market. This gives rise to the first corollary of this chapter.

[5]Notice that the particular decomposition that I used is motivated by Hotteling's (1929) seminal paper.

[6]This can be rationalized as a large set of preferences (from 0-1) where in some markets there are no individuals at the extremes.

Corollary 2.1.1 *In some cases the most profitable firm is not necessarily the most cost efficient.*

As a result, it is not necessary any more for the most cost efficient entrant to enter but rather the most profitable (higher demand might compensate for the high fixed costs of an independent). The proof is straightforward. The demand for differentiation states that in some cases $a_{y,j,t} > a_{c-s,j,t}$ which means that it is possible that $\Pi_{y,j,t} > \Pi_{c-s,j,t}$ even though the C-Ss are more efficient, $f_{y,j,t} > f_{c-s,j,t}$. Hence, the assumption of product differentiation and market specific characteristics (markets are different as well) allow for an inefficient, higher cost, but favoured by demand for differentiation independent to enter the market. To be more specific, even though the C-Ss have a cost advantage they might be faced at the same time with relatively lower demand ($\alpha_{c-s} < \alpha_y$) and in some cases the lower demand might induce the less efficient to outbid (the English auction stage will formally be described later on) the C-S and enter the market. Hence, I am not constrained by a first in, last out equilibria (where the most efficient firm enters first as with Abbring and Cambell (2010)) since a less efficient but more profitable entrant is more likely to enter and survive, in some cases, in the market. It also follows, in this case, that the most efficient incumbent (C-S) might exit earlier than a less efficient incumbent (independent), given some demand shocks.

Thus, given their product type, the entrants will rank the markets based on profitability (decide where to enter) and then will bid for the right to enter the market (decide whether to enter). A common problem with the entry game (given the choice of the market) is the issue of multiple equilibria. In order to illustrate the issue, I provide a game similar to the one presented by Bresnahan and Reiss (1990).

In the above game (see table 2.1) there are two potential entrants, player 1 and 2, with $a > b > 0$. If both enter the market they become unprofitable, while if only one enters then the entrant has positive profits. This game has two Nash Equilibria. This result generates

		Player 2	
		Enter	Stay Out
Player 1	Enter	$-a, -b$	$a, 0$
	Stay Out	$0, b$	$0, 0$

Table 2.1: Entry Game

an empirical estimation issue. The literature has overcome this issue by identifying in the data a first mover and as a result redefining the game with a Subgame notion that generates a unique N.E. and a unique prediction on the identity of the entrant[7]. However, the data available cover a time period where the market has been relatively stable (satiated), with small entry and exit of the C-Ss, and as a result it was not possible to identify a first mover. On the other hand, it was observed that the retail space in Central London, and generally in metropolitan areas, is scarce.

Scarcity of retail space can be seen in the second map provided in the appendix. In the map it can be seen that in the area between Holborn, Covent Garden and Temple tube stations there are approximately 200 coffee shops. Notice that the walking distance between Holborn and Covent Garden is between 10-15 minutes. Furthermore, other retail units are present within this area such as restaurants, pubs and textile retailers. Therefore, I believe that the scarcity of retail space is a reasonable assumption. As a result of the scarcity issue, I will assume that the entrants will need to bid (compete) for the right to enter the market (acquire retail space for their shop). The entrants compete by participating in an English Auction. Notice that the method of competition (type of auction) is not important but rather the competition assumption. In other words, by the efficiency result of the auction theory, the prediction of the identity of the winner (in this case the entrants identity) is unique, i.e. the most profitable wins the auction.

In order to present the effect of an English Auction to the entry game some further

[7]See for example Berry (1992) and Toivanen and Waterson (2005).

simplifying assumptions will be taken and abstract, for the time being, from product differentiation effects. Assume the following rank of fixed costs for the incumbents (denoted as In) and the entrants (denoted as En): $f^{In}_{1,j} < f^{In}_{2,j} < ... < f^{In}_{N,j}$ and $f^{En}_{1,j} < f^{En}_{2,j} < ... < f^{En}_{m,j}$ where n is the number of incumbents, m the number of potential entrants and the numbers 1 to j correspond to markets (ranked from the ones with the smallest value of fixed cost). As a result the following rank of profitabilities is observed: $\Pi^{In}_{1,j} > \Pi^{In}_{2,j} > ... > \Pi^{In}_{n,j}$ and $\Pi^{En}_{1,j} > \Pi^{En}_{2,j} > ... > \Pi^{En}_{m,j}$. Notice, that product differentiation will only re-order firms within the particular ranking. As a result there will be no adverse effect from introducing product differentiation.

Let me define $\bar{\mathrm{B}}^{In}$ the outside option for an incumbent, the minimum value that makes the incumbent willing to exit, and $\bar{\mathrm{B}}^{En}$ the outside option for the entrant, an option to locate in the market without buying out (replacing) the incumbent. Intuitively, the last assumption allows for the entrants to enter the market without always having to replace an incumbent. The outside option of the entrants is equivalent to entrants acquiring an empty retail space or acquiring a retail firm which is not specialized in the coffee industry. Similarly the outside option of the incumbent might be an offer from an interested entrant of another industry (restaurant or grocery) to acquire the incumbent's retail space. Assume also that there are only two profitable entrants with a fixed cost draw smaller than the one of the least profitable incumbent:

Assumption 1:

$$\Pi^{In}_{n-1,j,t}(n+1, f^{In}_{n-1}) > \Pi^{En}_{1,j,t}(n+1, f^{En}_{1}) > \Pi^{En}_{2,j,t}(n+1, f^{En}_{2}) > \Pi^{In}_{n,j,t}(n, f^{In}_{n}) > 0 \tag{2.4}$$

$$0 > \Pi^{En}_{1,j,t}(n+2, f^{En}_{1}) > \Pi^{En}_{2,j,t}(n+2, f^{En}_{2}) \tag{2.5}$$

The first condition (2.4) states that the two entrants are more profitable than the least profitable incumbent but less profitable than the next in order incumbent. The second condition (2.5) states that it is not possible for the entrants to enter the market without displacing or replacing the incumbent[8]. The next result presents the equilibrium behavior.

Lemma 2.1.2 *Given assumption 1, the most profitable entrant will enter replacing the incumbent with a bid equal to the profit of the second most profitable entrant if the incumbent's outside option is low enough.*

For the proof please see the appendix. In the above specific case, two entrants are profitable if only one of them enters the market by replacing an incumbent. The lemma 2.1.2 states that there is a unique equilibrium with the most profitable entrant replacing the incumbent and the less profitable entrant not entering the market. In this case the assumption of an English auction assumption solves the multiplicity issues with respect to the identity of the entrant. Notice that the assumption of an English auction is not essential for the equilibrium characterization since any auction setting will generate the same prediction (efficiency result of auction theory), that the most profitable enters.

An issue with the competition prior entry is that it is not feasible to empirically estimate either the entrant's sunk costs or the incumbents' scrap value. This is due to unobservable issues that cannot be resolved. To be more specific, an econometrician observes the number of successful entrants but does not observe the last most profitable entrant that failed to enter which determines the level of sunk cost. This unobservable characteristic is of immense importance since it defines the sunk cost (highest bid) of the entrant and in some cases (replacement) the scrap value of the incumbent[9]. This will be further explained later on.

The purpose of lemma 2.1.2 was to introduce in a simple case the solution for the equi-

[8] This is a simplifying assumption.

[9] For given market structure and demand characteristics the sunk cost is not unique since it depends on the most profitable entrant that *failed* to enter.

librium multiplicity problem and to present an example on how exit can be linked with entry. However, let me now be more formal on how this assumption solves the entry multiplicity problem.

Proposition 2.1.3 *If the entrants compete for the right to enter the market then there is a unique prediction on the entry game; the most profitable enter.*

Proof: Assume M the number of potential entrants and L the number of market opportunities (number of new entrants that can be sustained in the market). Assume that $M > L$. Notice that for other cases $M < L$ and $M = L$ the prediction is unique; everyone enters. Rank the entrants according to their profitability $\Pi_{1,j}^{En} > ... > \Pi_{L-1,j}^{En} > \Pi_{L,j}^{En} > \Pi_{L+1,j}^{En} > ... > \Pi_{M,j}^{En}$. Then examine the $L+1$ and L entrant, by definition $\Pi_{L,j}^{En} > \Pi_{L+1,j}^{En}$ which means that the L entrant will outbid the $L+1$ and the $L+1$ will be outbidden by any entrant ranked from 1 to L. Therefore, the $L+1$ entrant will not enter the market. The same holds for all entrants ranked from $L+1$ to M. Therefore, a unique prediction is that only the most profitable enter (ranked from 1 to L).

QED

This result is very useful, in this context, since it solves the equilibrium multiplicity issues as presented by Bresnahan and Reiss (1990). To be more specific, under the assumption of competition prior entry this will generate a unique NE with the most profitable (but not necessarily the most efficient, see 2.1.1) entering the market. Furthermore, the assumption of an English auction can be used in industries like the airlines as well. In the airlines' industry the firms need to bid for the right to locate themselves in a hub or operate on a route. Additionally, this assumption might be relevant to the telecommunications' industry where a network will be made available to the highest bidder. Most importantly, the scarcity of retail space in metropolitan areas suggests that this assumption is a reasonable one. The scarcity of locations will enforce the potential entrants to bid for the right to enter the market which will create an extra sunk cost. Alternatively, this can be thought of as the need of an entrant to acquire a firm in a metropolitan area in order to enter the market.

D. Levin and J. L. Smith's (1994) paper investigates entry in auctions. However, they introduce entry decisions (endogenizing auction participation decisions) to an auction setting while I introduce auction (competition) prior to the entry game. They show that the efficiency of the auction is preserved. Hence, the entrant with the highest valuation of the market is going to win the auction.

The proposition 2.1.3, has presented a new modelling approach to solve the equilibrium multiplicity issue at the entry game. Additionally, the proposition 2.1.3 suggests that the entry decision of an individual firm is conditional to the entry decisions of the competitors (endogeneity of individual entry decision). Furthermore, I have also presented how it is possible for an incumbent to be replaced.

Let me now be more specific as to the choice of an entrant to replace or displace an incumbent. Assume that the fixed cost draws are such that there is only one potential entrant and that the incumbent's profit becomes negative if the potential entrant enters. Assume as well that the following conditions hold:

Assumption 2:

$$\Pi^{En}_{1,j,t}(n, f^{En}_1) > \Pi^{In}_{n,j,t}(n, f^{In}_n) > 0 \tag{2.6}$$

$$\Pi^{In}_{n-1,j,t}(n+1, f^{In}_{n-1}) > \Pi^{En}_{1,j,t}(n+1, f^{En}_1) > 0 > \Pi^{In}_{n,j,t}(n+1, f^{In}_n) \tag{2.7}$$

The first condition states that the most profitable entrant (from all the potential entrants) is more profitable than the least profitable incumbent if the market structure remains unchanged. The second condition introduces the second least profitable of the incumbents (superscript $n-1$) and states that the entrant will be profitable even if the least profitable incumbent (indexed as n) stays in the market. However, this is not the case for the incumbent; if the entrant enters and the market structure increases by one firm then the least profitable incumbent will have negative profit.

Lemma 2.1.4 *Given assumption 2: If $\bar{B}^{In} > \bar{B}^{En}$ then the incumbent will be displaced. If $\bar{B}^{In} \leq \bar{B}^{En}$ then the incumbent will be replaced.*

The lemma 2.1.4 explains why we observe in some instances entry and exit in satiated markets (where the total number of firms remains unchanged across time). To be more specific, it is possible for the market demand to be stable across time but at the same time we might observe entry with replacement or displacement (keeping the number of suppliers constant as well) if the entrants enjoy a better cost draw (or if there is a change on demand within a market[10]). These two properties of this model, replacement and displacement, give rise to a link between entry and exit. To be more specific, the number of the entrants (through changes to the number of existing firms in the market) and their types (whether the incumbents will be replaced) influence the decisions of the incumbents to exit. All benchmark models that investigate entry and exit, predict that entry will generate exit by increasing the competition and decreasing the profits of the incumbents (through an increase on the number of competitors, n parameter in the model). While in this case it is predicted that exit can be generated even if an incumbent is still profitable and this is possible through the replacement effects.

Furthermore, it is possible that the entrants will neither replace nor displace the incumbents. This is the case if the demand increases and can sustain more firms than the current number of incumbents; when even the least profitable incumbent has positive profit[11]. The

[10]i.e. an increase on demand for independent coffee shops and an equivalent decrease on demand for C-Ss.
[11]In other words and for a given time period and a given market, $B_{In} > B_{En}$, where the B_{En} corresponds

last effect suggests, as expected, that demand (market) increase will decrease the likelihood of exit of the incumbents. In addition, an incumbent might choose to exit if, for example, the market shrinks even with a lack of new entrants.

In the case where there are more potential entrants than incumbents to exit then the English auction will define the identity of the entrants (most profitable) and as a result the incumbents' scrap value in the case where they are replaced. The intuition is the following: if there are a number of possible entrants but only one of them can enter the market, otherwise it is unprofitable, then by the English auction argument the most profitable entrant will bid up to the point where the second most profitable entrant will not find it profitable to bid higher. Thus, $B^1_{En,j,t} = \Pi^2_{En,j,t}$, where superscript 1 is an identifier for the most profitable entrant and $\Pi^2_{En,j,t}$ is the profit of the second most profitable entrant. Notice that $B^M_{En,j,t} = f$, the bid will determine the sunk cost (f) and as a result it is specified by the entrants' behavior, hence endogenous. Similarly this argument can be used for more entrants and more than 2 incumbents to exit. In all cases the prediction is unique; the most profitable enter or remain (in the case of replacement, this will be explained later on) in the market.

Let me now proceed to the final stage, the exit decision. First of all, notice that if replacement is present then there is a unique prediction of the identity of the incumbent to exit. The main reason for this is the fact that the least profitable incumbent will be replaced; the entrants have no incentive (in this model at least[12]) to replace a more profitable incumbent. However, if there is displacement or if the market demand is declining then there is a similar equilibrium multiplicity issue, with respect to the identity of the incumbent to exit, with the entry game. In order to visualize this issue assume the game reported in table 2.2.

In the above game (table 2.2) there are two incumbents that become unprofitable if

to the maximum bid offered by the entrant to replace the incumbent, which in this case is rejected by the entrant since it chooses to enter through the outside option.

[12] I assumed that the demand shares are equal between the incumbents.

		Player 2	
		Exit	Stay In
Player 1	Exit	$0, 0$	$0, b$
	Stay In	$a, 0$	$-b, -a$

Table 2.2: Exit Game

both stay in the market but they remain profitable if one of them leaves the market. It is also assumed that one of them is relatively more profitable in any state of the world ($a > b > 0$). Therefore, there are two pure strategies N.E. with only one of the incumbents exiting. However, I will assume that the incumbents use a strategy which specifies that *the least profitable incumbent exits*[13]. This assumption guarantees that the exit decisions are not influenced by other players' exit decisions but rather on incumbents' rank of profitability. In other words, independently of the decision of the least profitable incumbent the second in order has a dominant strategy which is always to stay in the market, if only one incumbent needs to be displaced. At the equilibrium, and by a rational expectations argument, the least profitable incumbent exits[14]. This assumption is similar, in concept, to the one taken by J. H. Abbring and J. R. Cambell (2010)[15]. Notice that it might not be a necessary assumption in this case, since the scarcity assumption might guarantee that even if a coffee shop incumbent is not replaced by a coffee shop entrant it might be replaced by another retailer (i.e. textile retailer), if we assume that retail space in Central London is never left unoccupied. Therefore, guaranteeing that the least profitable exit the market. Both of these assumptions (least profitable exit and scarcity effect on the exit stage) have a common prediction that the least profitable incumbent exits. This guarantees a unique equilibrium, on the identity of the exit firm, even if I allow for product differentiation (unique N.E. between groups as well). In other words, the determinant of the exit decision is the rank of profitability and the type of an

[13]This is one of the N.E. presented.

[14]An incumbent's exit decision will have been influenced by other incumbents' exit decisions if the players were employing mixed strategies.

[15]They assume a first in, last out strategy.

incumbent, independent or C-S, does not generate multiplicity issues. To conclude, the least profitable will be replaced or will exit and a unique N.E. will be observed in the markets.

Having a unique solution to both the entry and exit stage guarantees a unique SPNE. However, the above structure of the game assumes that the incumbents cannot influence entry. This is indeed the case for the independents, since by assumption they cannot expand and enter with more stores in the market, but this is not the case with the C-Ss. I am not formally seeking to establish the C-Ss' ability to influence both entry and exit but a simple numerical example of strategic manipulation of exit is provided in the appendix, for the interested reader.

In this model entry deterrence is possible by the entrants themselves, the entrants deter other entry instead of incumbents deterring entry (as has usually been investigated by the literature). The case of entry deterrence, in this model, is a special case of the entry behavior. To be more specific, assume $\Pi^{En}_{1,j,t}(n, f^{En}_1) > \Pi^{In}_{n-1,j,t}(n, f^{In}_{n-1}) > \Pi^{En}_{2,j,t}(n, f^{En}_2) > \Pi^{In}_{n,j,t}(n, f^{In}_n) > 0$ and $0 > \Pi^{En}_{1,j,t}(n+1, f^{En}_1)$. In this case the unique N.E. predicts that the least profitable incumbent is replaced (by the second condition) by the most profitable entrant, assuming low enough outside scrap value. Hence, this is an efficient result at the same time, since the most profitable of both entrants and incumbents occupy the market. For more details and a formal proof please see the appendix. This is a slightly different approach to Sutton's series of papers[16] and the literature that examines endogenous sunk cost. The main difference is that the entrant firms are the ones that sunk a cost in order to prevent a less profitable entrant to enter. Hence, the endogenous cost arises because of competition between entrants rather than the incumbents' effort to deter entry.

To sum up, the above model presents a theory where exit depends on entry but not vice versa for the independents (non-strategic fringe). The entry depends on the type of the incumbents, the size and the characteristics of the market and whether the entrants can

[16]See Sutton (1986), Shaked and Sutton (1987) and Sutton (1991).

generate exit. Entry might also be influenced by incumbents' deterring effects; an incumbent by expanding, through opening new stores, can in principle deter entry. However and in the case of the independents, they are not able in principle to follow this strategy either because of credit or managerial constraints. Consequently, the independent incumbents cannot influence entry[17]. Entry, on the other hand, will influence the independents' exit decisions since the entrants are able to acquire (replace) or displace (if they are more profitable) an incumbent. Notice, as well, that for the entrants that are more profitable than the incumbents it is a dominating strategy to enter, irrespective of the behavior of the independent incumbents (exit)[18].

I will now focus on the non-strategic fringe of the firms, the independent incumbents. Their profit functions can be defined as:

$$\Pi_{y,j,t} = d_{j,t}(Z)\alpha_{y,j,t}(own_{c-s,j,t-1}, Ent_{c-s,j,t}, own_{y,j,t-1}, Ent_{y,j,t})S(Y)_{j,t} - f_y - f_{y,j} \tag{2.8}$$

Notice that I have introduced the effect of market structure into an independent's incumbent profit function. This was achieved by assuming that the residual demand, $\alpha_{y,j,t}$, depends on the market structure of the industry. To be more specific, $own_{c-s,j,t-1}$ refers to the number of C-Ss incumbents and $Ent_{c-s,j,t}$ refers to the number of C-Ss entrants. A similar notation has been introduced for the independents' market structure variables, $own_{y,j,t-1}$ and $Ent_{y,j,t}$. The market structure elements have been also decomposed to entrants and incumbents in order to introduce learning (entrants having a larger impact on the profitability than

[17] A further justification for the assumption that independents are not able to influence entry is the fact that in the data set, and for the time period examined, I do not observe independents' expansion (I do not observe independents becoming small C-Ss).

[18] In the case of displacement it is straightforward that the entrant will enter the market. In the case of replacement it is an equilibrium result for the entrant to enter and the incumbent to exit. Thus, from these two links we can see that entry is realized if the profitability of the incumbent is positive given the current structure (before exit is realized).

incumbents), as proposed by Toivanen and Waterson (2005).

Finally, an incumbent will exit if its outside option is greater than its profit. Hence, exit will be observed if:

$$B_{y,j,t} \geq d_{j,t}(Z)\alpha_{y,j,t}(own_{c-s,j,t-1}, Ent_{c-s,j,t-1}, own_{y,j,t-1}, Ent_{y,j,t-1})S(Y)_{j,t} - f_y - f_{y,j} + \rho k_y + \sigma u_{y,t} \quad (2.9)$$

Where $B_{y,j,t}$ is the outside option (scrap value) of the independents. Notice that the scrap value depends on time and on the incumbents' identity, since more profitable incumbents will require a higher scrap value to exit and by the fact that the entrants' types are redrawn every period and the scrap value which depends on the maximum replacement bid changes on time as a result. The $u_{y,t}$ and the k_y is an iid error term normally distributed with mean zero.

However, since I examine a metropolitan area I need to take into consideration spillover effects from neighbouring markets. To be more specific, the requirement that entrants will bid for their right to enter a market guarantees that the most profitable entrant will enter in the most profitable market. As a result, the entry decision will be influenced by neighbouring areas. Entry will be influenced by the strength of demand and market structure, as with Seim (2006)[19], but also through the fixed costs draw of the entrant and the local incumbents. Exit on the other hand depends on local entry, since entrants might displace or replace incumbents, local demand changes and does not depend on entry - exit, demand and the market structure of neighbouring (adjacent) markets. For example, an exit of an incumbent in a neighbouring market will have no impact in a local market. There will be no changes to the intensity of

[19]Entry decisions should be made in the same manner as with Seim (2006) and as a result this is not further examined in this topic.

the competition (with respect to the number of incumbents) in the current market.

I assume that entry in a neighbouring market will not decrease the demand in the local market. I feel confident that people are choosing places to visit, rather than coffee shops, and then choose a coffee shop to enjoy their coffee. However, demand or market structure shocks in one market might influence the adjacent market and for that reason I incorporate these in the empirical analysis. To be more specific, the existence of a more profitable market might generate entry in one market by the most profitable entrants. As a result, this will decrease the entry in the less profitable market and become less likely for an incumbent to be displaced. Hence, exit should not be directly influenced by the neighbouring markets but the entry is influenced and is correlated between markets.

In order to control for adjacent markets I will assume that they influence the profit function, equation (2.9), in a linear manner. Hence, the independent incumbent's profit function, the no-strategic fringe, is:

$$\begin{aligned} d_{j,t}(Z)\alpha_{y,j,t}(own_{c-s,j,t-1}, Ent_{c-s,j,t}, own_{y,j,t-1}, Ent_{y,j,t})S(Y)_{j,t} - f_y - f_{y,j} - B_{y,j,t} \\ + \rho k_{y,t} + \sigma u_{y,j,t} + f(own_{-c-s,t-1}, Ent_{-c-s,t}, own_{-y,t-1}, Ent_{-y,t}) < 0 \end{aligned} \tag{2.10}$$

Where $f(.)$ is the function that incorporates the neighbourhood effects. Hence if equation (2.10) is smaller than zero an independent incumbent will exit while if it is greater than zero then the independent Incumbent will stay in the market.

Admittedly the approach presented in this chapter can be enriched by introducing dynamics[20]. For example, it is possible for an incumbent to prefer to stay in the market, even if its profitability becomes negative, in order to be replaced by entrants with a better draw

[20] Introducing, for example, uncertainty of the entrants on the incumbents' profitability.

of fixed costs in the future (or if there is demand changes within the markets[21]). In the appendix I present a simple dynamic aspect of the model. It is shown that the expected growth of demand is the most decisive factor that might postpone a coffee shop's exit.

2.2 Conclusion

To conclude, in this chapter a simple entry - exit game has been presented. Entry with exit has been linked through the choice of displacement and replacement. The multiple equilibria on both exit and entry were tackled by assuming that entrants compete at the entry stage. It has been shown that for an individual independent incumbent, a non-strategic fringe, the likelihood of exit will be influenced by the market structure variables (entrants and the number of incumbents). The market structure variables of other groups, such as the C-Ss, should influence the independent's profitability differently from its own variables. This is mainly because of product differentiation and the shifts through the $\alpha_{y,j,t}$ term. Admittedly the theoretical model is richer in structure and will allow for empirically investigating the determinants of market structure in general, investigating both the C-Ss' entry-exit decision and the independents' entry decision. However, this is not in the scope of this topic and is left for future research. In the empirical estimation I will investigate the determinants of the presence of independents in the markets through their exit decisions. In the chapter that follows I present the data set and define the relevant market.

[21] i.e. an increase on demand for independent coffee shops.

Chapter 3

Data and Market Definition

In this chapter I present the data gathered for the estimation. I use three main sources: the White and Yellow pages to identify the coffee shops, counts of people that enter and exit a tube station to generate variables that capture demand characteristics and finally from the office of National Statistics (neighbourhood Statistics) to construct local demographic variables. I also define the relevant market, describe issues and the approach used to resolve them.

3.1 Data

I have constructed a unique data-set on coffee shops in central London. As far as I know, this is one of few data-sets that includes both independents and C-Ss in a particular market (P. Jia (2008) being the other one). The names, addresses and telephone numbers of the coffee shops have been individually gathered from the paper formats of the Yellow and White pages catalogues[1]. Since either of the sources might suffer from typographic errors across years I used the address and the telephone numbers to eliminate the possibility that a specific coffee shop is registered as two different entities. The Yellow pages categorize the firms based on their activities. This was convenient since it provided the ability to easily identify the coffee shops. Furthermore, from 2005 the White pages include a categorization of firms based on their activities as well. As a result I was able to identify some further coffee shops that were not included in the Yellow pages. Notice that the listings in the White pages are free of charge in contrast to the ones in Yellow pages.

The Yellow pages (Yell pages UK) can be accessed at the Berkshire Record Office (BRO), at Reading UK. The BRO archives stores public information about people and businesses. The main use of the archives is to trace and explore the history of a person. I use the Yellow pages for Central London from 2000 to 2009. There are five peripheral areas in London but due to time, budget constraints and the mere size of the project I have chosen to focus only on Central London.

The White pages (BT's Phonebook) are accessible by BT's (British Telecommunication) archives located in Central London. They have available copies of Central London's White pages from 2001 to 2011 (I used up to 2009) in paper format and prior to 2001 in micro fiche. I have decided to use this series of phonebooks from 2001 and onwards mainly because of the difficulty of using micro fiche to gather data.

[1]This was an approach taken by Toivanen and Waterson (2005) as well.

I have decided to go through both White and Yellow pages as a robustness check of the sample. The firms are not obliged to register in the Yellow pages (something that is costly for them) and most importantly they are not obliged to register every year. There were a number of firms that were registered in one year and then re-registered some years after. This could create problems when a researcher is interested in identifying the year of entry and the year of exit. For that reason, I have decided to use the business directory of the White pages where the telephone numbers of all firms are listed. As a result I have corrected approximately 30% of the sample (in some cases I had entries and exits in the wrong year).

However, there were two further issues that had to be tackled. The first one is that the Yellow pages are circulated every June while the White pages are circulated every September (from 2005 and onwards). I have decided to use the entries from the White pages as the main source since the Yellow pages is a source that depends on the willingness of the firm to be registered. In any case, the mismatch[2] between the two resources constitutes less than 5% of the sample. The second issue is with respect to the definition of Central London. The White pages define Central London in a narrower geographic manner than Yellow pages. I have decided to follow the White pages definition of Central London and disregard coffee shops outside this area, in order to maintain consistency across the sample (following the narrowest definition in order to be in line with both data sources). If otherwise then the coffee shops outside Central London would have suffered from measurement errors. Furthermore, in the case where two coffee shops with different names were registered with the same address within a particular year, I decided to randomly drop one of the two in order to avoid duplicates (this was a rare case though).

In total more than 1900 coffee shops were gathered. Those included coffee shops that

[2]For example, there were some cases where entry of a coffee shop appeared in the White pages while there was no entry in Yellow pages, and vice versa for exit. This is because the White pages cover a longer period within a year than Yellow pages. In other words entries between the months of June-August will not be covered by the Yellow pages editions.

have existed (within the time period of the sample), exited or entered, during 2000-2009 in Central London. For the reader that is interested in grasping the difference between the size of Central London's and London's area, I provide a in the appendix. The coffee shops were then geographically mapped using a software freely available on the internet by Batchgeo[3]. This website maps the addresses (mainly using the postcodes) to a Google map. It also provides the user with the geographic coordinates of the inputs. In the case that some addresses were not matched to a particular point I have manually used the Google map to find the correct address. In most of such cases the addresses have suffered from a typographic error, which has been corrected. I then used the geographic coordinates to match the coffee shops to a particular market; more information will be given in the section that defines the relevant market, by using the Euclidean distance metric[4].

3.1.1 Market Structure

Let me now describe the data available on the number of companies. I have created three categories: independents, C-Ss and Other C-Ss. The C-Ss are divided in two sub-categories, large and small scale C-Ss (the last one is named Other C-Ss). The largest firms which are included in the C-Ss category are Starbucks, Costa Coffee, Coffee Republic and Caffe Nero. The sub-category of C-Ss with a smaller scale of Chain-Stores (more than 1 coffee shop but less than 10 in Central London) consists of more than 20 firms. Notice that the four largest C-Ss had a minimum of 30 coffee shops in Central London. Hence, changing the upper bound of the Other C-Ss (which was set at 10) will not have any impact on the categorization of the C-Ss, if the criterion is less than three times the present value of the upper bound. The lower bound was chosen to be 2 stores in order to identify the non-strategic fringe (the importance of identifying a non-strategic fringe has been explained in the theoretical chapter of this topic)

[3] $http://batchgeo.com/$

[4] The Euclidean distance metric has also been used by P. Davis (2006) to define a relevant market.

of coffee shops which were named as independents. I have decided to decompose the C-Ss into two subgroups because I believe that the smaller C-Ss might be more aggressively competing with the independents than the major C-Ss. In other words, the major C-Ss leave no space for their individual stores (within Central London) to adjust their product availability or pricing in different sub-markets, while I feel that this might not be the case for the smaller C-Ss (which have more freedom at individual store level). Some examples of small C-Ss are Aroma, Seattle Coffee Co, Baggelmania, Apostrophe, Manhattan Coffee Co. and AMT.

As for the independents, it was found in the data that the independents are quite heterogeneous with respect to their operations. Four different subcategories of independent coffee shops were identified; patisseries, sandwich bars, delicatessens and coffee shops. The larger in size subcategory are coffee shops, the second in size are sandwich bars and the smaller one (less than 100 firms) are patisseries and delicatessens[5]. In the empirical analysis I do not separate the different subcategories of independent coffee shops.

As for the major C-Ss, Starbucks is the largest operator with more than 100 coffee shops in Central London. In 2003 Starbucks had begun a worldwide acquisition of Seattle Coffee Co which was completed by 2003. As a result the number of Starbucks stores exogenously increased dramatically within a year; approximately 40 new shops were opened just in Central London[6]. With the exception of that year, Starbucks had a small number of coffee shops opened in Central London afterwards, approximately 5 per year. The second largest player, Costa Coffee, had mild entry behavior with 2-3 new stores opening each year in Central London. Moreover, Caffé Nero had acquired Aroma in 2002, which generated a similar jump of the number of new C-Ss but afterwards Caffé Nero had 1-2 stores opened every year. Additionally, it seems that Coffee Republic with approximately 30 coffee shops in Central

[5] I realize that the subcategories are observed with a measurement error since in most cases the name of the coffee shop does not reveal its operations and a coffee shop might have chosen to be listed as a coffee shop rather than another subcategory.

[6] I control for this effect by introducing time fixed effects.

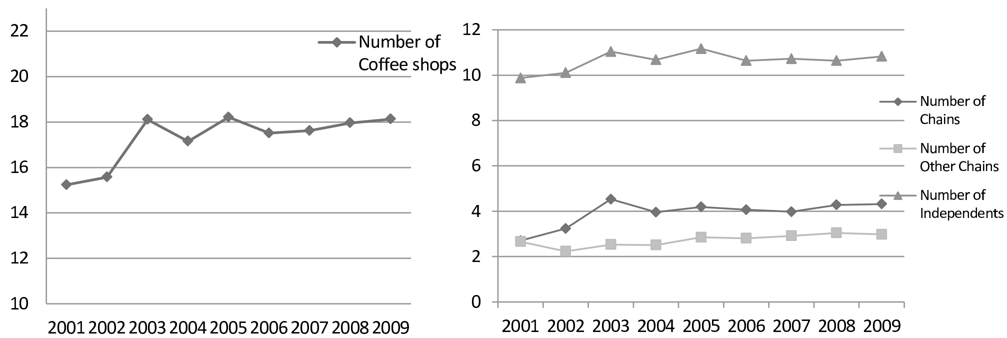

Figure 3.1: Number of Coffee Shops and Subgroups Market Shares

London has been a minor player in the industry, with minimum entry and mainly exiting the market.

The total entry of the C-Ss corresponds to 23% of all entry, the other C-Ss category corresponds to 18% and the independents to 59%. The average number of C-Ss per market is 3.91, which corresponds to 23% of the market. The average for other C-Ss is 2.73, which corresponds to 16% and for the independents is 10.6 which corresponds to 62% of the market. This means that the bulk of entry comes from the independents and suggests that the independents are not displaced or deterred by the C-Ss (since the independents keep entering the market and they are preserving their large share of the market). The graph (3.1) presents the market size and the market structure of the industry.

The graphs where constructed by taking the average cross-sectional value per market[7] and plotted across the years available. In graph 3.1 we can see that the number of coffee shops remains relatively unchanged across time, with the only exemption being the years prior to 2003. Most importantly, the right hand side graph suggests that the C-Ss fail to dominate the market. This can be seen at the right hand side graph of figure 3.1 where the C-Ss enjoy a small share of the market and it is relatively unchanged across time; the latter holds across all groups as well. Interestingly, the graphs in figure 3.1 show that the industry is overall

[7] The market will be defined in the section that follows.

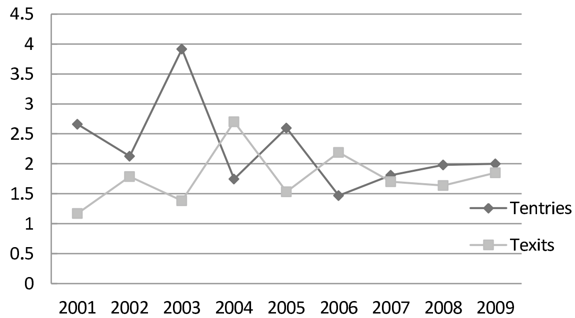

Figure 3.2: Total Entries and Exits

relatively stable (satiated) and this holds either overall or within groups. However, notice that within markets it is observed that there are both increasing and decreasing numbers of coffee shops across time.

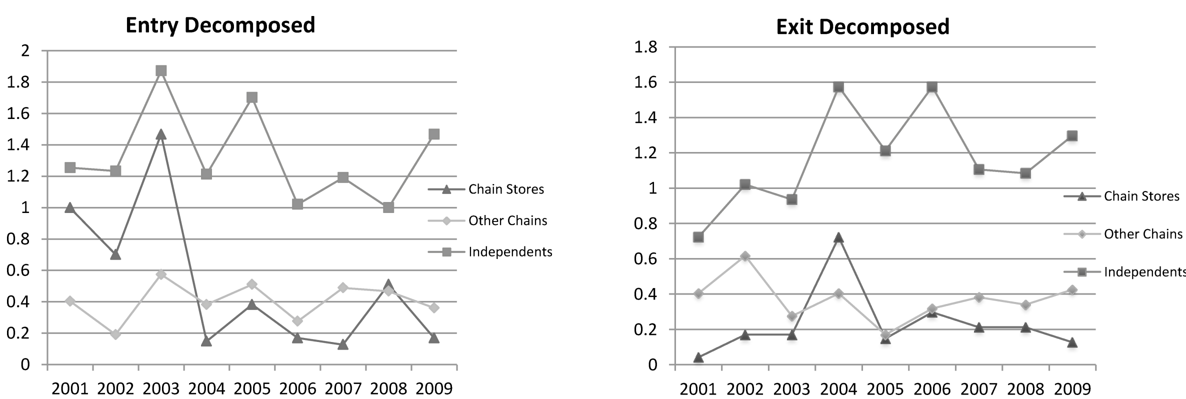

Figure 3.3: Entries and Exits by Subgroups Market Shares

The second group of graphs (figure 3.2 and figure 3.3) present a similar case as with the first group. The total entries are approximately equal to the total exits (on average across all years). It is also worthwhile to mention that there are cases where exits are larger than entries within the sample, thus a lot of variation both on entry and exit, but on average it seems that they cancel out each other. The graphs of the second figure (figure 3.3) show that both entry and exit are dominated by the independents. The smallest exit rate belongs to the major C-Ss, the minor (other) C-Ss have approximately the same entry and exit rate. Most importantly, the entry rate of the independents is higher than their exit rate, suggesting that the independents are not being displaced or deterred to enter the market by the C-Ss. Another notable result is the entry of the C-Ss in 2003 where there is a jump. This jump is attributed to the Starbucks acquisition of Seattle Coffee Co. Furthermore, it seems that this aggressive entry had an impact on the group of C-Ss rather on the other groups since the C-Ss had the smallest growth after 2003. The exit rates are influenced by 2003 as well. This can be seen in the right hand side of the last group of graphs in figure 3.3. In 2003 there is a jump on the number of exits for both the independents and the major C-Ss. On average there are 1.77 exits per year per tube station with 13% (or 0.23 per year per station), attributed to the Chain Stores, 21% (or 0.37 per year per station) to the minor (other) C-Ss and 66% (or 1.17 per year per station) to the independents. On total there are 18 firms per market in a year (see the 3.2 graph), on average, with 2 entries per tube station per year and 1.78 exits. More than 50% of these entries and exits are attributed to the independents. The C-Ss, both major and minor, have a smaller presence in the market and smaller entry and exit. Summary statistics are provided in the appendix.

In the following graphs I abstract from time variation and focus on cross-sectional variation[8]. The 3^{rd} set of graphs (see figure 3.4) present the number of firms per tube station and the number of the subgroups with respect to the Totaltube[9] variable.

The left hand side graph, of the 3.4 figure, suggests that as the traffic of a tube station increases (more people are visiting it) the number of coffee shops that can be supported increases. However, it seems that from a point and afterwards it is inconclusive, for log values of tube traffic greater than 9. This suggests that in tube stations with high traffic there are other factors that influence the number of firms; strategic interactions might be one of them or other market characteristics. As for the right hand side graph, it seems that the previous finding holds within subgroups as well. The number of coffee shops, within

[8]Hence, each observation corresponds to a tube station with the variables being averaged across time.
[9]The total number of people that visit the tube station, averaged across time.

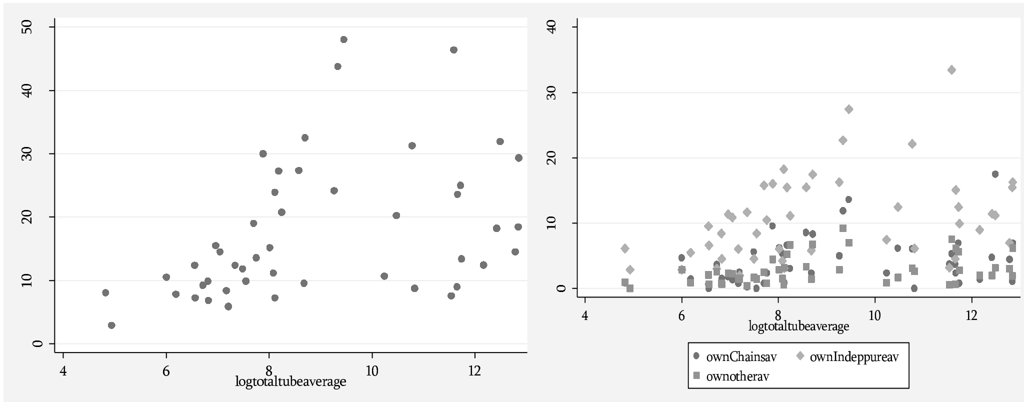

Figure 3.4: Total Firms and Subgroups to Totaltube

subgroups, increases as the traffic increases up to a point and afterwards is inconclusive. A possible explanation to that finding is that higher traffic areas can sustain a larger number of coffee shops but from a point and afterwards this is not necessarily the case as it seems that other forces come in to play. Furthermore, the number of independents seems to remain high (relative to the other subgroups) irrespectively of the traffic of the tube station. The failure of the C-Ss to displace the independents can be attributed by the existence of product differentiation and/or a focus of the C-Ss to within their group competition. Finally, in the appendix I also provide a set of graphs that present the number of firms and its decomposition into the subgroups with respect to the geographic size of the area.

3.1.2 Tube Stations Data

In order to estimate the demand characteristics that determine the exit decision of independents I propose the use of tube stations' data, a previously unexplored approach. Notice that large metropolitan areas have been avoided by the researchers in the past either because of lack of data or because of the weakness of local population and demographics data to explain the entry and exit behavior of firms. As for the tube stations' data, I use this source to proxy for the size of the market, the demand for differentiated products and other demand characteristics such as whether an area has a high business density or low unemployment. The tube stations' data capture the number of people visiting an area, a measurement of footfall, which I regard as having a large impact on the profitability of retail firms in metropolitan areas[10,11]. The market characteristics can be estimated by utilizing expected traveling behavior of the commuters. For instance, commuters at the morning rush hours are expected to travel at their places of occupation and as a result I can identify areas with high business density and low unemployment.

Tube stations data were kindly provided by Transport for London (TFL). The data corresponds to the traffic of the tube stations in a typical[12] day of the year. The data are gathered for a particular month (November, which remains the same across my sample) in a year. The sample provides a typical weekday (average traffic of the counted month) while Saturday and Sunday is given separately. For the empirical investigation I have merged Saturday and Sunday[13]. While I do not have yearly data for these, I feel confident that cross-sectional and time variation of the tube stations traffic will be well represented.

I have disregarded Tower Gateway station due to lack of data (tube stations entries and exits). I have also dropped Bank station and Monument because the tube stations data are merged (not separated from each other). I have decided to drop these two stations because the distance between them is far enough to consider them as different markets (more than 100ft) and also because the two sites probably attract different groups of population. To be more specific, the Bank of England's headquarters are located next to Bank station, which means that a more business oriented population is attracted to that area, while the north

[10] Admittedly, similar footfall variables in a different context, using the number of employees of business centers, have been used by R. Thomadsen (2005).

[11] The Starbucks state in their website "*Given we tend to locate in places with the highest footfall, usually on high streets and in prime locations, our rents have traditionally been very high, and we have in the past made decisions during a period of rapid expansion that continue to prove challenging.*", please see *http://starbucks.co.uk/blog/speech-at-london-chamber-of-commerce/*1248

[12] As defined by the TFL.

[13] I believe that these days should reflect a measurement for leisure (through travelling) and I cannot think of a particular reason why they should be categorized individually rather than as a group.

bank of Thames is very close to the Monument which I assume that is more attractive for leisure.

Furthermore, a number of tube stations were merged (using coordinates that are half way along their distance to define a "new" merged tube station), because of the small distance between them (less than 50ft). The stations are: Aldgate East station merged with Aldgate station, Great Portland Street station with Regent's Park, Euston Square station with Warren Street and Edgware Road station with Edgware (circle) station. I have decided to merge these stations in order to avoid defining a market too narrowly, this will be made more clearly later on. I have also dropped Shoreditch and Bermondsey because BT's Phonebook (White Pages) does not cover these areas adequately. This leaves me with 47 potential markets.

A series of variables were created, from the tube stations' data, to capture demand heterogeneity. To be more specific, I have created a variable for morning rush hours exits (7-10 am) to capture business density across markets (named as Outrush). It is assumed that people's exit (destinations) during the morning rush hours are more likely to be their work place and as a result these data reveal areas with high business density through a large number of exits (visits). I expect that areas with high business density will be characterized by higher propensity to consume but at the same time less taste for differentiation (independents will be less profitable in these areas). The higher propensity to consume can be explained as being either more likely to consume coffee while at work at the morning, or that people who spend most of their time close to their jobs are more likely to stop for a coffee at a store nearby. Whether the profitability of an independent coffee shop will be positively influenced by locating in such area or not will be investigated at the empirical estimation chapter.

Another variable constructed from this dataset is the tube stations entries during the morning rush hours (7-10 am) which is named Inrush. I assume that people entering a tube station during the morning rush hours are more likely to be residents of an area that are employed (leaving an area to commute to their jobs) and as a result it is possible to characterize residential areas with high employment rates. This variable is meant to capture residential density and the working population of the area, an inverse deprivation variable[14]. The residential areas with high employment numbers should increase the consumption of coffee and as a result the coffee shops profitability, mainly because of an income effect (given that the good is normal and not inferior).

A variable, which is the sum of people that visit (exit) the tube station during the weekend, is also constructed in order to capture whether an area is leisure oriented; this variable is named Weekend. In the latter variable it is anticipated that an area which is frequently visited (number of people that exit the tube station) during the weekends is an area for leisure activities. It is also assumed that in leisure areas people are more interested in trying a differentiated coffee shop and as a result it is anticipated that the scope for differentiation can be estimated. A problem with the weekend variable that came to my attention is that some tube stations exhibited closures during the weekends. In order to control this problem I have introduced a series of dummy variables[15].

The last variable, constructed from these data, is the total number of people that visit and leave the tube station, named Totaltube. This variable is meant to estimate the impact of the demand size (number of foot fall) on the independent's profitability. It is anticipated that areas with high number of visitors should increase the coffee shops profitability since the size of the market increases[16]. Finally, summary statistics for the tube stations' data can be found at the table 3.1).

[14]Since lower employment corresponds to higher unemployment

[15]The tube station Cannon St. had closures during the weekends across all of my sample. While the Chancery Lane tube station had closures from 2001 to 2005 and Temple tube station had closures form 2001 to 2003.

[16]On the other hand, it is always possible that the increased traffic might decrease the probability for a given commuter to buy coffee, a crowding out effect. This might be the case if there are queue effects, which decrease the willingness of people to buy coffee. This issue will be addressed in the empirical estimation chapter.

Variable	Observations	Mean	Std. Dev.	Min	Max
Totaltube	470	200th	153th	16.2th	554th
InRush	470	7.17th	10.9th	0.26th	51.1th
OutRush	470	14.5th	9.70th	0.97th	46.4th
Weekend	470	54.6th	44.6th	0th	155th

Table 3.1: Tube Station Variables Summary Statistics

In the tube stations data there are substantial variations across all variables, even though I just focus on a relatively small area of London (as defined by Central London's Phonebooks[17]). For example, Totaltube has a minimum of 16.2th and a maximum of 554th visitors. The first variable measures the "traffic" of the tube station. The InRush variable (number of people that leave an area) has a minimum of 0.26th in a year and a maximum of 51.1th. For the business density variable (Outrush) there is a minimum of 0.97th and a maximum of 46.4th. Finally, the Weekends variable (which measures the number of people that visit a tube station during the weekends), has a min of zero and a maximum of 155th. The minimum is zero mainly because of partial closures of some tube stations[18].

3.1.3 Benchmark Variables

I have also gathered variables from sources commonly used by the literature to estimate demand characteristics. To be more specific, local population characteristics are gathered from the Lower Layer Super Output Areas (hereafter defined as LLSOA) dataset, of the Office of National Statistics (ONS). The LLSOA dataset is the smallest geographic definition of Central London. The variables constructed by this dataset are the percentage of claimant benefits (this includes claimants from all sources of social benefits[19]), residential population and the

[17] A map that presents to area that investigated and the wider area of London is given at the appendix

[18] If I ignore the tube stations which had closures during the weekends then the min value is 2.398th.

[19] Breaking this variable into a more specific, for example only unemployment claimants, was not possible because of data unavailability in most areas for the period prior to 2006.

demographics on residential population (pensioners). These are the benchmark variables used by the empirical literature of entry in concentrated markets models to estimate the demand characteristics of the industry.

A problem with these data is that in most of the cases the tube station is not located in the centre of the area of interest. Hence, I expect a measurement error for these variables. A more serious problem is that for some cases the categorization of some areas is not small enough. For example, there are three tube stations located in the City of London 001D (as reported by LLSOA). These are the Cannon Street, the Mansion House and the Liverpool Street tube station[20]. Overall, there are 6 cases with LLSOA data being assigned to more than one tube station. As a consequence I anticipate that the LLSOA data will exhibit smaller across markets variation and might add spatial correlation. In order to control for the latter I have created a set of dummy variables that are going to be used in the empirical specification.

Another issue with the variables constructed from the LLSOA data is that the date of publishing the data and the period they cover are different. To be more specific, the claiming benefits variable (hereafter referred to as Claimben) is measured every August, the housing variable is measured every March and the population statistics is measured every June. This is due to the fact that there are different agencies responsible in gathering and publishing the data statistics.

3.1.4 Data to Construct a Proxy for Fixed Costs

Finally, I have gathered real estate data in order to generate a proxy variable for the fixed costs of the coffee shops. The fixed cost variable is constructed by collecting the values of flats sold for each postcode in the dataset. The sources used are the *mouseprice.com* and *rightmove.com* websites. I believe that the average residential property value of an area

[20]These three tube stations are some of the ones with the smallest distance between them.

should be positively correlated to the commercial value. Moreover, the commercial value of the property should mirror the rent that the coffee shop is paying[21] and as a result I should capture the importance of the fixed costs fairly well, since the rent is a major part of the coffee shops' fixed costs. However, part of the fixed costs of a coffee shop should be the labor and the utilities of the store as well, but unfortunately there are no available sources to measure these factors to my knowledge. In any case, I believe that the rent of a property is the most important part of the fixed costs.

In order to gather the data for the fixed cost variables, I have used the first three digits of the postcodes (the number of the digits is either six or seven) from the coffee shops data (using their addresses) to retrieve data on properties sold per tube station market. The three digit level generates, most of the time, a satisfactory size of an area. On average a three digit postcode area corresponds to just a smaller area than the coverage of a tube station (the market and the area of the tube station will be defined at the market definition section). In some rare cases though (two cases) a three digit area corresponded to a larger area covering more than three tube stations. Notice that for more disaggregated data (four or even five digit level postcodes) will either be too difficult to find sufficient observations, since in most of the cases there are less than ten properties actually sold for all the years of interest, or the time needed to gather data, for this control variable, is prohibitively high. The three digit postcode classification provides me with 66 postcodes in Central London. For these 66 postcodes I have gathered property (flats) sold prices from 2000 to 2010 with 20 observations per postcode per year, a total of 14,520 observations (approximately). The choice of taking 20 observations per postcode per year covers 100% of the actual properties sold for some areas

[21] Admittedly it might be the case that the properties might have been bought by the coffee shops instead of being leased. Unfortunately, it was not possible to find any information that states with certainty whether coffee shops are leasing or buying their property. In the latter case the constructed variable should fail to capture the importance of fixed costs since the expense of buying a place should be a sunk cost rather than a fixed cost. However, I feel confident that the majority of the coffee shops are with lease contracts. See for example the Coffee Republic (major C-S) website, see page 55 in the following website $http://www.coffeerepublic.co.uk/uploads/files/CR\%20Sales\%20Brochure.pdf$, which suggests that 21% of the turnover goes for rent payments.

but for some others it is a small sub-sample.

The Rightmove website, in contrast to the Mouseprice website, provides to the interested researcher the history of the sold prices of a particular property. Through these websites a researcher can search for a particular postcode and find all the properties which correspond to that postcode. For each property the price and the date of the sale appears, if there was any sale, but unfortunately the number of bedrooms does not. In order to access this information, the viewer will need to pay a fee. However, even if this fee is paid the number of the searches that you are able to access is restricted (less than 350 searches can be performed with full information within a month)[22]. Hence, I have decided to gather data on properties sold of less than 1m (deflated across years)[23].

The postcodes used to gather data on the fixed cost variable were manually matched to the tube stations. In most of the cases there were more than one postcode for a particular tube station. However, some postcodes were either adjacent to, or included a large area of the tube station, while in some other cases a postcode corresponded to a smaller area of the tube station market. For that reason two categories have been created. The first one was named major and the second one minor. The major ones received double the weight of the minor and as a result I have created a weighted average of the value of flats sold in the tube station area. For example, assume 3 major and 2 minor be part of a tube station, in this case the major ones received a 1/4 weight and the minors 1/8, which was multiplied to the corresponding average value of the postcode. The average property value sold across the entire sample is $372,123.60$ with a standard deviation of 109,218. The summary statistics, which are provided in the appendix, suggest that there is high variation on the property values sold.

[22] I have actually paid a fee and found out that I can only access the full information on the sold properties for a small number of pages.

[23] Admittedly this can be problematic since it might be the case that an area will have very expensive properties and as a result I only gather information for small sized properties (i.e. only 1 bedroom flats) while in other areas (cheaper) I will gather information on all kind of flats (i.e. from 1 to 4 bedroom flats). However, I believe that this should not be a major issue since the majority of the flats available in Central London are either 1 or 2 bedroom flats, thus it is more likely to gather information on 1 or 2 bedroom flats.

I have also constructed two variables to control for data issues of the fixed cost variables. The first variable controls for the area of South of Thames. This area includes 5 tube stations for which I had only two postcodes available. Consequently, there is not enough information to estimate the fixed costs across these five tube stations. The second variable is for tube stations that have a small number of sold properties. This might create measurement error since it is more likely to overestimate or underestimate the average property value of an area.

In order to identify the effect of the fixed costs on the profitability of the coffee shops I will generate two variables from these data. The first one, hereafter named fixcost, will abstract from time variation. A second variable, fixcosttime, is constructed in order to capture the time variation of the fixed cost within a coffee shop observation. This variable will be equal to the average value of the properties sold at a tube station.

The first variable was constructed by applying the average value of the properties sold (at the particular tube station) from the time that a coffee shops enters to all the periods that the coffee shop appears in the sample. This variable should capture the time invariant part of the fixed cost (within a coffee shop observation) since I expect that the initial value of this variable will play the most significant part on my effort to control for the fixed costs[24]. Notice that this variable will exhibit cross sectional variation (different tube stations take different values of fixed cost) and time variation across coffee shops, since coffee shops enter in different years within a given market.

Notice that, as I have shown (in the theoretical chapter of this topic), the profit structure of an entrant will be different from its profits after the first year of existence (profits as an incumbent) and this is mainly because of the sunk costs, which occur at entry. In order to avoid this issue I drop observations, from the sample, for the first year of a coffee shop's existence. As a result the zero value of the dependent variable is uniquely identified.

[24]It is a common belief in the industry that the commercial rents are sticky across time. This is mainly because of a clause on the lease, usually used in such contracts, which specifies that the rent will increase after a predetermined number of years, and at a predetermined rate.

Consequently, the fixcost variable will be different from the fixcosttime variable across all observations. The reason is that the first observation of the fixcosttime, which is the only observation that is equal at a given year with the observations of fixcost, is lost. An example is given in the table that follows (table 3.2).

Year	ExitIndep	Fixcosttime	Fixcost
2002	.	301393.8	301393.8
2003	0	307874.7	301393.8
2004	0	329148.7	301393.8
2005	0	335178.9	301393.8
2006	1	364071.2	301393.8
2007	.	395575.5	301393.8

Table 3.2: Fixcosttime vs. Fixcost Example

In the above table I assumed that a coffee shop entered in 2002 and exited in 2006. The fixcost variable is fixed across time and is equal to 301,393.80, the value which corresponds to the coffee shop's entry. Notice that the values presented above are actual data and they correspond to the average flats sold in Chancery Lane tube station market. The Fixcosttime variable takes different values across time. In 2002 the value of that variable is the same with the values of Fixcost across time. However, by the construction of the dependent variable (ExitIndep) the first observation, for all variables, is dropped[25] and as a result the fixcosttime variable is not equal to the fixcost at any time period. Hence, the fixcosttime should capture the time variation of the fixed costs.

3.2 Market Definition

It is assumed that the area of tube stations is suitable for defining the market of coffee shops in Central London. The footfall should be far more important as a driving force for a firm's

[25]I drop the first observations of the entrants in order to uniquely identify the zero value of the dependent variable, as it was shown in the previous paragraphs.

profitability in a metropolitan area than local population characteristics. Tube stations are a source of footfall and as a result equally as important. An indication of its importance has also been presented on the descriptive statistics. The total number of tube stations in Central London is 56, thus 56 potential markets for coffee shops. Some stations have been disregarded because of lack of data and some other stations were merged because of the small distance between them (I cannot assume that these stations are separated markets). Consequently, I was left with 47 tube stations. The distance between the tube stations will be used to generate a variable for the geographic size (area) of the tube station. This variable corresponds to the area of a circle, with the tube station at the centroid and the minimum distance between the tube stations as the radius. A map of the tube stations in Central London is also provided in the appendix.

However, complexities are generated when defining the tube stations as the relevant market. Mainly because the tube stations are not a predetermined relevant market by any authority. Electoral, economic or census sub categorizations are not useful to estimate demand characteristics in a metropolitan area since they are either too widely defined and/or there is no objective way for an authority to count the foot-fall of an area, which I believe plays an immense part on the profitability of firms in some industries (i.e. retail). For the task of defining a market I will employ the intuition presented in the literature of market delineation. This literature suggests demand substitutability, following G. J. Stigler and R. A. Sherwin (1985), of no overlapping markets as a criterion. However, this requires the researcher to apply tests on price elasticity from different definitions (broad vs narrow for example) between geographically different markets, i.e. test for prices co-integration[26] or co-movements[27]. This is not feasible with these data, since data on prices are not available, and as a result I adopt

[26]See F. Asche, K. G. Salvanes and F. Steen (1997).
[27]See Benson, B.L., and M.D. Faminow (1990) for a review.

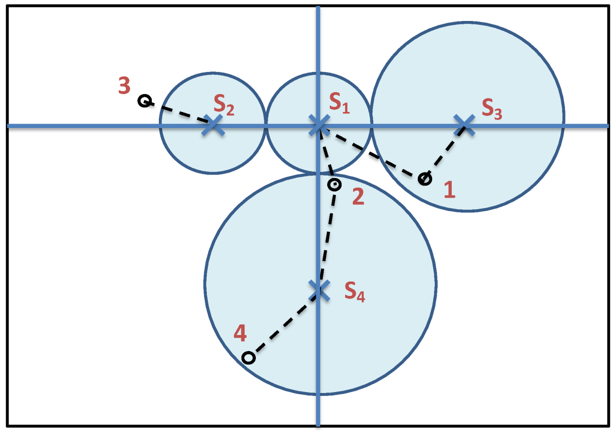

Figure 3.5: Uniform Approach

a more intuitive approach that addresses the same issues[28] with the delineation literature[29].

I present three alternative definitions of a relevant market and argue which is the best one to use. Notice that, in all cases, I aim to avoid overlapping markets. The first approach, which is graphically presented in the first figure (see figure 3.5), will be named uniform approach. The uniform approach is constructed by taking centroid from a tube station with a radius of half the distance between the two closest tube stations. This is a similar approach to K. Seim (2006) with an important modification. K. Seim (2006) used circles centered to a census defined area to capture the intensity of competition, while I use her approach to define the tube stations market (circles centered at a tube station). Furthermore, there are econometric issues that cannot be solved by this approach, as I am going to explain later on.

In graph (3.5), I present a hypothetically squared shaped city (the actual shape of the city is not an issue in this case). In this city I have four tube stations (S_1, S_2, S_3 and S_4). The city has only two underground routes which are depicted by the horizontal and vertical blue lines. I also present four hypothetical location choices of the coffee shops (1, 2, 3 and

[28]See for example E.U. Guidance on Relevant markets; the web-page is: $http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:1997:372:0005:0013:EN:PDF$.

[29]P. Davis (2006) paper is faced with similar, but distinct, issues in a different context.

4). I have used the location of the tube station as the centroid of the blue circles. The blue circles are constructed based on the minimum distance of the closest neighboring tube station[30]. Coffee shops are categorized in a market based on whether they are located within the area of a circle. This criterion was used in order to avoid overlapping markets. However, the tube stations which are closest to each other, and more likely to be the busiest stations, cover the smallest geographic area of the town while the stations that are located in a greater distance cover a larger geographic area. This is the first inconsistency in this market definition. Smaller geographical areas correspond to tube stations with higher traffic, this generates a small market over-representation problem. However, this is an issue that researchers are faced with any form of data. To be more specific, census area categorization is based on the size of population rather than the geographic size of an area. Hence, I should also expect in census data the same inconsistency; greater areas correspond to smaller populations (even within a city). The researchers have been correcting this issue by introducing a control variable equal to the geographic area of the market.

The next issue is a misallocation bias. Let me examine point (2); the coffee shop that corresponds to location 2 is closest to tube station S_1 but because of the min distance criterion it is categorized to market S_4. However, a commuter will prefer to use station S_1 to reach point (2). Alternatively, it is more likely for those coffee shops to be influenced by S_1 traffic rather than S_4. Hence, I will misallocate coffee shops in larger areas with a higher probability if I use this approach. An example where this issue fails can be seen through points (1) and (4), since these two points are correctly allocated to S_3 and S_4 respectively. This might create bias in my estimations since smaller areas will be allocated disproportionably a lower number of coffee shops.

[30]This approach generates heterogeneously sized markets. I could use as a criterion the minimum distance between the two nearest tube stations across all of my sample (the min between all the minimum distances). However, this will result in the market being too narrowly defined and failing to allocate the main mass of the coffee shops in the markets. To be more specific, the min-min criterion (mentioned in this footnote) results into a distance of 50 metres around the tube stations (an area just $2500m^2$) and a total number of 600 coffee shops being allocated from the 1900 total.

The next issue is the minimum distance bias. This is depicted from points (1) and (3). The points (1) and (3) share approximately the same distance between them and their nearest tube station. However, point (1) is allocated as a coffee shop that belongs to market S_3, while point (3) is not allocated to S_2. Notice though that I should expect that point (3) is more likely to be influenced by station S_2, if the assumption that closer tube stations exhibit higher traffic is true, rather than point (1) from S_3. This is a similar bias to the previous one; the main difference though is that now I exclude point (3) from the estimation because of the criterion used on defining the market.

Another issue is the treatment of coffee shops within an area, the within markets bias. To be more specific, a coffee shop that is located at the exit of the tube station will most likely absorb higher number of commuters than a coffee shop at the boundary of the market. However, if I do not tackle this problem a coffee shop at the boundary of the market will be influenced by tube stations' traffic in the same way as a coffee shop located next to the station.

Finally, the current definition of the market generates a small sample representation. In other words, in the first graph (3.5) the observations that are going to be used are the ones that belong to the blue circles. As a result this method will not capture all the population of the coffee shops in the metropolitan area.

An alternative approach is to split the metropolitan area into parts that will allocate all the coffee shop to their nearest tube station. In this case the market is not as well defined as in the first one. However, it solves the misallocation bias and the small sample representation (all the coffee shops will be allocated to a market). For example, point (2) now belongs to the first market (S_1) rather than to the fourth market (S_4). This is a consequence of re-balancing the area of closely located tube stations. It also solves for the minimum distance bias; both (1) and (3) are located in a market. But increases the within markets bias, see point (5). The

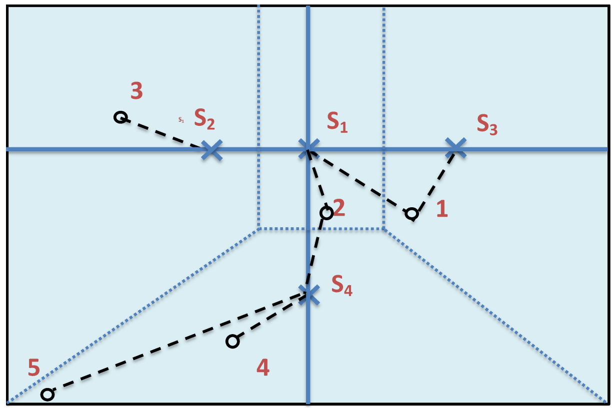

Figure 3.6: 2^{nd} Approach

graph 3.6 presents this approach.

However, this approach magnifies the small market over-representation problem. In other words, the tube station that covers the greatest area is the one with potentially the smallest traffic, tube station S_4. As a result this tube station might have an equal number of coffee shops, in an extreme scenario, even if the majority of the coffee shops lie in a great distance (which might not be explained by tube stations). Hence, cross sectional variation of coffee shops, across tube station markets, will be reduced.

The third approach is constructed by using the average distance metric between neighboring tube stations given that the distance is smaller than a threshold value, otherwise I use the threshold value. The last approach will be adopted for the empirical investigation. The third approach solves the minimum distance bias, the misallocation bias and, up to a point, the small sample representation. It also reduces the small market over-representation; notice that point (5) does not belong to (S_4) anymore. The graph 3.7 presents this approach. Notice that the within market bias will be solved by using appropriate weights. The weight that is used is the coffee shop's distance to the tube station (let's name the distance as D_i). If I divide the demand shifters (in this case tube stations) with the proposed weight then the coffee shops at a greater distant will be matched with a smaller demand. In this way further

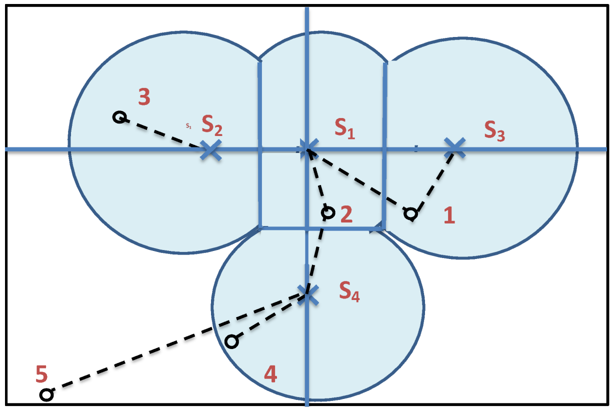

Figure 3.7: 3^{rd} approach

away coffee shops are less likely to be influenced by the tube stations' traffic.

The criterion used for this approach is:

$$min\{\frac{D_i}{2}, \bar{\mathrm{D}}\}$$

Where D_i is the distance between the two neighboring tube stations. I have used different threshold points for $\bar{\mathrm{D}}$. A consistent approach will be to use a criterion based on the peoples' willingness to travel from a tube station to a coffee shop. As a result a criterion that can be used is 5, 10 minutes and 15 minutes travel on foot. When I use the 15 minutes criterion 90% of the coffee shops data are included in the sample, while the 10 minutes criterion generates only 60%[31]. I have decided to use the 15 minutes criterion in order to cover the majority of the market. Hence, the small sample representation should not be an issue, since I almost capture the whole population of coffee shops.

In order to allocate the coffee shops to a market, I have calculated the Euclidean distance of each coffee shop to all 47 tube stations and then compared these distances to the above min criterion. Hence, if the Euclidean distance of the coffee shop from a specific tube station

[31]Notice that a decrease of the radius by 1/3 will decrease the geographic size of the market by more than 50%.

is smaller or equal than the min criterion then the coffee shop is allocated to that tube station market, it belongs to the area of the tube station. If this is not the case, then I proceed to the next tube station and if there is no match to a particular tube station the coffee shop is dropped from the data[32]. Notice that this approach has generated a 90% match of coffee shops to tube stations' markets (approximately 1700 coffee shops were allocated to the tube stations' markets from the 1900 of the sample).

Notice, that the minimum distance between the tube stations is 0.00207 ($\bar{\mathrm{D}}$) with respect to Euclidean distance metric. This corresponds to a diameter of approximately 1250 ft or a distance from a tube station of 625 ft. With respect to walking distance, this corresponds to 3.5 min and this is the case if I assume a walking speed of 3 ft per second.

Furthermore, I divide the demand variables, the variables from the tube stations' data, with the distance of a particular coffee shop to the tube station (D_i) which was allocated. Under the proposed weight the coffee shops in a greater distant will be matched with a smaller demand within a tube station. In this way further away coffee shops are less likely to be influenced by the tube stations' traffic.

3.3 Conclusion

To conclude this chapter, I believe that the coffee shops industry is a good case study since both the C-Ss and the independents are present in the sample and there is a high variation of exit and entry, both across time and markets[33]. Another interesting feature is the failure of the C-Ss to displace the independents and dominate the market (globally at least). Most

[32]The algorithm is the following; for coffee shop 'j' calculate $D_{i,j}$. If $D_{i,j} \leq min\{\frac{D_i}{2}, \bar{\mathrm{D}}\}$ then set 1 to a tube station 'i' dummy variable. Otherwise set it equal to zero. If $D_{i,j}$ is larger than all the min criterion then drop the coffee shop. To be more specific, I have summed all the tube station dummies and if the sum for a specific observation equals to zero (no allocation) I drop the observation.

[33]Other industries, such as the groceries and fast-food, might lack this variation when the market has been established.

importantly, coffee shops are highly differentiated and this allows examining the impact of the C-Ss presence to independents' profitability. Finally, I have gathered data from tube stations commuting patterns and data from national statistics to estimate the importance of demand characteristics. In the next chapter I present the empirical results.

Chapter 4

Empirical Investigation and Counterfactual Analysis

In this chapter the empirical investigation and the counterfactual analysis is presented. The empirical estimation is split in two parts. In the first part I estimate the importance of market specific effects to the profitability of the independent coffee shops and present evidence for the existence of product differentiation. I also show that the benchmark variables fail to explain the demand effects that influence the independents' exit decision. This is in contrast to the variables constructed by the tube stations data. In the second section, of this part, I control for time demand effects. To be more specific, I show that the marginal propensity to consume coffee in the morning and on weekends are important factors that need to be controlled. I also show that a coffee shop is relatively more profitable if it is located in an area that is characterized as leisure (which I attribute as a taste parameter for product differentiation), in an area that is characterized by high employment with respect to the residential population and an area that has *low* business density.

In the second part of this chapter I present two counterfactual excercises. In the first case a city planner enforces a maximum cap on the number of new coffee shops in the market. This has a disproportional effect on the independent coffee shops. I show that the number of independents decreases within three years. In the second exercise I present a more targeted policy, where a city planner restricts the number of new C-Ss to zero if the C-Ss enjoy a market share larger than 40%. This is a more successful policy since it increases the number of independents by approximately 25% within a year.

4.1 Empirical Investigation

In this section I will estimate equation (2.10). The variables that are going to be used in order to control for the demand size of the market are Total Entry and Exit from the tube station (tube station traffic) or area population (from the benchmark data source) or both. The Inrush and Outrush variables from the tube stations' data capture the demand characteristics of a tube station market, such as employment and business density, while the Weekend variable categorizes the areas as leisure (scope for product differentiation). These variables are expected to influence the market share of the independents. However, I cannot identify these demand characteristic with the variables derived from the benchmark approach, i.e. pensioners and number of benefit claimants (these two variables identify the spending power of a representative buyer).

The dependent variable is the probability of an independent to exit. It takes a value of 1 if an independent firm exits, zero if an incumbent remains in the market and is dropped out of the sample otherwise. As presented by equations 2.1 and 2.2, an entrant and an incumbent have different profit functions. Hence, if both states of the world (incumbent and entrant) are equal to zero then I would not uniquely identify the value for zero. Therefore, I have decided to drop the entrants from the sample. In total there are 4,382 observations from 918 independents (across 9 years). Furthermore, as mentioned in the previous chapters I abstract from the exit behavior of the C-Ss for two reasons. Firstly, the C-Ss exit behavior is exogenously to an independent coffee shops decision to exit (no issue of endogeneity that needs to be tackled). In addition, C-Ss' exit is rarely observed and as a result the lack of variance will generate difficulties on estimating the parameters of interest.

A maximum likelihood estimation is utilized with the dependent variable being the independents exit decision. More formally:

$$\ln \mathcal{L}(\beta) = \sum_{t=1}^{T}\Bigg(\sum_{j=1}^{J}\Bigg(\sum_{i=1}^{n}\Big(Y_{i,j,t}\ln\Phi(x'_{i,j,t}\beta) + (1-Y_{i,j,t})\ln\big(1-\Phi(x'_{i,j,t}\beta)\big)\Big)\Bigg)\Bigg)$$

Where Y is:

$$Y_{i,j,t} = \mathbf{1}_{\{Y^*_{i,j,t}<0\}} = \begin{cases} 1 & \text{if } Y^*_{i,j,t} < 0 \;\; \text{Exit of Independent Incumbent,} \\ 0 & \text{otherwise.} \end{cases}$$

and:

$$Y^*_{i,j,t} = \beta_0 + \beta_1 d_{j,t}(Z) + \beta_2\alpha_{i,j,t} + \beta_3 S(Y)_{j,t} + \beta_4 f_{j,t} + \beta_5 f(.)_{j,t} + u_i + \varepsilon_{i,j,t} \tag{4.1}$$

Notice that $Y^*_{i,j,t}$ is a reduced form estimation of equation (2.10). Where $d_{j,t}(Z)$ is a vector of variables that include the demand characteristics of market j in period t, $\alpha_{j,t}$ is the demand share of individual i (residual demand) which is determined by the market structure variables (entrants and incumbents for each group). $S(Y)_{j,t}$ is the size of demand in market j at time period t, $f_{j,t}$ is the fixed cost of an area at period t and f(.) are neighboring variables to control for spillover effects (from neighboring areas). Finally, $\varepsilon_{i,j,t}$ and u_i is the error term (random-effects estimation). I assume that the error term is i.i.d. normally distributed with mean zero and variance one.

Five different specifications of equation (4.1) are presented. In the first one I estimate equation (4.1) without including demographics of the local population. In the second estimation I incorporate the local demographics but I ignore the tube station variables in order to compare the results with the benchmark approach. In the third specification I include both the local population and the tube station variables. In the fourth specification I include some extra control variables and introduce variables such as demand variables at the neighbour markets in order to control for potential spatial correlation between the demand variables. In the final specification, I use only tube station variables, following the initial assumption that markets within London are defined solely by their footfall characteristics, and some further control variables[1]. I also include nonlinear effects (squared values) of the independents market structure variables (incumbents and entrants), squared terms of the Other C-Ss incumbents, exterior demand controls and market structure variables. When I include the squared terms, I take appropriate corrections on the reported coefficients[2]. Finally, notice that the tube market demand variables, the fixed costs variables and the geographic size of the area (Area variable) have all been divided by 1000.

For the convenience of the reader a list with the names and abbreviations of the variables is provided in the appendix. Furthermore, the coefficients and the standard errors reported in the table that follows are the marginal effect ones. Finally, all the specifications are based on a random-effects model.

Independent Variables	Probit (1) Probability for an Independent to exit	Probit (2) Probability for an Independent to exit	Probit (3) Probability for an Independent to exit	Probit (4) Probability for an Independent to exit	Probit (5) Probability for an Independent to exit
Fixcost	0.0001	0.0001	0.0001	0.0002	0.0002*
	(0.0001)	(0.0001)	(0.0001)	(0.00012)	(0.00011)
Fixcosttim	-0.0002	-0.0002	-0.0001	-0.0002	-0.00014
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.00013)
Pop	-	0.00003	0.00001	0.00002	-
		(0.00003)	(0.00002)	(0.00002)	
Pensioners	-	-0.0001	3.55e-06	-0.00002	-
		(0.0001)	(0.00011)	(0.00011)	
Claimben	-	0.0001	0.00005	0.00006	-

[1]These controls include year dummy variables, dummy variables for tube stations that exhibited closures, dummies for the benchmark variables that correspond to more than one market and a number of dummy variables that control for tube station that lie at the boundary of the market. The last group of variables are meant to control for the fact that I don't have sufficient data to control for neighbouring effects for sub-markets that lie at the boundary of Central London.

[2]If the square of variables are included in the estimation then the marginal effect will be calculated as $\frac{dy}{dx} = be\hat{t}a_0 + 2 * \hat{\beta_1} * \bar{X}$. Where $\bar{X}$ is the average value of the variable that its squared term is included, $\hat{\beta_0}$ is the coefficient that corresponds to X and $\hat{\beta_1}$ the coefficient that corresponds to X^2. Therefore, I can use the following transformation to calculate the coefficient of interest: $\hat{\beta_0} = \frac{dy}{dx} - 2 * \hat{\beta_1} * \bar{X}$.

		(0.00006)	(0.00006)	(0.00006)	
Area	-0.0001**	-0.0004	-0.0001**	-0.00008*	-0.0011***
	(0.00004)	(0.00005)	(0.00005)	(0.00005)	(0.00004)
Weekend	-0.0754**	-	-0.0753***	-0.0744***	-0.0732**
	(0.0301)		(0.0294)	(0.0289)	(0.0290)
Inrush	-0.0414**	-	-0.0405**	-0.0405**	-0.0407**
	(0.0189)		(0.0188)	(0.0185)	(0.0183)
Outrush	-0.0643**	-	-0.0622**	-0.0619**	-0.0631**
	(0.0303)		(0.0306)	(0.0295)	(0.0292)
Totaltube	0.0258**	-	0.0257**	0.0255**	0.0252**
	(0.0105)		(0.0103)	(0.01021)	(0.0101)
L1OwnIndep	0.0008	0.0006	0.01520***	0.0161***	0.0129***
	(0.0011)	(0.0013)	(0.0038)	(0.0037)	(0.0033)
EntryIndep	0.0047	0.0027	0.0224**	0.0218**	0.0255**
	(0.0035)	(0.0037)	(0.0076)	(0.0075)	(0.0073)
L1OwnCS	-0.0005	0.0017	0.0019	0.0018	0.0018
	(0.0021)	(0.0025)	(0.0029)	(0.0028)	(0.0025)
EntryCS	0.0001	0.0032	0.0044	0.0042	0.0028
	(0.0063)	(0.0066)	(0.0065)	(0.0064)	(0.0062)
L1OwnOther	-0.0026	-0.0004	0.0003	0.0001	-0.0003
	(0.0032)	(0.0035)	(0.0037)	(0.0036)	(0.0035)
EntyOther	0.0180**	0.0180**	0.0147**	0.0144**	0.0161**
	(0.0074)	(0.0076)	(0.0075)	(0.0074)	(0.0072)
Mark. Str. Var. Squared	No	No	Yes	Yes	Yes
Mark. Str. Ext. Comp.	Yes	Yes	Yes	Yes	Yes
Dem. Ext.	No	No	No	Yes	Yes
Growth Var	No	No	Yes	Yes	No
Constant	-1.6581***	-1.7793***	-2.1273***	-2.1610***	-2.0496***
	(0.2295)	(0.2717)	(0.3344)	(0.3665)	(0.2779)
Obs.	4382	4382	4382	4382	4382
Groups	932	932	932	932	932
Sigma_u	0.3162	0.3475	0.2274	0.1630	0.1444
Rho	0.0909	0.1078	0.0492	0.0259	0.0204
LogLikel.	-1523.8463	-1520.9047	-1506.4388	-1506.0922	-1513.464
yhat	0.108	0.1076	0.1056	0.1059	0.1071

Notes: All the specifications above are based on the random-effects model. In all the specifications I have included control variables for missing data and year fixed effects. The standard errors are reported in the parenthesis. The coefficients and the standard errors reported are the ones that correspond to the marginal effects, with the exception being the one of the constant term.
* Statistically Significant at 10%.
**Statistically Significant at 5%.
***Statistically Significant at 1%

Table 4.1: Estimation Results

Likelihood ratio tests were performed in order to test the hypothesis that the tube station variables (and as a consequence footfall variables more generally) should be used in the studies of entries and exits in metropolitan areas. The hypothesis that the 2^{nd} specification better fits the data than the 1^{st} one has been rejected. Moreover, the 3^{rd} specification better fits the data than either the 1^{st} or the 2^{nd}. The 4^{th} specification better fits the data than the 2^{nd} but this is not the case with the 1^{st} and the 3^{rd} specification. The last specification better fits the data than either of the other specifications. As a result I cannot reject the hypothesis that footfall variables better describe the demand shifts than the benchmark local demographics variables.

First of all, notice that I have included the square of the independents entry (EntryIndep squared), the square of the lag of own independent stores (L1OwnIndep squared) and the square term of the lag of own Other C-Ss (L1OwnOther squared) in the 3^{rd}, 4^{th} and 5^{th} specification. If I exclude the nonlinear terms then the entry of independents and the lag number of own stores ceases to be statistically significant (see 1^{st} and 2^{nd} specification). I have tested, in all specifications, whether these variables should have been excluded from the specifications and the hypothesis has been rejected. Nonlinear variables for the other market structure variables do not change any of the results in the reported specifications and I reject the hypothesis that they should be included. This is a first result in favor of the existence of product differentiation in this market. A competitive model with homogeneous firms is rejected. Mainly because the non-linear terms should have the same significant and the same importance (same coefficient) of the market structure variables across all groups (in the homogeneous case), this is not the case here.

In all the specifications the entry and the incumbents of the independents increases the likelihood of exit, they exhibit a significant and positive coefficient. In contrast, the other market structure variables are statistically insignificant except for the entry of other C-Ss

(EntryOther). The fact that only entry of smaller C-Ss is significant suggests that there is a temporary effect of these C-Ss to the profitability of the independents. To be more specific, an entrant becomes incumbent after its first year of existence and the fact that there is no significant effect on the other C-Ss incumbents suggests that the profitability of the independents is influenced temporarily; it is influenced only the first year of the other C-Ss existence. Furthermore, notice that individually the independents market structure variables are more important (exhibit higher coefficient) than any corresponding market structure variable of the C-Ss groups (compare for example the coefficient of independent entrants with the one of C-Ss and other C-Ss).

The above results are robust to different specifications and are in favor of product differentiation. As with respect to the product differentiation, in a homogeneous market it should be expected that splitting the firms into different subgroups should not rise to different importance (coefficients) on the independents profitability and they should also be statistically significant. As it has just been shown this is not the case. This result can be better explained by the model presented in the theoretical chapter that controls for product differentiation, where the competition within groups (independents) is more important than the competition between the groups[3]. Consequently, the lack of significance and the smaller importance of the market structure (lag incumbents and entrants) coefficients of the C-Ss and the smaller C-Ss (this will be further analyzed later on) is an indication that differentiation safeguards the independents from the C-Ss presence in the markets.

The product differentiation arises from the taste parameters. An econometrician can infer the existence of product differentiation by the behavior of the firms (revealed preferences approach), as it has been explained above, through the intensity of competition between

[3] The second order effect I believe is due to demand spillover effects, as suggested in the theoretical model, which increase the profitability of the incumbent by a decreasing manner (by increasing the demand within a subgroup). Alternatively the 2^{nd} order effect might arise from agglomeration (clustering of coffee shops increases the demand for coffee). In either case I believe that this result is in favor of the initial hypothesis of existence of product differentiation.

and within groups. In this study I have tried to implicitly quantify the importance of this parameter through the weekend variable. The hypothesis is that leisure areas will reflect the demand for product differentiation and by the weekend variable I can identify the leisure areas (rank areas to "more" or "less" leisure oriented) and as a result its coefficient is an indirect measure of the product differentiation parameter. This variable is statistically significant across all specifications and increases the profitability of the independents (negative sign to the likelihood of exit). Since this parameter increases the profitability of independents it protects them from being displaced by the C-Ss (as it has been shown by the theoretical model). Additionally, it is the most important variable since its coefficient is larger than the other market demand variables. However, further investigation is needed, which will be presented at a later stage, since there might be another explanation for the magnitude of this coefficient. To be more specific, higher demand for coffee during the weekends might be the driving force which increases the independents profitability.

In the first specification all the tube station variables are statistically significant at 5%. The only market structure variable that is statistically significant is entry of other C-Ss. To be more specific, as the number of entrants of small (other) C-Ss increases, the likelihood of an independent to exit increases. In other words the profitability of the incumbents decreases. This result is counterintuitive since same group market structure variables do not influence the likelihood of exit of the independents but a market structure of another group does. As I am going to show this result is driven by omitted variables bias. Moreover, the geographic size of the area decreases the likelihood of exit and it is statistically significant at 5% but the fixed cost variables, even though they have the anticipated impact to the independents profitability, fail to be significantly important.

In the second specification the benchmark demand variables fail to explain the independents likelihood of exit. The fixed cost variables fails to be significant but they have the anticipated sign. The market structure variables are not statistically significant, except of entry of other C-Ss, and the area becomes insignificant as well. This suggests that benchmark demand variables fail to explain the profit variation of the coffee shops.

In the third specification, where I have included the benchmark and the tube stations demand variables, the squared own market structure variables (non-linear effects) and the market demand growth variables I get results in line with the theoretical predictions of the theoretical chapter and the corresponding literature of this topic. In this case all the tube station variables remain statistically significant at 5%, with an exception of the weekends variable which is significant at 1%. The local demographics are statistically insignificant and the area is statistically significant at 10% with a negative sign (in larger areas it is more likely for an incumbent to stay in the market). The fixed cost variables are once again statistically insignificant. The entry of independents is significant at the 5%, the number of independent incumbents (lag number of own independent stores) is statistical significant at 1% and they both influence the likelihood of exit (profitability) positively (negatively), with the former having a greater impact. The last result is in line with the results of O. Toivanen and M. Waterson (2005). The squared terms of the own market structure variables (lag number and entrants of independents) are both significant with a negative sign. This suggests that as the number of entrants increases, the marginal effect decreases. Moreover, entry by other C-Ss influences exit positively at a 5% significance level but the sign is smaller than the respective one of independents.

In the fourth specification I have included some further control variables, the market demand exterior variables. It can be seen that the variables of my interest remain significant (tube station variables, market structure variables and their square terms) and the sign of the coefficients unchanged, suggesting that they are robust to different specifications. The area and the entry of other C-Ss variables are significant (at 10%), a decrease for the latter variable compared to the previous specifications. The fixed cost variables are insignificant. Furthermore, some of the demand exterior variables are significant and I fail to reject the hypothesis that they should not be included in the estimation. Finally, the growth variables are not statistically significant and the hypothesis that they should be incorporated to the model has been rejected.

In the final specification I have dropped the local demand (benchmark) and the growth variables[4]. The area variable is strongly statistically significant, at 1%, and influences negatively the likelihood of exit. The tube stations variables, which capture demand characteristics, are statistically significant at 5%. The demand shifters, which determine the demand share of the independents, influence negatively the likelihood of exit (increase the independents' profitability). The size of the tube station influences positively the likelihood of exit but this is due to the decomposition of the tube stations variables (when I add the tube stations coefficients it becomes negative and if only Totaltube is used at the probit it exhibits a negative sign as well). The market structure variables for independents, incumbents and entrants, are statistically significant at 1% and 5% respectively and influence positively the likelihood of exit. The coefficient of the independent entrants is larger than incumbents suggesting, as with previous specifications, that the learning effect is significant (I have tested the hypothesis that the two coefficients are equal and rejected). The square terms of the independent entrants and incumbents are statistically significant with negative sign suggesting decreasing returns to their numbers. The only other market structure variable that is statistically significant, at 5%, is the entry of other C-Ss with a positive sign. This suggests that smaller C-Ss have a temporary effect on the profitability of the independents, since the incumbents have no significant effect. A noticeable result is that most of the times (with the exception of the fixed cost variables) the sign of the coefficients of the statistically significant variables is robust across all the specifications.

I have also introduced control variables for the tube stations that are located close to Thames, close to a park and tube stations that operate as train stations as a robustness check.

[4]This is because previous tests have suggested that they should not be included in the empirical estimation.

However, these control variables have been found statistically insignificant and the hypothesis that should be included in the specifications has been rejected. Therefore, whether a coffee shop is located at a tube station that supports a train network, or located close in a park or even located on the banks of the river Thames that will not matter to its profitability.

Finally, the claiming benefit variable is a proxy for an areas deprivation. The total population of an area is used in the literature as a variable to capture the size of the demand. I have also included the number of pensioners in an area in order to control for different spending patterns within age cohorts. However, none of these variables are statistically significant in either of the specifications used.

Let me now interpret the results of the last specification. The tube stations weekend, in and out at rush hour variables (Inrush and Outrush) decrease the likelihood of exit. Most importantly, the weekend out variable has the greater impact from all the other tube station variables. The marginal effect is -0.0732 and is statistically significant at 5% points. The weekend out variable is meant to capture the demand for differentiated products since it is assumed that people at leisure areas are more likely to prefer a differentiated coffee shop. As for the interpretation of the coefficient, a 10% increase of the number of visitors per weekend, which corresponds to 5000 people, will increase the profitability of the coffee shops by approximately 70% on average[5]. In the next section I will explicitly estimate the importance of a coffee shop being located at a leisure area and the consumption effect of the weekend (it is possible that people are more likely to consume coffee at the weekend).

The inrush variable identifies the income effect of local population, since higher traffic in rush hours means that a larger number of people are working in that area and use the tube station to commute to their working places. The marginal effect of this variable is -0.0406 and it is statistically significant at a 5% point. Hence, the coefficient suggests that a 10%

[5]The effect was calculated in the following way. The marginal effect corresponds to a 1% change of the likelihood of an independent to exit. Therefore, I have calculated the 1 percentage point of the average. In the above case that will correspond to 500 people.

increase of employment, an increase by 623, will increase the profitability of an independent by 40%.

The outrush variable, which measures the number of people that exit a tube station during the morning rush hours, identifies whether a tube station is located in a high business density area. I am anticipating that this variable will capture the business density effect on the independents profitability. To be more specific, I am expecting that it is more likely for people who travel during the morning rush hours to commute for work and as a result their destination (exits from the tube) should be their work places. I found that an increase on the number of exits by a 130 per day (1% increase) increases the profitability of the incumbent (reduces the likelihood of exit) by 6% (the exact coefficient is -0.0631) and it is statistically significant at 5% points. Notice that the outrush variable influences the profitability by a larger magnitude than the inrush variable. Hence, it seems that an independent located at an area with a high number of visitors (exits from tube stations) will be more profitable than an independent in a residential area, the difference of the coefficients has also been found statistically significant. However, it is also likely that during the rush hours people are consuming more coffee. Notice that I am going to further investigate, in the next section, this prospect.

The last variable, which measures the actual number of people visiting the tube station, is positively related to the likelihood of exit. The coefficient is 0.0252 and is statistically significant at 5%. Notice that the coefficient has a positive sign which means that as the total traffic of the station increases the likelihood to exit increases (increase of visits - size of the market - decreases the independents profitability). However, the fact that I am using three variables that are part of the Totaltube variable means that the variation from the total tube variable is deducted. As a result when I add all the coefficients of the tube stations variables, since the existence of the other variables decrease the variation, the effect becomes negative and is equal to -0.1518. I have also used a specification which includes only the total exits and entries from the tube station variable (Totaltube), excluding the other tube station variables, and the sign was negative and the variable statistically significant, verifying the intuition presented above. Therefore, increased traffic, which increases the overall number of people that may buy a cup of coffee, of a tube station increases the profitability of an incumbent and decreases its probability to exit. Hence, an 1800 overall increase of visits per week (1% increase of this variable) will increase the independent's profitability by 15%. Notice that I have mentioned at a previous stage that there might be two effects, for this variable, that work in opposite direction. On the one hand, as the number of buyers increases the aggregate demand should increase, and on the other hand as the number of buyers increases the likelihood of a commuter to buy a coffee (a decrease on the propensity to consume) decreases. However, I have found no evidence for the latter effect since second order effects (which should capture the decrease) of the Totaltube variable are statistically insignificant[6].

As for the own market structure variables of independents, both variables are statistical significant at 1% for the incumbents and 5% for the entrants. The entrants', which measures the change to competition, marginal effect is larger than the incumbents (which measures the intensity of competition of the existing firms). To be more specific, the entrants' marginal effect is 0.0255 while the incumbents' is 0.0129, almost half as much. This suggests the presence of demand learning effects and verifies the results of Toivanen and Waterson (2005). A new independent entrant will decrease the profitability of the independent incumbent by almost 2% while if a market has one more independent incumbent store (cross-sectional difference on the number of independent incumbents) this will decrease the profitability by about 1%.

The only other market structure variable that is statistically significant is the entry of other C-Ss, at 5%. As mentioned above, the insignificance of the other C-Ss incumbents to the profitability of the independents suggests that the effect is temporary. The marginal effect is 0.0161 and is smaller than the independent entrants' effect (0.0255). This suggests that

[6]The specification is not presented in this chapter.

the initial assumption for the existence of differentiation is correct. In addition, the failure of the other market structure variables can be attributed to the fact that there is differentiation and that competition within the three groups is more important than competition between the groups[7].

From the control variables that were used the only one that was statistically significant is the other C-Ss incumbents exterior variable. The marginal effect is 0.0025 and is statistically significant at 10% points (with s.e. 0.0015)[8]. I believe that there might two forces that influence the likelihood of exit through the exterior market structure variables. The first possible explanation is that an increase in a neighbour's other C-Ss decreases the overall demand in the current area. In other words, there is a demand effect from clustering of coffee shops (agglomeration) in neighboring areas. Secondly, a high number of incumbents in the neighborhood areas might generate higher entry of coffee shops in the local area, an indirect effect.

Moreover, the fixed costs variable is statistically significant at 10%, the coefficient has a positive sign and is equal to 0.0002. Notice that the fixed cost variable has been divided by 1000 and its average value is 370 approximately. Hence, if the values of the residential properties increase by 3700 (1% of 370,000) then the fixed costs will decrease the incumbents profitability, through an increase of fixed costs, by 2%. Notice that the fixed cost variable that captures the time variation within a coffee shop observation is statistically insignificant and takes a negative sign. The direction of the sign suggests that fixed costs increases across time (within a market), in other words it decreases the likelihood of exit of an independent coffee shop. This is anticipated since increased fixed costs are less likely to influence the

[7] A possible critique for the lack of C-Ss effects on the independents' profitability might be the fact that the C-Ss have mainly entered the market in the years prior 2000. Therefore, the surviving independents as well the entrants have already gone through a selection process. However, the within and between competition result should be robust to this argument since all models with homogeneous firms predict that even in the long run, in this case in a satiated market, there should be no difference from splitting the firms into different subcategories.

[8] This is not reported in the table due to space limitations.

incumbents and more likely to influence the entrants, which means that an incumbent has a cost advantage and it is less likely to exit compared to the entrants (assuming the same demand across incumbents and entrants).

Finally, the area variable is significant at 1% and has a negative sign, which is equal to -0.0001. This means that an increase on the geographic size of the market decreases the likelihood of exit of an independent. For the likelihood of exit to decrease it is necessary that the profits of the incumbent increases. A large area might correspond to higher location dispersity of the firms or to a larger geographic market (larger demand). However, I believe that the second scenario should be rejected since local demographic variables, such as population and benefit claimants, have been found insignificant (they do not influence the profitability of the independent coffee shops). Consequently, I assert that the area is an indirect measurement of geographic competition intensity. Notice that the average value of the area is 263,929.50, which means that if the area increases by 200,000[9] (which corresponds to a 447 m^2 increase) the profitability of the independents will increase by 1%. This a relatively small increase on profits, given that the assumed increase on the geographic area was almost equal to the average geographic area.

To conclude, the weekends variable which is an estimation of the product differentiation parameter has been found significant, robust and the most important factor that influences independents' incumbents profitability. Furthermore, the fact that within groups competition is more important, both in size and with respect to statistical significance, also suggests the importance of product differentiation for the independents survival in the market. Most importantly, I have shown that demand market specific effects influence the profitability of an independent coffee shop. Market effects include areas with business density, employment of residential population and leisure areas. In the next section I re-present some of the specifications analyzed in order to separate the increased propensity to consume coffee in the

[9] Notice that in the estimation the fixed costs variables have been divided by 1000

morning hours and the weekends from the other variables of interest.

4.2 Identifying the Increased Propensity to Consume

In this section I am going to re-investigate the 1^{st}, the 4^{th} (the 4^{th} will be applied with a small modification since the benchmark demand variables are dropped) and the 5^{th} specification but I am going to decompose the weekend, the Inrush and the Outrush variables. I am going to split each of these three variables into two parts, a part with the lowest percentile of the variables and a part with the highest percentile. The idea is that the lower percentile of the variables will capture the increased propensity to consume in the weekends and in the morning rush hours. The higher part will incorporate both the increased propensity and the effects of residential, business and leisure areas that might add to the profitability. In other words, by decomposing the variables the tube stations are ranked to low and high business density areas for example. The percentile used is the 50%. By using the percentiles I can identify explicitly the different effects on the independents profitability and most importantly quantify the importance of product differentiation. This is done by taking the difference of the coefficients from the decomposed variable. To be more specific, the first variable generates a coefficient $\beta_1 = \beta_c$ where c is for the increased propensity to consume. While the second variable will generate a coefficient $\beta_2 = \beta_c + \beta_x$ where x is the effect of interest (i.e. business density effect). Therefore by taking the difference of β_1 and β_2 I can identify β_x. An example of how these variables are constructed is given in the figure (4.1).

In figure (4.1) I have decomposed the Outrush variable in two parts. A variable for the lower 50 percentile which incorporates the number of commuters that exit during the morning rush hours for tube stations with low exit traffic and zero otherwise. For example, a tube station with low exit traffic during the morning rush hours is Covent Garden and a tube station with high traffic is Liverpool Street. Therefore, the lower 50 percentile will take 0.7

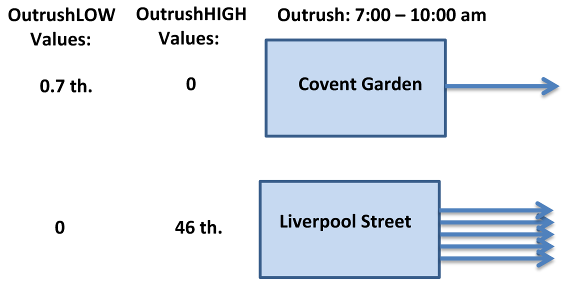

Figure 4.1: Identifying the Increased Propensity to Consume

th. for Covent Garden and zero for Liverpool Street. As for the second variable, it is exactly the reverse. It will take 46 thousand for Liverpool Street and zero for Covent Garden[10]. The identification strategy used has been adopted from the literature that examines price asymmetries, see for example Borenstein, Cameron and Gilbert (1997). Finally, in the next table I am presenting the result of the revised empirical estimation.

Independent Variables	Probit (6) Probability for an Independent to exit	Probit (7) Probability for an Independent to exit	Probit (8) Probability for an Independent to exit
Fixcost	0.00009	0.00019*	0.00019*
	(0.00013)	(0.00011)	(0.00011)
fixcosttime	-0.00017	-0.00013	-0.00013
	(0.00011)	(0.00011)	(0.00011)
Area	-0.00008**	-0.00011***	-0.00011***
	(0.00004)	(0.00004)	(0.00004)
WeekendNleis	-0.0686**	-0.0708**	-0.0689**
	(0.0324)	(0.0318)	(0.0316)
WeekendLeis	-0.0930***	-0.087***	-0.0887***
	(0.0340)	(0.0326)	(0.0327)
InrushNResid	-0.0046	0.0022	-0.0004
	(0.0417)	(0.0394)	(0.0393)
InrushResid	-0.0513**	-0.0494**	-0.0496**
	(0.0207)	(0.0201)	(0.0200)
OutrsushNBus	-0.1866**	-0.1528*	-0.1665**
	(0.0883)	(0.081)	(0.0835)
OutrsushBus	-0.0809**	-0.0771**	-0.0779**
	(0.0339)	(0.0327)	(0.0327)

[10]Notice that this approach does not create multi-collinearity since there is no coefficient that can be multiplied with one of the variables to generate the other one. This is given that I am not incorporating the initial variable (otherwise I would have created multi-collinearity).

Totaltube	0.0320***	0.0301***	0.0307***
	(0.0118)	(0.0113)	(0.0113)
L1OwnIdep	0.0009	0.0127***	0.0124***
	(0.0011)	(0.0033)	(0.0032)
EntryIndep	0.0048	0.0247**	0.0254**
	(0.0035)	(0.0073)	(0.0072)
L1OwnCS	-0.0007	0.0012	0.0016
	(0.0021)	(0.0025)	(0.0025)
EntryCS	-0.00002	0.0027	0.0025
	(0.0063)	(0.0063)	(0.0062)
L1OwnOther	-0.0022	-0.0002	-0.0004
	(0.0032)	(0.0034)	(0.0034)
EntyOther	0.0177**	0.0162**	0.0162**
	(0.0074)	(0.0072)	(0.0072)
Mark. Str. Var. Squared	No	Yes	Yes
Mark. Str. Ext. Comp.	Yes	Yes	Yes
Dem. Ext. Var.	No	Yes	Yes
Growth Var	No	Yes	No
Year Fixed Effects	Yes	Yes	Yes
Constant	-1.6658***	-1.98118***	-2.0231***
	(0.2322)	(0.3556)	(0.2734)
Obs.	4382	4382	4382
Groups	932	932	932
Sigma_u	0.3324	0.1931	0.1848
Rho	0.0995	0.0359	0.0330
LogLikel.	-1521.0909	-1511.4107	-1511.6705
yhat	0.1059	0.1053	0.1053

Notes: All the specifications above are based on the random-effects model. In all the specifications I have included control variables for missing data and year fixed effects. The standard errors are reported in the parenthesis. The coefficients and the standard errors reported are the ones that correspond to the marginal effects, with the exception being the one of the constant term.
*Statistically Significant at 10%.
**Statistically Significant at 5%.
***Statistically Significant at 1%

Table 4.2: Estimation Results, Identifying Increased Propensity to Consume

Likelihood ratio tests indicate that the last specification (8) is the one that better fits the data. Furthermore, independently of the specification used the tube station variables are robust since they are both statistically significant at either 1% or 5% and the sign of their coefficients remains unchanged. The market structure variables remain unchanged as with the previous specifications, see table (4.1). Both the independent incumbents and their entrants are significant with a positive sign, when I include their squared terms. Additionally, the entrant's coefficient is larger than the incumbent's coefficient, verifying the presence of learning effects in the markets. The other market structure variable that matters is the entry of other C-Ss (smaller C-Ss) which influences the independents' exit positively. However, the independents' entrants coefficient is larger than the corresponding one of the other C-Ss. The latter suggests, combined with the fact that the rest market structure variables fail to be significant, the existence of product differentiation (within groups competition is more important than between groups). The fixed cost variable is significant in the last two specifications and has the expected sign but the variable that captures fixed cost time changes is insignificant. This suggests that the independents' exit behavior is mainly driven by demand shifts and the intensity of competition. Finally, the area is significant at either 5% or 1% and the sign is negative.

The results that I am going to present are the ones from the final specification (8). As expected the weekend variable in areas with a high number of visitors (named WeekendLeis) exhibits a larger coefficient (in absolute values) than the weekend variable with low number of visitors (0.0887 0 vs. 0.0689). The latter coefficient is meant to capture the increased propensity to consume in the weekends while the former incorporates both the propensity to consume and the leisure effect (the product differentiation taste parameter). As a result an estimate value of the product differentiation effect is -0.0198, which is computed by taking the difference between the two coefficients. This means that an increase of traffic (visitors) by 500 in leisure areas at the weekends will increase the profitability of the independents by 2% more than other areas (after controlling for the increased propensity to consume coffee at the weekends).

Most surprisingly, an independent coffee shop located at an area with high business density is less profitable than in areas with low business density (OutrsushNBus vs. OutrsushBus). To be more specific, areas with low number of visitors during the morning rush hours takes a sign of -0.1665 (OutrsushNBus), while areas of high number of visitors during the morning hours take a sign of -0.0779. This indicates that the independent coffee shops which are located in areas with a high cluster of business are less profitable by 0.0886%. This also suggests that the C-Ss are actually enjoying a competitive advantage and the demand of these areas favours the C-Ss. Furthermore, the coefficient of the OutrsushNBus variable should capture the increased propensity to consume in the morning hours for people that visit an area (exit a tube station).

Finally, the number of people that leave a tube station in non-residential areas (InrushNResid) fail to be significant and as a result a comparison with the corresponding variable in residential areas (InrushResid) might be misleading. As a result, I cannot identify the increased propensity to consume parameter (in the morning hours for people that leave their area) and the effect of increased employment of the residents of an area.

In the appendix I present another specification which tests whether the demand shares change across years. It is shown that demand shocks, shifts in taste, are present. Most importantly, all the above results are robust to the new specification as well.

To conclude, in this section I have presented an approach to quantify the importance of product differentiation on the profitability of the independent coffee shops. I have shown that the independents located in areas with high business density are less profitable than other locations. I have found that low deprivation areas increases independent coffee shops profitability and that the learning effects remain robust. Therefore, market specific demand effects are an important determinant of independent coffee shops.

4.3 Counterfactual Analysis

The purpose of this section is to investigate the impact of two city planning scenarios on the presence of independents' in Central London. Planning regulation has been proposed, by lobbyists against the growth of C-Ss, in order to protect small independent stores. The lobbyists have been using the term "Clone Town", which refers to the phenomenon that high-street local shops are being replaced or displaced by C-Ss and as a result the town centres are becoming more homogeneous (a town losing its uniqueness). An independent think-tank, New Economics Foundation (NEF), has found that in 2010 41% of the English towns are clones[11]. Arguments against regulation include cost efficiencies and productivity, these are characteristics that favour C-Ss. While independents are thought to pay higher wages, in some cases they employ more people, and the revenues generated are re-invested in the local community thus promoting growth within those areas. A paper that examines some of these factors is F. Schivardi and E. Viviano (2011) for Italy and papers that focus on the groceries sector in UK are R. Griffith and H. Harmgart (2008) and R. Sadun (2008).

In 1996 a regulation was imposed on the groceries sector in UK[12] which introduced entry constraints on large stores (greater than 2500 m^2) located at the outskirts of a town in order to restrain city centre "draining" effects. R. Sadun (2008) found that there was no effect on local employment from the introduction of this regulation.

The above regulation cannot be applied in the coffee shops market as an intervention mechanism since the coffee shops operate units smaller than 2500 m^2. Furthermore, in order to open a coffee shop in UK, the owner will need to hold an A3 permit on the premises of the establishment. The A3 permit is required by both restaurants and coffee shops. This permit requires that the coffee shops satisfy some food safety management procedures, HACCP[13].

[11] $http://www.neweconomics.org/publications/reimagining-the-high-street$

[12] Planning Policy Guideline 6 (PPG6) in 1996.

[13] See the following: http://www.food.gov.uk/multimedia/pdfs/publication/hygieneguidebooklet.pdf.

Besides that basic requirement, coffee shop licensing is mainly decentralized and local authorities have the freedom to set some further standards or impose further licence requirements. For example, the London Borough of Camden requires a licence for a firm to place tables and chairs on the pavement[14]. However, it seems that the licensing requirements do not impose a barrier for new coffee shops to enter.

In the spirit of the 1996 regulation I impose a cap on the maximum number of coffee shops that can enter Central London, in the first counterfactual analysis.

4.3.1 Maximum Cap on Entry

I assume the introduction of a centralized policy which places a maximum number of entrants per subgroups at a given area. The maximum number is set to 2 per subgroup, thus a maximum entry of six coffee shops per year per tube station. I have introduced this shock (policy) in 2007 in order to compare the counterfactual results with the actual behavior of the independent coffee shops (actual data). Notice that the maximum entry of independents is 4 during this period (2007-2009), while for the C-Ss it is 2 and for the other C-Ss is 3. As a result this counterfactual analysis will mainly influence the independents entry behavior.

In order to simulate the response of the independent incumbents, after this shock, I have used the coefficients estimated from the panel probit and their error terms[15]. In a sense I have assumed that the unobservable terms, which are included in the error term, remain unaffected by the introduction of this shock. I have simulated in each period the probability of exit, summing over the coefficients which were multiplied by the unchanged variables and multiplied by the new Entry variables and then added the true error term. To be more specific, the equation that generates the prediction for a given year is (ignoring the time and

[14]See the following: http://camden.gov.uk/ccm/content/business/business-regulations/licensing-and-permits/licences
/entertainment-related-licences/tables-and-chairs-licence.en

[15]From the previous section.

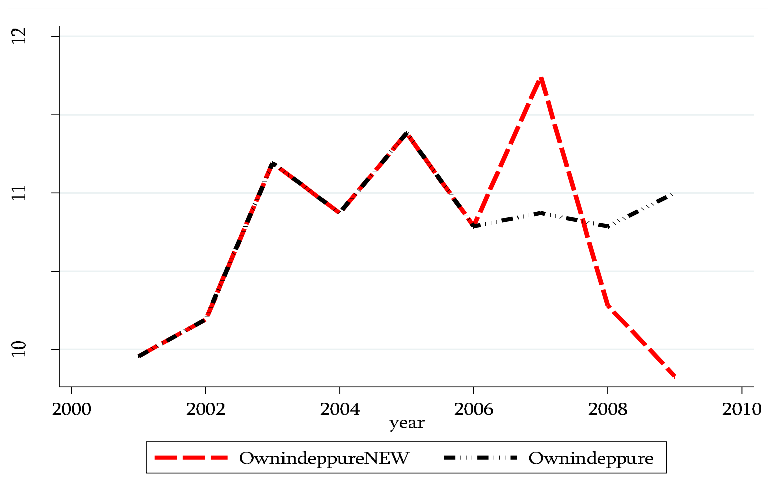

Figure 4.2: Average Number of Independents per tube station

space subscripts for easiness):

$$\hat{y} = \hat{b}_0 + \hat{b}_1 X_{true} + \hat{b}_2 X_{New} + \hat{\varepsilon}$$

Where $\hat{y}$ are the predicted values (new values), the subscript "true" is for the true variables, "New" for the variables that are affected by the counterfactual analysis and $\hat{\varepsilon}$ is for the error term which was generated by the panel probit with the true data. Notice that for each year after 2007 I have recalculated the number of incumbents per subgroups (since the shock had an impact on the number of incumbents). I have then generated the average exit rate and multiplied that with the number of incumbents that had not exited in the previous period, according to the counterfactual result, but had exited according to the true data. This approach allows me to calculate the number of exits for a part of the sample where I lack estimated errors[16]. The next figure (4.2) plots the results of the exercise with respect to the number of independent coffee shops.

[16] I implicitly assume that the error term for this category of coffee shops is not different from all the others. Furthermore, by multiplying with the estimated exit rate I have assumed that these coffee shops (new entrants that become incumbents) will behave in the same manner with all the other incumbents in the market.

On the horizontal axis I have plotted the time period of the data and on the vertical the average number of independents per tube station. The red dashed line corresponds to the counterfactual number of independents per tube station (OwnindeppureNEW; this is the number of independents on average) and the black discontinuous line refers to the actual number of independents (Ownindeppure). Interestingly, the number of independents increases immediately after the shock (introduction of regulation) but in the following year it decreases to a point that reaches a lower level than the pre-shock period. Thus, the intervention fails to safeguard or even increase the number of the independents in the market since after 3 years the number of independents decreases by approximately 14% ((11-9.5)/11). Notice that this holds even though the number of exits has decreased[17]. It seems that the decrease on the number of exits is not enough to compensate for the decrease on the number of entries. The last result, supports the displacing and replacing ideas presented in the theoretical chapter of this topic. This is mainly because the least profitable and most inefficient incumbents are forced to exit from the market at an earlier stage. Consequently, the counterfactual results suggest that a policy of a maximum cap on the number of entrants will definitely generate a loss of independents.

Furthermore, notice that the entry of C-Ss and other C-Ss is largely unaffected by this policy and that the exit rates of these groups are lower than the exit rates of the independents. However, the entry decision of the C-Ss (small and large) is not endogenized. As a result I am expecting that the effects on independents from the presented policy will be smaller than the actual (real) effects from implementing this policy. To be more specific, by restricting the entry of independents I am expecting an increase on the entry of the C-S (both small and large) while in this scenario I assume that their entry remains unchanged. This will increase the likelihood of exit (more exits) and as a result decrease the number of independents even further. For example, assume a market with 4 independent entrants, 1 C-Ss and 0 other

[17]The entry variables increases exit thus by placing a cap the exit rates decreases.

C-Ss. By placing a cap I am imposing 2 independent entrants, 1 C-S and 0 (zero) other C-Ss. However, it should be expected that the C-Ss will respond to this policy by increasing their entry, for example 2 C-Ss instead of 1. As a result, I underestimate the effects on the number of independents in the market of Central London. However, the analysis is useful since it provides a maximum bound (independents are going to be necessarily smaller in number) on the number of independent coffee shops.

To conclude, this policy can be adopted by a planning authority in order to promote growth in other retail sectors, within a metropolitan area, that have been underdeveloped (for example efforts to establish a shopping centre). However, in the case of coffee shops this policy will largely benefit the C-Ss and the decrease of the coffee shops will be disproportionately against the independents, thus a loss on product differentiation. The driving force of this result is that the independents have a higher entry and exit rate. This means that by restricting entry the independents' exit rate remains relatively high and the net result is a decrease on the number of independents. In other words, a selection process is constrained, a process which guarantees that the less profitable independent incumbents will be displaced or replaced by a more profitable independent and as a result the entry will cancel out exit. The next section presents a counterfactual exercise where the cap is more targeted.

4.3.2 Targeted Maximum Cap on Entry

In the second scenario I impose a zero entry of C-Ss and other C-Ss if their joint market share is larger than 40%. This exercise has been motivated by antitrust authority's policies which are implemented when there is evidence of presence and abuse of market power. The main difference is that I do not impose immediate liquidation of C-Ss assets (unlike what an anti-trust authority would have done) in areas with market power but rather an intervention in order to safeguard the presence of the independents and promote their entry in these markets.

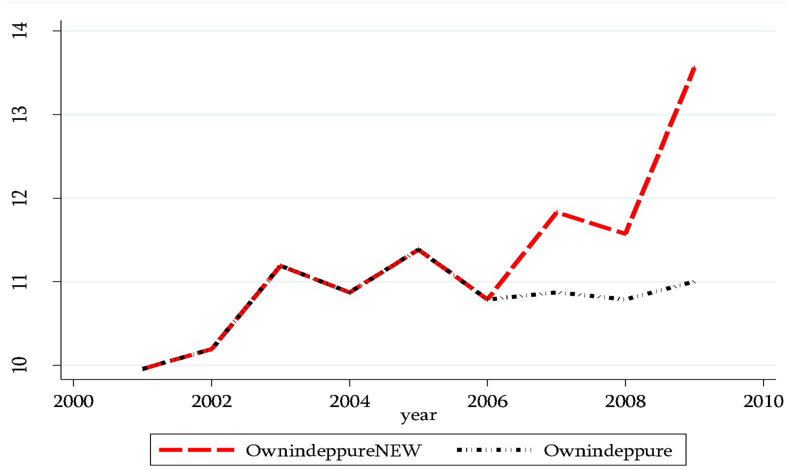

Figure 4.3: Average Number of Independents per tube station Scenario 2

This policy is more targeted compared to the previous case. In this scenario I focus on how to decrease C-Ss market power (target the C-Ss) while in the previous scenario a local community planner is restricting the total number of coffee shops. The counterfactual approach is exactly the same as with the previous one (generating predicted values within the sample and comparing them with the actual behavior). Thus, the approach will not be presented in this section. The results of this exercise are presented in the figure (4.3).

The vertical axis corresponds to the number of coffee shops and the horizontal to the time period. The black discontinued line corresponds to the actual number of independents (Ownindeppure) while the red line corresponds to the number of independents under the counterfactual scenario (OwnindeppureNEW). As it can be seen the new policy is more successful in establishing a large presence of independents in the markets, which results to an increase on differentiated products. The number of independents increases by approximately 9% within a year (an increase of 0.9575 from a total of 10.872 of actual coffee shops). While within 3 years there is an increase of 23%, in 2009 a net increase of 2.561462 is observed while the actual coffee shops are 11 on average. Therefore, compared to the previous scenario the targeted policy manages to successfully decrease the market shares of the C-Ss across markets and increase the number of independents.

Notice that the entry decision of the independents is not endogenized. As a result, I am expecting a higher number of entries of independents. The intuition is that less anticipated entry of C-Ss (since the cap is binding) will result to more independents' entries. However, since the marginal effect of entry on the exit rate is less than 1, I anticipate that the overall number of independents will be even higher (if endogenized). Consequently, the above predictions will be a lower bound on the number of independents in the markets.

4.4 Conclusion

In this chapter I have presented the results of the empirical and counterfactual analysis. I found presence of product differentiation (within the group of independents competition is more important than between groups), time effects of consumption (marginal propensity to consume) and market effects. I have also shown that city planning policies can be distortionary. To be more specific, placing a cap on the maximum number of coffee shops that enter a market will disproportionably decrease the number of independent coffee shops and it will increase the market concentration of the market. On the other hand, restricting entry of C-Ss in markets that are dominating it will increase the number of independent coffee shops by approximately 25% within 3 years.

Chapter 5

Conclusion and Appendix

5.1 Conclusion

A different aspect of the Chain-Stores' effects on the independents has been presented. An aspect that rejects the conventional belief that market concentration increases by the presence of Chain-Stores and their ability to abuse their power to displace the independents. It is actually shown that product differentiation is a tool to preserve the presence of independents (small firms) in the market. More particularly, it is shown that in the coffee shops' market of Central London, there is no effect on the independents' profitability, resulting from the C-Ss' presence or expansion. The independents' exit is found to depend mainly on the number of independent incumbents and entrants (within group competition is more important than between groups). Furthermore, the significance of product differentiation for the buyers is estimated, their taste parameters (marginal propensity to consume conditional on the time of the day and area) and market specific effects are identified .

In the theoretical model both entry and exit are incorporated. An incumbent can be replaced and displaced by the entrant or can choose to exit. The identity of the entrant will depend on the demand characteristics, where markets with higher demand for differentiation generate more profitable independents. The theoretical model predicts that product differentiation and market specific characteristics will safeguard the independent incumbents from the C-Ss entry behavior. It also describes the evolution of market structure when C-Ss, independents and product differentiation are present in the markets. I have characterized the factors that influence the independents' (a non-strategic fringe) exit decisions. Consequently and by identifying this fringe, I have tested the importance of product differentiation, market and time specific effects for the independent coffee shops' presence in Central London with a simple and tractable empirical approach.

The unique data set allows investigation of the factors that determine the presence of independents in a metropolitan area. Tube stations' data, a previously unexplored approach, were utilized to construct footfall variables that measure the size of demand and estimate the importance of demand characteristics. This topic is the first research project that investigates such a metropolitan area using footfall data and examines the impact of product differentiation and market effects for independents in an industry where C-Ss are present. This is a very useful data source to investigate the means to decrease market concentration and improve policy planning in metropolitan areas. The significance of investigating such areas lies in the fact that they influence a large part of a country's population, in contrast to the majority of the literature that investigates small isolated towns.

The empirical investigation was divided into two parts. In the first part it is shown that local demographics fail to capture the demand parameters influencing the independents' profits. It is also shown that the footfall variables are the most appropriate source to be used in the studies of entry and exit in metropolitan areas. Furthermore, it is found that within groups competition is more important than between groups. The latter result suggests the presence of product differentiation.

In the second part of the empirical estimation I have taken an approach used to identify asymmetric behavior to identify the increased propensity to consume and the demand parameters of interest; such as the taste for differentiation and the income effect. This was achieved by decomposing the market demand variables into two parts; a higher and lower percentile. Hence, I have identified the increased propensity to consume, which was given by the part of the variable with the lower percentile, and the demand parameters. It is shown that there is a higher propensity to consume coffee on the weekends and that the profitability of independents increases even more if they are located in leisure areas (the higher percentile variable of the number of people that visit a tube station on the weekends). The latter, I anticipate that quantifies the product differentiation effect. The decomposition of the variable that measures the number of visitors in an area during the morning rush hours identifies the propensity to consume coffee in the morning and the effect of being located in a business center. Interestingly, it is found that an independent coffee shop located in a business center will be less profitable[1]. Finally, it is found that less deprived areas are more profitable for the independent coffee shops.

To conclude, in this topic it was established that the "clone city" effect does not apply to the coffee shops' market of Central London. Instead, it is found that there is no effect on the independents' profitability due to the presence or expansion of Chain- Stores in the said market. The key finding of this topic is that product differentiation is a tool to preserve independent presence in the market since within groups competition is found to be more important than between groups competition. Moreover, the key contribution, to the existing empirical literature, is the introduction of an identification strategy used to quantify the demand market effects and the increased propensity to consume during weekdays' morning rush hours and weekends. Further research is required to introduce a dynamic approach that might reveal further interesting information on the strategic behavior of the C-Ss entry and

[1]Let me remind the reader that the latter result can be explained by the fact that Chain-Stores are specialized in serving fast coffee; something that matches better the preferences of people in such areas.

Figure 5.1: Map of London and Central London.

exit and its importance on the industry's market structure and evolution[2]. Another extension is to endogenize the entry of independents in order to investigate the evolution of the market[3].

5.A Appendix

The map (5.1) presents the geographic area of London. The area within the black line is the market of Central London.

The next map (5.2) presents the market of Central London and the location of coffee shops. The red color corresponds to the independents, the blue to other C-Ss and the green to the C-Ss.

[2]I believe that the simultaneity of C-Ss entry and exit decisions can be tackled with a nested algorithm that takes in to consideration the entry decisions of the independents in the profit function of the C-Ss.

[3]I believe that combining Ericson and Pakes (1995) and K. Seim (2006) papers might be an approach to investigate the evolution of the market.

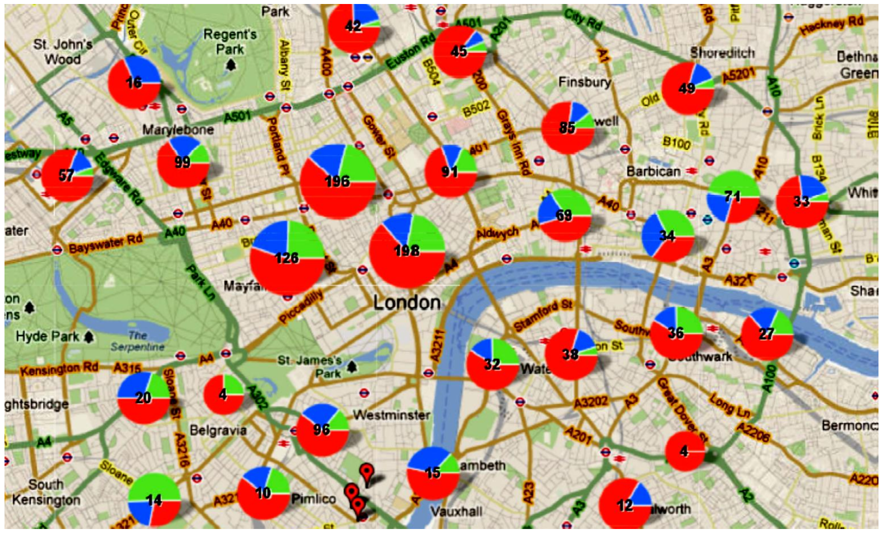

Figure 5.2: Coffee Shops Density in Central London.

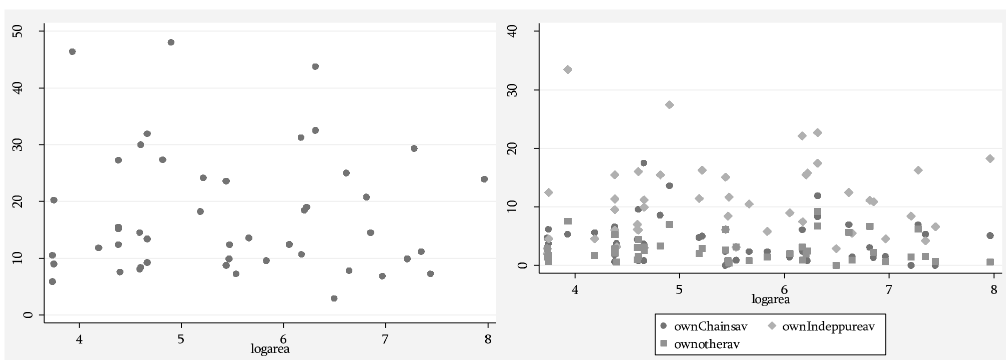

Figure 5.3: Total Number of Firms to Log Area.

5.A.1 Firms to Area Figure

The next graph (5.3) plots the number of firms and its decomposition to the three subgroups, at the vertical axis, and the logarithm of the geographic size of the market at the horizontal axis, where the area is measured in m^2.

In these group of graphs (5.3) the evidence is inconclusive. The number of coffee shops seems to be independent to the geographic size of the market, see left hand side graph. This might suggest that that the profitability of the coffee shops might not be influenced by the geographic size of the market. A similar lack of pattern seems to arise in the right hand side graph, when I decompose the number of firms to the three subgroups. However, since the above statistics are descriptive in nature, it is not safe to reach any conclusion.

5.A.2 Data sources and Issues

Identification of Independents' subcategories

The identification was possible by going through the four Yellow pages categories (these four categories can be actually found in the Yellow pages) and also by matching the name of a coffee shop with a particular subcategory. I have also used the actual name of the coffee shop to categorize it since in some cases the name revealed its specialization (for example "Tiffin's Sandwich Bar" can be categorized as a Sandwich Bar[4]).

5.A.3 Summary Statistics

Summary Statistics for the variables used in the empirical investigation are presented in the table below.

Variable	Observations	Mean	Std. Dev.	Min	Max
TubeStatMinDist	47	0.00699	0.00251	0.00413	0.01746
Area	47	263929.5	159709.6	92587.88	767650.2
Population	47	1937.754	362.385	1109	3284
Claimben	47	8.47045	5.82473	0	26
Pensioners	47	235.6099	83.16672	81	421
Totalcoffeeshops	47	17.2766	11.3908	0	51
Indep. Incumb.	47	10.634	7.0547	0	38
C-Ss Incumb.	47	3.9173	3.9452	0	23

[4]Notice that this particular firm had chosen to be listed in the Yellow pages as a coffee shop and not as a sandwich bar. In some cases a firm which offered both services (coffee shop and a sandwich bar) could have chosen to be listed under one of the two, in order to avoid paying fees for two listings. In other cases a similar firm could have decided to be listed in both categories. Finally, in some other cases a firm could have chosen to be listed as a coffee shop for a number of years, then as a patisserie for another time period and finally as a coffee shop.

Other C-Ss Incumb	47	2.7258	2.4066	0	11
Net entries	47	0.48227	2.32828	-9	12
Total entries	47	2.25332	2.21714	0	13
Indep. entries	47	1.32861	1.47276	0	10
C-Ss entries	47	0.52009	0.99950	0	9
Other C-Ss entries	47	0.40462	0.67111	0	3
Total exits	47	1.77305	1.8306	0	9
Indep. exits	47	1.17021	1.3258	0	6
C-Ss exits	47	0.23404	0.5589	0	4
Other C-Ss exits	47	0.37116	0.6931	0	5
Average flat value	66	372.1th	109.2th	122.3th	800th

Table 5.1: Summary Statistics

Where TubeStatMinDist is for Tube Stations Minimum Distance. An important observation is that all the variables exhibit significant variation suggesting that Central London is highly diversified even though its geographic coverage is small compared to London as a whole.

5.A.4 Timing

5.A.5 Theoretical Model

Within the sections that follow I will formally develop the arguments presented in the theoretical chapter of this topic.

Displacement and Replacement

Lemma 5.A.1 *Given assumption 2:*

If $\bar{B}^{In} > \bar{B}^{En}$ *then the incumbent will be displaced.*

If $\bar{B}^{In} \leq \bar{B}^{En}$ *then the incumbent will be replaced.*

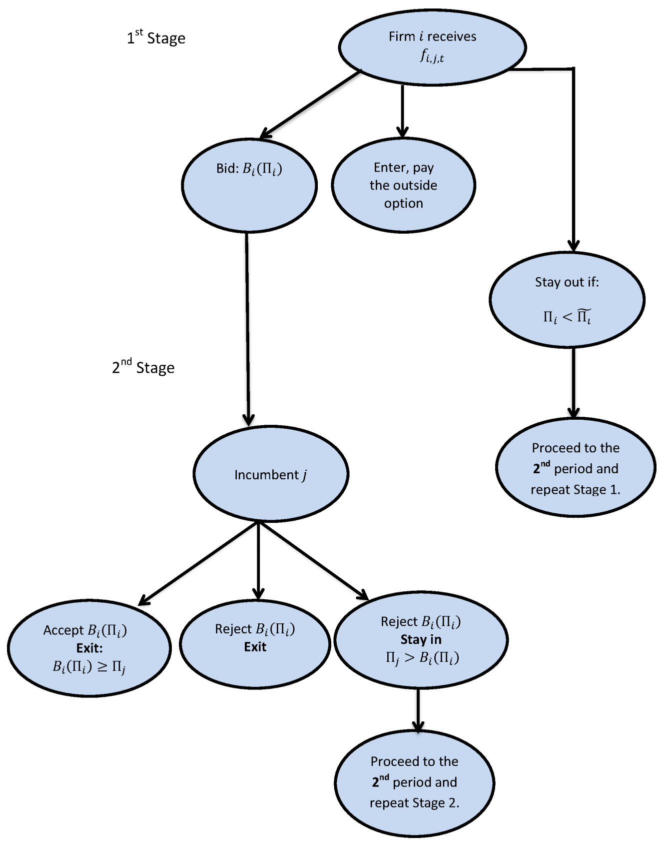

Figure 5.4: Timing David vs. Goliath

Proof: The proof is straightforward, by 2.7 the incumbent will always exit if not replaced. As a result the entrant by 2.6 will enter independently of displacing or replacing the incumbent. Hence, for the entrant to displace or replace the incumbent it will depend on their cost. If the outside option for the entrant is smaller than the minimum value of the incumbent, which is willing to accept, (1^{st} condition) to exit then the entrant will choose to enter through the outside option increasing the number of companies to (n+1) and displacing the incumbent. In other words, $\Pi^{En}_{1,j,t}(n, f^{En}_1) - \bar{\mathrm{B}}^{In} < \Pi^{En}_{1,j,t}(n, f^{En}_1) - \bar{\mathrm{B}}_{En} \Rightarrow \bar{\mathrm{B}}^{In} > \bar{\mathrm{B}}_{En}$. I implicitly assume that the incumbent's $\bar{\mathrm{B}}_{In}$ is the scrap value. Otherwise, the incumbent will be willing to accept $\bar{\mathrm{B}}^{In} - \varepsilon$, instead of $\bar{\mathrm{B}}^{In}$, rather than just exit the market. If however the incumbent's min value, $\bar{\mathrm{B}}^{In}$, is smaller than the entrant's outside option, $\bar{\mathrm{B}}^{En}$ (2^{nd} condition), then the entrant will choose to buyout the incumbent. The incumbent accepts the offer and leaves the market (the entrant has a first mover advantage, a backwards induction argument). Hence, the incumbent is replaced.

QED

Multiple Equilibria

Lemma 5.A.2 *Given assumption 1, the most profitable entrant will enter replacing the incumbent with a bid equal to the profit of the second most profitable entrant if the incumbent's outside option is low enough.*

Proof: First of all, notice that the outside option, in this case, is irrelevant since it is not possible for both entrants to enter and it is not possible for one entrant to enter while the least profitable incumbent is still in the market. By the English auction assumption the most profitable entrant will bid the valuation (profit) of the second entrant and win the right to enter. The most profitable entrant will outbid the second most profitable entrant (the most profitable entrant will increase the bid until it is not profitable for the second entrant to bid).

The incumbent will accept the entrant's bit if $\Pi^{En}_{2,j,t}(n, f^{En}_2) > \bar{\mathrm{B}}^{In}$. By the assumption (2.4) $\Pi^{En}_2(n, f^{En}_2) > \Pi^{In}_n(n, f^{In}_n)$ it will only be incentive compatible for the incumbent to exit when the bid (which is equal to the profitability of the $\Pi^{En}_2(n, f^{En}_2)$) is greater than her scrap value $\bar{\mathrm{B}}^{In}$. If the scrap value is larger than the second most profitable entrant then the incumbent will be replaced if $\bar{\mathrm{B}}^{In} < \Pi^{En}_1(n, f^{En}_1)$ since the entrant can further increase the bid as long as it is profitable. Hence, the incumbent is replaced for low enough $\bar{\mathrm{B}}^{In}$.

QED

Entry Deterrence

I will now present a case of entry deterrence. I will assume that the fixed cost draws are such that it could be feasible for two entrants to enter and two incumbents to exit. Some further conditions are provided in the 3^{rd} assumption:

Assumption 3:

$$\Pi^{En}_{1,j,t}(n, f^{En}_1) > \Pi^{In}_{n-1,j,t}(n, f^{In}_{n-1}) > \Pi^{En}_{2,j,t}(n, f^{En}_2) > \Pi^{In}_{n,j,t}(n, f^{In}_n) > 0 = \bar{\mathrm{B}}^{In} \tag{5.1}$$

$$0 > \Pi^{En}_{1,j,t}(n+1, f^{En}_1) \tag{5.2}$$

The first condition states that the most profitable entrant is more profitable than the second least incumbent. But the second most profitable entrant is not. The second condition states that it is not possible for the most profitable entrant to enter without replacing an incumbent.

Lemma 5.A.3 *Given assumption 3, the most profitable entrant will enter by replacing the least profitable incumbent.*

Proof: First of all, notice that condition (5.2) states that it is not possible for any of the entrants to enter without replacing the least profitable incumbent. As a result the existence of an outside option is irrelevant for the entrants. The outside of the incumbents is also irrelevant since I have assumed zero value for the outside option. Both conditions (5.1) and (5.2) state that the second most profitable entrant will only enter if it replace the least profitable incumbent, by a backwards induction argument. However, for the most profitable entrant it will be less costly to replace the least profitable incumbent instead of replacing the $n-1$ incumbent. This is because by (5.1) the n-1 incumbent is more profitable (and as a result requires a higher bid) than the second in order profitable entrant. Hence, by the English auction assumption the most profitable incumbent will outbid the second most profitable entrant and replace the least profitable incumbent. Hence, one entry and one exit.

QED

I have named this case as entry deterrence since one of the potential entrants deters the entry of the other. Notice that the entry deterrence is defined differently to most of the literature, see for example Dixit (1980). To be more specific, in this topic an entrant is the one that deters entry while most of the researchers have focused on incumbents' deterring entry.

Dynamic Model

Let me present a simple dynamic aspect of the game. Assume that the game is repeated twice and that in the first period there are n incumbents and one potential entrant with a fixed cost draw such that it is necessary to replace the least profitable incumbent ($\Pi_{n,t}^{In}(n+1, f_n^{In}) < \Pi_{1,t}^{En}(n+1, f_1^{En}) < 0$) in every period. Let me also assume that only the least profitable incumbent has negative profits in the first period. In the second period there is a new draw of fixed costs and in some cases it is possible for a draw gives a favorable outcome to the incumbent. For example, a case with two draws such that the least profitable incumbent needs to be replaced is $\Pi^{In}_{n,t+1}(n, f^{In}_n) < \Pi^{En}_{2,t+1}(n, f^{En}_2) < \Pi^{En}_{1,t+1}(n, f^{En}_1) < 0$. In this case the bid will be equal the profitability of the second most profitable entrant. A further assumption is needed:

Assumption 4:

$$E_t\bar{\mathrm{B}}^{In}_{n,t+1} = E_t\Pi^{En}_{n,t+1}(n, f^{En}_n) > \Pi^{En}_{n,t}(n, f^{En}_n) > |\Pi^{In}_{n,t}(n, f^{In}_n) + E_t\Pi^{In}_{n,t+1}(n, f^{In}_n)| \qquad (5.3)$$

$$\frac{E_t\bar{\mathrm{B}}^{In}_{n,t+1}}{2} > \bar{\mathrm{B}}^{In}_{n,t} \qquad (5.4)$$

The equation (5.3) states that the expected bid to replace the incumbent at $t+1$ is higher than the sum of the incumbents profit at t and $t+1$. Hence, it is profitable (at expectations) for the incumbent to refuse being replaced and exit at $t+1$. The second condition states that the expected bid at $t+1$ is more than double the current bid. The above discussion generates the next result:

Corollary 5.A.4 *An incumbent will refuse to be replaced at a given period if assumption 4 holds.*

The proof is a straightforward result from the 4^{th} assumption and the assumption that within each period there is a unique entrant to replace the incumbent. Thus, even in the case where the entrant is more profitable than the incumbent it is possible for the incumbent to refuse being replaced if it anticipates a better draw of entrants' types in the near future that will raise their displacement bid. In the empirical investigation I control for this possibility by incorporating the growth of the demand variables (expected changes on profitability).

A simple numerical example of strategic manipulation of exit

Let $a_y = \frac{2}{3}$ and $a_{c-s} = \frac{1}{3}$, the value of the market (total demand) is 10 and there is an independent incumbent with fixed costs 5. Let two potential entrants, an independent with fixed costs 4 and a C-S with 3.5. The independent is faced with a higher cost and the C-S has a valuation of the market equal to -0.1666 (=1/3*10-3.5). However, the independent entrant will enter by buying out the incumbent. The valuation of the entrant is 2.67 and the valuation of the incumbent is 1.67. As a result the entrant can pay a sunk cost of 1.67, to the incumbent, that will generate an exit of the incumbent and the total number of firms in the market will stay unchanged. I assume that if two firms of the same group exist they will split the subgroup market (for example 3.33 each for the independents).

If however, $a_y = a_{c-s} = \frac{1}{2}$ the C-S will enter for sure and an independent will enter by displacing the incumbent. In this case the number of firms increases and the incumbent exits. Thus, there is both a restructure of the industry (within groups) and a change in the market structure as well (from 1 independent and 0 C-Ss to 1 independent and 1 C-S).

Let me keep the market shares as defined above, but now assume that an entry of independent (C-S) increases the demand by $\frac{1}{3}$ and the demand of the C-S (independent) decreases by $\frac{1}{3}$, in order to preserve the size of the market (the market shares need to add to one). Hence the market shares are $a_y = 0.67$ ($a_{c-s} = 0.33$) if an extra independent enters and no C-S and $a_{c-s} = 0.67$ ($a_y = 0.33$) if two C-S enter and one independent exist. Furthermore, if 3 C-S enter then the market share will be $a_{c-s} = 0.89$ and $a_y = 0.11$. For illustrative reasons I assume that the shares are linearly changing. Let me also assume that the cost of the C-S is 3. In this case the independent incumbent should exit, given that the C-S entrance is certain, since even if an extra independent enters its profitability will still be negative. Hence, there might be 1 independent entrant and 1 C-S. However, if 2 C-Ss enters the total revenues are 6.67 and the total costs are 6. The independents, both the incumbent and the entrant, have negative profitability. If a third C-S enters then the revenues are 8.9 and the fixed costs are 9 but this is unprofitable for the C-Ss.

Hence, in this case (with demand spillover effects) at equilibrium there will be 2 C-Ss and zero independents. This generates an increase in the number of firms and the displacement of the independent incumbent by a C-S. The endogenous sunk cost will be zero since the incumbent will be displaced in any case (I assume zero outside cost for the entrants to enter), the C-S will enter with two stores and whether the incumbent stays to the market the C-S profitability will be unchanged. The market structure will be consistent by zero independents and two C-Ss.

A simple numerical example of strategic manipulation of exit:

I now focus on the demand within the C-Ss group. Let me assume that there is a C-S incumbent, named A, with profitability 2 and FC 3 and a potential entrant B with FC 2.5. Initially the valuation of the market is 5 but if Entrant B enters then the market expands to 6.5 (with one or two shops and replace C-S A) and if a second type A enters the market the market with no C-S B entry then the market expands to 8.5. This means that the total profitability under two firms of type A is 2.5 (and zero of type B) while two firm of type B is 1.5 (an zero C-S of type A), if there is one A and one B then the profitability is 0.25 for A and 0.75 for B. In this case it is profitable for B to displace incumbent A (by offering 0.25) and enter the market with two stores. However, if C-S behaves strategically then A should enter with a second store in order to prevent displacement and generate a profit of 2.5 (or 1.25 per store). In any case the profitability of the C-S A is reduced but it remains in the market because of the business stealing effect (expansion) which is greater than the cannibalization (business stealing within own shops).

5.A.6 Definition of Variables

Fixcost = fixed cost

Fixcosttime = Fixed cost changes across time

Pop = Local residential population.

Housing = Number of houses in the area.

Pensioners = Number of pensioners living in the area.

Claimben = Number of people claiming social benefits.

Area = The area of the tube station in squared metres (m^2).

Weekend = Number of people that exit a tube station during the weekend (both in Saturday and Sunday).

Inrush = Number of people that enter a tube station during the morning rush hours (7am to 10am).

Outrush = Number of people that exit a tube station during the morning rush hours (7am to 10am).

Totaltube = Total number of people that visit a tube station on an average day and weekend (sum).

WeekendNleis = Number of people that exit a tube station during the weekend in no-leisure areas. Tube stations at the lower 50 percentile.

WeekendLleis = Number of people that exit a tube station during the weekend in leisure areas. Tube stations at the upper 50 percentile.

InrushNResid = Number of people that enter a tube station during the morning rush hours (7am to 10 am) in the tube stations at the lower 50 percentile of this variable.

InrushResid = Number of people that enter a tube station during the morning rush hours (7am to 10am) in the tube stations at the upper 50 percentile of this variable.

OutrushNBus = Number of people that exit a tube station during the morning rush hours (7am to 10am) in no-business areas. Tube stations at the lower 50 percentile.

OutrushBus = Number of people that exit a tube station during the morning rush hours (7am to 10am) in business areas. Tube stations at the upper 50 percentile.

L1OwnIndep = The lag of the number of independent incumbents.

L1OwnCS = The lag of the number of C-Ss Incumbents.

L1OwnOtCS= The lag of the number of other C-Ss Incumbents.

EntryIndep = The number of independent Entrants.

EntryCS= The number of C-Ss Entrants.

EntryOther= The number of other C-Ss Entrants.

Trains = A dummy variable that takes 1 if at the particular tube stations there is a train station as well.

Parks = A dummy variable that takes 1 if the tube station is located next to a park.

Thames= A dummy variable that takes 1 if the tube station is located near the Thames river.

5.A.7 Investigating the Shifts on the Demand Size of the Market

In this section I am going to show the presence of demand shifts across time. I achieve that by multiplying the Totaltube variable to the years of the sample. Hence, I break this variable into 9 parts, each part corresponding to a particular year. The specification that I am going to use is specification (8), which was found the most appropriate (the one that better fits the data).

Independent Variables	Probit (8) Probability for an Independent to exit
Fixcost	0.0002
	(0.00011)
fixcosttime	-0.00013
	(0.0001)
Area	-0.00010***
	(0.00004)
WeekendNleis	-0.0862*
	(0.0444)
WeekendLeis	-0.106**
	(0.0438)
InrushNResid	-0.0165
	(0.0384)
InrushResid	-0.0642**
	(0.0266)
OutrsushNBus	-0.1767*
	(0.0927)
OutrsushBus	-0.0895**
	(0.0401)
Totaltube2001	0.0371**
	(0.0150)
Totaltube2002	0.0362**
	(0.0145)
Totaltube2003	0.0356**
	(0.0151)
Totaltube2004	0.0367**
	(0.0150)
Totaltube2005	0.0202
	(0.0239)
Totaltube2006	0.0372**
	(0.0151)
Totaltube2007	0.0373**
	(0.0152)
Totaltube2008	0.0345**
	(0.0165)
Totaltube2009	0.0357**
	(0.0154)
L1OwnIdep	0.0078***
	(0.0030)
EntryIndep	0.0159**
	(0.0069)
L1OwnCS	-0.0016
	(0.0023)

EntryCS	0.0044
	(0.0057)
L1OwnOther	-0-.0008
	(0.0031)
EntyOther	0.0151**
	(0.0067)
Constant	-2.0291***
	(0.2697)
Obs.	4382
Groups	932
Sigma_u	0.2058
Rho	0.0406
LogLikel.	-1503.7033
yhat	0.0926

Table 5.2: Shifts of Demand Effects on Estimation

Notes: All the probits above are based on the random-effects model. In all the specifications I have included control variables for missing data and year fixed effects. The standard errors are reported in the parenthesis. The coefficients and the standard errors reported are the ones that correspond to the marginal effects, with the exception being the one of the constant term.
*Statistically Significant at 10%.
**Statistically Significant at 5%
***Statistically Significant at 1%

In the above table we can see that all the previous results remain robust to the new specification. Furthermore, it can be seen that the Totaltube variables are statistically significant with the exception the one in 2005. The changes of demand is attributed to demand shifts (income or preference shocks).

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Topic II: Buyers Reporting a Cartel

In this topic I investigate the strategic interaction between buyers and suppliers when the buyers are able (informed) to report a cartel to the antitrust authority. The cartel anticipates the threat of being reported and as a result chooses to satisfy the buyers' Incentives Compatibility Constraint (ICC) by indirectly compensating the buyers. Reporting generates a commitment mechanism, between the cartel members, which constrains the collusive profits. It is shown that the likelihood of collusion is negatively related to the cost of reporting, that is a more stable cartel is generated. Most importantly, it is shown that if an antitrust authority tackles the cost of reporting, or increases the transparency of a market, it generates two opposing forces. It increases the consumer surplus in existing hidden cartels but at the same time increases the likelihood of cartel formation, potentially increasing the number of cartels. It is shown that the first effect dominates; therefore tackling reporting costs is of immense importance. I also investigate an alternative mechanism to control for reporting, threat of exclusion. I show that it is a credible threat. I further show that compensation can actually be given at equilibrium if the buyers are faced with heterogeneous costs of reporting. Finally, a comparison with treble damages, a different private enforcement policy, reveals that reporting is the most efficient policy.

The second topic is divided in to five chapters. The first chapter includes the motivation, the research questions and the literature review. In the second chapter I formally present the model and characterize the equilibrium behavior. The third chapter, of this topic, investigates alternative mechanisms that a cartel can use and compare the proposed policy (allowing for buyers' reporting to the anti-trust authority) with another private enforcement policy (treble damages). In the fourth chapter I conclude and provide the mathematical appendix. In the last chapter I report the bibliography.

Chapter 6

Introduction and Literature Review

In this chapter I present the research questions of the second topic, the motivation and the framework used. The most important findings are also being discussed. Finally, in the last section of this chapter I present the relevant literature.

6.1 Introduction

Antitrust authority investigations can be self-initiated, result from the application of a leniency programme or from buyers reporting a cartel to the antitrust authority. Self-initiated investigations are generated by either the buyers' (consumers) complaints of high prices or even of suppliers' suspicious behavior (trade tactics). In a recent case the Office of Fair Trade (OFT), UK's antitrust authority, initiated an investigation in to the UK's construction industry after a buyer's report and found a bid-rigging operation. The OFT found more than 100 companies involved. The cartel members had managed to co-ordinate without being detected for 7 consecutive years, from 1999 to 2006. The cartel members were fined with 129.2 UK million pounds in total, since the cartel had affected projects in excess of 200mn. Furthermore, OFT states with respect to reporting on cartels: "*In addition to our own research and market intelligence, the OFT relies on complaints to help us in enforcing competition law. If you suspect that a competitor, supplier, customer or any other business is infringing the law, you may contact us with your concerns.*" [1]. Hence, understanding the driving forces of reporting and the strategic interplay of players is not only of academic importance. In this topic some further research questions are need to be answered. Research questions such as: What tools can a cartel use to control for reporting? What will be the social cost? and Should the antitrust authority target buyers' cost of reporting?

Though there is a large literature on public enforcement policy, the research on private enforcement has been developed relatively more recently. This literature has focused to private lawsuits and leniency programmes but has surprisingly failed to account for the choice of buyers to report a cartel to the antitrust authority [2]. In this topic I assume that buyers are more likely to trace the existence of a cartel (or misbehavior) than an antitrust authority (regulator). Given the existence of a cartel, the buyers choose whether to report. The cartel's

[1] $http://www.oft.gov.uk/about-the-oft/legal-powers/legal/competition-act-1998/complaints$

[2] With only one exemption a paper by McAfee, Mialon and Mialon in (2008).

members will need to tackle this threat by satisfying the buyers' Incentive Compatibility Constraint (ICC) and by making the buyers just indifferent from reporting and not reporting. I show that at equilibrium there will be no reporting[3] which means that the results are not driven by the actual act of reporting but from the mere fact that the threat of reporting exists. A cartel's commitment to satisfy the ICC of the buyers decreases its profit and increases stability, since deviation is relatively less profitable. Interestingly, being informed on suppliers' competitiveness is both a blessing and a curse. The threat of reporting forces the cartel members to set lower prices than the benchmark case, with the buyers being uninformed, and as a result implicitly compensating the buyers. However, at the same time the likelihood of collusion increases and as a result it is more likely for the buyers to be faced with collusive prices.

An alternative mechanism, to control reporting, is presented. The threat of exclusion, foreclosure, is a robust strategy to deter reporting. However, I show that as the size of the buyers increases or the size of suppliers decreases or even the number of buyers decreases it becomes more difficult to sustain such a strategy. The size of the buyers matters because it corresponds to a higher profit per buyer for a given supplier. The driving force of this result is the trade-off between foregoing profits in one period (by punishing a buyer) and enjoying higher profits in the future. The number of buyers matters because a smaller number of buyers corresponds to a higher per buyer profit for the suppliers and as a result a greater cost for the implementation of the threat of exclusion. Hence, the last result suggests that buyers' associations reduce the credibility of the threat of exclusion since these associations increase the number of buyers that need to be excluded by a cartel. The number of suppliers approximates the intensity of competition, since I assume competition à la Cournot, and as a result more intense competition reduces the per buyer profit of the suppliers and decreases

[3]The simple case, mentioned above, naively predicts that reporting will not be observed. However, when I relax the assumption of successful antitrust authority investigation, probability being less than one, then reporting is an equilibrium action.

the cost of the threat. Finally, the number of buyers matters since it decreases the per buyer profit. Therefore, anonymity for the reporting buyer and monitoring cartel members' behaviour after prosecution is essential to protect the buyers from the cartel's retaliation tactics.

As for social welfare, it is shown that two main forces are working in opposite directions. First of all, if the antitrust authority decreases the cost of reporting then the Consumer Surplus (CS) increases, given that a cartel has been formed. Mainly, the ICC will bind the collusive profits at a lower level thus enforcing the cartel to lower its price[4] and as a result increasing the CS of the buyers and decreasing the Dead Weight Loss (DWL). The second driving force is the likelihood of collusion. The antitrust authority by reducing the cost of reporting, increases the likelihood of cartel formation and generates more stable cartels. This means that it increases the number of potential cartels that can be created. The stability increases because the relative decrease on the deviation profits is higher than the relative decrease of the collusive profits. However, it is shown that the first effect dominates the second.

When compared to another private enforcement policy, treble damages[5], I show that the most efficient policy is reporting. Hence, policy makers should aim to reduce reporting costs rather than promoting private lawsuits. This comparison identifies boundaries for buyers' optimal response, between three possible alternatives[6], given the existence of a cartel. In this way this topic identifies factors that can explain why in EU private lawsuits are less frequent than in USA[7]. Furthermore, conditions for reporting to be observed (cartel chooses the benchmark quantity and takes the risk of being reported) are presented in the relevant

[4]The buyers become more willing to report and as a result the cartel will need to lower its price in order to make the buyers indifferent from reporting again.

[5]Treble damages refer to buyers suing cartel members for anti-competitive damages and receiving triple their damages.

[6]Reporting or reporting and taking a legal action or just taking legal action

[7]This problem has been identified by EU and measures to increase private engagement on the control of cartels have been suggested through a White Paper (see EU website, $http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0165:FIN:EN:PDF$. However, investigating reporting as a deterrence mechanism has been ignored.

chapter.

6.2 Literature Review

This research project is related to an increasing amount of literature that examines the efficiency of private antitrust authority enforcement policies. The literature on private enforcement has initially focused on buyers taking legal action against the cartel members (treble damages and decoupling)[8]. Becker's and Stigler's (1974) paper is the first one that proposed private enforcers, that benefit from damages awarded by the court, to achieve deterrence efficiency. Papers by Landes and Posner (1975) and Posner (1992) argue that private enforcement generates incentives for over-deterrence[9]. On the other hand, Polinsky (1980) shows that it can lead to under-deterrence because of limited liability[10].

Furthermore, Salant (1987) and Baker (1988) have suggested that treble damages are neutral with respect to the social welfare, and do not constrain the cartels to lower prices and profits[11]. However, researchers have later shown that neutrality fails given some fair assumptions. To be more specific, Spulber (1989) achieves to show that by introducing a limited liability in the cartel members' ability to compensate the buyers. In addition, Spulber (1989) shows that neutrality fails if legal costs, transaction costs, are introduced. Furthermore, according to Besanko and Spulber (1990) neutrality fails if information asymmetries exist, between buyers and cartel, on the marginal costs of the cartel members.

[8]The literature on leniency programmes is not mentioned, even though it is related to the private enforcement literature, since it is not related to buyers - suppliers interaction. For a seminal paper on leniency programmes see $M.MottaandM.Polo$(2003)

[9]The buyers take their suppliers to the court even if there is no antitrust authority violation

[10]Where limited liability refers to the maximum fine that can be imposed to the cartel members. In most of the cases compensation for cartel damages will drive the cartel member's to bankruptcy and as a result the market will be distorted.

[11]The buyers anticipate the compensation if a cartel is found, increase their demand (to maximize their compensation) and this cancels out the deterrence effects of the policy (the cost of the penalty is canceled out by the increased demand).

An alternative to treble damages is decoupling, see for example Schwartz (1980), Polinsky (1986) and Polinsky and Che (1991). In this case, if a private lawsuit is filed and the plaintiff wins the court trial then the penalty imposed by the court will be equal to treble the damages sustained but the claimant will receive only once the amount of damages. Decoupling has been suggested in order to keep the deterrence of cartels as high as possible, for the private enforcement, but eliminate the inefficiencies of the treble damages policy[12]. A major inefficiency is created with the strategic use of lawsuits by the competitors of a group of companies. A nice example of such inefficiency is given by McAfee, Mialon and Mialon (2008)[13]: "hostile takeover targets often initiate antitrust authority suits against their acquirers, because such suits create substantial delays that allow the target firms to implement antitakeover strategies, such as poison pills. If the intended takeover is good for the market, these antitrust authority actions have a negative effect". The authors incorporate private and public enforcement into their model of strategic interaction and find that in most of the cases both are necessary to achieve efficiency. This is line with Segal and Whinston (2006) results, who find that both private and public enforcement policies are necessary for an efficient anti-trust policy.

The literature mentioned above assumes that buyers have full information in the anti-competitive action taken by the cartel. The researchers mainly assume that the buyers either know or form beliefs on the marginal costs of the cartel's members. Harrington and Chen (2006), on the other hand, examine buyers updating (they introduce uncertainty) their private information on the suppliers' cost distribution and its consequences on a cartel's pricing schedule given a multiple damages penalty[14]. They assume that the suppliers cost has a random element and that the buyers do not condition their information to the cost shocks (since it is unobservable for them) but rather on the prices chosen by their suppliers. The

[12]The buyers will not increase their demand anymore.

[13]For further reading on the strategic abuse of the antitrust authority legislation please see Baumol and Ordover (1985), McAfee and Vakkur (2004) and McAfee, Mialon and Mialon (2006).

[14]The authors assume that the buyers get suspicious if the prices behave abnormally across time.

authors provide a dynamic perspective to the literature.

In this topic I investigate the impact of buyers reporting the existence of a cartel to the antitrust authority, an approach which blends private and public enforcement. However, this is not the first research project that blends private and public enforcement policies. To be more specific, McAfee, Mialon and Mialon (2008), from hereafter it will be referred as MMM, examine the efficiency and the deterrence effect of private and public enforcement policies. It is the first research project, as far as I know, that investigates the strategic interactions generated by reporting. In MMM's paper reporting is mentioned as cheap-talk because, as they argue, reporting should be costless. In this topic, this opinion is not endorsed since a cartel will be able (through foreclosures for example) to generate a cost of reporting or a buyer might be unwilling to damage a long running relationship (a fall in its suppliers reliability). Alternatively, it might be the case that the buyers will need to pay a cost to gather "convincing" information for the antitrust authority. The OFT recognizes the problems that might arise from reporting (the suppliers being able to generate a cost of reporting) and provides anonymity[15] and a prize for a buyer that reports[16]. The OFT, however, mentions that it will prioritize the complaints based on the seriousness of the offence, which means that the buyers will need to gather convincing proof to persuade the OFT that a cartel exists (or at least to initiate an investigation).

MMM's paper also relax the assumption of reporting costlessly (as an extension to their basic model), however they abstract from strategic interaction between buyers and suppliers. They assume that the cartel has an exogenous probability to take-up an anti-competitive behaviour that yields a fix predetermined payoff for cartel members, antitrust authority and buyers (conditioned to each players' actions). As a result, the cartel has no tools to counteract

[15] The OFT states "*We usually expect complaints to be made in writing,...complaints regarding suspected cartels should be made over the telephone by calling our cartel hotline*". See the website: $http://www.oft.gov.uk/about-the-oft/legal-powers/legal/competition-act-1998/complaints.$

[16] See the following website for reference: $http://www.oft.gov.uk/OFTwork/competition-act-and-cartels/cartels/rewards\#.UMzfhG9dDvA$

the threat of reporting. Finally, by fixing the collusive outcome the authors restrict the strategic behavior of the cartel members.

When I introduce strategic interaction I observe that a cartel will be formed if there is a cost of reporting, a "transaction cost", under full information. The results of this topic are compared with Spulber's (1989)[17], who uses a similar "transaction cost" under a treble damages policy. In this topic I allow the cartel to vary the seriousness (where seriousness refers to the difference of the collusive outcome from the Cournot) of its action and to use alternative ways to control reporting. In this way I am able to investigate the strategic interaction between cartel's members, buyers and the antitrust authority. To be more specific, I assume that the cartel can compensate the buyers for damages, introducing a mechanism to control for reporting. I also present an alternative mechanism to control reporting, I mainly assume that the cartel can threaten buyers with exclusion (in most of the literature it is referred as foreclosure). Moreover, I investigate what happens to the likelihood of collusion and infer whether the ability of buyers to report makes the industries more collusive. Lastly, I examine whether it is optimal for an antitrust authority to lower the cost of reporting. I examine the consequences to the welfare if the cost of reporting decreases; the DWL in an existing cartel decreases but at the same time the industries become less competitive overall, thus DWL is created in other markets. I actually show that measures such as reducing the cost of reporting and providing safeguards for the buyers that report, should be employed be the antitrust authority.

6.3 Conclusion

This topic is motivated by the observation that buyers have reported a cartel and the OFT has initiated an investigation and successfully prosecuted a cartel. As a result, in this topic

[17]Even though he does not formally prove this argument.

I want to investigate what determines reporting, what strategies can a cartel use to deter reporting, the social welfare implications and to compare reporting with an alternative private enforcement policy, that of buyers taking legal actions. This topic is relevant to the literature of private and public enforcement. The closest papers to this piece of research are McAfee, Mialon and Mialon (2008) and Harrington and Chen (2006). However, none of these papers examine the strategic options that a cartel may use and do not investigate the consequence to welfare or characterize the optimal private enforcement policy.

Chapter 7

Basic Model and Social Welfare Implications

A simple model that captures the interaction between buyers, suppliers and antitrust authority is constructed in order to investigate factors that influence reporting, cartel formation and the likelihood of collusion. I further present a social welfare analysis. To be more specific, I investigate whether it is optimal for an antitrust authority to take a policy that lowers the cost of reporting.

7.1 Model

The antitrust authority is faced with uncertainty as to whether there is a cartel in a market and it is assumed that it does not generate self-initiated investigations[1]. On the other hand, I assume that the buyers know with certainty whether (or not) their suppliers are competing à la Cournot but are faced with a cost of reporting (this might be a cost with respect to time and effort to make a meaningful complaint or a cost of potential retaliation tactics by the suppliers). Thus, the buyers might be willing to report the existence of a cartel if the benefits under Cournot (Consumer Surplus) outweigh the cost of reporting and the benefits under collusion. If the suppliers decide to form a cartel then they need to take into consideration the incentives of their buyers to report. Hence, the suppliers might decide to compensate their buyers for the increase in prices, given they have formed a cartel. When the antitrust authority receives a report it decides whether to investigate the market and if a cartel is found it imposes Cournot competition and chooses the penalty that will apply. A graph of the timing follows.

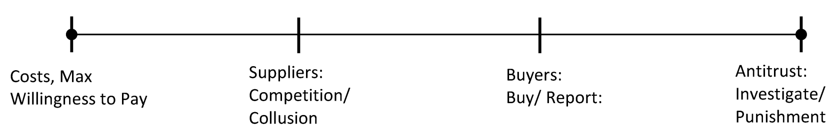

Figure 7.1: Timeline, Ch.7

There are three players that interact in the market; the buyers of the cartel, the suppliers and the antitrust authority. The costs of the suppliers ($C \in [0, C^{max}]$), the buyers'willingness to pay, the antitrust authority's investigation costs ($C_A \in [0, C_A^{max}]$)[2] and the cost of reporting ($v \in [0, v^{max}]$) are determined by "nature". All the costs are common knowledge between buyers and suppliers but the antitrust authority knows only its own cost of investigation.

[1]This can be rationalized by the fact that antitrust authority is not committed to investigating all the industries in a country. However, they are randomly investigating. For simplifying reasons though I will assume no investigation.

[2]Where A is for antitrust authority.

The suppliers choose their quantities by maximizing their profits (joint or not) and decide whether to pay compensation[3] ($Comp$) to the buyers, so that there is no reporting. The buyers are homogeneous in a finite population M and an individual buyer has a well defined demand function (Q(P) downward sloping and bounded), additive to the number of buyers. This demand function defines a Consumer Surplus, (CS) which is a function of reporting, $CS(I_R^B; Q, v)$. I also need to assume that $v'(Q) \geq 0$ and $v''(Q) \geq 0$[4], the cost of reporting is convex with respect to quantities. The buyers decide to report (signal) to the antitrust authority, an action denoted as $I_R^B \in \{0, 1\}$, where subscript R is for the choice to report and superscript B is for buyers, with $I_R^B = 1$ if there is reporting and zero otherwise. It is assumed that the CS is a convex function of quantity, $\frac{\vartheta CS(I_R^B;Q,v)}{\vartheta Q} > 0$ and $\frac{\vartheta^2 CS(I_R^B;Q,v)}{\vartheta Q^2} > 0$. Moreover, the buyers decide after trade (ex post) on whether they will report.

Finally, the antitrust authority decides whether to investigate; an action denoted as $I_{In}^A \in \{0, 1\}$, where subscript In is for the choice to investigate and superscript A is for Antitrust-Authority. If a cartel is revealed then the antitrust-authority will impose competition by enforcing a quantity such that $Q^A = max\{Q^c, Q^*\}$[5], where Q^c is the Cournot quantity and Q^* is the observed quantity chosen by the suppliers. Furthermore, the antitrust authority might decide not to investigate and as a result not to intervene, this is explicitly modelled as the antitrust authority choosing quantity Q^*. However, it is assumed that type I and II error is not possible. Where type I error refers to the antitrust authority investigating but falsely conclude that there is no cartel and type II error refers to the antitrust authority claiming the existence of a cartel when the suppliers are competing. Notice though that the key to the analysis is the antitrust authority's belief of the value of the Cournot quantity and the probability that a cartel exists. To conclude, the players strategic choices are:

[3]More information on the compensation will be provided in the next sections.

[4]The last assumption is necessary to generate uniqueness, see figure 7.2.

[5]I am implicitly assuming that there is no penalty for the creation of a cartel; but instead the antitrust authority imposes Cournot competition. This assumption is made in order to simplify the analysis. As it will be shown, the assumption will not influence the conclusions adversely except in the case where the penalty structure depends on the cost of reporting.

- Suppliers: $s_S = \{Q, Comp\}$
- Buyers: $s_B = \{I_R^B\}$
- Antitrust Authority: $s_A = \{I_{In}^A, Q^A\}$

For the repeated form of this game I assume that nature chooses the parameters in period zero only. The purpose of the last assumption is to avoid production or demand shocks that might create unnecessary complexities. Furthermore, the repeated game assumption allows the cartel members to employ Grim trigger strategies.

The stage game has to be solved backwards. Consequently, I first need to examine the interaction between buyers and antitrust authority. The conduct between the buyers and the antitrust authority can be captured by a signalling game, where the buyers announce (report) that collusion exists and the antitrust authority responds with investigation. The equilibrium between the buyers and the antitrust authority will be defined by using the concept of Perfect Bayesian Equilibrium[6].

7.1.1 Buyers and Antitrust Authority

In this section I will examine the interaction between the buyers and the antitrust authority. I will mainly investigate the incentives of the buyers to report (signal) and the antitrust authority's reaction (to investigate). First of all, some further assumptions are necessary. It will be assumed that the buyers know with certainty if a cartel exists and that they are always worse off with the creation of a cartel (this assumption excludes cases where buyers might provide a noisy signal to the antitrust authority). If the buyers are not always worse off with the creation of a cartel, then strategic reporting might be generated, something that I am not interested in investigating in this topic. I will also assume that if the antitrust authority

[6]See Cho and Kreps (1987) and Fudenberg and Tirole (1989).

investigates and a cartel exists, the cartel will be revealed with probability one. Introducing uncertainty of the antitrust authority's successfulness will generate reporting conditional on the probability of an authority to investigate and punish (allowing for type I error), this is examined at a later stage.

I also assume that if a cartel is formed it will be able to compensate the buyers (denoted as *Comp*), in order to avoid being reported. More specifically, given that a cartel is formed: $Comp = Comp^*$ if $I_R^B = 0$ and $Comp = 0$ if $I_R^B = 1$, where $Comp^*$ is suppliers choice variable. The actual amount of compensation will be decided by the cartel at the equilibrium. As for the antitrust authority, I will assume that its prior on the likelihood of cartel formation is equal to zero, $P_1 = 0$[7]. Moreover, the probability of detection equals one[8] and the cost of investigation is small enough for the antitrust authority to investigate whenever there is updating in its beliefs. The purpose of the last two assumptions is to shift the focus on the consequences of reporting and neutralize any deterrence effect that policies of the antitrust authority might have on the cartel's behavior. As for the payoff functions, the buyer value function is defined as:

$$V^B(I_R^B; v, Q^*, Comp, I_{In}^A, Q^A) = CS(I_R^B, v; Q^*, Comp, I_{In}^A, Q^A) - v * I_R^B + Comp * (1 - I_R^B) \quad (7.1)$$

The value function is defined as the difference of the CS with the cost of reporting plus any compensation paid to the buyers. The CS received by the buyers depends on the actions of both the suppliers and the antitrust authority. The cost of reporting is conditional on the action of buyers[9]. The compensation, which is decided by the suppliers, is conditional on the

[7]Where being the probability that a cartel exists and $1 - P_1 = 1$ the probability that it does not. This assumption is equivalent to the legal argument that someone is innocent until he is found guilty.

[8]In other words, if a cartel exists and the antitrust authority investigates then it will punish with probability equal to one.

[9]Since the buyers can choose to report even if there is no cartel.

buyers not to report[10].

The antitrust authority maximizes the social welfare function while taking into consideration their costs of investigation (C_A). Assuming equal weight to the CS and to the suppliers profits, I derive the following value function:

$$\begin{aligned} V^A(I_{In}^A, Q^A; Pr, C_{ATA}, Q^*, Comp, I_R^B) = \sum_{j=0,1} \Bigg\{ Pr_j \sum_{m=1}^{M} V_m^B(I_R^B; v, Q^A, Comp, I_{In}^A, Q^A) \\ + Pr_j \sum_{i=1}^{N} \Pi_i(Q, Comp; C, I_{In}^A, Q^A, I_R^B) + I_{In}^A * C_A \Bigg\} \quad (7.2) \end{aligned}$$

Pr refers to antitrust authority's prior beliefs in the existence of a cartel, when $Pr_{j=0}$ there is no cartel and $Pr_{j=1}$ there is a cartel. The antitrust authority's payoff function depends on the choices of the suppliers and the buyers and the beliefs (ex-ante and ex-post, in the case with updating) on whether a cartel exists. Equation (7.2) presents the information asymmetry between antitrust authority and the participants of the market, buyers and suppliers, on the behavior of the suppliers. Notice that the incentives of the buyers and the antitrust authority are aligned (higher CS is desirable by both), however this is not the case with the suppliers. A complete description of the value functions for each choice set is provided in the mathematical appendix. Note that the suppliers' profit function will be defined in a later stage.

The equilibrium of the signalling game, between buyers and antitrust authority, is defined as a strategy that generates the max payoff of the two players given the antitrust authority's beliefs and out of equilibrium path beliefs. The next two Lemma characterize the two equilibria that arise. However, let me first define CS_c as the Consumer Surplus generated under Cournot competition, CS_m as the Consumer Surplus under Collusion and $Comp$ as

[10] I implicitly assume that reporting is a public signal. Alternatively, the cartel members observe whether an antitrust authority initiates an investigation and the compensation can be conditional on investigation (At equilibrium the antitrust authority only investigates if there has been reporting. This is a result of the priors being equal to zero and the existence of cost of investigation for the antitrust authority.).

Compensation paid to the buyers.

Lemma 7.1.1 *Pooling Equilibrium:*
If $v \geq CS_c - CS_m - Comp$*, the buyers never report and the antitrust authority choose not to investigate,* $(I_0^B, (I_0^A, (I_1^A, Q^A)))$ *with* $Pr_1 = 0$ *(no updating). While the antitrust authority investigates whenever there is reporting.*

The proof of the above lemma and the one that follows will be given in the mathematical appendix. The first lemma states that there will be no reporting if the cost of reporting is higher than the difference of CS's, under Cournot and collusion, and the compensation. In other words, if the cartel manages to make the buyers just indifferent from the Cournot equilibrium (i.e. by choosing accordingly the amount of compensation or choosing sufficiently low prices) then there will be no reporting and the cartel will remain hidden from the antitrust authority. Alternatively, it might be the case that the costs of reporting may be forbiddingly high for the buyers to report.

Lemma 7.1.2 *Separating Equilibrium:*
If $v < CS_c - CS_m - Comp$*, the buyers report under collusion and the antitrust authority investigate,* $((I_1^B, I_0^B), ((I_1^A, Q^A), I_0^A))$ *with* Pr_1 *equal to 1 if there is reporting* Pr_1 *and equal to zero if not.*

A direct observation that arises from the above lemmas is that there are only truth telling strategies used by the buyers. This is driven by the assumption that buyers are always worse off under cartel formation, as well as from the fact that there is no noisy signal and that the buyers have no uncertainty of the competitiveness of the market. As for the last lemma, it states that collusion is not possible if the cost of reporting is low enough, consequently there is only one equilibrium with reporting and it is conditional on the cost of reporting and the compensation the buyers will receive. Therefore, reporting will not be observed if the cartel members are able to compensate the buyers. An interesting result that emerges is that the absence of reporting, in industries where the buyers are able to report (have insight information), does not mean that a cartel does not exist. It might be the case that the cartel is successfully controlling for reporting.

The condition used to define the two lemmas can be used to define the Incentives Compatibility Constraint (ICC from hereafter) of the buyers. A cartel will need to choose its compensation in order for the buyers not to report, otherwise the suppliers will not collude (this is derived with basic backward induction arguments of the cartel members' participation behaviour[11]). The ICC is found by rearranging the condition of lemma 7.1.1:

$$Comp \begin{cases} \geq CS_c - CS_m - v & \text{if } v < CS_c - CS_m^{be}, \\ = 0 & \text{if } v > CS_c - CS_m^{be}. \end{cases}$$

The above condition states that the compensation decreases as the cost of reporting increases[12]. Furthermore, notice that there is a max value for v such that no compensation needs to be paid, this can be seen by the second part of the ICC. The max point is found by comparing the loss of the CS under the benchmark case[13], superscript (be) is for benchmark, where no reporting is observed and no compensation needs to be paid. This is equivalent to setting the ICC equal to zero and finding the cost of reporting that is greater than the difference of the CS under Cournot and collusion.

The above analysis has implicitly assumed that the antitrust authority requires all buyers

[11]If the buyers are allowed to report then the cartel members will know with certainty that the antitrust authority will dissolve the cartel. Hence, if there is a specific date that the cartel will dissolve then the suppliers (cartel members) will deviate in the period before the break-down. The last argument suggests that the incentives of deviation will be such that the cartel becomes unstable from period zero and as a result will not be formed at all.

[12]It is not optimal, as it will be argued later on, for the cartel to overcompensate. Hence, the ICC will hold with equality.

[13]Under linear demand ($P = a - bQ$) the benchmark collusive quantity is $Q_m = \frac{a-c}{2b}$. Notice that the under linear demand can be written as $CS = \frac{bQ^2}{2}$ hence the CS under collusion (benchmark case) is $CS_m = \frac{(a-c)^2}{8b}$.

to report, thus excluding the possibility of a free-rider's problem between buyers. However, this problem is present due to the existence of the cost of reporting. The cost of reporting needs to be paid by at least one buyer but the benefits (CS under Cournot) will be shared by all. A buyer might not be willing to report if someone else is going to report, thus free-riding on other buyers. An example of this dilemma is presented in the game that follows.

Buyer i / Buyer j	Report	Do not report
Report	$CS_{i,c} - v$, $CS_{j,c} - v$	$CS_{i,c} - v$, $CS_{j,c}$
Do not report	$CS_{i,c}$, $CS_{j,c} - v$	$CS_{i,m}$, $CS_{j,m}$

Table 7.1: Reporting Dilemma

The row player corresponds to buyer i while the column are buyers j where $j \epsilon \{1, .., i-1, i+1, ..., n\}$ and $j \neq i$. A similar issue is examined by Palfrey and Rosenthal (1984). In their paper they show that there are M (number of buyers) equilibria in pure strategies with M-1 buyers not reporting and one buyer reporting. They also show that if not all but some players use pure strategies then there is at most one equilibrium in mixed strategies and if all players choose mixed strategies there are at most two equilibria in mixed strategies with reporting.

As for the antitrust authority, it is worthwhile to mention that requiring all buyers to report is not optimal. Since reporting is a wasteful activity. At the same time Palfrey and Rosenthal (1984) have shown that if there is a rule that requires only one player to pay the cost (report) for a project that benefits all (competition in the next stage) then there will be at least one buyer that will report. Thus, the optimal rule should be set to one buyer to report.

7.1.2 Cartel

The cartel anticipates the behavior of both the antitrust authority's and the buyers' and as a consequence it should take them into consideration. However before presenting the Cartel's incentives, I will take some further simplifying assumptions. I assume that the suppliers employ Grim strategies to sustain collusion with the punishment being the Cournot equilibrium for all the remaining periods[14]. As for the maximization problem of the suppliers, the cartel will need to satisfy the ICC of the buyers otherwise they will be reported and the cartel will break down, this is according to the buyers' behaviour derived from lemma 7.1.1. Hence, the cartel should choose the collusive quantity given an extra constraint that needs to be satisfied, the ICC of the buyers. The cartel's maximization problem is defined as:

$$
\begin{aligned}
\arg\max_{q} \Pi &= (P-c)Q - comp \\
s.t. & \\
[1]\ P &= P(Q) \\
[2]\ Comp &= CS_c - CS_m - v \text{ if } v < CS_c - CS_m^{be} \\
[3]\ Comp &= 0 \text{ if } v > CS_c - CS_m^{be} \\
[4]\ \Pi_c &\leq \Pi_m
\end{aligned}
$$

The cartel maximizes its profit's by choosing a quantity subject to the aggregate demand, the ICC which is presented in constraints 2 and 3 and the cartel's own incentive compatibility constraint. The last constraint states that the collusive profits need to be greater than the ones under Cournot for a cartel to form, cartel's own ICC. Notice that if constraints [2] and

[14] Admittedly there might be an optimal punishment period. However, I take as exogenous the punishment period in order to simplify the analysis.

[3] are dropped then I get the benchmark model (monopoly quantity). The 2^{nd} constraint states that a cartel to be successfully formed it has to make the buyers just indifferent on reporting. While the 3^{rd} constraint states that if the cost of reporting is forbiddingly high, for the buyers to report, then the cartel should ignore the threat of reporting (not a credible threat).

Proposition 7.1.3 *If the condition of the 2^{nd} constraint holds and $v > 0$, then the optimum collusive quantity and price will be found by setting compensation equal to zero.*

For the proof see the mathematical appendix. The above proposition (proposition 7.1.3) states that under costly reporting a cartel will be formed by setting the compensation equal to zero and choosing a quantity that satisfies the ICC. The intuition is that the cartel internalizes the loss of CS for quantities smaller than the one that satisfies the ICC and as a consequence it chooses zero compensation. However, the buyers are implicitly compensated by being offered a lower price compared to the benchmark case. Moreover, the proposition states that if the cost of reporting is too high (constraint 3 is binding) then the ICC (constraint 2) is not binding and the cartel is back to the benchmark case. Notice that in the last case the threat of reporting is not credible. A graphical illustration is provided in the figure that follows.

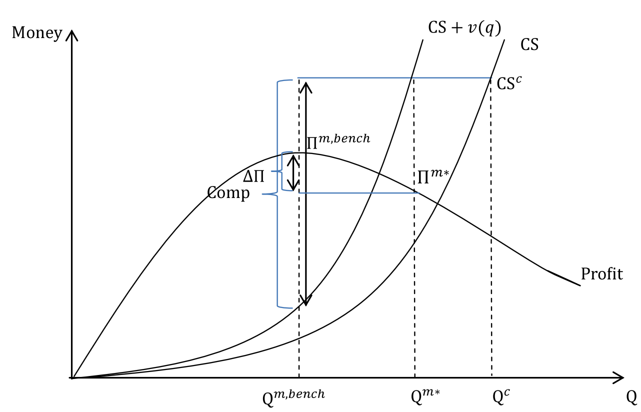

Figure 7.2: Cartel's Profit and Buyers Incentives

In the above figure I report the quantity at the horizontal axis and the monetary value of the three functions presented at the vertical axis. The three functions are the profit function, which is a concave function to quantity, the CS and the CS having added the cost of reporting, which are convex. Moreover, it is trivial to show that for linear demand the CS is a convex function on quantity and that it crosses the profit function at a point between the benchmark collusive quantity, Q_m^{be}, and the Cournot quantity Q_c. Notice that by introducing the cost of reporting the CS shifts upwards, this is because the cost of reporting is always positive, $v(Q) > 0$. I have also assumed, in the previous section, that $v'(Q) \geq 0$ and $v''(Q) \geq 0$. Therefore, it has a higher slope than the simple CS and a unique point when setting the ICC with equality, $CS_c = CS + v$.

Furthermore, there are three points of interest; the benchmark collusive quantity Q_m^{be}, the collusive quantity that makes that buyers just indifferent from reporting Q_m^*, and the Cournot quantity, Q_c. The CS at the Cournot quantity is found at the point CS_c at the graph, from which a horizontal line was drawn which extends that point up to the benchmark collusive quantity. Additionally, the extended line crosses $CS + v(q)$ at the point that defines the collusive quantity Q_m^*. In other words, the collusive quantity that makes buyers indifferent will provide a CS and cost of reporting that equals in value with the CS_c, $CS(Q_m^*) + v(Q_m^*) = CS(Q_c)$. Π_m^* is the collusive profit when choosing Q_m^*. I have also drawn a horizontal line that extends Π_m^* up to the benchmark collusive quantity. Notice that the choice of setting the $CS(Q_c)$ being larger than Π_m^{be} is not random, since this holds under linear demand and for the number of companies being greater than two. As for the cartel's choice, if it decides to produce Q_m^{be} then it will increase its profit by $\Delta\Pi$, as depicted in the figure, but at the same time it will have to compensate buyers by $Comp = CS(Q_c) - CS(Q_m^{be}) - v(Q_m^{be})$, depicted in the graph as $Comp$. As it can be seen from the graph the difference between the increased profits and the compensation is going to be negative. The compensation increases by a faster rate than the increase on profits, since $CS(Q) + Profit$ must be increasing in quantities but less than the welfare optimum. Therefore, it is not optimal for the cartel to choose a quantity smaller or higher than Q_m^*. Therefore, the solution for the cartel will be found by setting the compensation equal to zero. For values of v that drives the Q_m^* (as depicted in the graph) to be smaller than the Q_m^{be}, the cartel should choose Q_m^{be} since it will generate higher profits and at the same time the buyers will not report. Finally, the last case corresponds to the possibility that the cost of reporting is prohibitively high. In this case the horizontal line drawn from point CS_c will cross the $CS + v(q)$ curve at a quantity smaller than Q_m^{be}, thus the cartel can choose Q_m^{be} and avoid be reported. Another interesting implication of proposition 7.1.3 is presented to the next corollary.

Corollary 7.1.4 *If reporting is costly then there will be neither reporting nor compensation of buyers when a cartel is formed.*

Proof: By proposition 7.1.3 there will be no compensation and the buyers are just indifferent from reporting if a cartel is formed. Moreover, by lemma 7.1.1 the buyers will not report and as a result the antitrust authority will not investigate, since there is no updating on its beliefs.

QED

This result states that it is not the actual act of reporting but the threat of reporting that matters. It also suggests that the policy of allowing buyers to report seems insufficient to counteract the creation of a cartel. However, the existence of the threat of reporting lowers the collusive profits and the Dead Weight Loss (DWL). The last statement is presented in the next proposition.

Proposition 7.1.5 *The cost of reporting influences non-negatively the collusive profits and non-positively the collusive quantity.*

For the proof see the appendix. Proposition 7.1.5 states that if the antitrust authority manages to decrease the cost of reporting the cartel profits will decrease. The driving force is the reduction of the ICC ($CS_m \uparrow = CS_c - v \downarrow \Rightarrow Q_m \uparrow$). By decreasing the cost of reporting, the collusive profits and the DWL decreases. A graphical representation of the proposition 7.1.5 is presented in the figure 7.3.

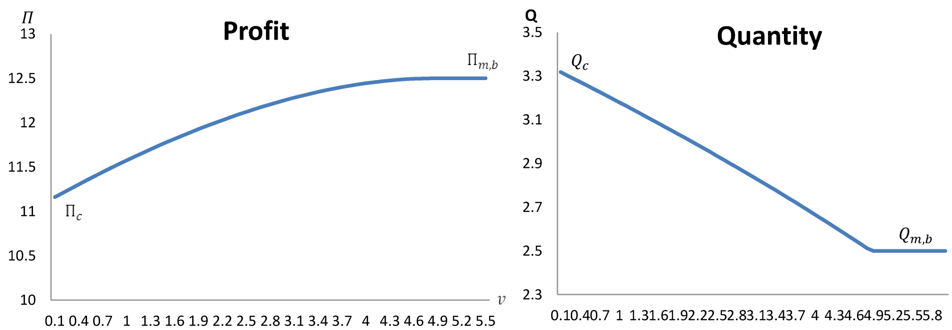

Figure 7.3: Profits and Quantity as a function of v

In the figure 7.3 I have calibrated the collusive quantity and profit as a function of the cost of reporting. I have assumed linear demand, $P = a - bQ$ where a is the maximum willingness to pay, b a measure of the slope and P is the price. I have also assumed that the cost of reporting enters linearly into the ICC of the buyers, $CS(Q_m) = CS(Q_c) - v$. Where the individual (buyer i) CS under linear demand is defined as $CS_i = \frac{bq_i^2}{2}$. The values used for the graph are $a - c = 10$, $n = b = 2$ and the cost of reporting takes values between 0.1 and 5. As expected the quantity decreases as the cost of reporting increases while the collusive profits increase. The collusive quantity and profits become independent from changes on the cost of reporting at the value of $v = 4.9$.

In order to investigate the impact of reporting on the likelihood of collusion I will first need to define the CS. After substituting for a linear inverse demand the CS becomes: $CS = \frac{(bQ^2)}{2}$[15]. Let me define the number of colluding suppliers as n. The Cournot quantity is $Q_c = \frac{n(a-c)}{(n+1)b}$ and the profits are: $\Pi_i^c = \frac{(a-c)^2}{(n+1)^2 b}$, where i stands for the individual supplier.

[15] The CS is defined as $CS = \frac{(a-P)Q}{2}$ substituting for the linear demand function I get $CS = \frac{(bQ^2)}{2}$.

Let the Minimum Discount Factor (which will be defined as MDF from hereafter and I am going to use δ for notation) be defined as the minimum discount factor that is required for the cartel to be stable as defined by a trigger strategy with an infinite horizon punishment, $\delta = \frac{\Pi_i^d - \Pi_i^m}{\Pi_i^d - \Pi_i^c}$, where Π_i^d are the profits of a firm that deviates from the collusive quantity. Notice that the benchmark trigger strategy is defined as choosing Q_m at t if Q_m was chosen at t-1 otherwise choose Q_c. This generates the following incentive compatibility constraint for the cartel: $\Pi_i^d + \delta * \frac{\Pi_i^c}{1-\delta} \geq \frac{\Pi_i^m}{1-\delta}$. The equality generates the condition for the minimum value of the discount factor that will generate collusion (when the left hand side is equal to the right hand side). Let me also define the probability of the generated discount factor being higher than the MDF as $f_\delta = Prob(\delta > \delta_{MDF})$. I will assume that f_δ is independent from other factors that influence collusion, defined as J. The last assumption suggests that $Prob(f_\delta \cap J) = f_\delta * J$.

Proposition 7.1.6 *The cost of reporting influences negatively the likelihood of collusion, given assumptions 1 and 2.*
Assumptions:

1. *Linear Demand*

2. *Independence between the MDF and other factors that influence collusion*

For the proof see the appendix. The intuition of this result is simple. By decreasing the costs of reporting, the collusive profits are relatively decreased by a smaller amount than the decrease in deviation profits, which means that the cartel becomes more stable (the incentives of deviation are relatively decreased). Alternatively, the reduction of the collusive profits will span to the infinite horizon while the decrease in the deviation profits will influence the first period only[16]. So a decrease on the cost of reporting decreases deviation profits by more than

[16] Let me remind the reader that the discount factor is calculated by setting the present value of the collusive profits equal to the profit under deviation in the first period and the present value of the Cournot profits starting from the period after the deviation

the decrease on the present value of the collusive profits (the incentives to deviate decreases). Hence, the discount factor required for stability (to satisfy the ICC of the cartel members) decreases and as a consequence the probability for a cartel to form increases[17].

Furthermore, the cost of reporting works as a mechanism of commitment, for the collusive companies, to a quantity that is higher than the benchmark one. The deviation becomes less profitable and the minimum discount required for a cartel to be sustained is reduced. Consequently, the cartel becomes more stable and the likelihood to collude increases.

This result is actually counterintuitive, because one might expect that a decrease on the costs of reporting and as a consequence an increase in the threat of being reported, will generate cartels with a smaller probability. However, as it has just been shown the cartel becomes more stable by satisfying the ICC[18] of the buyers and as a result the cartel is not threatened by reporting. In this case, this result states that if an antitrust authority decreases the cost of reporting it will decrease the DWL, in existing cartels, but with the trade-off of increasing the stability of a cartel and an increase in the probability of a cartel being created. This last statement will be further explored in the section where I analyze welfare implications. Finally, a similar result has been found by other researchers as well, see for example Symeonidis (1999). He shows that restricting collusive profits increases the likelihood of collusion by reducing the incentives to deviate.

Notice that proposition 7.1.6, as well as the previous results, are derived by some relative general assumptions on the functional form of the cost of reporting[19]. For example, the cost of reporting might be a function of the collusive quantity, representing the CS that the buyers are willing to loose in order to avoid the inconvenience of reporting and giving testimony for the cartel actions, or be just a fixed cost. Under either functional form the results will remain

[17] Notice that I have implicitly assumed that the realized discount factor is generated by a distribution that has a single crossing property.

[18] Consequently the buyers will not report.

[19] This means that a regulator does not need to investigate the specific function that the costs of reporting might obey to take action.

unchanged, the only difference is that the collusive quantity will be calculated differently. This is due to the fact that the results are driven by the existence of the ICC that the cartel needs to satisfy and the assumption of costly reporting.

On the other hand, if the cost of reporting is zero then the cartel is not possible to form. The reason is that the ICC will bind at a point where the CS under collusion is equal to the CS under Cournot, $CS_m = CS_c$. Consequently, the cartel cannot satisfy the ICC constraint and at the same time receive collusive profits greater than the Cournot profits. Furthermore, if the cartel decides not to satisfy the ICC then the buyers will report, see lemma 7.1.2 (the separating equilibrium), and as a result the cartel will be investigated and dissolved. The next corollary summarizes the above findings.

Corollary 7.1.7 *If the cost of reporting is zero then the likelihood of collusion is zero.*

<u>Proof:</u> The ICC constraint is binding and the cartel needs to compensate the buyers. However, compensation needs to be zero for a cartel to be profitable (see proof of proposition 7.1.4). As a result the $CS^m = CS^c$ and the optimal choice of the cartel is the Cournot equilibrium. Hence, zero probability of a cartel to be formed.

QED

The last result, in contrast to proposition 7.1.6, states that if the antitrust authority manages to eliminate the costs of reporting then a cartel is not possible to form. The results of this section can be combined to describe how the cost of reporting influences the likelihood of collusion. To be more specific, proposition 7.1.6 states that the likelihood of collusion increases as the cost of reporting decreases. Consequently, there is a point where the MDF is not defined and the likelihood of collusion is zero (not possible to collude since they will be immediately be reported). Therefore, I can combine proposition 7.1.3, 7.1.6 and corollary 7.1.7 to describe the relationship between the likelihood of collusion and the cost of reporting. By proposition 7.1.6 the likelihood of collusion is decreasing with respect to v. By corollary 7.1.7; for zero cost the likelihood drops to zero suggesting at the limit that there is a discontinuity, while by proposition 7.1.3 the v has a maximum bound that can be found by substituting into the ICC the benchmark collusive quantity.

Notice that if I assume price competition (Bertrand) the results do not change. Actually under Bertrand the likelihood of collusion is independent from the cost of reporting while the collusive quantity and profits remain constant. Hence, the likelihood of collusion is non-increasing (in general) to the cost of reporting. For more details please see the appendix. In the next section I present a simple example.

A simple example

I assume a linear demand ($P = a - bQ$). From proposition 7.1.3 the cartel will choose a quantity that is higher than the one under the benchmark case. Assume that the cost of reporting enters the collusive quantity in the following way[20]:

$$Q_m = \frac{(a - c + \gamma)}{2b} \tag{7.3}$$

Where $\gamma = f(v)$ is a function of v, which captures the effect of the cost of reporting on the collusive quantity. I assume that γ is positively related to v. Notice that $\gamma > 0$ and that if $\gamma = 0$ then we are back to the benchmark collusive case (this corresponds to the case where $v = 0$). I further assume that γ decreases as the cost of reporting increases in other words: $\frac{\vartheta\gamma}{\vartheta v} < 0$. This is assumed in order to be in line with proposition 7.1.5, which states

[20]This is actually not a proper way to introduce the cost of reporting in the collusive quantity since the v should influence the ICC and from the ICC should the collusive quantity be defined. However, the quantity presented might be an approximate expression of the equilibrium Q_m. To be more specific the ICC is defined as $CS_m = (1 - v)CS_c$ and this generates $\frac{(a-bQ_m)Q_m}{2b} = (1 - v)\frac{(a-bQ_c)Q_m}{2b}$. Rearranging terms $Q_m = \frac{a-\sqrt{a^2-4b(a-bQ_c)Q_c(1-v)}}{2b}$ and setting $\gamma = c - \sqrt{a^2 - 4b(a - bQ_c)Q_c(1 - v)}$. Notice that γ depends negatively on v.

that the cost of reporting influences non-positively the collusive quantity, as it is presented in the example. Moreover, the Cournot equilibrium is reached when γ equals to:

$$\gamma^{max} = \frac{(a-c)(n-1)}{(n+1)} \tag{7.4}$$

Which is found by setting equation 7.3 equal to the Cournot quantity. Moreover, the minimum is found under the benchmark collusion case. Therefore, $\frac{\vartheta Q_m}{\vartheta v} < 0$ (as predicted in the previous section). Equation (9.3), which is the condition for no deviation from the cartel members, states that $(1-\delta)\frac{\vartheta \Pi_d}{\vartheta v} - \frac{\vartheta \Pi_m}{\vartheta v} > 0$. Notice that this condition is a rearrangement of the MDF condition. Equation (9.3) can be rewritten as:

$$\frac{\vartheta \Pi_d}{\Pi_d - \Pi_{c,i}} > \frac{\vartheta \Pi_{m,i}}{\Pi_{m,i} - \Pi_{c,i}} \tag{7.5}$$

Hence, I need to show that the relative change on the deviation profits is greater than the relative change on the collusive profits[21], for the likelihood of collusion to be negatively related to the cost of reporting. To verify that the condition holds I need to get an expression of all the profit functions and their derivatives. Let me first define the collusive profits: $\Pi_{m,i} = \frac{(a-c)^2-\gamma^2}{4nb}$[22]. The derivative of the collusive profits with respect to the cost of reporting is:

$$\frac{\vartheta \Pi_{m,i}}{\vartheta v} = -\frac{\vartheta \gamma}{\vartheta v}\frac{\gamma}{2nb} \tag{7.6}$$

Notice that $\frac{\vartheta \Pi_{m,i}}{\vartheta v} > 0$, as expected. For the deviation profits the maximization problem

[21]It is defined as relative because it is not quite proportional since I am subtracting a constant, the Cournot profits, in the denominator of each fraction.

[22]The quantity is defined by 7.3 and the price is $P_m = a - bQ_m$. The profits are defined as $\Pi_{m,i} = (a - bQ_m - c)q_{m,i}$, substituting for Q_m this generates $\Pi_{m,i} = \frac{(a-c-\gamma)(a-c+\gamma)}{4nb} = \frac{(a-c)^2-\gamma^2}{4nb}$.

is not constrained by the ICC of the buyers[23]. Thus, $\Pi_d = b(q_d)^2$ [24] and as a consequence I only need to find the deviation quantity. Maximizing the profit function of the deviating firm I get the following expression $q_d = \frac{(n+1)(a-c)-\gamma(n-1)}{4nb}$. Notice that the deviation quantity is influenced negatively by the γ factor. Therefore, $\frac{\vartheta q_d}{\vartheta v} > 0$ in contrast to what happens with the collusive quantity $\frac{\vartheta Q_{m,i}}{\vartheta v} < 0$. The intuition is that the collusive quantity defines the residual demand hence an increase in v decreases the collusive quantity which in turn increases the residual demand and the deviating firm can sell more. Mathematically, the cost of reporting does not influence the deviating firm's maximization problem which means that γ only appears through the collusive quantity. The next step is to substitute q_d into the profit function:

$$\Pi_d = \frac{[(n+1)(a-c)-\gamma(n-1)]^2}{16n^2b} \tag{7.7}$$

Notice that for $\gamma = 0$ I get the benchmark case. The derivative of the above profit function with respect to the cost of reporting is positive as well:

$$\frac{\vartheta \Pi_d}{\vartheta v} = -\frac{\frac{\vartheta \gamma}{\vartheta v}(n-1)[(n+1)(a-c)-\gamma(n-1)]}{8n^2b} \tag{7.8}$$

The next step is to get an expression for the denominators of condition 7.5. The Cournot profits are defined as: $\Pi_{c,i} = \frac{(a-c)^2}{b(n+1)^2}$. The denominator at the left hand side is (after some algebra):

---

[23]As it has been shown in the proof of proposition 7.1.6, the firm that deviates will choose a quantity that is greater than the individual collusive quantity. This means that under deviation the ICC will always be satisfied (the ICC will no bind the deviating firm's profits).

[24]The deviation profits are defined as $\Pi_d = (P_d - c)q_d = (a - c - bq_d - (n-1)bQ_{i,m})q_d$ and at the same time the first order condition (foc) of the profit maximization is $0 = a - c - (n-1)bQ_{i,m} - 2bq_d$. The foc can be rewritten as $bq_d = a - c - (n-1)bQ_{i,m} - bq_d$ and by substituting this expression in the profit function I get $\Pi_d = b(q_d)^2$.

$$\Pi_d - \Pi_c = \frac{(n-1)[[(n+1)(a-c) - \gamma(n-1)](n+1) + 4n(a-c)]}{16n^2} \tag{7.9}$$

While the denominator at the right hand side is:

$$\Pi_{m,i} - \Pi_c = \frac{(n-1)(a-c) + \gamma(n+1)}{4n} \tag{7.10}$$

Substituting the reduced forms of 7.6, 7.8 and equations 7.9 and 7.10 into 7.5 and after some algebra, what remains is the following condition:

$$\gamma < \frac{(a-c)(n-1)}{(n+1)} \tag{7.11}$$

The above condition always holds since equation 7.4 gives the maximum value of γ which is the right hand side of equation 7.11. Therefore, the likelihood of collusion is negatively related to the cost of reporting.

In this section I have shown that a decrease in the cost of reporting will actually generate more stable cartels. The mechanism behind this result is twofold. First of all, the cartel needs to commit at smaller profit, by increasing its supply. The second force is the incentive for a cartel member to deviate; the cartel by committing to a smaller profit it further decreases the deviation profit and as consequence the stability increases.

7.2 Social Welfare Implications

The purpose of this section is to establish that a policy targeting on decreasing the cost of reporting will increase the Social Welfare (SW). Thus, justifying as socially optimal the OFT efforts to increase market transparency in the markets, which implicitly decreases the cost of reporting.

7.2.1 Social Welfare

In this section I will assume that the SW is maximized when the DWL is minimized (this is equivalent to assume equal weights between buyers and suppliers). Some further simplifying assumptions are presented below:

Assumptions:

1. The discount factor is generated by a uniform distribution.
2. If the generated discount factor is greater than the MDF, then the likelihood of collusion equals to 1.
3. There are m identical industries.
4. Linear Demand.
5. Independence between the MDF and other factors that influence collusion.

Under the above assumption, I show that the cost of reporting influences negatively the SW. I also show that the efficiency gain (decrease on prices) is greater than the potential increase in the number of cartels, through an increase to their stability.

Proposition 7.2.1 *Under the above assumptions, there is a negative relationship between the cost of reporting and the SW.*

For the proof see the appendix. As it was argued at the introduction, there are two effects working on the opposite direction. The first one, the reduction of the cost of reporting decreases the DWL ($\frac{\vartheta DWL}{\vartheta v} > 0$), which is a consequence of proposition 7.1.3. While at the same time a decrease on the costs of reporting decreases the MDF, stabilizing the cartel, and as a result increases the likelihood of collusion. This means that by reducing the costs of reporting the DWL will decline in existing collusive industries but at the same time it will increase the number of the cartels in a country. However as proposition 7.2.1 states, the gains from reducing the DWL outweighs the potential losses from the increase on the probability for a cartel to be created in other industries.

Moreover, the cost of reporting can also be interpreted as the cost that buyers need to pay in order to discover the competitive status of their suppliers. If this is the case then the analysis in the previous sections remains unchanged but the welfare implications change. Mainly because the question that needs to be answered is whether market transparency between participants is desirable. Additionally, the measures that an antitrust authority needs to take change as well. Instead of reducing the cost of reporting the authority will need to take measures to increase the market transparency between market participants (buyers and suppliers). For example, it might enforce a good trade act that requires suppliers to trade on a particular code. Notice that the last suggestion is a policy that is already used in the UK by OFT.

7.3 Conclusion

In this chapter I have shown that for a cartel to be formed it is required for buyers to be prevented from reporting. Consequently, the cartel's profit is constrained to lower values than the benchmark monopoly profit. However, this generates a lower MDF, required for a stable cartel, and as a result reporting increases the likelihood of collusion. When I examine the effect of an antitrust authority policy on lowering the cost of reporting I show that the social welfare increases, even though the likelihood of a cartel to be created increases. The driving force of the last result is the increase of Consumer Surplus which cancels out the decrease of

Social Welfare from the increased probability of a cartel to be generated.

Chapter 8

Cartel Mechanisms on Controlling Reporting and Optimal Antitrust Policy

In this chapter I investigate alternative mechanisms to control for reporting. To be more specific, I examine whether the threat of exclusion (foreclosure) is a robust strategy for a cartel to use. The credibility of this threat depends on the size and the number of buyers, as well as the number of suppliers. Thus, anonymity for the reporting buyer and monitoring cartel members' behavior after prosecution is essential to protect the buyers from the cartel's retaliation tactics. I also introduce buyers heterogeneity with respect to the cost of reporting. I show that under some conditions the cartel can compensate the buyers. At the last section I compare reporting with treble damages to characterize the most efficient policy.

8.1 Introduction

The cartels have been found to employ a number of strategies to avoid being detected. For example, in a case with Recruitment Agencies in UK[1] they used the threat of exclusion as a mechanism to enforce collusion. In addition it is possible for the cartel to price discriminately based on whether the buyers are informed or not. However, in order to argue about antitrust authority's intervention I will need to compare the policy of allowing buyers to report with the alternative of buyers taking legal actions (treble damages). Therefore, I am interested in answering the following questions: What alternative mechanisms can a cartel use to avoid being reported? And what is the optimal private enforcement policy?

For the threat of exclusion to be credible the cartel will need to take a re-instate strategy. This is due to the fact that the punishment of a reporting buyer needs to be taken when the antitrust authority has imposed competition. Therefore, for a cartel member to have an incentive to punish at the competition stage (when a cartel has been dissolved) it is required that the cartel will be re-instated. Consequently, I employ a sharp trigger strategy (as defined by P. Schiraldi and F. Nava (2012)). I compare the minimum discount factor (MDF) generated from this strategy with the benchmark one (required to prevent deviation at the collusive stage) and I show that the re-instated MDF is more binding for some parameter values. I also shown that the threat of exclusion becomes more difficult to implement when the number of buyers is small, the number of excluded buyers is large and when the number of suppliers is small as well. Another interesting result, of this chapter, is that differences on the cost of reporting might generate compensation.

At the last section, I compare two private enforcement policies. The first one is a policy to promote buyers' reporting to the antitrust authority and the alternative is to allow for the buyers to take legal action against the cartel. I further relax the assumption of a cartel being

[1]See $http://www.oft.gov.uk/OFTwork/competition-act-and-cartels/ca98/closure/recruitment-agencies/$.

detected with probability one and I also allow for the probability of a buyer to successfully win a legal action, given the existence of a cartel, to be less than one. Finally, I show that reporting is a more efficient policy than taking legal action.

The next section presents the threat of exclusion and in the second section the case with the heterogeneous cost of reporting is presented. In the third section I compare the two private enforcement policies and in the last section I conclude.

8.2 Threat of Exclusion, foreclosure

The threat of exclusion, foreclosure, is not a new concept in economics. The effect of foreclosure has been examined in mergers and has been used to rationalize tie-ins; see for example Ordover, Saloner and Salop (1990), Whinston (1990) and Rey and Tirole (2007). However, as far as I know the threat of exclusion has not been examined as a tool of collusion. The threat of exclusion in a collusive framework is not only of a mere academic interest. Quite recently there was a cartel case with Recruitment Agencies in UK which begun in 2003 and ended in 2006[2]. The recruitment agencies were responsible for finding candidates for intermediaries and certain construction companies in the UK. Seven companies had colluded in order to protect their margins from the entrance of an intermediary, (Parc UK Ltd). The cartel had boycotted the new entrant (have threaten with exclusion their buyers). The investigation was triggered by a leniency applicant (in 2005). Even though the breakdown of the cartel was not caused by buyers reporting on the cartel, this case is interesting since it suggests the use of the threat of exclusion as a tool to enforce collusion. Thus, this section introduces the threat of exclusion as a mechanism to control for reporting.

In this section I am going to assume that the buyers have no direct cost of reporting

[2]See *http://www.oft.gov.uk/OFTwork/competition-act-and-cartels/ca98/closure/recruitment-agencies/*.

($v = 0$) but the cartel's members can use exclusionary threats to their buyers. As a result the cartel generates an indirect cost of reporting (when using the exclusionary threat). To be more specific, excluding a buyer will generate a zero Consumer Surplus (CS). Therefore, the difference of the CS without reporting and the CS under exclusion (which is zero) is the cost of reporting. Consequently, in this section I rationalize the existence of the cost of reporting[3], which was assumed previously. I further believe that the use of the threat of exclusion is a reasonable assumption since practitioners have suggested that exclusionary threats are used either explicitly or implicitly to coordinate different practices. See for example Intel in 2009 (fined by EU for 1bn Euro) where it used exclusionary threats to bundle its products and decrease competition on the microchip market. Furthermore, I am avoiding the term foreclosure since I focus in final product buyers.

First of all note that, with the exception of the cost of reporting, all the other assumptions of chapter 7 hold (Cournot Competition, timing and anti-trust authority have zero prior probability for the likelihood of collusion). In addition, note that when a cartel is formed it is possible that some buyers (if buyers are heterogeneous) will be excluded in any case. Therefore, threatening this group of buyers with exclusion is not credible. An illustration of this case is given to the next subsection.

8.2.1 Excluded Buyers

Assume that the buyers are heterogeneous with respect to their willingness to pay (infinitely heterogeneous). This is equivalent to assume m buyers with different maximum willingness to pay and individual demands that can be aggregated ($P = \sum_{i=1}^{m}(a_i - bq_i)$)[4]. The suppliers, though, cannot price discriminately when competing but they might know that there are

[3]In this way I explicitly propose an interpretation of what the cost of reporting might be.

[4]Therefore, the buyers are not imposed on buying a one unit of quantity.

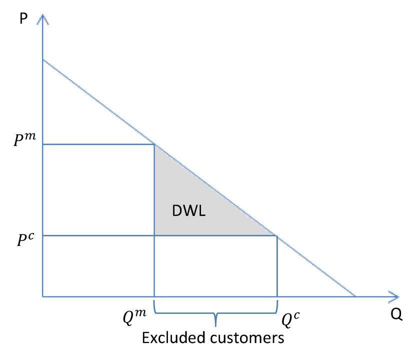

Figure 8.1: Collusive Price and Excluded Buyers

different types of buyers in the market[5]. Let me now give an example how the groups of excluded and included buyers are generated. The next figure (8.1) presents the argument.

In figure (8.1) I present the collusive price and quantity, as well as the corresponding ones for the competitive case. First of all, notice that an increase in price will create a reduction in the quantity supplied (from Q^c to Q^m). Hence, any buyer with maximum willingness to pay greater than the Cournot price but smaller than the collusive price will be excluded (shadowed area). This means that it is meaningless to threaten buyers who are already excluded from the market with exclusion. However, this generates an interesting result; the cartel is more threatened of being reported by the excluded (marginal) buyers than the included ones (as it will be shown) and as a result the cartel is willing to compensate (with lower price or compensation - monetary transfer) only the excluded buyers and keep them in the market. This holds if the threat of exclusion is robust to the included buyers.

However, I still need to show that there is an equilibrium strategy (pricing or compensating) that will guarantee no reporting from the excluded buyers. This is done in the next subsection.

[5]This assumption will be better understood later on.

8.2.2 Equilibrium Cartel Behavior

In this subsection I present the equilibrium behavior of the cartel when both excluded and included buyers are present. In order to simplify the analysis I will assume that there are two groups of buyers with different maximum willingness to pay. To be more specific assume a population of buyers (m_{in}) with a_{in} (the maximum willingness to pay for the included buyers) and a population of buyers (m_{ex}) with a_{ex} (the maximum willingness to pay for the excluded buyers), where subscript *in* is for Included and subscript *ex* for Excluded. Assume that $a_{in} > a_{ex}$ and that $P^m > a_{ex}$ (the group with the lowest willingness to pay is excluded), where P^m is the benchmark uniform (imposing no discrimination) collusive price. I am also assuming that the cartel can identify the two groups[6], with no mimicking. Furthermore and as presented in the graph (8.1), a cartel can only use an exclusionary threat to the "included" buyers and compensate the excluded. The cartel can either compensate the excluded buyers by setting a price $\bar{\mathrm{P}}$ that is just affordable for this group, where $P^{co} \leq \bar{\mathrm{P}} < P^m$ [7], (which generates price discrimination) or set a higher price and make a monetary transfer to the excluded buyers (compensate). However, the last case cannot be an equilibrium response since the cartel can profit from the excluded by offering at least their reservation price (than not selling and paying for compensation which generates a negative return from this group of buyers)[8]. Therefore, the excluded buyers will be offered a lower price than the included. However, I still need to show that the exclusionary threat is credible.

[6]So I implicitly assume that the cartel might suspect that the buyers have different valuations. Thus, it offers the collusive price to all and if a buyer refuses to buy then the cartel is willing to offer a lower price up to the Cournot. I do not investigate the bargaining process that might arise but I definitely know that the equilibrium price for this cohort of buyers needs to be smaller than the collusive and greater or equal than the Cournot.

[7]Since $P^m > a_{ex} \Rightarrow \bar{\mathrm{P}} < P^m$.

[8]$\Pi^m = \Pi^m_{In} + (\bar{\mathrm{P}} - c)Q_{Ex} > \Pi^m_{In} - Comp$ as long as $\bar{\mathrm{P}} - c > 0$. Notice that Π^m_{In} is the part of the collusive profit derived from the inclusive buyers.

8.2.3 Threat of Exclusion

In order to focus entirely on the credibility of the threat of exclusion I will assume that there are no excluded buyers ($m_{ex} = 0$). Therefore, I am looking at the homogenous case (buyers are identical). The demand is defined as $P = a - bQ$, where I have neglected the subscript In because of the buyers homogeneity assumption.

First of all, notice that the threat is credible with respect to the buyers. Being excluded will generate a zero CS which is worse than CS_m (as long as $P^m < a$ which always holds). As for the cartel members, the exclusionary threat will take place after the cartel has been dissolved, since the antitrust authority would have investigated and enforced Cournot competition. Thus, the exclusion of a buyer will take place at the Cournot stage. This means that the cartel members will need to employ a sharp trigger strategy (a cartel re-instate strategy), as defined by P. Schiraldi and F. Nava (2012)[9], given that a buyer has been excluded. At the intervention (by the antitrust authority) stage the suppliers will need to exclude the reporting party, generating Cournot profits smaller than the benchmark case (where everyone is supplied). At the last stage suppliers decide to re-instate the cartel given that the reporting buyers (notice that I am not restricting reporting to only one buyer) has been excluded, in order for the suppliers to have an incentive to punish the reporting party. I also assume that the cartel members know which buyer has reported and from where they buy (which supplier). A strategy of enforced punishment, following P. Schiraldi and F. Nava (2012), can be defined as:

- if: $Q_{m,t-1}$ then $q_{i,m,t}$
- if: $Q_{t-1} > Q_{m,t-1}$ then $q_{i,c,t}$

[9]They define a trigger strategy of an infinitely repeated game where the suppliers might re-instate with a positive probability. Their strategy refinement is more general than mine since I restrict that probability to be equal to one.

- if: reporting in $t-2$ and $Q_{X,t-1}$ then $q_{i,m}$
- if: reporting in $t-2$ and $Q_{c,t-1}$ then $q_{i,c}$

Where $Q_{X,t-1}$ is the aggregate Cournot quantity under exclusion. Notice that the quantity under exclusion needs to be smaller than the Cournot quantity, $Q_{X,t-1} < Q_{c,t-1}$. Subscript t corresponds to time. The first two points, of the above strategy, are the benchmark trigger strategy. These two points state that if in the previous period (t-1) the aggregate quantity was equal to the collusive then the individual supplier should choose the collusive quantity, otherwise choose Cournot. Notice that this strategy corresponds to the benchmark Grim strategy with an infinite punishment. The last two points correspond to the case where a buyer has reported (in t-2) and the cartel needs to employ a strategy to punish the buyer. To be more specific, these two points state that if there was reporting in period t-2 and the supplier has punished the buyer at t-1 ($Q_{X,t-1}$) then the firm should choose the collusive quantity, otherwise choose the Cournot (with an infinite punishment as well). It is implicitly assumed that the anti-trust authority is not able to monitor the market from the second period and onwards. Notice, that the last two points define the out of the equilibrium path (at equilibrium there will be no reporting). However, I need to examine these points in order to verify that the threat is credible.

I also need to show that a discount factor exists that supports such a strategy. To do so I need to compare the stream of profit under compliance and under no compliance, where compliance corresponds to punishing the buyer. The compliance profit is $\Pi_X + \frac{\delta \Pi_m}{1-\delta}$, while the profit without punishment is $\frac{\Pi_c}{1-\delta}$. By setting the compliance profit greater than or equal to the profit without compliance I get the following discount factor requirement:

$$\delta \geq \delta^E = \frac{\Pi_{c,i} - \Pi_{X,i}}{\Pi_{m,i} - \Pi_{X,i}} \tag{8.1}$$

Where superscript E is used to denote the MDF required for this strategy to be credible. Since $\Pi_{m,i} > \Pi_{c,i}$ and both the numerator and denominator are positive then there is a discount factor that supports this strategy (sufficient condition). The above minimum discount factor is calculated based on individual cartel member incentives and assuming that this member will need to punish the reporting buyer (generating $\Pi_{X,i}$). The next step is to compare δ^{E} (defined in equation 8.1) with the benchmark one ($\delta^{Ben} = \frac{\Pi_{d,i}-\Pi_{m,i}}{\Pi_{d,i}-\Pi_{c,i}} \geq \delta^{E}$) and infer which is more binding, where binding refers to the highest MDF. The benchmark MDF will be higher if:

$$\delta^{Ben} > \delta^{E}$$

Rearranging terms:

$$\delta^{Ben}\Pi_{m,i} - \Pi_{c,i} + (1-\delta^{Ben})\Pi_{X,i} > 0$$

This means that it is sufficient to focus on $\delta^{Ben}\Pi_{m,i} - \Pi_{c,i} > 0$. Substituting for δ^{Ben} and rearranging terms:

$$(\Pi_{d,i} - \Pi_{m,i})\Pi_{m,i} > \Pi_{c,i}(\Pi_{d,i} - \Pi_{c,i})$$

Gathering terms with respect to $\Pi_{d,i}$ this gives:

$$\Pi_{d,i}(\Pi_{m,i} - \Pi_{c,i}) - (\Pi^2_{m,i} - \Pi^2_{c,i}) > 0$$

Straightforward algebra gives:

$$\Pi_{d,i} - \Pi_{m,i} - \Pi_{c,i} > 0 \tag{8.2}$$

For the above condition to hold the number of suppliers needs to be larger than 4.[10] However, it will be more interesting to see how the above condition behaves as the number of buyers and the excluded buyers changes. Let define the benchmark MDF, having substituted for $\Pi_{d,i}$, $\Pi_{m,i}$ and $\Pi_{c,i}$:

$$\delta = \frac{(n+1)^2}{(n+1)^2 + 4n} \tag{8.3}$$

Notice that the above MDF depends solely on the number of suppliers (n). I am now going to assume that the size of the market is fixed, while I change the number of buyers (m). Let me also define parameter "A" as the number of buyers that need to be punished, where $A \ \epsilon \ (0, m]$. The size of the market is kept fixed in order to simplify the analysis. Mainly because I am not interested to investigate what happens as the size of the market changes. However, these parameterizations will allow me to examine the impact of the size of buyers (as m increases, keeping constant the size of the market (parameter a), the size of the buyers (quantity per buyer) decreases) and the impact of the number of excluded buyers given the size of the market (as A increases and given m and the size of the market a the number of excluded buyers, which corresponds to higher quantity, increases). Consequently, this assumption allows me to keep the benchmark MDF unchanged with respect to other factors (such as parameters a, b and c) except of n. Notice that I let the max value of A to be m in order to examine what happens if the supplier needs to punish all of their buyers. Additionally, the term $m - A$ will capture the number of buyers that have not reported (and there is no need to punish). Let me now examine what happens with the MDF under the threat of exclusion when the number of buyers changes, keeping the size of the market

[10] Substituting for $\Pi_{d,i} = \frac{(n+1)^2(a-c)^2}{16bn^2}$, $\Pi_{m,i} = \frac{(a-c)^2}{4bn}$ and $\Pi_{c,i} = \frac{(a-c)^2}{(n+1)^2 b}$

unchanged.

Define $\pi_c = \frac{\Pi_{c,i}}{m}$ the per buyer profit of a supplier[11]. Furthermore, define $\Pi_{X,i} = (m - A)\pi_c = \frac{(m-A)\Pi_{c,i}}{m}$. The last equation relates the profits under the threat of exclusion with the ones under the benchmark case. Notice that as the m parameter increases, the cost of the threat of exclusion decreases (since the cost of exclusion is the profit foregone in that period). To be more specific as m$\uparrow$ then $\Pi_{X,i} \uparrow$ (for given A) which means that the foregone profits decreases (cost of implementing this strategy), $\Delta\Pi \downarrow = \Pi_{c,i} - \Pi_{X,i} \uparrow$. The next step is to substitute the above expressions, of the Cournot profits, in the MDF under threat of exclusion. Substituting for $\Pi_{X,i}$ into 8.1 gives:

$$\delta = \frac{\Pi_{c,i} - \frac{(m-A)\Pi_{c,i}}{m}}{\Pi_{m,i} - \frac{(m-A)\Pi_{c,i}}{m}}$$

Substituting for $\Pi_{m,i} = \frac{(a-c)^2}{4bn}$, $\Pi_{c,i} = \frac{(a-c)^2}{(n+1)^2 b}$ and after some algebra I get:

$$\delta = \frac{4An}{m(n-1)^2 + 4nA} \tag{8.4}$$

The new MDF depends on the number of suppliers, the number of buyers and the number of excluded buyers (A). Some comparative statics are reported below:

$$\frac{\vartheta\delta}{\vartheta A} = \frac{4nm(n-1)^2}{(m(n-1)^2 + 4nA)^2} > 0, \tag{8.5}$$

$$\frac{\vartheta\delta}{\vartheta n} = -\frac{4Am(n^2-1)}{(m(n-1)^2 + 4nA)^2} < 0, \tag{8.6}$$

$$\frac{\vartheta\delta}{\vartheta m} = -\frac{4An(n-1)^2}{(m(n-1)^2 + 4nA)^2} < 0 \tag{8.7}$$

[11] Just to remind the reader that both suppliers and buyers are homogeneous. Thus, the profits and the buyers should be equally divided between the firms.

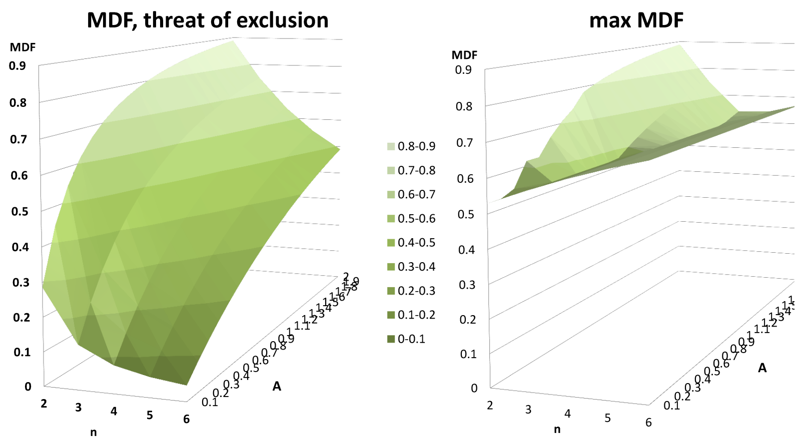

Figure 8.2: Minimum Discount Factor

The first derivative states that as the size of a buyer (A) (or the number of excluded buyers) that needs to be excluded increases the cartel becomes less stable. Due to the fact that the excluded buyers absorb a greater proportion of the profits as (A) increases (the punishment becomes harder to be implemented[12]). While the MDF will be negatively influenced by a change in the number of suppliers (n). This means that as the number of suppliers increases competition becomes more intense and the suppliers can extract less profit per buyer. Hence, the cost of punishment decreases as the number of suppliers, the intensity of competition, increases (see the partial derivative 8.6). Furthermore, as the number of buyers increases (m) the cost of implementing the threat decreases (see the partial derivative 8.7). The intuition is that as m increases the per buyer profit decreases and as a result the cost of punishment decreases. However, I need to be careful how to interpret these comparative statics since the MDF of the benchmark case might dominate (higher) the MDF under the threat of exclusion. The figure 8.2 presents this case.

In the vertical axis I have introduced the MDF and in the horizontal the number of suppliers (taking values from 2 to 6) and the parameter A (taking values from 0.1 to 2). In

[12]More profits need to be foregone.

the first graph I present the MDF under the threat of the exclusion and in the second graph I have plotted the maximum of the MDF under the benchmark trigger strategy and the MDF under the threat of exclusion strategy (the sharp trigger strategy). I have imposed that the maximum number of buyers per supplier to be equal to two (m=2). Notice that for a cartel to be stable the realized discount factor needs to be greater than the surface of the plotted MDF in both the graphs. The MDF under the threat of exclusion takes its maximum when the number of suppliers are 2 (smallest possible) and the supplier needs to punish all of its buyers (m=A=2), while the minimum is generated when the number of suppliers is 6 and the punishment is the smallest of all (A=0.1).

As it was shown (by the comparative statics) the MDF increases as the number of buyers that need to be excluded (parameter A) increases and decreases as the number of suppliers (parameter n) increases. The intuition is simple, as the number of buyers that need to be excluded increases (parameter A) the cost of punishment increases and the cartel member needs to be more patient (willing to sacrifice a greater portion of current date profits with the potential of high profits tomorrow). However, as the number of suppliers increases the cost of the punishment decreases. This is due to the fact that the number of suppliers corresponds to the intensity of competition (à la Cournot) and as a result as n increases the Cournot profits decreases (the cost of foregoing profits decrease) which means that the cartel member needs to be relatively less patient. Hence, there are two effects working in opposite directions, the number of buyers that need to be punished that increases the MDF and the number of suppliers that decreases the MDF generated by the sharp trigger strategy.

However, the MDF under the benchmark case might be greater than the one under the threat of exclusion. This is what I show in the second graph where I have plotted the max MDF. I have identified the regions where the MDF under the threat of exclusion dominates the benchmark MDF and vice versa. The flattened surface is generated due to the benchmark MDF which dominates the new MDF. Notice that the MDF of the benchmark case is independent of A (but not of n) and as a result the MDF is only two dimensional and generates a flat area. As can be seen, the MDF under the threat of exclusion is higher when the number of suppliers is small, while the benchmark MDF dominates from a point and afterwards (for $n \geq 5$, as shown in the previous paragraphs, see 8.2). This suggests that the threat of exclusion is more difficult to sustain if the number of suppliers is small and the number of buyers that need to be punished is large enough.

The threat of exclusion forces buyers that can afford to pay for the increase in prices (included buyers) to accept the benchmark collusive price. While for the excluded buyers, the buyers that cannot afford the increase, the cartel will need to set a price such that they are just indifferent from reporting and to remain in the market (see section 8.2.2). Therefore, price discrimination arises because of the threat of exclusion and the ability of the cartel to identify the excluded buyers.

However, notice that reporting is neutral with respect to the likelihood of collusion, for the range of values ($n \geq 5$) that generate an MDF independent of the factors that influence the compliance strategy (enforcement of the threat of exclusion). This is mainly because the ability of the buyers to report does not constrain the collusive profits and this is because of the threat of exclusion. However, for the region where the MDF of the compliance strategy is higher than the one of the stability then there is a possibility that the true discount factor belongs in between these values ($\delta_s < \delta < \delta_{cp}$, where s is for stability and cp for compliance strategy). This means that the cartel is not possible to form since a compliance strategy to punish reporting is not credible. This is in contrast to what the majority of the research has shown, which argue that for a small number of suppliers collusion is more likely.

To conclude, the threat of exclusion is a credible strategy to control reporting and as a consequence the antitrust authority should take measures to protect buyers from such tactics. Anonymity for the reporting buyer and monitoring of cartel members' behaviour after prosecution is essential (in order to avoid exclusion).

8.3 Heterogenous cost of reporting

This section assumes exogenous differences on cost of reporting. Assume that there are two groups of buyers. A group of population H which faces a cost of reporting v^H and another group of population of size L which faces a cost of reporting v^L, with $v^H > v^L$. Let me remind the reader that the total population of buyers is M. Assume that v^H is such that the high cost group will never report[13]. I will also assume that there are no excluded buyers; the buyers maximum willingness to pay is identical. In order to simplify the analysis it will be assumed that if a cartel is reported, it is going to be punished with a probability equal one (probability of an antitrust authority to detect and successfully prosecute a cartel is one). Last, I assume that the cartel cannot use 3^{rd} degree price discrimination, thus the cartel must set a uniform price under a linear demand. This can be rationalized if the use of 3^{rd} degree price discrimination raises anticompetitive concerns to the antitrust authority. However, the cartel knows which buyers are informed and as a result is able to compensate. Therefore, there is a range on the population of "informed" (where informed from now on will refer to the buyers that are faced with lower cost of reporting) buyers that the cartel will choose to satisfy the ICC while for a sufficiently low number of informed buyers the cartel will choose to compensate these buyers through a monetary transfer[14]. This result is presented in the next proposition.

Proposition 8.3.1 *Compensation as a monetary transfer at equilibrium:*
If $\frac{L}{M^2} \geq \frac{(P^*-c)q^*-\Pi'}{CS(Q_c)-CS(Q_m)-v}$ *the cartel chooses to satisfy the ICC. If* $\frac{L}{M^2} < \frac{(P^*-c)q^*-\Pi'}{CS(Q_c)-CS(Q_m)-v}$ *the*

[13]The buyers are faced with a cost such that $CS_{m,b} > CS_{co} + v^H$

[14]Notice that compensation generates a 3^{rd} degree discrimination. However, the fact that it is is a monetary transfer this will remain unobserved by the antitrust authority. Therefore, satisfying the requirement that there is no *price* discrimination.

cartel chooses to compensate the informed buyers and the optimal quantity will be found at the benchmark case.

Where, Π' are the profits that arise when satisfying the buyers' ICC. The proof is based on comparing the profits when the ICC is satisfied and the profits when compensation is provided. A sketch of the proof is the following:

The maximization problem under compensation is defined as:

$$\arg\max_{q} \Pi = (P_m - c)Q_m - \sum_{j}^{L} \left\{ CS_{c,j} - CS_{m,j} + v \right\} \tag{8.8}$$

Where the compensation is the sum of L buyers CS. By using the terms: $Q_j = \frac{Q}{M}$ and under linear demand $CS = \frac{bQ^2}{2}$ I generate the following profit function:

$$\arg\max_{q} \Pi = (P_m - c)Q_m - \frac{L}{M^2} \left\{ CS_{Q_c} - CS_{Q_m} + v \right\}$$

The above equation is generated by summing L times the expression $CS_{Q_c} - CS_{Q_m} + v$ (homogeneous buyers need to have j identical CS) and by substituting $Q_j = \frac{Q}{M}$ into the CS expressions. In addition, notice that the f.o.c. (first order condition) has a unique solution at Q*. The next step is to compare the profit function as defined by 8.8 with the profit's under ICC (Π'). This comparison generates the condition presented in proposition 8.3.1.

The intuition of the proposition is the following, if the population of informed buyers is low enough then the compensation that needs to be paid is less than the increase in profits by restricting the quantity and as a result the cartel will find it optimal, higher profits, to compensate the informed buyers. In this case the informed buyers are better off than the uninformed, since the informed are compensated. However, the uninformed will benefit if the population of the informed buyers (L) is high enough, since the cartel will decide to satisfy the ICC (by setting a lower price). As a result the number of informed buyers constrains the ability of the cartel to extract CS from the uninformed buyers.

Moreover, notice that the price will exhibit a jump in prices (from the price that satisfies the ICC of the informed buyers to the benchmark collusive), as the ratio of the population changes. This is achieved when the population ratio $\frac{L}{M^2}$ is initially lower than $\frac{(P^*-c)q^*-\Pi'}{CS(Q_c)-CS(Q_m)-v}$ and then increases beyond that point. Notice that in this case the likelihood of collusion will depend on the population of the informed buyers. As L increases the collusive profits decrease (in the case where compensation needs to be paid) and the likelihood increases (see Proposition 7.1.6[15]). In the case where the cartel needs to satisfy the buyers' ICC, an increase on the L share of the population will not have an impact to the collusive profits (the cartel is already satisfying the incentives of the informed buyers) therefore no impact on the likelihood of collusion either.

Finally, when the cartel is able to price discriminately then it will find it optimal to set a price (P^L) to the informed buyers which satisfies their ICC and the benchmark collusive price to the uninformed buyers. In this case the uninformed buyers do not benefit from the existence of the informed buyers. Therefore, price discrimination can be used as a tool for the cartel to control reporting[16]. Notice that price discrimination does not arise on differences of maximum willingness to pay between different groups of buyers, or the size of the markets, but merely from the fact that buyers are either informed on the existence of a cartel and can report or not.

[15]Actually this is a straightforward result from proposition 7.1.6 and 8.3.1. By proposition 8.3.1 as the population of informed buyers increases the collusive profits decreases. Hence, in this case the population parameter has the same properties of the cost of reporting. To be more specific both are binding the collusive profits (under both cases the cartel is forced to satisfy the ICC) and this is the driving force of proposition 7.1.6. The only difference is that the two effect have an opposite, with respect to the sign, impact on the likelihood of collusion.

[16]The no arbitrage assumption for a 3^{rd} degree price discrimination applies.

8.4 A Comparison with Treble Damages

Let me now compare the results of the previous sections to the ones in the treble damages literature. Spulber (1989) uses a cost for legal action and reaches to similar conclusions on how the cartel chooses its quantity but does not investigate the cartel's stability, some further differences will be presented in this section as well. However, I need first to introduce buyers' choice of taking legal action in the basic model, in order to compare the two policies.

Let me define the cost of taking a case to the court as k. I assume that the damages that can be retrieved by the buyers are just once, and not triple, the difference between CS under Cournot and collusion[17]. Furthermore, the game needs to be redefined in order to include the possibility that buyers can take legal action. The cartel's and antitrust authority's choice set remains unchanged but the buyers can also choose to take the cartel to the court in period zero. If the buyers win the case they receive the exact amount of their damages in the next period, $CS_{co} - CS_m$, and the antitrust authority punishes the cartel in period 2[18]. If the buyers lose the case they have to pay the legal expenses, k. In addition, if the buyers were unsuccessful in winning the case, the antitrust authority will not take any further measures against the cartel. Furthermore, I have assumed that if a buyer reports then it takes one period for an antitrust authority to investigate and dissolve a cartel. In this way I am capturing the fact that antitrust authority's investigations are time demanding. The time-line is presented in figure (8.3).

Moreover, I am going to assume that the antitrust authority punishes the cartel with a penalty $Pen(Q)$ whenever a cartel is found either because of reporting or because the buyers won a case in the court. Assume that, $Pen'(Q) < 0$, the penalty increases as the quantity decreases and $Pen''(Q) > 0$. Furthermore, I allow the buyers to report first and then take legal action. If reporting happens and the antitrust authority traces the existence of a cartel,

[17] This is a simplifying assumption.

[18] The antitrust authority observes the decision of the court and then takes further action

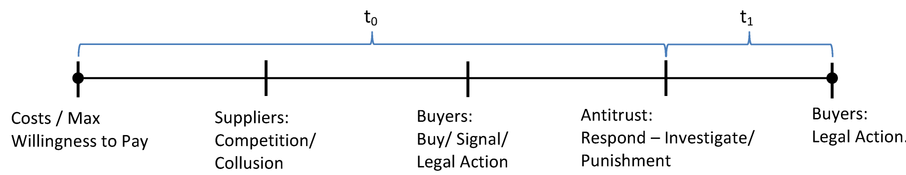

Figure 8.3: Timeline Extended, Ch. 8

the buyers can sue and win with probability equal to 1. Moreover, I will assume a type I error, there is a cartel but the antitrust authority fails to successfully dissolve it. This will be captured by introducing a probability h for an antitrust authority to successfully punish a cartel.

The analysis that am presenting in this section is based on comparing the different actions of the players and identifying their optimal behavior. I first define the buyers' value function from reporting the cartel:

$$V_r = CS_m + \frac{h\delta CS_{co}}{1-\delta} + \frac{(1-h)\delta CS_m}{1-\delta} - v \tag{8.9}$$

Where subscript r is for reporting, h the probability of a cartel being punished and δ the discount factor (used for the buyers to discount the future). Notice that the parameter h captures the uncertainty to the benefits of a successful antitrust authority investigation. This was done in order to enrich the framework and as a robustness check on the driving forces of reporting. Furthermore and in contrast to the previous chapter, the discount factor appears to the buyers payoff function. This is a result of the assumption that punishment of the antitrust authority and court decisions are taken in the next period. Notice that in the previous chapter the discount factor did not appear because the buyers had an incentive to report from the first period (since the cartel was dissolved immediately).

The buyers' payoff when they first report and then take legal action is:

$$V_{r,l} = CS_m + h\delta^2(CS_{co} - CS)m) + \frac{h\delta CS_{co}}{(1-\delta)} + \frac{(1-h)\delta CS_m}{(1-\delta)} - v \tag{8.10}$$

Where the subscript l is for legal action. Notice that the term $CS_{co} - CS_m$ appears in equation 8.10. This term is the damages paid to the buyers when a case in the court is won. The damages are multiplied by the discount factor raised to the square; this is due to the assumption that legal action will be chosen in period one and the decision of the court will be formalized in period two. Thus, the benefits of this action will be enjoyed in the second period while the costs will be borne at period zero. Moreover, there are no costs of taking a legal action since if the antitrust authority has penalized the cartel, with probability h, then the buyers will win the case for sure and the legal costs will be paid by the cartel (if the antitrust authority has not found a cartel then the buyers have no incentive to take a legal action). I implicitly assume that if the antitrust authority fails to penalize a cartel then the buyers or the antitrust authority cannot pursue a retrial[19]. Finally, it is trivial to show that $V_{r,l} > V_r$. This means that the buyers should always prefer to report and claim damages than just to report.

According to the EU Green Paper[20], the buyers are failing to reclaim their damages in most antitrust authority cases. This means that $V_{r,l} < V_r$. For this case to hold the buyers need to face costs that make them unwilling to reclaim damages or faced with difficulties to prove that they have been directly harmed by the activities of the cartel. This means that the equation 8.10 should account for these factors as well. I believe that this will be driven by the difficulty of the buyers to legally prove that they have been directly damaged by the cartel[21].

[19]On the other hand, even if I allow for a retrial, or appeal, the results should not change much. Almost certainly, the probability of a cartel to be punished will be a more complex expression of the sum on future probabilities of winning the case. In any case this scenario is left for future research. Furthermore, Bourjade, Ray and Seabright (2009) have investigated the implication on private enforcement of allowing pre-trail bargaining. Consequently, it would also be interesting to extend the current model in the same direction with Bourjade, Ray and Seabright (2009).

[20]See EU website: $http://eur-lex.europa.eu/LexUriServ/site/en/com/2005/com2005\_0672en01.pdf$.

[21]This has also been the main argument presented in the Green paper.

As a result I will assume that the buyers will win a legal action with probability $h_b < 1$ if a cartel is found, thus introducing another source of uncertainty. Therefore, I redefine the buyers' value function as:

$$V'_{r,l} = CS_m + h\delta^2 h_b(CS_{co} - CS_m) - h\delta^2(1 - h_b)k + \frac{h\delta CS_c}{(1-\delta)} + \frac{(1-h)\delta CS_m}{(1-\delta)} - v \quad (8.11)$$

Notice that now k appears in equation 8.11. This is due to the fact that the buyers are faced with a positive probability to lose the court case even though a cartel has been found by the antitrust authority. For the findings of the Green Paper to hold (buyers failure to take a legal action), equation (8.9) needs to be greater than (8.11) which means that the expected gain from taking a legal action is smaller than the expected costs, $h_b(CS_{co} - CS_m) - (1 - h_b)k < 0$. The parameter h_b will increase when the legal barriers are reduced. This is mainly because it becomes less difficult to prove that the cartel has inflicted damages on the buyers. While if procedural barriers decreases then k (the cost) decreases. This provides us with the following condition, such that there is only reporting (derived by comparing equation 8.9 and 8.11):

$$h_b < \frac{k}{CS_{co} - CS_m + k} \quad (8.12)$$

Let me now assume that the buyers are choosing only to take a legal action, without reporting first to the antitrust authority. The buyers payoff function is then defined as:

$$V_l = CS_m + hh_b\delta(CS_{co} - CS_m) - ((1-h) + h(1-h_b))k + \frac{h\delta CS_{co}}{(1-\delta)} + \frac{(1-h)\delta CS_m}{(1-\delta)} \quad (8.13)$$

Notice that k now appears without a discount factor, this is because the legal action is taking place in period zero. Furthermore, the expected benefit from taking a legal action, the term $hh_b\delta(CS_{co} - CS_m)$, is discounted because of the assumption that damages are going to be paid in the next period. Additionally, the legal expenses are multiplied by the probability that the court acknowledges that a cartel exists but fails to link the buyers with any damages and the probability that the court has ruled against the existence of the cartel. Moreover, the discounted utility (the last two expressions of the right hand side of 8.13) are independent on h_b. This is mainly because the antitrust authority will take measures against the cartel and impose Cournot if the court has decided that a cartel exists, irrespective of the decision of the court on whether the buyers have suffered any damages. Hence, the next period's CS is conditional on the probability of a cartel being found, but the buyers damages payment depends on whether they have successfully proven direct harm. Finally, for equation 8.9 to be greater than equation 8.13 the following needs to hold:

$$h < \frac{k - v}{h_b(\delta(CS_{co} - CSm) + k)} \tag{8.14}$$

Condition (8.14) states that if the probability of a cartel being punished is smaller (low enough) than the right hand side then the buyers will prefer to report than take immediately a legal action against the cartel, given that condition (8.12) holds. If condition (8.12) does not hold then I need to compare (8.11) with (8.13). To be more specific, I need to compare the value function of reporting and taking legal action with just taking legal action. For the former to generate a higher value for the buyers, the following condition needs to be satisfied:

$$h < \frac{k - v}{k(\delta(1 - h_b) + h_b)} \tag{8.15}$$

This condition states that the probability of a cartel being punished needs to be sufficiently low for the buyers to report and take legal action than simply taking legal action. In other words, the buyers are willing to pay the cost of reporting to dissolve the uncertainty with respect to the existence of a cartel and then take a legal action. Therefore, if the buyers take a legal action they will only need to prove direct damage from the cartel than the existence of the cartel as well.

All in all, the above analysis states that private enforcement does not necessarily fail in the presence of limited legal actions, as it is implicitly suggested by the EU antitrust authority. On the contrary, the analysis suggests that the buyers are behaving according to their incentives when faced with different challenges and as a consequence the private enforcement is present in the EU context. It is just uses another mean to an end.

Cartel's Incentives

The next step is to examine the incentives of the cartel. The cartel can choose either to ignore the buyers' incentives and take the risk of being reported (benchmark maximization problem) or make the buyers just indifferent from taking any action (satisfying the buyers ICC). The option of not satisfying the buyers' ICC is a consequence of relaxing the assumption that the cartel will be punished with probability 1 (the h parameter). Therefore, there are two different approaches with respect to profit maximization. The first one is the benchmark case where the cartel maximizes its expected profits while the second one is to satisfy the buyers ICC. Assume that condition (8.14) and (8.15) holds; the cartel knows that the buyers prefer reporting to any other action. As a result, the quantity satisfying the ICC of the buyers will be found by setting equation (8.9) equal to $\frac{CS_m}{(1-\delta)}$, see proposition 7.1.3 (this generates the following equation $CS_m = CS_{co} - \frac{(1-\delta)v}{h\delta}$ which will define the quantity that satisfies the ICC). However, another condition needs to be found such that the cartel will prefer to satisfy the ICC than take the risk to be reported (benchmark collusive quantity). The condition will be found by setting the collusive profits when satisfying the ICC, $\Pi_{m,L}$, greater or equal than the expected profits when the ICC is not satisfied, $\frac{\Pi_{m,L}}{(1-\delta)} \geq \Pi_{m,b} - h\delta Pen(Q_{m,b}) + \frac{h\delta\Pi_{co}}{(1-\delta)} + \frac{(1-h)\delta\Pi_{m,b}}{(1-\delta)}$. Where

$\Pi_{m,b}$ is the collusive profit when the cartel maximizes the expected profit. By comparing the profit functions and substituting for $Pen(Q_{m,b}) = \Pi_{m,b} - \Pi_{co}$, I reach the following condition:

$$h \geq \frac{\Pi_{m,b} - \Pi_{m,L}}{\delta(2-\delta)(\Pi_{m,b} - \Pi_{co})} \tag{8.16}$$

For the right hand side to be smaller than one it has to be that $\Pi_{m,L} > (1-\delta)^2\Pi_{m,b} + \delta(2-\delta)\Pi_{co}$. To be more precise, the collusive profits under the ICC condition need to be sufficiently high or equivalently the reporting cost, which defines $\Pi_{m,L}$, needs to be sufficiently high.

Assume condition (8.15) hold and (8.14) does not hold; the buyers prefer to report and take a legal action afterwards. The cartel needs to satisfy an ICC which is found by setting equation 8.12 equal to $\frac{CS_m}{(1-\delta)}$. Consequently, the ICC is defined as:

$$CS_m = CS_{co} - \frac{(1-\delta)v}{h\delta[1+\delta h_b(1-\delta)]} - \frac{\delta(1-\delta)(1-h_b)k}{1+\delta h_b(1-\delta)} \tag{8.17}$$

The cartel will satisfy the above condition if the profits that arise, which will be defined as $\Pi_{m,rl}$ are greater than the expected profit of the benchmark maximization problem. Hence, a new condition arises from the comparison of the two profit functions: $\frac{\Pi_{m,rl}}{(1-\delta)} \geq \Pi_{b,rl} - h\delta Pen(Q^{b,rl}) - hh_b\delta^2(CS_{co} - CS_{b,rl} + k) + \frac{h\delta\Pi_{co}}{(1-\delta)} + \frac{(1-h)\delta\Pi_{b,rl}}{(1-\delta)}$. Where $\Pi_{b,rl}$ is the collusive profit under the benchmark maximization problem. A further simplifying assumption is needed; I am going to assume that $t_{b,rl}(\Pi_{b,rl} - \Pi_{co}) = CS_{co} - CS_{b,rl}$[22]. In other words, the difference of the CS can be expressed as the difference of the collusive and Cournot profits times a multiplier, $t_{m,bl}$, which is greater than one. Therefore, the condition is defined as:

$$h \geq \frac{\Pi_{b,rl} - \Pi_{m,rl}}{\delta[(\Pi_{b,rl} - \Pi_{co})(2-\delta+h_b t_{b,rl}\delta(1-\delta)) + kh_b\delta(1-\delta)]} \tag{8.18}$$

[22]This assumption, even though not necessary, will help me to find a well-defined condition.

Notice that the right hand side of the above condition is going to be smaller than one for a sufficiently high discount factor. This is a similar condition with (8.16) the only difference is that I have a different ICC that needs to be satisfied and as a consequence a different expression for the collusive profits.

For the buyers to prefer to take the initiative of suing the cartel from the first period, it has to be that neither (8.15) nor (8.14) holds. In this case, the ICC that needs to be satisfied is[23]:

$$CS_m = CS_{co} - \frac{(1 - hh_b)(1 - \delta)k}{h\delta(1 + h_b(1 - \delta))} \tag{8.19}$$

For a cartel to satisfy the buyers' ICC (equation 8.19) it needs to generate greater profits than the expected profits of taking the risk of being sued. This generates the following condition: $\frac{\Pi_{m,l}}{(1-\delta)} \geq \Pi_{b,l} - h\delta^2 Pen(q_{b,l}) - hh_b\delta(CS_{co} - CS_{b,l} + k) + \frac{h\delta\Pi_{co}}{(1-\delta)} + \frac{(1-h)\delta\Pi_{b,l}}{(1-\delta)}$[24]. Where $\Pi_{b,l}$ is the benchmark collusive profit when the buyers decide to take a legal action from period zero. The condition for the last inequality to hold is:

$$h \geq \frac{\Pi_{b,l} - \Pi_{m,l}}{\delta[(\Pi_{b,l} - \Pi_{co})(1 + \delta(1 - \delta)(1 + h_b t_{b,l})) + h_b k]} \tag{8.20}$$

The above condition states that for the cartel to choose to satisfy the buyers ICC the risk of being punished (h) needs to be sufficiently high. For illustration, I present in figure (8.4) the equilibrium behavior of the cartel for different parameter values of h for a given ICC of the buyer (assuming for example that the buyers will always take a legal action first).

In the horizontal axis (of figure 8.4) I have plotted the probability of a cartel to be

[23]The condition is found by rearranging terms in $\frac{CS_m}{(1-\delta)} = CS_m - \delta[(1 - h) + h(1 - h_b)]k + \delta hh_b(CS_{co} - CS_m) + \frac{\delta hCS_{co}}{(1-\delta)} + \frac{\delta(1-h)CS_m}{(1-\delta)}$.

[24]Notice that the structure of the penalty is assumed to be the same as with the previous cases ($Pen(q_{b,l}) = \Pi_{b,l} - \Pi_{co}$). I implicitly assume that if a cartel is found the anti-trust authority will be able to calculate the true level of damages (no error on calculating the penalty).

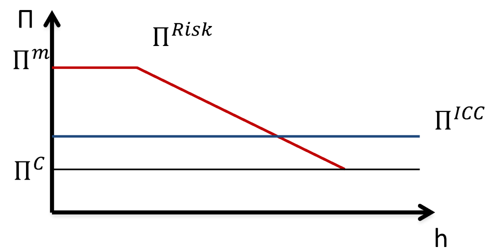

Figure 8.4: Cartel Incentives

punished (h) and on the vertical the profits. The lower profit sustained is the Cournot (Π^c) and the maximum is the benchmark collusive (Π^m). The cartel has two strategies. The first one is to satisfy the buyers ICC which generates Π^{ICC}. The profit of this strategy is independent of the punishment probability (h), since by definition the cartel will not be reported. The second strategy is to choose the benchmark collusive quantity and take the risk of being punished (Π^{Risk}), notice that there is a probability of $1-h$ that a cartel will not be punished. This strategy will generate expected profits which are declining to the h parameter. The equilibrium strategy will be the one that generates the higher stream of profits. To be more specific, for high values of h the strategy which satisfies the buyers ICC generates the highest profits, thus the optimal one. This is what condition 8.20 states.

Using this approach (comparing the different strategies of the cartel to characterize the optimal behavior) I have characterized the equilibrium behavior for all the parameter values of h and h_b. In other words, the parameter values of h and h_b will generate a specific behavior of the buyers (i.e. report or report and take legal action or even take a legal action) and given that behavior I found conditions for the optimal behavior of the cartel (satisfy buyers ICC or take the risk of being reported). The full equilibrium characterization, of each subcase, is presented in table 8.1. However, notice that the factor $t_{b,rl}$ presented in that table (which simplifies the buyers damages paid by the cartel) is going to be different than the one used in the previous case ($t_{b,l}$) since $Q_{b,l} \neq Q_{b,rl}$ and $\Pi_{b,l} > \Pi_{b,rl}$. This is because the cartel is going to be punished by the antitrust authority and pay a penalty, with probability h, in period 2 for $\Pi_{b,rl}$ while for $\Pi_{b,l}$ the penalty is paid in period one.

Buyers			
	Reporting	Reporting & Legal Action	Legal Action
Condition	$h_b < \frac{k}{CS_c - CS_m + k}$ $h < \frac{k-v}{k(\delta(1-h_b)+h_b)}$	$h_b > \frac{k}{CS_c - CS_m + k}$ $h > \frac{k-v}{h_b(\delta(CS_c - CS_m)+k)}$	$h > \frac{k-v}{k(\delta(1-h_b)+h_b)}$ $h > \frac{k-v}{h_b(\delta(CS_c - CS_m)+k)}$
ICC	$CS_m = CS_c - \frac{(1-\delta)v}{h\delta}$	$CS_m = CS_c - \frac{(1-\delta)v}{h\delta(1+\delta h_b(1-\delta))} - \frac{\delta(1-\delta)(1-h_b)k}{1+\delta h_b(1-\delta)}$	$CS_m = CS_c - \frac{(1-hh_b)(1-\delta)k}{h\delta(1+h_b(1-\delta))}$
Cartel			
Condition to satisfy ICC	$h \geq \frac{\Pi_b - \Pi_{m,l}}{\delta(2-\delta)(\Pi_b - \Pi_c)}$	$h \geq \frac{\Pi_{b,rl} - \Pi_{m,rl}}{\delta[(\Pi_{b,rl} - \Pi_c)(2-\delta+h_b t_{b,rl}\delta(1-\delta)) + kh_b\delta(1-\delta)]}$	$h \geq \frac{\Pi_{b,l} - \Pi_{m,l}}{\delta[(\Pi_{b,l} - \Pi_c)(1+\delta(1-\delta)(1+h_b t_{b,l})) + h_b k]}$
Inefficiencies	v	$k+v$	k
Deterrence, when ICC is satisfied	$\Pi_b - \Pi_{m,r}$	$\Pi_b - \Pi_{m,rl}$	$\Pi_b - \Pi_{m,l}$

Table 8.1: Reporting vs. Treble Damages

In table (8.1) the inefficiencies and the deterrent effect for each state are also reported. The inefficiency is normally defined as the difference from the social optimum. In this chapter I define the inefficiency as the difference of the social optimum from the sum of the collusive profit, the penalty paid to the antitrust authority, the damages paid to the buyers and the enforcement costs. In the latter case, the inefficiency under treble damages is always going to be greater than the case with reporting. The main reason for this result is that with both public and private enforcement, the damages paid to the buyers is always going to be greater than the cost of reporting (the penalty is going to be the same whether the buyers report or take a legal action). While the deterrent effect is measured as the actual reduction of the collusive profits relative to the benchmark case. For instance, when buyers report a cartel the deterrent effect will be equal to $\Pi_b - \Pi_{m,L}$. Hence, the case with the highest deterrent effect will be the one with the lowest value on the ICC. This is not helpful since the conditions given for each case to hold are derived from comparing the best alternatives of the buyers. In other words, the deterrent effect cannot be compared between the different cases. However, if the probability of a cartel being punished is such that the cartel chooses not to satisfy the ICC then the deterrent effect is equal to the penalty of the antitrust authority.

Furthermore, the equilibrium is characterized in the "Condition to Satisfy ICC" row for each subcase. In other words, given the values for k, v, and h_b there is an h value for the buyers either to report or take legal action or even report first and then take legal actions. At the same time, there is a value of h for each subcase that the cartel will decide to satisfy the buyers ICC, otherwise it sets the benchmark collusive quantity and takes the risk of being reported.

An interesting result that emerges is that the most inefficient case is when the buyers choose both to report and take a legal action. The intuition for this case is that the society needs to pay both the cost of reporting and the cost of legal actions to punish the cartel. Furthermore, the following proposition states that the most efficient policy is the one under reporting.

Proposition 8.4.1 *The most efficient policy is reporting, given the assumptions of this section.*

For the proof see appendix. The intuition is simple, in the treble damages case the cartel will need to pay for damages both to the antitrust authority and the buyers which means that it is not, any more, a mere monetary transfer (of excess profits transferred to the buyers or the antitrust authority). Moreover, in the proof it is shown that the relative inefficiency is independent of the penalty. If this is not the case then the penalty structure will influence the expected collusive profits and as a result will generate a deterrent effect (the efficiency in this case depends on the penalty structure).

To sum up, the best policy with respect to efficiency is to promote reporting, whether the condition for a cartel to satisfy the ICC holds or not. As for the deterrent effect it seems that it depends mainly on the best alternative of the buyers. However, the antitrust authority can always construct a penalty structure that incorporates the reduction of the profits by a private deterrent policy. Thus, with respect to both efficiency and deterrent reporting is the best choice. Finally, it seems that the EU officials have wrongfully predicted that the private enforcement has failed in EU. On the contrary, the private enforcement had its share of success; it has found another means to an end.

8.5 Conclusion

In this chapter I have shown that the threat of exclusion is a robust strategy for a cartel to enforce no reporting. However, the credibility of this threat depends positively on the number of buyers and the number of suppliers and negatively the number of buyers that need to be excluded. When I introduce heterogeneous costs of reporting I show that in some cases it gives rise to compensation being paid to the buyers with the lowest cost of reporting. At the last section I have compared reporting with buyers taking legal action (treble damages) and have shown that reporting is a more efficient policy.

Chapter 9

Conclusion and Mathematical Appendix

9.1 Conclusion

The purpose of this topic was to examine the impact of reporting on the likelihood of collusion and on social welfare. It is shown that the strategic interaction between buyers and suppliers generates some intuitive results. The cartel will choose its quantity by satisfying the ICC of the buyers. Furthermore, for costly reporting the threat of reporting reduces the collusive profits and increases the likelihood of collusion. At the equilibrium of the simple model there is no reporting from the buyers of the cartel. In other words, it is the mere threat of reporting that influences the results. Reporting will be observed if the assumption of the cartel being punished with certainty, after a buyer's report, is relaxed[1]. The above results suggest some empirical implications. First of all, in markets where buyers are better informed we should

[1]This has been shown in the social welfare section. In that section it was shown that there is a range of values (low enough conviction probability) that the cartel will choose to take the risk of being reported rather than satisfy the buyers ICC.

anticipate collusion more frequently[2]. In addition, the cartels should be more likely to remain hidden and should be more stable (less frequent price wars), when faced with informed buyers.

The results of this topic have some interesting implications on the policies of the antitrust authority. To be more precise, if the antitrust authority reduces the cost of reporting then the society becomes better off, in terms of welfare. To eliminate the cost of reporting, the buyers should be overcompensated for cartel damages. Alternatively, the antitrust authority might set a good practice code to increase the transparency in an industry and as a consequence to minimize the likelihood of collusion.

An alternative mechanism, to control reporting, is proposed in chapter 8. The threat of exclusion, foreclosure, is a robust strategy to deter reporting. However, it was shown that as the size of the buyers increases or the size of suppliers decreases it becomes more difficult to sustain such a strategy. Additionally, I find that as the number of buyers increases the threat becomes more robust. The driving force of this result is the trade-off between foregoing profits in one period and enjoying higher profits in the future. The size of the buyers matters because it corresponds to a higher profit per buyer for a given supplier. The number of suppliers represents the intensity of competition (since I assume competition à la Cournot) and as a result more intense competition reduces the per buyer profit and decreases the cost of the threat. Finally, the number of buyers matters since it decreases the per buyer profit. The credibility of the threat of exclusion suggests that anonymity (for the reporting buyer) and monitoring (cartel members' behavior after prosecution) is essential to protect the buyers from cartel's retaliation tactics.

I also investigate the importance of buyers' information on the cartel's behavior. It has been shown that uninformed buyers benefit from the existence of informed buyers[3] since

[2] In this case I am interpreting the cost of reporting as the cost of acquiring information. Therefore, if the buyers are relatively more informed in some industries then they are less likely to occur high costs of reporting.

[3] Let me remind the reader that I found two cases; a case where the neutrality effect is present (compensating the informed buyers will have no impact on the collusive quantity) and a case where it is not present due

the cartel under some conditions will choose to set a lower than the benchmark (monopoly) price. This result is driven by the assumption that the cartel cannot use 3^{rd} degree price discrimination. If the cartel is able to discriminate then it will find it optimal to set a price for the informed buyers that satisfies their ICC (low) and sell at the benchmark collusive price to the uninformed (high). Most interestingly price discrimination may arise solely due to the information available to the buyers.

Finally, a comparison with the treble damages suggests that reporting is an equivalent policy with respect to the cartel's deterrent effect but more efficient. This result contradicts the conclusions of EU's White Paper of private enforcement failure in the European area. More particularly, the lack of private legal actions does not account for a failure on private enforcement, since the buyers have the choice of reporting. Furthermore, even if reporting or legal actions are not present, this does not mean that private deterrents fails. The reason is that the cartels remain hidden by satisfying the buyers' ICC and as a result the collusive profits are going to be less than the ones with no private enforcement (or the threat of it). For the cartels that are prosecuted it seems that the buyers prefer to report than take any legal action, suggesting that this is their best alternative. However, the findings of this topic agree with some of the conclusions of the EU paper. Private legal actions will increase if the cost of prosecution and the requirements to prove a direct damage from the cartel are reduced.

A natural extension of this topic will be the introduction of dynamics, combined with uncertainty on both the marginal cost of the suppliers and their likelihood of collusion. This is possible if buyers monitoring the suppliers prices is introduced and learning on the marginal cost of their suppliers and the likelihood of collusion is allowed. Further dynamics can be introduced by allowing a stochastic element on the marginal cost.

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to credit constraints. In the case of the neutrality problem the uninformed buyers benefit if the number of buyers is high enough. While in the case where buyers are credit constrained the uninformed buyers always benefit.

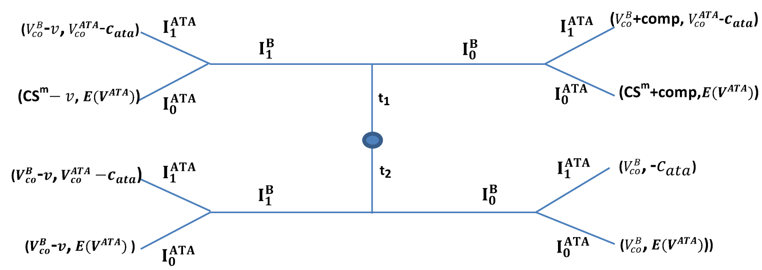

Figure 9.1: Signalling

9.2 Mathematical Appendix

9.2.1 Signalling Game

The signalling game between buyers and antitrust authority takes place after the suppliers have decided whether to collude or not, presented as t_1 and t_2 respectively[4]. If collusion is observed the buyers choose whether to report (signal, $I_1^B = 1$[5]) its existence or not ($I_0^B = 0$) and the antitrust authority choose whether to investigate (respond, $I_1^{ATA} = 1$) or not ($I_0^{ATA} = 0$).

As for the payoffs; if the buyers decide to report and antitrust authority to investigate when there is collusion, then the antitrust authority will achieve a positive return, $V^{ATA} - c^{ATA} > 0$. As for the buyers, they receive CS under Cournot minus the cost of reporting. In other words, if we have $(I_1^B, I_1^{ATA}/t_1)$ then the payoffs of the two players are $(V_c^B - v, V^{ATA} - c^{ATA})$, where subscript "c" is for Cournot, v is for the cost of reporting and c^{ATA} the cost of investigation for the anti-trust authority. When suppliers collude and buyers report but the antitrust authority decides not to investigate then the value function of the antitrust authority will be equal to the expected Social Welfare (SW)[6] ($E(V^{ATA})$). The value function

[4] Notice that the behaviour of suppliers will be taken as given in the signalling game

[5] The notation has been simplified in order to be easily distinguished in the graph since the antitrust authority has a similar binary action

[6] The antitrust authority beliefs are updated

of the buyers is $V_m^B - v$, where the subscript "m" is for collusion, and it is equal to the CS under collusion minus the cost of reporting. To sum up, if $(I_1^B, I_0^{ATA}/t_1)$ the payoffs are $(V_m^B - v, E(V^{ATA}))$. If the buyers do not report but the antitrust authority investigates; then the value function of the antitrust authority will be equal to SW under Cournot minus the cost of reporting, V_c^{ATA} since if it investigates will reveal the cartel and impose Cournot quantities. The buyers receive CS under Cournot plus compensation. So at $(I_0^B, I_1^{ATA}/t_1)$ I have $(V_c^B + comp, V_c^{ATA} - c^{ATA})$. If the suppliers collude, the buyers do not report and the antitrust authority does not investigate $(I_0^B, I_0^{ATA}/t_1)$ then the antitrust authority receives an expected SW without paying a cost of investigation. The buyers' value function will be equal to the CS under collusion plus compensation $(V_m^B + comp, EV^{ATA})$.

As for the case where suppliers are competing à la Cournot; when the buyers report and the antitrust authority investigates $(I_1^B, I_1^{ATA}/t_2)$, the antitrust authority's payoff will be equal to SW under Cournot minus the cost of investigation $(V_c^{ATA} - c^{ATA})$. The buyers, on the other hand, receive CS under Cournot and bear a cost to report $(V_c^B - v, V_c^{ATA} - c^{ATA})$. When suppliers compete à la Cournot, the buyers report and the antitrust authority chooses not to investigate $(I_1^B, I_0^{ATA}/t_2)$, the antitrust authority will receive an expected SW with its beliefs being updated and without bearing the cost of investigation. The buyers in this case will receive CS under Cournot but at the same time incurring the cost of reporting $(V_c^B - v, E(V^{ATA}))$. While if the buyers do not report and the antitrust authority chooses to investigate $(I_0^B, I_1^{ATA}, /t_2)$, the authority's value function will be equal to the SW under Cournot (given the assumption on the priors) but at the same time it will incur the cost of investigation. As for the buyers payoff, it will be equal to the CS under Cournot $(V_c^B, V_c^{ATA} - c^{ATA})$. Finally, if the buyers do not report and the antitrust authority choose not to investigate $(I_0^B, I_0^{ATA}, /t_2)$ then the antitrust authority payoff will be equal to the expected SW without the beliefs being updated and the buyers' payoff will be equal to the CS under Cournot $(V_c^B, V_c^{ATA} - c^{ATA})$.

9.2.2 Proofs for Lemma 2.1.2 and 2.1.4

Notice that some immediate results follow as a consequence of the assumptions and the specification of the payoff functions of the players.

Result 9.2.1 *A pooling equilibrium with buyers always choosing to report cannot exist.*

Proof: If there is no cartel and given that the cost of reporting is positive, $v > 0$, the buyers will not report, irrespective to the antitrust authority's best response. This refers to the t_2 path. This can be seen when comparing the buyers' payoff function, see figure 9.1, when there is competition à la Cournot ($V_c^B - v < V_c^B$).

QED

In other words the existence of a reporting cost enforces the buyers not to report if there is competition à la Cournot.

Result 9.2.2 *There cannot be an equilibrium with the antitrust authority always investigating a market.*

Result 9.2.3 *There cannot be a separating equilibrium with the buyers choosing to report if there is no collusion and not to report if collusion exists.*

The result 9.2.2 follows from result 9.2.1 and the assumption that the prior beliefs of a cartel to exist are equal to zero. As for the third result (9.2.3), it is an extension of the first two. Moreover, the strategies remained to be examined have been reduced even further by the intuitive criterion of Cho and Kreps (1987). Notice that under a pooling equilibrium, there is no updating and as a consequence of that the beliefs of the antitrust authority are equal to zero.

Let me now restate lemma 7.1.1 and provide the proof needed.

Lemma 7.1.1: *Pooling Equilibrium:*

If $v \geq CS_c - CS_m - Comp$, the buyers never report and the antitrust authority choose not to investigate, $(I_0^B, (I_0^A, (I_1^A, Q^A)))$ with $Pr_1 = 0$, no updating. While the antitrust authority investigates whenever there is reporting.

Proof of the 7.1.1 Lemma:

If there is Cournot competition between the suppliers then it is obvious that the buyers will not report, see result 9.2.1. As for the antitrust authority, since there is no reporting there is no updating on their beliefs which means that the best choice is not to investigate, the only choice that provides a non-negative return. Notice that by the prior beliefs of a cartel's probability of existence is zero and as a result the antitrust authority without reporting always believes that the industry is competitive. As a result, $V_c^{ATA} - c^{ATA}$ under no reporting and investigation is always smaller than V_c^{ATA}. On the other hand, under collusion the buyers will not report if the cost of reporting is higher than the gain of switching to Cournot $(v \geq CS_c - CS_m - Comp)$[7]. The antitrust authority's beliefs have not been updated which means that their best choice is not to investigate, as shown previously. As for the out of equilibrium beliefs, if a report is registered the antitrust authority believes that a cartel exists and the best choice is to investigate, by the 9.2.1 result. The other out of equilibrium paths are rejected by the intuitive criterion.

QED

I will now restate lemma 7.1.2 and provide its proof.

Lemma 7.1.2: *Separating Equilibrium:*

If $v < CS_c - CS_m - Comp$, the buyers report under collusion and the antitrust authority investigate, $((I_1^B, I_0^B), ((I_1^A, Q^A), I_0^A))$ with Pr_1 equal to 1 if there is reporting Pr_1 and equal

[7]The condition is found by setting $V^B(I_1^B/I_1^{ATA}, t_1, .) \leq V^B(I_0^B/I_0^{ATA}, t_1, .)$

to zero if not.

Proof of Lemma 7.1.2:

Under Cournot and for a positive cost of reporting the buyers will not report, by the 9.2.1 result. If there is collusion, the buyers will report if the cost of reporting is smaller than the gains of a change of competition ($v < CS_c - CS_m - Comp$), given the antitrust authority's optimal choice[8]. As for the antitrust authority, their beliefs are updated if there is reporting with $P_1 = 1$, because of truth-telling strategies[9], and since its value function is greater under Cournot (even after deducting for the costs of investigation and this holds by assumption) the antitrust authority will choose to investigate ($V_c^{ATA} - c^{ATA} > V_m^{ATA}$). If there is no reporting then $P_1 = 0$ and as a consequence it is better not to investigate, see the proof of lemma 7.1.1.

QED

9.2.3 Proposition 7.1.3

Proposition 7.1.3: *If the condition of the* 2^{nd} *constraint holds and* $v > 0$*, then the optimum collusive quantity and price will be found by setting compensation equal to zero.*

Proof: Let me assume that the 2^{nd} constraint binds (the cost of reporting is sufficiently low). If the cartel choose a quantity that violates the ICC of buyers, compensation is smaller than the right hand side of the second constraint, then by lemma 7.1.2 the buyers will report and the antitrust authority will impose the Cournot equilibrium (the cost of reporting is smaller than the benefits of reporting). Therefore, compensation is necessary for a cartel to form. Let me assume that the cartel sets a quantity that is smaller by ε than the one that makes the buyers indifferent from reporting[10], denoted as Q'. Thus, the buyers need to be

[8] In other words, if they do not report the buyers receive $CS_m + Comp$ while if they report $CS_c - v$ but $CS_c - v > CS_m + Comp$.

[9] No reporting under Cournot.

[10] The quantity that makes buyers just indifferent without being paid any compensation will be found by setting the 2^{nd} constraint equal to zero (comp=0), thus $Q' : CS_m = CS_c - v$

compensated by the decrease of their CS, $Comp = \Delta CS = \int_0^{Q'} P(x)dx - \int_0^{Q'-\varepsilon} P(x)dx = \int_{Q'-\varepsilon}^{Q'} P(x)dx$. While, the additional revenues generated are $\Delta TR = P(Q'-\varepsilon)(Q'\varepsilon) - P(Q')Q'$ which are smaller than the cost of compensation $\Delta TR < \Delta CS$, for any downward sloping inverse demand function. In other words, the collusion generates Dead Weight Loss (DWL) and as a consequence the change on revenues from further decreasing the quantity is going to be smaller than the change on costs ($TR < TC$), which means that it is not optimal to deviate downwards from the buyers indifference point. It is trivial to show that the collusive profits are not maximized when the cartel chooses a quantity that is higher than the one that makes the buyers just indifferent ($CS^c - CS^m - v > 0$) if the cost of reporting is sufficiently small (if the condition for the constraint is binding)[11]. So it is not optimal to deviate upwards either, and as a consequence to that the equilibrium will be found by setting the 2^{nd} constraint equal to zero.

If the cost of reporting is zero then the cartel will not be formed, since it cannot compensate and retrieve positive returns at the same time. If the cost of reporting is higher than $CS^c - CS^{m,be}$ (the ICC is not binding any more), then the optimum will be found by maximizing the profit function of the cartel given the 1^{st} and the 3^{rd} constraint.

QED

[11] If the quantity generated by satisfying the second constraint is larger than the benchmark collusive. So by setting $Q_m^{ben} < Q(ICC)$, where ICC is the quantity derived from the second constraint will generate the condition which requires the cost of reporting to be sufficiently small. To be more specific, from the second constraint by setting compensation equal to zero, $CS_m = CS_c - v$ and since the CS depends positively on the quantity: $q(ICC) = f(,-v)$. Then by setting the latter equation smaller than the benchmark collusive: $Q_m^{ben} < f(,-v)$ which means that $v < G(.,Q_m^{ben})$. Where $f(,-v)$ is a function of the collusive quantity related to the parameters of the model (i.e. maximum willingness to pay) and the cost of reporting. Notice that the minus sign on the cost of reporting is presented in order to show that the collusive quantity depends negatively on the cost of reporting. The $G(.,q_m^{ben}$ is a function that relates the parameters of the collusive quantity to the benchmark one.

9.2.4 Proposition 7.1.5

Proposition 7.1.5: *The cost of reporting influences non-negatively the collusive profits and non-positively the collusive quantity.*

Proof: Assume that the cost of reporting is sufficiently low. Increasing the cost of reporting increases the value of the second constraint and as a consequence the collusive profits will increase (by proposition 7.1.3, a decrease on the cost of reporting increases the CS_m of the second constraint of the cartel's profit maximization problem). For the collusive profits to increase, the quantity needs to decrease. In other words, $\frac{\vartheta \Pi_m}{\vartheta v} = \frac{\vartheta Q_m}{\vartheta v}(\frac{\vartheta P_m}{\vartheta Q_m} Q_m + P_m - c)$, the term in the parenthesis is the difference between Marginal Revenue, MR, and Marginal Cost, MC. For the benchmark case MR needs to be equal to MC which means that for any quantity greater than the benchmark $MR < MC$. Therefore, $\frac{\vartheta P_m}{\vartheta Q_m} Q_m + P_m - c < 0$. Furthermore, the ICC is defined as $CS_m = CS_c - v$ which means that an increase in v decreases CS_m and as a result decreases quantity (since the CS depends positively on the quantity). To be more specific: $\frac{\vartheta CS_m}{\vartheta v} = \frac{\vartheta CS_m}{\vartheta Q_m} \frac{\vartheta Q_m}{\vartheta v} < 0$ and the fact that $\frac{\vartheta CS-m}{\vartheta Q_m} > 0$ this means that $\frac{\vartheta Q_m}{\vartheta v} < 0$ and as a consequence $\frac{\vartheta \Pi_m}{\vartheta v} > 0$. When the benchmark optimum is reached, an increase in the reporting costs neither increases nor decreases collusive profits. As a result of that neither quantity is influenced.

QED

9.2.5 Proposition 7.1.6

Proposition 7.1.6: *The cost of reporting influences negatively the likelihood of collusion, given assumptions 1 and 2.*

Assumptions:

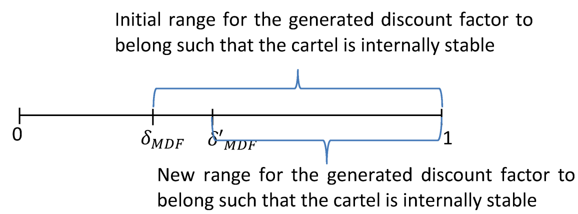

Figure 9.2: Likelihood of Collusion and MDF

1. *Linear Demand*

2. *Independence between the MDF and other factors that influence collusion*

In this section I present two alternative proofs, with the second one being a smaller version.

<u>Proof I:</u>

The minimum discount factor required for an internally stable cartel is defined as:

$$\delta = \frac{\Pi_d - \Pi_m}{\Pi_d - \Pi_c} \tag{9.1}$$

Where Π_d stands for profit under deviation. Moreover, notice that the probability of a generated discount factor be greater than the MDF is negatively influenced by the actual level of MDF. In other words, if the MDF increases then there is a smaller range for the realized discount factor to be generated. The figure 9.2 provides a graphical illustration of the argument.

In other words, an increase of the MDF decreases $f_\delta = Pr(\delta > \delta_{MDF})$. The likelihood is defined by the 2^{nd} assumption. It specifies that an increase on δ_{MDF} decreases both f_δ and the probability of collusion. Thus, it is sufficient to examine what happens to the MDF to infer how the likelihood of collusion changes by the cost of reporting. Let me take the derivative of the MDF (the right hand side of 9.1) with respect to the cost of reporting and after rearranging terms I get:

$$\frac{\vartheta\delta}{\vartheta v} = \frac{\frac{\vartheta\Pi_d}{\vartheta v}(\Pi_m - \Pi_c) - \frac{\vartheta\Pi_m}{\vartheta v}(\Pi_d - \Pi_c)}{(\Pi_d - \Pi_c)^2} \tag{9.2}$$

It is known that $\Pi_d > \Pi_m$ for any $\Pi_m > \Pi_c$. By proposition 7.1.3: $P_d < P_m$, since deviation should happen only to higher quantities and because the collusive quantities is smaller than the benchmark (this holds for any Cournot competition model). By proposition 7.1.5 $\frac{\vartheta q_d}{\vartheta v}, \frac{\vartheta Q_m}{\vartheta v} < 0$. The derivative of the deviation quantity with respect to the cost of reporting is negative since the deviation quantity depends positively on the collusive quantity which in turn depends negatively on the cost of reporting ($\frac{\vartheta q_d}{\vartheta v} = \frac{\vartheta q_d}{\vartheta Q_m}\frac{\vartheta Q_m}{\vartheta v}$). Furthermore, notice that at $v \to v^{max} \Rightarrow \Pi_d \to \Pi_{d,be}$ and $\Pi_m \to \Pi_{m,be}$. Moreover, by the monotonicity of the profit function with respect to the cost of reporting: $\Pi_d < \Pi_{d,be}$ and $\Pi_m < \Pi_{m,be}$. It is also known that $\Pi_{d,be} > \Pi_{m,be}$. Notice also that as $v \to 0$, $\Pi_d = \Pi_m = \Pi_c$. However for $\frac{\vartheta\delta}{\vartheta v}$ to be positive, the following needs to hold (which is found by rearranging 9.2):

$$(1-\delta)\frac{\vartheta\Pi_d}{\vartheta v} - \frac{\vartheta\Pi_m}{\vartheta v} > 0 \tag{9.3}$$

The above condition was found by focusing on the numerator of 9.2 and setting it greater than zero. Then multiply both sides of the inequality with $\Pi_d - \Pi_c$ which gives $\frac{\vartheta\Pi_d}{\vartheta v}\frac{\Pi_m - \Pi_c}{\Pi_d - \Pi_c} - \frac{\vartheta\Pi_m}{\vartheta v}$ and finally the term $\frac{\Pi_m - \Pi_c}{\Pi_d - \Pi_c} = 1 - \delta$. Furthermore, notice that by proposition 7.1.5, an increase on the cost of reporting increases the collusive profits and as a consequence the deviation profits' has to increase as well. Condition 9.3 states that the deviation profits need to change by more than the Cournot, with a change on the reporting cost, for at least some part in the range $[0, v^{max}]$. By the assumption of linear demand the change in the deviation profits is:

$$\frac{\vartheta \Pi_d}{\vartheta v} = \frac{\vartheta q_d}{v}\left(\frac{\vartheta P_d}{\vartheta q_d} * q_d + P_d - c\right) + \frac{\vartheta P_d}{\vartheta Q_{m,-i}} \frac{\vartheta Q_{m,-i}}{\vartheta v} * q_d \tag{9.4}$$

The derivative was taken from the following equation $\Pi_d = (a - c - q_d - Q_{m,-i})q_d$. Where $Q_{m,-i}$ is the collusive quantity of $n-1$ companies, excluding the company that deviates. Notice that the first term in the parenthesis is equal to zero, since the profit maximization assumption states that the First Order Condition, FOC ($MR = MC$), needs to hold[12]. This means that $\frac{\vartheta \Pi_d}{\vartheta v} = -b * \frac{\vartheta Q_{m,-i}}{\vartheta v}$ and by proposition: 7.1.5 $\frac{\vartheta Q_{m,-i}}{\vartheta v} < 0$ which means that $\frac{\vartheta \Pi_d}{\vartheta v} > 0$. The quantity under deviation can be derived from the first order condition of the deviating company's maximization problem: $q_d = \frac{a - c - b * Q_{m,-i}}{2b}$. Moreover, the Cournot quantity is defined as: $q_{c,i} = \frac{a-c}{(n+1)b}$. As a consequence, q_d can be expressed as $q_d = \frac{(n+1)(q_{c,i} - q_{m,i}) + 2q_{m,i}}{2}$. The collusive profits are defined as $\Pi_{m,i} = (P_m - c) * q_{m,i}$. The change of a company's collusive profit is: $\frac{\vartheta \Pi_{m,i}}{\vartheta v} = \frac{\vartheta q_{m,i}}{\vartheta v}\left(\frac{\vartheta P_m}{\vartheta q_{m,i}} q_{m,i} + P_m - c\right)$. Notice that for the collusive profits $MR = MC$ at Π_{be} but in this case $\Pi_{m,i} < \Pi_{be,i}$ which means that $MR < MC$.

Under linear demand $\frac{(\vartheta \Pi_{m,i})}{\vartheta v} = \frac{\vartheta q_{m,i}}{\vartheta v}(-bnq_{m,i} + P_m - c)$, and in the same style with the work on $\frac{\vartheta \Pi_d}{\vartheta v}$ I get: $\frac{\vartheta \Pi_{m,i}}{\vartheta v} = \frac{\vartheta q_{m,i}}{\vartheta v}((n+1)b(q_{c,i} - q_{m,i}) - b(n-1)q_{m,i})$. Substituting the reduced forms of $\frac{\vartheta \Pi_{m,i}}{\vartheta v}$ and $\frac{\vartheta \Pi_d}{\vartheta v}$ into condition 9.3, provides me with the following equation:

$$[n + 1 - \delta(n-1)][(n+1)(q_{c,i} - q_{m,i}) + 2q_{m,i}] > 2q_{m,i}(n+1)$$

Rearranging terms:

$$(n+1)(q_{c,i} - q_{m,i}) > \frac{\delta(n-1)}{(n+1)}[(n+1)(q_{c,i} - q_{m,i}) + 2q_{m,i}] \tag{9.5}$$

[12]Since deviation is achieved by increasing the quantity this means that the ICC is not binding any more and as a result the maximization problem of the deviation company is the benchmark one

Furthermore, notice that the discount factor can be re-written as:

$$\delta = \frac{(n+1)^2(q_{c,i}-q_{m,i})^2}{[(n+1)(q_{c,i}-q_{m,i})+2(q_{c,i}+q_{m,i})](n-1)(q_{c,i}-q_{m,i})} \tag{9.6}$$

The discount factor has been found by using the following equations: $\Pi_d = b(q_d)^2$, $\Pi_{c,i} = b(q_{c,i})^2$ and $\Pi_{m,i} = (b(n+1)(q_{c,i}-q_{m,i}) + bq_{m,i})q_{m,i}$. Substituting the discount factor 9.6 into equation (9.5) I have found that the inequality holds and as a consequence $\frac{\vartheta\delta}{\vartheta v} > 0$.

QED

<u>Proof II:</u> The minimum discount factor is defined as:

$$(1-\delta)\Pi_d + \delta\Pi_{c,i} = \Pi_{m,i}$$

Taking the derivative of the above equation with respect to the collusive quantity this generates the following equation.

$$\frac{\vartheta\Pi_d}{\vartheta q_{m,i}}(1-\delta) - \frac{\vartheta\delta}{\vartheta q_{m,i}}(\Pi_d - \Pi_{c,i}) = \frac{\vartheta\Pi_{m,i}}{\vartheta q_{m,i}}$$

Rearranging terms:

$$\frac{\vartheta\delta}{\vartheta q_{m,i}}(\Pi_d - \Pi_{c,i}) = \frac{\vartheta\Pi_d}{\vartheta q_{m,i}}(1-\delta) - \frac{\vartheta\Pi_{m,i}}{\vartheta q_{m,i}} \tag{9.7}$$

Notice that by proposition 7.1.5 $\frac{\vartheta\Pi_{m,i}}{\vartheta q_{m,i}} > 0$. The next step is to show that $\frac{\vartheta\Pi_d}{\vartheta q_{m,i}} < 0$. Notice that the deviation profit's for linear demand are defined as $\Pi_d = (a - c - bq_d - b(n-1)q_{m,i})q_d$ and the f.o.c.'s generate $q_d = \frac{a-c-b(n-1)q_{m,i}}{2b}$. Notice that $\frac{\vartheta q_d}{\vartheta q_{m,i}} < 0$. Also let me define the deviation profit's as $\Pi_d = bq_d^2$ (substituting the f.o.c. into the profit function). Taking the derivative of the deviation profit function with respect to q_d generates $\vartheta\Pi_d = 2bq_d\vartheta q_d > 0$.

Therefore, $\frac{\vartheta \Pi_d}{\vartheta q_{m,i}} < 0$. As a result the rhs of equation 9.7 is negative. In addition $\Pi_d - \Pi_{c,i} > 0$ (otherwise no cartel can be sustained). Therefore:

$$\frac{\vartheta \delta}{\vartheta q_{m,i}} < 0$$

Furthermore, by proposition 7.1.5 $\frac{\vartheta q_{m,i}}{\vartheta v} < 0$. Therefore:

$$\frac{\vartheta \delta}{\vartheta v} > 0 \tag{9.8}$$

QED

9.2.6 Bertrand Competition

Assume that suppliers compete with respect to prices. Under this case the deviation profits will be equal to the industry's collusive profits, since the deviating company captures the whole market, thus $\Pi_d = n\Pi_{m,i}$. The competitive profits are equal to zero, Bertrand competition drives the prices to the MC. Combining this result I get the following benchmark discount factor:

$$\delta = \frac{n-1}{n} \tag{9.9}$$

Under reporting the cartel still needs to satisfy the ICC of the buyers, define its profit's as $\Pi_{m',i}$, and as a consequence the collusive quantity and profits are still constrained by the cost of reporting. The deviation profits will be equal with n times $\Pi_{m',i}$, since a deviating company will not set a higher price (since it will sell nothing). Thus even though the deviating company is not interested in satisfying the ICC of the buyers (since the buyers will not report the deviator because the cartel will break down in the next period, in any case), to maximize its own profits it will need to set a price just below the one set by the other colluding companies. As a result, $\Pi_d = n\Pi_{m',i}$ which means that the MDF is identical to the benchmark case and is independent on the cost of reporting, see equations below:

$\delta = \frac{\Pi_d - \Pi_{m',i}}{\Pi_d - \Pi_{c,i}}$

$\delta = \frac{n\Pi_{m',i} - \Pi_{m',i}}{n\Pi_{m',i}}$

$\delta = \frac{n-1}{n}$

9.2.7 Proposition 7.2.1

Proposition 7.2.1: *Under the above assumptions, there is a negative relationship between the cost of reporting and the SW.*

Proof:

By the first three assumptions of the proposition, a country's social welfare loss (SWL) will be equal to the probability of an industry to be collusive (likelihood of collusion) times the number of industries (denoted as m) and the DWL. Algebraically this is defined as $SWL = TDWL = m(1-\delta)DWL$, where TDWL is the total DWL. Taking the derivative of the SWL with respect to cost of reporting: $\frac{\vartheta TDWL}{\vartheta v} = m[(1-\delta)\frac{\vartheta DWL}{\vartheta v} - \frac{\vartheta \delta}{\vartheta v}DWL]$. Under linear demand the $DWL = \frac{b(Q_c - Q_m)^2}{2}$, while $\frac{\vartheta DWL}{\vartheta v} = -bn\frac{\vartheta q_{m,i}}{\vartheta v}(Q_c - Q_m)$. As a consequence to that the following equation is generated:

$$\frac{\vartheta TDWL}{\theta v} = m[-(1-\delta)nb\frac{\vartheta q_{m,i}}{\vartheta v}(Q_c - Q_m) - \frac{\vartheta \delta}{\vartheta v}\frac{b(Q_c - Q_m)^2}{2}] \tag{9.10}$$

I then substitute for $\frac{\vartheta \delta}{\vartheta v}$ and $1-\delta$ (which is equal to $\frac{\Pi_m - \Pi_c}{\Pi_d - \Pi_c}$). I then take common factors:

$$\frac{\vartheta TDWL}{\vartheta v} = \frac{-mbn(Q_c - Q_m)}{2\Pi_d - \Pi_c}[2(\Pi_m - \Pi_c)\frac{\vartheta q_{m,i}}{\vartheta v} + \frac{\vartheta \Pi_d}{\vartheta v}(\Pi_m - \Pi_c)(q_{c,i} - q_{m,i}) - \frac{\vartheta \Pi_m}{\vartheta v}(q_{c,i} - q_{m,i})]$$

Then I gather the first and the third term, substitute for $\frac{\vartheta \Pi_m}{\vartheta v}$, $\frac{\vartheta \Pi_d}{\vartheta v}$ [13] and for $\Pi_m - \Pi_c$[14]. As a result and after some algebra I get:

$$\frac{\vartheta TDWL}{\vartheta v} = \frac{-mb^2 n(Q_c - Q_m)(q_{c,i} - q_{m,i})}{2(\Pi_d - \Pi_c)} \frac{\vartheta q_{m,i}}{\vartheta v} [2(nq_{m,i} - q_{c,i}) - (n+1)(q_{c,i} - q_{m,i}) + (n-1)q_{m,i}$$

$$-(n-1)q_d \frac{b(q_{c,i} - q_{m,i})(nq_{m,i} - q_{c,i})}{\Pi_d - \Pi_c}]$$

First of all notice that the common factor is positive, since the derivative of the collusive quantity with respect to the cost of reporting is negative and this is multiplied by a minus. From now on I will ignore the common factor and analyze the terms within the parenthesis. The first three terms, within the parenthesis, can be rewritten as $2nbq_{m,i} - (n+1)bq_{c,i} + 2(nq_{m,i} - q_{c,i})$. Additionally, I use the fact that $nbq_{m,i} - P_m + c \geq 0$[15] which can be rewritten as $2nq_{m,i} - (n+1)q_{c,i}$. This means that the first two terms of $2nbq_{m,i} - (n+1)bq_{c,i} + 2(nq_{m,i} - q_{c,i})$ are positive. Hence I am left with:

$$2(nq_{m,i} - q_{c,i}) - (n-1)q_d \frac{b(q_{c,i} - q_{m,i})(nq_{m,i} - q_{c,i})}{\Pi_d - \Pi_c}$$

Dividing the above terms with $(nq_{m,i} - q_{c,i})$ and multiplying with $\Pi_d - \Pi_c$ I get the following sufficient condition for the $\frac{\vartheta TDWL}{\vartheta v}$ to be non -negative:

$$2(\Pi_d - \Pi_c) - b(n-1)q_d(q_{c,i} - q_{m,i}) \geq 0 \tag{9.11}$$

Thus $\frac{\vartheta TDWL}{\vartheta v} > 0$. Substituting for the deviation and Cournot profits, see proof of proposition 7.1.6, I am left with $2q_d q_{c,i} - 2(q_{c,i})^2$ and it is trivial to show that $q_d > q_{c,i}$. Mainly

[13] The last two equations can be found in the proof of the proposition 7.1.6.

[14] This is equal to $\Pi_m - \Pi_c = b[(q_{c,i} - q_{m,i})(nq_{m,i} - q_{c,i})]$

[15] This is a condition for the collusive profits to be no-negative.

because $q_{d,be}$, which is the minimum value for q_d[16], is going to be greater than $q_{c,i}$. It is also known that $\Pi_d \to \Pi_{c,i}$ as $v \to 0$ and as a consequence $q_d \to q_{c,i}$. By the monotonicity of the demand function the deviation profit's will be monotonically decreasing which means that the deviation quantity will be monotonically decreasing as well. This means that $q_d > q_{c,i}$ for all $v \in [0, v^{max}]$.

QED

9.2.8 Proposition 8.4.1

Proposition 8.4.1: *The most efficient policy is reporting, given the assumptions of this section.*

Proof:

Let the inefficiency be the amount that needs to be paid by the cartel in excess of the value generated in the market. For reporting the inefficiency is defined as:

$$IN_r = h(v + Pen - \Delta\Pi) \tag{9.12}$$

Where IN_r is the inefficiency under the case where buyers report and $\Delta\Pi$ the difference between collusive and Cournot profits. In other words, the inefficiency is created when the cartel members decide to choose a quantity that does not satisfy the ICC (the same case holds for the the treble damages case). As for the treble damages case:

$$IN_l = h(k + Pen + h_b\Delta CS - \Delta\Pi) \tag{9.13}$$

[16] The residual demand shrinks as the collusive quantity increases. Thus the deviation quantity will also decrease as the collusive quantity increases.

IN_l is the inefficiency created in the treble damages case. Notice that the term $h_b \Delta CS$ appears, this is the damages paid to the buyers if they win the court case. The next step is to compare the max inefficiency under the reporting case with the minimum one under treble damages. This is achieved by imposing h^{max} for IN_r and h^{min} for I_l[17]. Notice that $h_r^{max} = h_l^{min}$[18]. Hence, in this case the buyers are actually indifferent between reporting and taking a legal action which means that $v = (1 - h_b)k + h_b \Delta CS$. Setting $IN_r < IN_l$ and substituting the above results I find that the most inefficient case is the treble damages case if $h_b k > 0$ which holds by assumption.

QED

[17]See the table in the previous section

[18]This can be seen in Table 8.1 of the appendix. The minimum bound of the h_r is the maximum bound of h_l

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Conclusion

My thesis was divided into two distinct parts. Both of them investigate the importance of demand side effects to the market structure and competition. In the first part, I have investigated the factors that determine the independent coffee shops exit decision in Central London. I have found that within group competition is more important than between groups' competition. This suggests the existence of product differentiation which can rationalize, according to my theoretical model, the C-Ss failure to dominate the markets (no "clone city" effects) through entry or strategic behavior[19]. The novelty of the first topic is the identification strategy that quantifies the demand market effects (such as an estimate for product differentiation, for income and business density effects) and the increased propensity to consume during the morning hours and at the weekend. Another important aspect of the first topic is the analysis of city planning implications (in metropolitan areas) on market structure. I have found that imposing a cap on the number of new coffee shops in the market will decrease the number of the independents. The intuition is that entry guarantees a natural process of replacement or displacement of unprofitable independents which is restricted by the intervention examined. In the second scenario explored, I have found that placing a targeted cap (restricting the entry of C-Ss when their market share is larger than 40%) is sufficient to guarantee a larger presence of independents in the markets.

[19] An example of C-Ss strategic behavior is presented in the appendix of the first topic. Admittedly I do not investigate whether the strategic behavior is present in the market of coffee shops in Central London but rather I assume that since it is equilibrium behavior it should be present on the data as well.

In the second topic, I have presented a theory of cartel detection. To be more specific, the buyers are informed whether their suppliers are colluding and as a result the cartel needs to satisfy their ICC in order to avoid being detected by the anti-trust authority and getting punished. The fact that the cartel needs to satisfy the buyers' ICC constrains its ability to set a monopoly price. The compliance to lower collusive profits decreases the deviation profits sufficiently to increase the cartel stability (increase the likelihood of collusion). However, it was shown that if the anti-trust authority reduces the cost of reporting then the social welfare will increase (the industries become more likely to collude but this is overcompensated by the Consumer Surplus increase, through a decrease on the collusive price). Furthermore, a comparison with an alternative antitrust policy (treble damages) indicates that reporting is a more efficient policy. An alternative mechanism to control for reporting, foreclosure, is presented. It is shown that the threat of exclusion is a credible threat. The implementation of this mechanism turns out to be easier as the number of buyers and suppliers increases but more difficult as the number of excluded buyers increases. Finally, it was shown that price discrimination can arise from differences on the cost of reporting.

For future research, a dynamic version of the first topic and the introduction of buyers uncertainty on the likelihood of collusion and/or the marginal cost of the buyers might reveal cartel pricing strategies that can be used for, an anti-trust authority, screening the industries. Finally, introducing stochastic elements on the suppliers cost in a context of uncertainty might also be interesting.