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Lucia Helena Salgado, *Universidade do Estado do Rio de Janeiro*
Humberto Bettini
Rafael Pinho de Morais, *Universidade do Estado do Rio de Janeiro*

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(Wrongly) Regulating the Cigarettes Market

Lucia Helena SALGADO¹, Rafael Pinho de MORAIS², Humberto BETTINI³

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¹ Rio de Janeiro State University (UERJ) and Institute for Applied Economic Research (Ipea).
² Rio de Janeiro State University (UERJ).
³ University of Campinas (Unicamp).
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 complementarity of 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.

I – 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 pike 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 seldomly 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. In the State of New York, as well as in Canada, Ireland, Malaysia, Romania, Singapore, Slovenia, Sweden, and in the United Kingdom, good-intended policy measures such as tax increase and price rises culminated 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 (33% and 168%, respectively, between years 2000 and 2009), 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 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, they could even quit smoking, with some negative impact on tax collected in present but a positive impact in terms of health conditions in the future and avoidance of future costs with medical treatment on diseases possibly associated with the smoking habit. This is not, however, a situation that holds in a number of countries, especially the low- and medium-income ones where smuggling of cigarettes is frequent.

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."

As seen, 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 exist. Ignoring the existence of such a market in both modelling and policy 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 no 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 on 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

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4 Our particular interest in the Brazilian case is due to the large fraction of smuggling and other illegal forms of supply in domestic cigarette markets – Iglesias (2006) states that up to a quarter of all consumed cigarettes in Brazil are from illegal origin – and also because we expect to receive some rich database on the Brazilian cigarettes market in the very near future. Therefore, Brazil appears commonly cited in this paper, although theoretical considerations do apply to a number of other countries.
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.

Sbranches of literature are relevant for our study and 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 the data in hands, we will be able to specify the precise econometric model, proceed empirical parameter estimations and discuss results, before eventually drawing conclusive policy recommendations.

This paper is organized as follows. In the following 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 presence of an addicting product 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.
The cigarettes market is certainly one of the most fascinating sectorial market for an Industrial Organization (IO) 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 generating addiction; 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 possibly harms his/her health in the longer term, bearing moreover an important impact on the public health expenditures in most countries; a good whose consumption decision is highly influenced by advertisement and marketing strategies of the firms in the sector.

Cigarettes are indeed goods in their own class: they deliver pleasure and social insertion for their consumers, in spite of being a licit drug. As such, economic regulation towards this product is one of a kind as it encompasses strong public health concerns because of the short and long term effects it can bring for both active and passive smokers. 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.

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 smoking habit and health complications 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 its 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$ 3,00. Accordingly, cigarette
prices are expected to rise 20% in 2012 and further 35% by 2015.

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 is totally feasible. The most traditional justification for
regulation being absent, the market failure in question has to do only with asymmetric

\[^5\] On the 28\textsuperscript{th} March 2013 this is about USD 1,50.
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 in not being natural monopolies, dealing with addiction and public health consequences – the cigarettes market is the only one facing frequent changes in its regulation. Addictive drugs are usually illicit. 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. Only the cigarettes market has a change in regulation being discussed or introduced almost every year in many jurisdictions.

Every new regulatory measure reshapes any market and reframes the behaviour of its stakeholders, both firms and consumers. Therefore, every new measure should be the object of careful inspection by IO economists, as well as other professionals, in any sector. This is truer 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 modelling theoretically and estimating 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 drugs market and some authors are well-known as specialists on that. What about the cigarettes market? Not much is available, at least in Economics. This paper tries to fill partially such gap.
III – Demand and supply in the cigarettes market

According to Carvalho & 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 available sources indicate.

In spite of its productive simplicity, cigarettes conform 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 addiction effects, pose a non-trivial framework for demand modelling.

Focusing first on the addictive aspect, cigarette consumption requires a separate framework for formal treatment in demand theory. Cigarette consumption differs from traditional goods because of the addictive effect it causes. The impact of addiction in 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) addictions pose a trace of irrationality and inconsistence in the behaviour of the economic agent. For their contribution in enhancing the theoretical framework for dealing with these aspects, Stigler & 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 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 & Lobão (1998). The first broadcasted model is due to Chaloupka (1991) and assumes a utility function defined as follows:
According to this notation, \( u \) is a concave function with a full set of defined second-order derivates according to each and all of its arguments. \( H_t \) stands for the health status of the consumer at period \( t \), \( R_t \) measures the relaxation nicotine addiction produces at period \( t \), and \( Z_t \) aggregates other goods. With some algebraic manipulation, the utility function becomes \( U_t = u[C_t, A_t, Y_t] \), with new variables including \( C_t \) (cigarette consumption at period \( t \)), \( A_t \) (addiction indicator for period \( t \), as a stock of the addicting element in the organism of the consumer), and \( Y_t \) (variable including all market inputs needed in production of composed health commodities). What is worth noticing is that this model specification is anchored on traditional consumer rationality assumptions.

In addition to Chaloupka (1991), there is a second utility model that was set as a reference for understanding and mapping out the structure of preferences under addiction: the model proposed by Becker, Grossman & Murphy (1994). According to these authors, utility function assumes the following specification:

\[
U = u[C_t, C_{t-1}, Y_t, \varepsilon_t]
\]

As with Chaloupka (1991)’s model, \( u \) is a concave function with a full set of defined second-order derivates according to each and all of its arguments. Variables include \( C_t \) (the amount of cigarettes consumed at period \( t \)), \( C_{t-1} \) (the amount of cigarettes consumed at period \( t-1 \)), \( Y_t \) (composite good at period \( t \)), and \( \varepsilon_t \) (impact of non-observable variables on utility function).

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 & Lobão (1998) surveys 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. In marketplace, FGV (2010) lists four distinct segments that coexist: (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:

1. level of metals;
2. level of tar/nicotine/carbon monoxide; and
3. presence of miscellaneous contaminants.

Pappas et al (2007) 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 greater for counterfeit than for authentic brands”. Moreover, “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, The World Bank (1999) says that some 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”, The World Bank (1999) says, as it also recognizes that the problem is acute and notices that it is usual to witness criminal organizations standing behind large scale tobacco smuggling, counting with comparatively sophisticated systems for the distribution of smuggled cigarettes in the destination country, coupled with a lack of control on the international movement of cigarettes.

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6 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. We shall return to Wasserman et al (1991) at Section V of the present paper.
Criminal activity is also made easy because of a few other aspects, The World Bank (1999) says: it is understood that the success of smuggling relies on the cigarette passing through a large number of owners in a short time, making it virtually impossible to track their movements. Additionally, poor enforcement of illegal sales and difficulty in separating legal and illegal sales help on reducing the smuggler risk. The World Bank (1999) says that in Russia, and in many low-income countries, the majority of cigarettes are sold on the street. If smuggling is such a common activity, how to fight it? In spite of pointing a way in, The World Bank (1999) 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 more 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 per cent. As a percentage of sale price, taxation rose from 38 to 50%. Smuggling rose, from zero to about 6%.”, The World Bank (2009) reports.

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

IV – 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 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 modeled given the specificities of the product and thus consumer behavior: addiction, time-dependence or not – in the case smokers consume for maintaining a given level of consumption each period independently – irrationality or rationality – which includes hyperbolic discounting preference structure – among other controversial features on the demand side. 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 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, they are indeed 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.
IV.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 one, it would most probably not include the possibility of going illegal and – above all – would hardly endogenize the type of competition actually taking place, as we do in this paper.

Given this lack of interest in the literature for such an important sector, the most relevant literature for our theoretical modelling is the one 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 firm 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 comprehend the situation of 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 advertising, R&D, and market structure. As other authors before, and following their former work, Hotelling framework gives the context and over there, a two-stage equilibrium context is built. In it stage, each firm either enters, by paying sunk costs, $\sigma > 0$.

And it chooses its location, or else it decides not to enter. In the second stage, each firm may produce any volume of output at zero cost. They seek here a Nash equilibrium in prices and then a two-stage price equilibrium in the two-stage game.
The important results for us in their model is to identify what determines the degree of concentration. It will depend upon the preferences of consumers or on the shapes of technology? The authors answer is that that the interplay of these two factors which matter: “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: firms always choose to offer distinct qualities at equilibrium, independently of the hypothesis of costs and price in 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 vertically 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).
IV.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 there is only one incumbent firm and there is only one potential entrant – just like in Sylos and Modigliani () – 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 insure compliance with 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 embedded by vertical differentiation.

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

<table>
<thead>
<tr>
<th>Incumbent</th>
<th>Legal</th>
<th>Illegal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legal</td>
<td></td>
<td>Illegal</td>
</tr>
<tr>
<td>Illegal</td>
<td></td>
<td>Not realistic</td>
</tr>
</tbody>
</table>

Entrant has high fixed cost (branding, marketing, compliance with regulation)
Competition under horizontal differentiation

Entrant has no fixed cost
Competition under vertical differentiation

IV.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 game tree 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 that advertisement in the cigarettes sector is merely persuasive, as it rarely circulates any useful information helping consumers in their choice decisions.

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 favor of abolishing advertisement in the cigarettes market. Advertisement in this market is merely persuasive – which the literature recognizes as socially wasteful, because firms engage in some propaganda race were 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 favor 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 abolishes. However, what our model offers is a diametrically opposed claim.

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

IV.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, thus 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, while $t$ is some transportation cost, measuring the

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

$$= -(1+g)p_I - t \mid x - i \mid \text{ if the consumer buys from the incumbent } I$$

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’s.

\footnote{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, specially when we deal with the illegal market. We intend to deal with this market size issue – and therefore with the overall efficacy of policies – in the empirical part of this paper, once we receive the data.}
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:

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

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:

\[
[L + (e - i)/3]^2 \geq 4 L (e + 2i) / 3 \quad \text{and} \quad [L + (i - e)/3]^2 \geq 4 L (i + 2e) / 3
\]

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:

\[ Ux = e x \ - \ pE \quad \text{if she buys from the Entrant E} \]
\[ i x \ - \ (1+g) pI \quad \text{if she buys from the Incumbent I} \]

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.

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 favor 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 illegalEntrant prefers to provide the lowest possible quality in order to fully differentiate its product from the Incumbent’s, lowering the strenght 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.

Proposition 6: The rise of regulated prices – alone has as only effect the increase in prices in the legal market and a migration of consumers to the illegal product.

V – On the pitfalls of usual cigarette demand estimation and its 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 many 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.

In Portuguese language, 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 long-term 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 (1998) estimates vary with a number of aspects, including age and income of the demanding public\(^9\), 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 (2000) 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.

It would be unfair to say product differentiation was not treated in academic literature devoted to empirically modelling the cigarette market. Among others, Carvalho & Lobão (1998) put cross price-elasticity aspects under light, an effect called “down-trading”. According to our understanding, the modelling methodology they embrace is not the most appropriate for dealing with such aspect though.

**Empirical implementation: a roadmap.**

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\(^9\) In this subject, it is worth reporting that Carvalho & Lobão (1998) obtained parameter estimates coherent with the emergent pattern that as age and income increase, price-elasticity of cigarette demand decreases.
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 (1998) 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:

Figure 1

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 differentiation products, as reported in Section III. 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 2, below.

Figure 2

Setting the problem in terms of Figure 2 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 (iiia) condition. If iiia condition is valid, no addition of alternatives shall modify the ratio of probabilities between any two existing alternatives. This point is known as the “blue bus / red bus paradox”, an illustrative example set in McFadden (1974).

According to Wooldridge (2002) iiia 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 (iiia) condition fails, the problem modelled in the terms of Figure 2 resembles McFadden’s second-colour bus. The tangible effect of a model built as Figure 2 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 \( K = \{1, 2, \ldots, k\} \), iiia is not supposed to hold in this picture.

Indeed, any variation in probability of choosing option \( k \left( \frac{\Delta p_k}{p_k} \right) \) is not supposed to be followed by a uniform \( \left( \frac{\Delta p_k}{p_k} \right) \) 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 iiia does not hold.

Then, the resource is to appeal to a nest framework instead of insisting with a common multinomial logit. Figure 3 below illustrates how a nested structure modifies the framework of the problem.

Figure 3

In a nested logit model, variance differs across the groups, while maintaining the iiia assumption within the groups. In this setting, the addition or subtraction of choices could preserve iiia 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 higher, as in The World Bank (1999).

Testing ex-ante and empirically the predicted effectiveness of tax increases on tobacco consumption: a tentative roadmap.

Crucial for the effectiveness of tax increases over cigarette consumption is the understanding regarding the choice set consumers faces: 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:

\[ U_{ij} = z_{ij}' \beta + \varepsilon_{ij} \]

In equation above, vector \( z_{ij} \) (implicit) contains the attributes of choices \( j \) and of the individuals \( i \) and vector \( w_l \) (implicit) containing the characteristics of the individuals. Summing both vector into a single one, one can state vector (explicit) \( z_{ij} = [x_{ij}, w_l] \). Vector \( z_{ij} \) may include variables such cigarette price, individual income, cigarette toxicological load, brand dummy variables, and so on. Indexes \( j=1,2,\ldots,J \) refer to alternatives (choices) and \( l=1,2,\ldots,L \) to subgroups (nests).

\[ ^{10} \text{It is worth noticing that this setting corresponds to the empirical implementation of a horizontal differentiation product theoretical problem.} \]
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 $X_i$ 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:

$$P(j|l) = \frac{e^{X_i^l X_j + z_l^T \beta}}{\sum_{j=1}^{J_l} e^{X_i^l X_j + z_l^T \beta}}$$

$$P_l = \frac{e^{z_l^T \gamma + \tau_l^T \xi_l}}{\sum_{l=1}^{L} e^{z_l^T \gamma + \tau_l^T \xi_l}}$$

It is worth noticing that both $\gamma$ and $\xi$ (present on the equation for $P_l$) 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 (as Figure 3 proposes, for instance), testing null hypothesis $\gamma = \tau = 0$ corresponds to testing the relevance of nesting structure.

With data on consumers and alternatives available, the model represented by Figure 3 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 (1998) 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 (RUM), what adheres to horizontal 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.

V – Conclusion

This brief conclusion presents the main guidance for policy makers from our results. The main idea behind the paper is the complementarity 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 is that the illegal option has to be made less attractive.

We built a model which somehow reconciles horizontal differentiation with vertical differentiation by endogenizing the type of competition. In most papers the market structure and the type of competition is taken for granted. 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, the first element of our understanding regarding this subject if that there is a clear case for integrated policies: tax policy shall be coupled with border controls if ever they are chosen as a policy tool in a setting where smuggling is relevant.
A second aspect relates to the question: “is there a case for asymmetric regulation?”. In many circumstances there is fairness in treating different ones differently, also benefiting competition and consumers in the long run. According to our analysis, there is no justification for asymmetric regulation in the cigarettes market. However, asymmetric regulation is the rule in practice, in the presence of an illegal cigarettes market. When a government implements stricter regulation – as concerns taxation, sanitary control and advertisement limitations – it benefits the illegal sector and reduces the incentives for legalization. Moreover, the average quality of cigarettes in the market decreases, harming the health of the population.

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