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(WRONGLY) REGULATING THE CIGARETTES MARKET

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(WRONGLY) REGULATING THE CIGARETTES MARKET

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Abstract

This paper aims at exploring the peculiarities of the cigarettes market and its consequences in terms of the desired regulation and the impacts of undesired regulatory measures. The main idea behind the paper is the need for complementarity of the regulatory policies independently implemented by different governmental bodies in the presence of a non-negligible black market, not compliant to any regulation. We build a model where companies choose between going legal or illegal – where the latter includes fake products produced locally as well as smuggled cigarettes, but could be easily extended to apply also to legal brands produced by firms not duly collecting their taxes. The companies' choices are influenced by the demand substitutability between the legal product and the illegal one. This paper motivation comes from the recent move of Brazilian authorities to strengthen the control over cigarettes companies and to increase the price of the products, as well as the introduction of standardized packaging in Australia since December 2012. As our model shows, those measures – which only impact the legal market, the one complying with regulatory and sanitary measures – totally backfires in the presence of an important illegal market, as they increase the payoffs and thus incentives of going or remaining illegal. If introduced in such context – quite common in most developing and least developed countries, but not only – they therefore lead to lower product quality and thus huge negative public health impacts.

Key words: *Cigarettes, Regulation, Illegal Markets*

(WRONGLY) REGULATING THE CIGARETTES MARKET

1. Introduction

Recent years have witnessed a strong move towards more strict regulation of the cigarettes markets around the world. Many countries have approved laws prohibiting smoking in public places – such as bars and restaurants – and many others have limited or even abolished cigarettes advertisement as well as the sponsoring of public events. On top of all those limitations – whose motivation is grounded on health problems supposedly caused by smoking – in almost every market the prices of cigarettes have increased due to a hike in taxes on this product to dissuade consumption.

Although an extremely exciting field of work for Industrial Organization (IO) economists – due to intrinsic product characteristics, as well as demand behaviour, market structure and the variety of governmental intervention – the cigarettes market has not received due attention by both theory and econometrics. Those radical changes in cigarettes regulation are seldom studied through formalized economic analysis. It is our purpose to discuss deeply the IO of the cigarettes market throughout this paper.

As reviewed in Salgado (2013), international experience indicates that the increase in taxes alone is commonly not only insufficient but can totally backfire, what is worrisome. Many countries witnessed good-intended policy measures such as tax increase and price rises culminating in an upraise of smuggling and other forms of stepping aside legality, which expose consumers to products of doubtful (if any) sanitary control. Actually, tax increase was seen as enough of a measure only in Australia and Hungary, since such measure was skilfully coupled with an increase in border protection against illegal trade. In those two countries, the intended reduction in overall cigarette consumption was eventually achieved.

A basic premise for the implementation of the increase in taxes is that consumers have no alternative but paying more for the cigarettes they usually consume, or reduce the quantity they smoke. In the limit – according to this premise – consumers could even quit smoking, with some negative impact on tax collected in the present but a possibly positive impact in the future as concerns arguably health conditions and possibly future public budgets. Such basic premise is not, however, a situation that holds clear-cut in a number of countries, especially the low- and medium-income ones where smuggling of cigarettes is frequent. Violating this basic premise can invalidate the results of tax increase measures.

Notwithstanding, in spite of country-specificities, world measures towards smoking combat are rather unified. According to WHO (2011), “in 2008, to help countries fulfill their WHO Framework Convention on Tobacco Control (FCTC) obligations, WHO introduced the MPOWER package of six evidence-based tobacco control measures that are proven to reduce tobacco use. MPOWER refers to M: Monitoring tobacco use and prevention policies; P: Protecting people from tobacco smoke; O: Offering help to quit tobacco use; W: Warning about the dangers of tobacco; E: Enforcing bans on tobacco advertising, promotion and sponsorship; and R: Raising taxes on tobacco. Each measure reflects one or more provisions of the WHO FCTC, and the package of six measures is an important entry point for scaling up efforts to reduce the demand for tobacco”. No distinction is made between developing and developed economies, all having their tobacco control policies being measured according to the same standards. We perceive this unified treatment as disturbing and misleading if a significant illegal cigarettes market exists. Ignoring the existence of such a market in both theoretical modelling and policy implementation is a mistake, allowing for wrong conclusions.

The present paper takes the illegal market into account. Our analysis challenges the measures affecting asymmetrically the companies legally established in the market and the cigarettes illegally introduced in the market of most developing countries, Brazil in particular.

There is little doubt the first four measures of MPOWER are positive for reducing the act of smoking as they affect the behaviour of people in general, and thus the legal and illegal companies symmetrically. However, it is our understanding that measures E and R only impact the legal market, restricting solely the activity of the legally constituted companies. This is of crucial importance in countries where the illegal market takes a relevant share, implying that these measures E and R can completely backfire.

We thus claim in this paper that developing countries have specificities not allowing one to analyse their cigarettes market within the same framework used for the developed world, especially in what regards the effectiveness and self-sufficiency of tax measures to dissuade cigarette consumption in a context of non-negligible illegal markets. As emphasized already in their abstract by Global Analysis Project Team (2013) – a very recent publication on the effectiveness of tobacco control policies in Thailand and Zimbabwe, “it cannot be assumed, therefore, that the tobacco control strategies being implemented in industrialized countries will be just as effective and appropriate when implemented in developing countries”. The authors go on emphasizing that “there is an urgent need to expand the number of such tobacco policy studies, particularly in low-income and middle-income countries”.

The present paper intends to contribute in filling some of these gaps in, and some branches of literature relevant for our study will be quickly reviewed in the paper. The first is the Law and Economics of compliance to regulatory measures. The second branch of literature of interest is the one focused on the structure of the cigarettes market itself, its particularities and segmentation. Those two efforts are crucial to the theoretical model presented in this paper. A third relevant branch of literature refers to the empirical techniques used in strategies of estimating the demand in such market in order to forecast the impact of regulatory measures such as tax increases. That part of the paper is more subject to future changes, since we still depend on data availability. With data in hands, we will be able to specify the precise econometric model, proceed to empirical parameter estimations and discuss results, before eventually drawing conclusive policy recommendations.

This paper is organized as follows. In the next section we introduce some background on the Law and Economics of the cigarettes market and its regulation. In section 3 we present the structure of demand and supply decisions in the cigarettes market when there exists a relevant illegal market in the geographical market being analysed. Section 4 presents our theoretical model and explores its main results. Section 5 presents our empirical strategy to complement the theoretical analysis we developed previously, which sets the demand side under thorough scrutiny. Section 6 concludes this paper.

2. Law and Economics of the cigarettes market

The cigarettes market is certainly one of the most fascinating markets for an Industrial Organization economist. It deals with a good showing features of experience good – one has to taste it to know if he/she likes it – and of credential good – only an expert in a laboratory can attest its quality and adequacy to consumption; a good whose consumption can be time-dependent; a good whose consumption in public spaces generates negative externalities to other people; a good that provides some pleasure in the short term for the consumer but supposedly has longer term effects on the smoker but not only; a good whose consumption decision – at least as it concerns preferred brand – is highly influenced by advertisement and marketing strategies of the firms in the sector.

Cigarettes are goods in their own class. In spite of being frequently pointed out as some sort of licit drug, they do indeed deliver pleasure for their consumers and work as some social signalling device. Moreover, the cigarettes market is not only one of the most regulated markets all over the world, but certainly bears a record of changes in regulation. As such, economic regulation towards this product is one of a kind.

On the other hand, as an economic activity tobacco is a culture responsible for a significant volume of jobs and income. In Brazil, family-run farms are the main tobacco growers, contributing to both rural employment and empowerment. For this reason, tough public policies looking at reducing the consumption of cigarettes are often received with criticism and organized *résistance* from both small farmers and large companies.

Data relating to cigarettes consumption and supposed health impacts are quite abundant. According to WHO (2011), tobacco smoking and physical inactivity are the two main behavioural risk factors behind deaths caused by non-communicable diseases (NCD). Moreover, WHO (2009) says smoking is the reason explaining 90% of all world cases of lung cancer and some 20% of all other cases of cancer.

Restrictive measures aiming at reducing smoking are embraced in almost every country in the world. A variety range of such policies are available, such as raising cigarette prices, non-price measures to reduce demand (consumer information, ban on advertising and promotion, on top of explicit smoking restrictions), public distribution or subsidy to nicotine replacement therapy and other cessation intervention, and so on.

Brazil is not exempt of such trend. Indeed, decrees regulating all sort of activities in the cigarette sector are also present and becoming increasingly restrictive. In 1996, advertising was banned from radio and television between 6am and 9pm. Since then, cigarette packs must carry warning phrases regarding the risks their consumption could generate. Also, no messages linking tobacco consumption to success in personal life aspects such as employment, sexual performance or sport could be broadcasted. Four years later, advertising became confined to sales points and cigarette brands were banned from advertising or supporting cultural or sport events in Brazil. Also, smoking was banned from commercial flights and other means of transportation. A comprehensive list of all regulatory measures related to cigarette sales and consumption in Brazil between the mid-1980s and year 2004 can be found at Annex C of Iglesias (2006). As seen, many (restrictive) changes were introduced in Brazil, but still nothing like in Australia, where since December 2012 cigarettes packaging is standardized in an opaque colour containing only a discrete mention to the brand name. In what regards price mechanisms, in 2011 the Brazilian government raised production taxes to 300% and set a minimum price at R\$ 3¹.

It should be emphasized that the usual suspect justifying intense regulation is absent in the case of the cigarettes market. There is no possible claim of being a natural monopoly: sunk costs or other barriers to entry do not seem that significant; the coexistence of (profitable) producers in the market seems totally feasible. The most traditional justification for regulation being absent, the market failure in question has to do only with asymmetric information – on the product quality, for example – and some paternalist behaviour by governments.

Moreover, compared with the addictive drugs market and alcoholic beverages market – similar to some extent in the sense of not being natural monopolies and dealing with a path-dependent product providing pleasure – the cigarettes market is the only one facing frequent changes in its regulation. Addictive drugs are usually illicit – and that is the end of the story. In some places, light ones are licit but regulation do not change that frequently – the rules were usually more or less established at the same time as those so-called light drugs were liberalized. As for alcoholic beverages, their sales is sometimes banished or limited for religious purposes but usually free in most occidental countries, being regulation restricted to forbidding sales to under-aged or already drunk people, or in certain places considered as critical for public order such as close to highways or inside stadiums. As concerns the

¹ On 30th September 2013 this is about USD 1.35.

cigarettes market, it faces changes in regulation being discussed or introduced almost every year in many jurisdictions.

Every new regulatory measure reframes the behaviour of its stakeholders, both firms and consumers and thus reshapes the market it is intended to affect. Therefore, every new measure should be the object of careful inspection by IO economists, as well as other professionals, in any sector. This is increasingly true for an economic activity where substantial changes take place quite frequently.

In spite of all those appealing – and challenging – features of the product and its market, the IO literature has been quite silent on both theoretical modelling and empirical estimation of key parameters for the cigarettes market, although some analytical keystones are already set by seminal studies such as Chaloupka and Warner (2000). If someone checks out the literature on medicines, for example, there is a substantial body of papers on the pharmaceutical market and some authors are well known as specialists on that. In what concerns the cigarettes market, not much is available, at least in Economics. This paper tries to fill partially such gap.

3. Demand and supply in the cigarettes market

According to Carvalho and Lobão (1998) some qualitative aspects for the consumption of cigarettes in Brazil include elements such (i) there are more smoking men than smoking women; (ii) smoking decreases with age; (iii) smoking decreases with income; (iv) a median smoker starts smoking at youth; and (v) the consumption of light blends is correlated with increased age and income. Such pattern for the Brazilian reality is not distant from the world, as other available sources indicate.

In spite of its productive simplicity, cigarettes give birth to a differentiated market structure, where brands compete for on basis of distinct flavours, intensities and toxicological loads. Such differences add complexities to this market and, summed with the supposed addiction effects, pose a non-trivial framework for demand modelling.

Focusing first on the so-called addictive aspect, cigarette consumption requires a separate framework for formal treatment in demand theory. Cigarette consumption differs from traditional goods because of the path-dependent consumption behaviour. The impact of this in the demand pattern is such that the grounds of consumer theory in Microeconomics had to be craftily modified in order to deal with phenomena of this kind as (i) current consumption level is a function of previous ones, and (ii) if there is addiction, it poses a trace of irrationality and inconsistency in the behaviour of the economic agent. These are a few reasons that justify the popularity of cigarette consumption within Behavioural Economics theory, modelling and experiments.

For their contribution in enhancing the theoretical framework for dealing with these aspects, Stigler and Becker (1977) became a mandatory source when modelling goods of the kind. Indeed, surrounding hypotheses regarding the stability of preferences and the assumption of metapreferences are needed in order to put a formal, rational agent-based model on its feet. Usually, the resource is to appeal for adaptive models that associate stocks and flows of the so-called addictive element.

Indeed, a couple of models for treating utility and demand for cigarette consumption is already set in theoretical and empirical grounds, as reviewed by Carvalho and Lobão (1998). The most broadcasted model is due to Chaloupka (1991) and assumes a utility function that highlights the health status of the consumer and the relaxation nicotine addiction. His formulations defines u as a concave function with a full set of defined second-order derivatives according to each and all of its arguments.

The setting of these utility models opened avenue to a number of empirical estimations, most of them electing the demand response to tax increases – by means of price-

elasticity estimates – as a prime theme on the study. Carvalho and Lobão (1998) survey some of them, and so does The World Bank (1999). According to this later source, “models that attempt to assess the impact of nicotine addiction on the effects of price increases make varying assumptions about whether smokers look ahead as the consequences of their actions or not. However, all models agree that, for an addictive substance such as nicotine, an individual’s current consumption levels will be determined by his or her past consumption levels as well as by the current price of the good. This relationship between past consumption and current consumption has important implications for modelling the impact of price rises on demand for tobacco. If smokers are addicted, they will respond relatively slowly to price increases, but their response will be greater in the long term”.

Provided this distinct temporal aspect is complied with, The World Bank (1999) says that some studies have already calculated the elasticity of demand in cross-countries basis. Apart on the specific variations according with each study, The World Bank (1999) notices that “there is [a] reasonable evidence that in middle-income and low-income countries, elasticity of demand is greater than in high-income countries. For example, in USA the elasticity is in turn of -0.4 while in China, Brazil and South Africa, studies have produced results in the range of -0.6 to -1.0 ”. As they say, “based on these results, -0.8 would be a reasonable estimate of the average elasticity of demand for middle and low income countries”.

These estimates back opinions that, based on these evidences, and working with a rough estimate of -0.8 , everything else constant, a tax increase policy in middle-income countries should be able to reduce tobacco consumption. This common wisdom gives a comfortable support for public policies aiming at reducing tobacco consumption by means of price raises caused by tax increases. We shall return to this wisdom at a subsequent section of this paper.

Dealing now with the second, distinctive aspect of cigarette markets, it shall be noticed that differentiation occurs in a non-negligible product dimension: the legality of the producer. FGV (2010) lists four distinct segments that coexist in marketplace: (i) products from legally constituted firms; (ii) products from tax-evasion firms; (iii) smuggling originated products; and (iv) Brazilian falsified products that ignore trademarks. According to estimates, Brazilian illegal market spammed between 15% and 35% of total sales in volume in the last two decades. Far from being a typical Brazilian characteristic, illegal markets are present worldwide. In Canada, about 30% of total domestic sales in 2008 came from illegal vendors.

It is worrisome the fact that counterfeit cigarettes are materially different from branded products, what transforms smuggling in a source of both fiscal and public health concerns. According to Pappas et al (2007), chemical comparisons between counterfeit cigarettes and branded products show strong differences in at least three characteristics, namely (i) level of metals; (ii) level of tar/nicotine/carbon monoxide; and (iii) presence of miscellaneous contaminants.

Pappas et al (op. cit.) also notice that researchers from the Center of Disease Control and Preventions (CDC), National Center for Environmental Health found that level of cadmium, thallium, and lead in mainstream smoke were far above the reference level for counterfeit than for authentic brands. Moreover, they do emphasize that toxic metal and metalloids constitute one of the more understudied major carcinogenic chemical classes in tobacco smoke.

The features of the illegal products are far from just anecdotal: counterfeit cigarettes and other forms of illegality are widespread. Once we focus on the supply side, World Bank (1999) says that about 30 per cent of internationally exported cigarettes are lost to smuggling, a situation more commonly found “where there are large variations in tax between

neighbouring states or countries, where there is widespread corruption and when contraband sales are tolerated”².

The World Bank (ibid.) also recognizes that the problem is acute and notices that it is usual to witness criminal organizations standing behind large scale tobacco smuggling, holding comparatively sophisticated systems for the distribution of smuggled cigarettes in the destination country. According to the publication, this is commonly coupled with a lack of control on the international movement of cigarettes.

Criminal activity is also made easy because of a few other aspects, The World Bank (ibid.) emphasizes: it is understood that the success of smuggling relies on the cigarettes passing through a large number of owners in a short time frame, making it virtually impossible to track down their movements. Additionally, poor enforcement of illegal sales and difficulty in separating legal from illegal sales contribute to reduce the smuggler’s risk. The World Bank (ibid.) says that in Russia and in many low-income countries the majority of cigarettes are sold in the streets. Smuggling being such a common activity, how to fight it? In spite of pointing a successful way, The World Bank (ibid.) highlights a way *not* to act: “while smuggling is undoubtedly a serious problem, and while steep differentials in tobacco tax rate between countries are an incentive to smugglers, the appropriate response to smuggling is not to forego tax increases”.

Accordingly, it is understood that the most suitable alternative is to crack down on crime, by means of increasing controls and dissuading the expected profitability of this economic activity. The ineffectiveness of tax increases for dealing with illegal sources is illustrated with empirical evidence from South Africa: “during the 1990, South Africa increased its excise prices on cigarette sharply, by more than 450%. As a percentage of sale price, taxation rose from 38 to 50%. Smuggling rose, from zero to about 6%”.

But what are the incentives producers (and dealers) face when choosing which side of legality to embrace? This is the theme of next section.

4. The theoretical model

This section presents the theoretical model we propose for studying a cigarettes market in a country where there is a possibility of coexistence of between a legal (and regulated) market and an illegal market. Our analysis aims at exploring the impacts of regulatory measures such as limitations on advertising and increase in taxes – the E and R of the MPOWER measures of the WHO, as mentioned before – on the market outcome. We focus on these measures affecting asymmetrically the legally constituted companies and the outlaws.

In order to allow us to focus on the market structure and the impact of the regulatory measures on the market equilibrium and welfare consequences, we assume the market size is given. This is a simplifying assumption and does not imply we believe the cigarettes demand is completely inelastic. As a matter of fact, there is a whole branch of literature discussing how the demand for cigarettes should be modelled given the specificities of the product and thus consumer behaviour: addiction or not, time-dependence or not – in the case smokers consume for maintaining a given level of consumption each period independently – irrationality or rationality among other controversial features on the demand side. We already made a summary reference to topics as these at a previous section of this paper. This assumption of a given market size allows us to overcome such complex issues and focus on the supply side and the regulatory impact on market outcomes. Such assumption isolates the

² The effect of tax difference between States of a Federation and neighboring countries poses empirical difficulties. In cigarette demand estimation literature, Wasserman et al (1991) encompasses this market aspect while modelling their consumer agents.

effects coming from an increase in the market itself from the ones coming from consumers migrating from the legal to the illegal product. We chose to focus on the latter in this paper.

In our theoretical approach, we restrict attention to the incentives of a potential new entrant firm to enter – or possibly remain – in illegality or on the other hand to decide to formalize its activities, becoming subject to all sorts of regulation affecting legally active cigarettes companies. Another particularity of this legal market is that prices are regulated and set by a regulatory agency. However, there are in reality different classes of cigarettes, each having a different price range. Usually the incumbent already produces a portfolio of cigarettes covering all different class available, and the entrant picks one or two when she decides to enter legally. This is the sort of entry we want to focus on, the entry of a smaller player, usually not a multinational firm. Our entrant is the type of firm that would only join the legal market if it is sufficiently attractive, i.e. if it pays off.

4.1. Some relevant literature

To our knowledge, there is no article modelling theoretically the cigarettes market focusing on the supply side, i.e. dealing with its market structure. Even if there is any, it would most probably not include the possibility of going illegal and – above all – would hardly endogenize the type of competition actually taking place. Given this lack of literature for such an important sector, the most relevant references for our theoretical modelling are the ones on vertical and horizontal differentiation, as reviewed quickly in Shy (1995) and more thoroughly in Beath and Katsoulacos (1991), among others. In Shaken and Sutton (1982) the notion of a perfect equilibrium in a multi-stage game is used to characterize industry equilibrium under Monopolistic Competition, where products are differentiated by quality. The analysis is based on a three stage non-cooperative game. In the first stage, firms choose whether or not to enter in the industry. At the end of the first stage, each firm observes which firms have entered, and which have not. In the second stage, each firm chooses the quality of its product. Then having observed its rival's quality, in the final stage of the game, firm chooses its price.

We propose here an extension of this model to include firm(s) that do(es) not respect the Law – the illegal firm(s) – and because of this observe the legal firm(s), choose low quality (does not incur in fixed investment) and in the second stage choose low price.

Shaked and Sutton (1987) examine the relationship between advertising, R&D, and market structure. As other authors did before, they build a Hotelling-type framework of a two-stage game and compute the equilibrium strategies. In its first stage, each firm may enter the market, by paying sunk costs $\sigma > 0$, and chooses its location. In the second stage, each firm may produce any volume of output at zero cost. They find a Nash equilibrium in prices for given locations and then a two-stage price equilibrium in the two-stage game.

For our purposes, the important results obtained with their model are to identify what determines the level of market concentration. Does it depend upon the preferences of consumers or on the shapes of technology? The authors' answer for the interplay of these two factors is: "All that matters is the relationship between costs and consumers willingness to pay."

Motta (1993) analyses a vertical product differentiated model with the aim of comparing (endogenous) equilibrium qualities under price and quantity competition. One of the main results of the model is that firms always choose to offer distinct qualities at equilibrium, independently of the hypothesis of costs and price or quantity competition.

Shaked and Sutton (1982) are very closely related to the illegal side of our model. Those authors modelled a 3-stage game where firms simultaneously choose to enter or not, their quality and their price (in this order) in face of consumers bearing heterogeneous incomes. Their point is that by choosing distinct qualities firms can share the market

accordingly (consumers with lowest incomes buy lowest quality goods etc.) and make positive profits, avoiding the typical Bertrand price competition which brings profits to zero when firms' products bear the same quality.

In our model we have a similar feature: two firms competing with goods of different qualities and being able to weaken price competition through product quality choice, i.e. differentiation. However, differently from Shaked and Sutton (1982), prices in the cigarettes market are regulated. But this is only true as concerns the legal segment of the market, while those authors' insights are used in the paper for dealing with the illegal branch of our game tree.

Another crucial difference between our model and Shaked and Sutton (1982) is that their model deals with horizontal differentiation in a very specific and peculiar setup. Our idea for the illegal branch of our game tree is that differentiation occurs, but in its vertical version. Every consumer recognizes that the illegal cigarette is of lower quality than the legal one produced by the incumbent firm. Therefore, our model is more closely related to Shaked and Sutton (1987).

4.2. The Setup

We assume there is a sequential game, where the incumbent firm – player 1, the one choosing first – has already opted to be legally constituted and this is observed by a potential new entrant firm. For the sake of simplicity, we assume in the model that there is only one incumbent firm and there is only one potential entrant – just like in Sylos and Modigliani (1958) – but the results remain qualitatively the same by assuming more incumbent firms and/or more illegal producers – as is usually the case in the real economy of most developing countries.

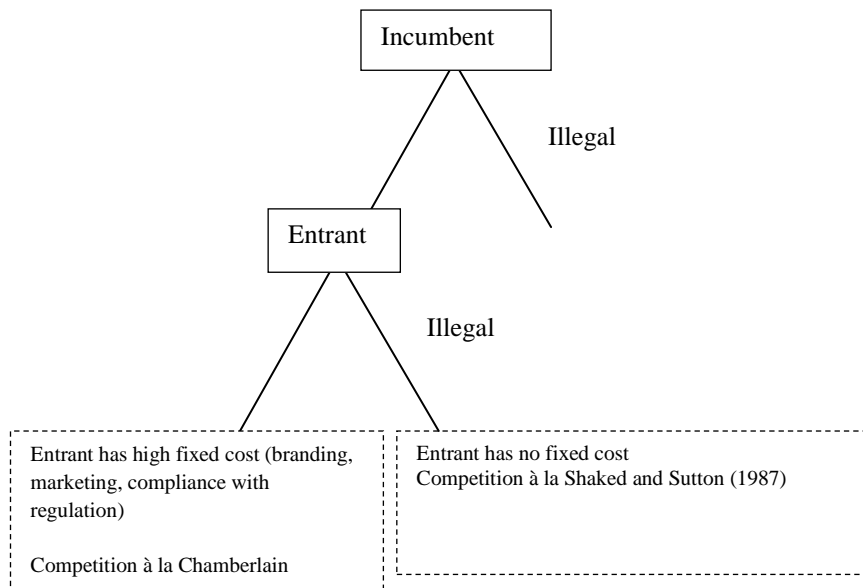
The potential entrant has three possible strategies at its disposal, where the first one refers to his reserve utility or participation constraint: she can stay out of the market and make no profit. As soon as at least one of the other two alternatives is profitable, such participation constraint is satisfied and can thus be ignored. The two relevant alternatives for the (now) entrant are to enter legally, competing on equal terms against the established incumbent, or to enter as a smuggler or producer of unregulated cheap cigarettes.

If the entrant chooses to enter legally, she has to incur some high entry or fixed cost – indeed a sunk cost – to start her business. Becoming a legal firm requires bureaucratic activities and tests to ensure compliance with the all the regulation in place – which includes compliance to pesticides limits, sanitary control of ingredients etc. It also requires some considerable investment in promoting its new brand, totally unknown from the public. The new brand being introduced has to be advertised for competing against the already established trademark owned by the incumbent.

On the other hand, by entering legally, player 2 joins a monopolistic competition model à la Chamberlain, which ensures each firm some positive profit. Although brands do compete fiercely, since they are horizontally differentiated products, each firm maintains some market power over its own brand.

If the entrant decides to enter illegally she faces no sunk cost but since it will not meet the regulatory requirements, it will be perceived by every consumer as of lower quality. The type of competition taking place then will be embedded by vertical differentiation.

The following table summarizes the game and the market structure we propose:



4.3. General Results

This subsection introduces the first results of our model. We motivated our assumptions in such a way that from now on we assume to be true the market structure shown in the strategic form of the Table 1 just above.

In such a case it is straightforward to check the following results.

Proposition 1: Limitations on advertisement – only affecting the regulated portion of the market – are responsible for making advertisement costs higher and therefore raise barriers to entry in the legal segment, increasing the attractiveness of the illegal option.

This is a very general result, in the sense that does not require any further assumption on the model. In particular, no assumption has to be made on the demand structure, on the choice variables of the firms, nor their precise payoff functions. We do not even need to assume anything as concerns advertisement in the cigarettes sector. It could even be the case that such propaganda is merely persuasive.

We can thus state in a quite robust way that restricting the activities of advertisement of the legal cigarettes firms pushes firms to go illegal. A totally different situation would take place in the case advertisement in cigarettes were completely banished.

Proposition 2: If advertisement in cigarettes were banished, efficiency would increase.

This is also a very general result. There is a strong argument in favour of abolishing advertisement in the cigarettes market. Advertisement in this market is mainly persuasive – which the literature recognizes as socially wasteful, because firms engage in some propaganda race where only the difference between the firms' expenses matter. As in a patent race, here firms spend more than socially desirable in advertisement.

What our modelling strategy does is to add up a new argument in favour of abolishing advertisement in the cigarettes market. If the government abolishes propaganda by tobacco companies, this will eliminate such activity and therefore clearly diminish the costs of becoming a legal firm. Such disappearance would eliminate a costly activity from the set of activities a cigarette firm has to perform if she decides to go legal. It would therefore reduce the entry cost, i.e. some sunk cost the firm has to incur if she decides to go legal, thus facilitating legal entry.

The striking feature is the following. Abolishing is usually – and correctly – thought as the limit of restricting, i.e. as restricting in the limit. It would be natural for one to abolish advertisement after having imposed an increasing number of restrictions. In the limit one

abolishes³. However, what our model offers is a diametrically opposed claim. Restricting propaganda has the opposite effect of abolishing it, in terms of the incentives to go legal. While the former increases the entry cost, the latter reduces it, making entry more attractive by increasing its payoff.

When more (legal) entry happens, there are a variety of sources of efficiency gains: not regulated (thus possibly harmful) illegal products are not available, at the same time as a broader choice of legal (and safe) products are available to consumers – both increasing consumers' welfare. Also, governmental budget improves, since more tax will be raised as a higher proportion of the cigarettes consumed will be those produced and commercialized in the legal market, thus subject to taxation. At the same time, the government will need to spend less on fighting the illegal market. In the limit, if there is no illegal market – as in our model of two firms when the entrant chooses to go legal – there shall be no expense on border control, prosecution of smugglers etc.

Finally, it should be noted that we are dealing with a static setup and we are not assuming any explicit advantage of the brand already established. In such context, being advertisement abolished, it should become harder for the entrant to enter. Even if the entrant will save on entry costs, entry barriers shall be higher as there will be no tool to convince consumers to switch from the incumbent's product to the entrant's product.

4.4. More specific results

This subsection presents results dependent on the specific sort of competition happening on both the legal branch of the game tree and the illegal one.

As for the setup, we assume that if the entrant goes legal, competition in the market place occurs as in the classical Hotelling model. The only difference here is that firms do not directly choose prices, since those are regulated (set by the government). However, if a firm goes legal, it has some discretion in setting prices as there are different classes of cigarettes – from the more basic product and packaging to luxurious products and packaging – and she can choose the one in which she wants to compete. We take the realistic assumption that the incumbent firm already offers a product in every class of cigarettes. As such, although firms choose price and quality of their product in the legal market, quality is closely regulated and prices follow quality in the determination of the class of the product. What we mean is that the pair (quality, price) of the product is actually one single choice variable of the firm in the legal market because of regulation, while both are freely set in the illegal market. This is another difference between the two branches, on top of the sunk cost of legal entry and the vertical differentiation in the illegal market.

It is obvious since Shaked and Sutton (1987) that usually differentiation takes place on both dimensions – vertically and horizontally – in a simultaneous way: “clearly, products will in practice be differentiated both in respect of attributes which correspond to the "horizontal" case, and also in respect of "vertical" attributes”. Our focus is on what dimension will prevail, this being chosen by the entrant. This is our crucial and most peculiar assumption: it is the entrant who chooses in our game the sort of competition she wants to engage with the incumbent firm: horizontal differentiation or vertical differentiation.

If the entrant chooses to go legally, it will incur the sunk cost F and will choose its location in a traditional Hotelling setting. Let x be the location of a consumer's taste in the spectrum of all possible different tastes ranging from 0 to L . Let e be the location of the entrant while i is the location of the incumbent, and g is the tax on the cigarette consumption,

³ This gradual path seems to be the one followed in real world by most countries. Australia is the first country apparently reaching the limit, since it has 2012 introduced standardized grayish packaging since December. The only space which was left for cigarettes propaganda was its own packaging and this channel was closed.

while t is some transportation cost, measuring the distance between the actual taste bought and the preferred taste of that particular consumer x .

$$U_x = -(1+g) p_E - t | x - e | \text{ if the consumer buys from the entrant E} \\ = -(1+g) p_I - t | x - i | \text{ if the consumer buys from the incumbent I}$$

We do not assume any reservation utility not because of addiction but as a simplifying assumption, as this allows us to focus on the substitution of E's product for I's⁴. We assume every consumer buys one unit of the good, which means she picks her preferred brand between E and I, in case E enters the legal market.

The indifferent consumer x – which is the demand of the Entrant's product as we assume a mass one of consumers – will be $(1+g) (p_I - p_E) / 2t + (L - i + e) / 2$. The Incumbent I's demand is $L - x$ which is $(1+g) (p_E - p_I) / 2t + (L + i - e) / 2$.

Assuming both firms have zero marginal costs and maximizing their profit functions yield the following optimal prices:

$$p_I = t (3L + i - e) / 3(1+g) \text{ and } p_E = t (3L - i + e) / 3(1+g)$$

From D'Aspremont, Gabszewicz and Thisse (1979) we know that this is only an equilibrium in the price game if the goods are sufficiently differentiated. In other words, the existence of such equilibrium requires:

$$[L + (e - i) / 3]^2 \leq L (e + 2i) / 3 \text{ and } [L + (i - e) / 3]^2 \leq L (i + 2e) / 3$$

If these conditions hold, the Entrant's E profit is equal to $t(3L - i + e)^2 / 18(1+g)$.

It is straightforward that the following lemma hold.

Lemma 1: The more differentiated the goods – i.e. the higher the transportation cost for the consumer – the higher the profit of the entrant.

Lemma 2: The higher the taxation (on the legal market), the lower the profit of the entrant.

Proposition 3: If the incumbent's location is given and not expected to adjust, the entrant will differentiate minimally if she enters the legal market.

If the incumbent cigarette manufacture is huge and the entrant will only grab a bite of the market, this entrant E – if entering legally – will choose a location very close to the incumbent's location, since this will ensure a higher market share. This is the principle of minimum differentiation.

Proposition 4: If once the entrant chooses to enter legally, the incumbent can react and adjust its location, then there is maximum differentiation if there exists an equilibrium.

If i can be adjusted after E decides to enter legally, it is as if there was a simultaneous setting of e and i . The minimum differentiation principle still applies under linear transportation cost, but then there is no equilibrium in a game where firms first set location and then prices. If on the other hand quadratic costs are assumed, there is an equilibrium, but it is under maximum differentiation, i.e. firms will locate in the extreme. It should be noticed that quadratic transportation costs are not too bad an assumption in the cigarettes market. There is vast evidence showing a strong fidelity of most consumers to their preferred brand.

As concerns the illegal branch of the game tree, consumers' utility is as follows:

$$U_x = e x - p_E \text{ if she buys from the Entrant E} \\ i x - (1+g) p_I \text{ if she buys from the Incumbent I}$$

Where the entrant E's quality is necessarily perceived as lower than the Incumbent's quality, or $0 \leq e \leq i \leq 1$. Here we keep the same notation but products are clearly vertically differentiated. It should also be noticed that taxes only impact the Incumbent I since now the Entrant E has chosen to enter by producing and selling in the black market.

Proposition 5: The new entrant chooses to differentiate its product fully if it goes illegal.

⁴ It is true that the governmental measures aim precisely at reducing the market size and this simplifying assumption prevents us from dealing with it. However, it allows us to focus on the substitution between products, especially when we deal with the illegal market.

This result is in accordance with the vast literature on vertical differentiation. This maximum differentiation principle is easier to obtain under vertical differentiation than under horizontal differentiation – another argument in favour of enforcing controls against the existence of the illegal market. This result has severe implications, as it means that once in the illegal market the Entrant E has no incentive at all to provide quality. We do not even need a framework with asymmetric information for obtaining such result. Even if consumers fully observe its quality, the illegal Entrant prefers to provide the lowest possible quality in order to fully differentiate its product from the Incumbent's, lowering the strength of price competition between them. By differentiating maximally, the Entrant E maximizes its profit. It should be noticed that once the Entrant enters illegally, the Incumbent I also has an incentive to differentiate her product. In this case, the Incumbent has an incentive to increase the quality of her products.

4.5. On the pitfalls of cigarette demand estimation and misleading policy recommendations

The list of studies that build on the conceptual frameworks pioneered by Chaloupka (1991) and by Becker, Grossman & Murphy (1994) is extensive: a number of papers and reports embraced this methodology and obtained lists of results for sets of variables. For our purposes, the variable that interests us the most is the price-elasticity of demand.

Among others, Wasserman et al (1991) and Barnett et al (1995) follow the methodological tradition above mentioned and try understanding the US cigarette market, always reporting price-elasticities in $[-1;0]$ interval then followed by public policy effects simulations. All literature review these papers do also reach estimates of the kind. Dealing with Brazilian scenario, Carvalho & Lobão (1998) present a comprehensive review of empirical studies devoted to demand pattern estimates and also find more recent studies obtaining the same figures, and so does their own model specification and empirical estimates for the Brazilian scenario: all reported estimates for the studies they review and their own experiments provide short-term elasticities in the interval $[-0.2;-0.1]$ and longterm elasticities in the interval $[-0.5;-0.14]$, results pretty much in line with those reported in The World Bank (2009) for instance. In Carvalho & Lobão (op. cit.) estimates vary with a number of aspects, including age and income of the demanding public, but the statement it is worth discussing is the support of the authors in what regards the usefulness of tax increases as an efficient measure towards the reduction of cigarette consumption. In their words, “for the purpose of simulating the impacts of public policies, our short- and long-term price-elasticity estimates suggest that public authorities shall not discard tax increases over cigarette prices as an efficient measure directed to the reduction of cigarette smoking in Brazil”.

A question that follows is: do these results keep valid in presence of a significant share of illegal products? Shall public policy base their decisions on these estimates? The World Bank (1999) responded negatively to these questions, and so Chaloupka & Warner (op. cit.) suggest, but what theoretical model stood behind? We agree with the The World Bank (1999) and, on doing so, we bring back to discussion a result obtained in previous section, namely that the effectiveness of tax policies depend on the size and variety of the set options of brands available to consumers.

5. Empirical implementation: a roadmap

Shall public policy base their decisions on these commonly found price-elasticities estimates? We argue they should not. In order to demonstrate this result, we now take distance from linear models and we model the consumer options of a smoker as a discrete choice model, a resource that is straightforward especially if qualitative dependent variables are to be used (smoking levels, brand options, etc.). This section will argue that, in presence of illegal options, tax increases do not perform as public authority may expect, hence

softening the conclusion Carvalho & Lobão (op. cit.) reported, and making an approach with the ones The World Bank (1999) supports. The simplest discrete choice models assume a binary response, or a dichotomous space of alternatives. Was smoking a decision regarding a single option, what means the existence of a single brand (that would be the case was it an industry of homogeneous goods), the choice of consumers could easily be modelled as follows:

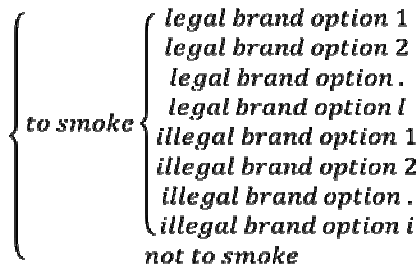
*{to smoke
not to smoke*

In this simple example, any decrease in the probability of smoking would correspond to an equivalent increase in the probability of not smoking. That would be regulator's heaven and policies such as price increases would have non-ambiguous effects. However, cigarette industry corresponds to a structure of (horizontal and vertical) differentiation products, as reported in Section III and theoretically developed in Section IV. That means that a set of heterogeneous products – brands, flavours, toxicological levels – exist and can sell strictly positive numbers in market. Whence the choice of consumers could better be represented in the terms of Figure below.

*{to smoke brand 1
to smoke brand 2
to smoke brand ..
to smoke brand k
not to smoke*

Setting the problem in terms of Figure above puts us in the context of multinomial choice (when there is more than a 2 alternative-choice universe) and leads us to wonder about the validity of a key assumption in econometrics of discrete choice: the independence of irrelevant alternatives (iia) condition. If iia condition is valid, no addition of alternatives shall modify the ratio of probabilities between any two existing alternatives, as stated long ago by McFadden (1974). According to Wooldridge (2002) iia is not supposed to hold when consumers (or decision-makers in general) face alternatives whose similarity is not constant in-among the options. Indeed, if the independence of irrelevant alternatives (iia) condition fails, the problem modelled in the terms of the previous Figure resembles McFadden's second-colour bus. The tangible effect of a model built as previous Figure presents is that as brand options are added (or subtracted, for the matter), the net effect on the consumption of existing alternatives is not equally distributed.

Conversely to considering the addition or subtraction of brands, we can now consider the problem of asymmetric regulation: consider brands 1 and 2 are the sole legal ones in market, what means they are the sole ones to be affected by a tax variation (for our interest, a tax increase). Under this scenario, if a public policy of any kind modifies the preference of consumers regarding a parcel of existing choices $K = \{1, 2, \dots, j, k\}$, iia is not supposed to hold in this picture. Indeed, any variation in probability of choosing option k ($|\Delta p_k| \neq 0, 0 \leq p_k \leq 1$) is not supposed to be followed by a uniform $|\Delta p_j| / (K - 1) \neq 0, \forall j \neq k, |k, j \in K$, that means an equally distributed variation in probability of choosing the remaining alternatives of the set (K). In fact, some alternatives are supposed to face increased variations than some others. This is clearly a case in which iia does not hold. Then, the resource is to appeal to a nest framework instead of insisting with a common multinomial logit. Figure below illustrates how a nested structure modifies the framework of the problem.



In a nested logit model, variance differs across the groups, while maintaining the iia assumption within the groups. In this setting, the addition or subtraction of choices could preserve iia among brands. Additionally, any kind of simultaneous alteration over all brands in the form of, say, a price increase, could easily restore what we called above “the regulator’s heaven”.

Actually, was a tax increase an effective and widespread measure, nesting would prove irrelevant and any tax increase would unequivocally result in diminishing cigarette consumption. However, this is not the result that holds in the presence of illegal brands, hence the need for a nested structure: illegal brands are not impacted with tax increases. In this circumstance, the net effect of tax increase will aggravate just some brands. Between two possible effects – consumer substituting a legal brand for an illegal one; consumer reducing or quitting smoking – it is the former which will more likely prevails, especially in the context of a middle-income country, where price-elasticity of cigarette demand is found to be higher.

6. Concluding Remarks

Crucial for the effectiveness of tax increases over cigarette consumption is the understanding regarding the choice set consumers face: under a circumstance of asymmetric regulation, the effect of a tax increase will not be homogeneous.

We can start the testing algorithm by assuming a utility specification as below:

$$U_{ij} = x'_{ij}\beta + s_{ij}$$

In equation above, vector x_{ij} (implicit) contains the attributes of choices j and of the individuals i^5 and vector w_i (implicit) containing the characteristics of the individuals. Summing both vector into a single one, one can state vector (explicit) $z_{ij} = [x_{ij}, w_i]$. Vector z_{ij} may include variables such cigarette price, individual income, cigarette toxicological load, brand dummy variables, and so forth. Indexes $j=1,2,\dots,J$ refer to alternatives (choices) and $l=1,2,\dots,L$ to subgroups (nests). From this utility function, a random utility model (RUM) can be fitted. If price is one of the shifters of utility level, a tax increase is supposed not to affect all choices equivalently, what means that iia is supposed to fail. Under this framing, the hypothesis that tax increases are not enough of a measure in the presence of smuggling products can be tested, thus providing an ex-ante assessment on the effectiveness of tax increases on cigarette consumption.

As above, let $x^{(j|l)}$ be the attributes of the choices and z_l be the attributes of the choice sets. Nested logit model leads to the definition of two sets of probabilities, the first ($P^{(j|l)}$) measuring the probability of choosing alternative j given the previous choice for group (nest) l , and the second (P_l) measuring the probability of choosing group (nest) l among the set of groups available. These formal probabilities are as follow:

$$P^{(j|l)} = \frac{e^{x^{(j|l)}\beta}}{\sum_{j=1}^J e^{x^{(j|l)}\beta}} \quad \text{and} \quad P_l = \frac{e^{z'_l\gamma + \tau_l\alpha_l}}{\sum_{l=1}^L e^{z'_l\gamma + \tau_l\alpha_l}}$$

⁵ It is worth noticing that this setting corresponds to the empirical implementation of a differentiation product theoretical problem.

It is worth noticing that both Ψ and Υ (present on the equation for P_i) are parameter matrices associated with variables related with the choice sets, as in Greene (2011). Indeed, once a utility function is specified and a nesting structure is defined, testing null hypothesis $\Psi = \Upsilon = 0$ corresponds to testing the relevance of nesting structure. With data on consumers and alternatives available, an econometric model can be estimated, and null hypothesis can be tested. In case of null rejection, nest structure holds. More important, null rejection means that price-elasticities of demand for cigarettes estimated by Carvalho & Lobão (op. cit.) and others are much probably overestimated, what means that tax increases imposed by public policy agencies may backfire, producing a product substitution towards low-quality varieties instead of leading to a tobacco consumption reduction. Also important noticing is that nested logit models are coherent with random utility models, what adheres to (horizontal and vertical) differentiation hypothesis, in spite of the existence of a pitfall, which is the impossibility of a well-defined testing procedure for discriminating among tree structures, which is a problematic aspect of the model. It is also worth noticing that the empirical results that can be achieved from this estimation exercise reinforce the main guidance for policy makers from our results: the complementarities of regulatory policies independently implemented by different governmental bodies in the presence of a non-negligible black market, not compliant to any regulation. Our main message then is that the illegal option has to be made less attractive.

We understand the cigarettes market in the presence of a relevant illegal market opportunity to be a setup where the entrant firm chooses precisely how she wants to compete against the incumbent firm. The way the entrant's product will differentiate from the incumbent's product precisely determines how their products will compete for consumers in the market. And this choice of the entrant firm is highly influenced by the profits she can obtain from both the legal and the illegal options. On theoretical grounds, we could show that tax increases can be effective only if coupled with an increased border control that limits the asymmetry among choice sets available for consumers. Hence, there is a clear case for integrated policies: tax policy must be coupled with active border, fiscal controls.

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