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Abstracts

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Key words: tax incidence, VAT, excise taxes, alcoholic beverages, imperfect competition

JEL codes: H22; H25; D43.

1 Introduction

The present paper aims at estimating the difference between shifting on prices of per unit and ad valorem consumption taxes, and found that per unit consumption taxes induce a significantly larger increase of prices than ad valorem consumption taxes do. The shifting on prices of indirect taxation has been studied for a long time on a theoretical point of view. Cournot (1838) already found that per unit and ad valorem consumption taxes operate differently under monopoly: he states that per unit taxes are always over-shifted on prices as ad valorem taxes may either be over-shifted or under-shifted. Wicksell (1896) also noted the difference between both kinds of taxes under monopoly and found that ad valorem taxes Pareto dominate per unit taxes.

The recent economic crisis, that increases public deficits and generate a new need fiscal revenue, has reniewed the public debate about increasing consumption taxes. Defenders of this kind of taxes argue that it is a simple way of collecting public revenue, with low collection costs and generating little distortion on the markets. However, consumption taxes are distorting, they induce decreases of production. Incidence of consumption taxes is not obvious either: the burden of these taxes is shared between demanders and suppliers, and the share of suppliers is itself shared between employees and owners of the firms. Under perfect competition, the shares of suppliers and consumers depend on price elasticities of the demand and the supply; both part support a share of the tax burden, generally a larger share for the consumers. Imperfect competition change the sharing of consumption taxes, as demonstrated theoretically Katz & Rosen (1985) - through a model of oligopoly with conjectural variations based on Seade (1980) - then Stern (1987) and Besley (1989). Under imperfect competition, the consumer share may be lower ar larger than under perfect competition, it may even be larger than 100%, which means that the oligopoly price whithout taxes increases when taxes increases. Empirical studies confirm these results (e.g.: Besley & Rosen 1999 and Carbonnier 2007).

Not only competition has inlfuence on the sharing of the tax burden between consumers and suppliers. Carbonnier (2008) studied the difference between shifting on prices of tax increases and tax decreases, and empirically confirmed his theoretical results. The way consumption taxes are implemented may also matters, and a large number of authors compare value-added taxes (VAT) to sales taxes (e.g.: Dungan et

al. 2008, Smart & Bird 2009, Keen & Lockwood 2010 and Whalley & Kononova 2010).

The present paper aims at understanding the difference of shifting on prices between per unit consumption taxes and ad valorem consumption taxes. Under perfect competition, there should be no difference between both kinds of taxes, but the tax burden is shared differently under imperfect competition. From a theoretical point of view, Suits & Musgrave (1953) studied monopoly and stated that ad valorem consumption taxes Pareto dominate per unit consumption taxes because tax shifting on prices is larger for per unit than for ad valorem consumption taxes. Delipalla & Keen (1992) studied a model of oligopoly with conjectural variations and confirmed that per unit consumption taxes shift more fully on prices than ad valorem consumption taxes. Other authors found the same results using different models of imperfect competition (e.g.: Skeath & Trandel 1994, Denicolo & Matteuzzi 2000 and Grazzini 2006). However, all this studies were done under partial equilibrium. The results are less homogenous when considering general equilibrium (e.g.: Blackorby & Murty 2007) or if introducing environmental issues (e.g.: Dröge & Schröder 2009). Myles (1996) propose on optimal combinaison of both kinds of taxes.

Whatever dominating each other or not with Pareto or welfare criteria, all studies pointed out that under imperfect competition, the shifting on prices of per unit consumption taxes should be larger than the shifting on prices of ad valorem consumption taxes. One intuitive explaination may be that with imperfect competition, firms have a market power and not only know the actual demand but could anticipate what would be the demand with higher or lower prices. Yet, if they decrease the before tax price after an increase of consumption taxes, it does not change the tax at all if it is per unit but it decreases the tax if it is ad valorem. Therefore, they are more likely to bear a share of the tax burden - by decreasing the before tax price - if it could decrease the proportial tax, and consequently decrease even more the after tax price than if it is a per unit consumption tax.

However, few empirical studies has been implemented in order to test this. Delipalla & O'Donnell (2001) looked at the European tabacco market, comparing ad valorem VAT and Excise taxes that are supposed to be per unit consumption taxes. However, the European system of Excise taxes on tabacco is complicated. Some European countries - France for exemple, that is considered in their panel - settle per unit excise taxes for main brands of cigarettes as the amount of ad valorem taxes on the brand of cigarettes leading the market. Therefore, excise taxes on tabacoo are not exactly per unit consumption

taxes. Furthermore, addiction changes fundamentally the behavior of consumers and therefore the pricing of suppliers (e.g.: Barnet et al. 1995).

Our point is to study the case of alcoholic beverages in France. They are sold in a market with imperfect competition: Young & Bielinska-Kwapsisz (2002) studied the market for alcoholic beverages in Washington D.C. and found taxes over-shifted on prices. They are submitted to two consumption taxes, a ad valorem one - VAT - and a per unit one - the specific excise duties on alcoholic beverages. The point is to compare respounces of prices to two increases of excise duties in 1993 and 1997 with respounce of prices of the same products to the increase of the full-rate of VAT in 1995. The shifting on prices of per unit excise duties is found significantly larger than the shifting on prices of ad valorem VAT.

The rest of the paper is organized as follows. Section 2 presents the theoretical background of the empirical study, with defining the parameters that should be estimated and explaining the empirical stategy. Section 3 presents the data: the times series, the indirect tax system in France and the reforms used for the econometrics. Section 4 presents the results of the estimations. Section 5 concludes.

2   Empirical framework and methodology

The aim of the present study is to estimate and compare the incidence of per unit and ad valorem consumption taxes. The incidence of consumption taxes is the sharing of the tax burden between suppliers and consumers. This paper focuses on the consumer share of this tax burden, that is the tax shifting on prices. The price p all taxes included and and the price p_w without any tax depend on each other as $p = (p_w + t)(1 + \tau)$ where t is the per unit tax and τ the rate of the ad valorem tax. The shifting on prices of per unit taxes is denoted x, the shifting on prices of ad valorem taxes is y. Tax shifting x is the ratio of effective variation of the price p tax included $\frac{\partial p}{\partial t}$ to the variation $\left.\frac{\partial p}{\partial t}\right|_{p_w = C^{te}}$ that would occur if the price p_w without any tax does not vary as taxes vary. As $\frac{\partial p}{\partial t} = (1 + \tau)\left(\frac{\partial p_w}{\partial t} + 1\right)$ and $\left.\frac{\partial p}{\partial t}\right|_{p_w = C^{te}} = 1 + \tau$ the shifting on prices x of the per unit taxes is given by equation (1).

$$x = \frac{\partial p}{\partial t} = 1 + \frac{\partial p_w}{\partial t} \tag{1}$$

In the same way, $\frac{\partial p}{\partial \tau} = p_w + t + (1 + \tau)\frac{\partial p_w}{\partial \tau}$ and $\frac{\partial p}{\partial \tau}\big|_{p_w = C^{te}} = p_w + t$. Therefore, the shifting on prices y

of the ad valorem taxes is given by equation (2).

$$y = 1 + \frac{1 + \tau}{p_w + t}\frac{\partial p_w}{\partial \tau} \tag{2}$$

The present paper aims at testing if the shifting on prices of one kind of consumption tax is larger than

the shifting on prices of the other kind of tax. According to our notations, the point is to test theoretical

results forecasting that x should be superior to y. To implement this test, both tax shifting should be

estimated. That for, new parameters x' and y' are defined as $p = (p_0 + x't) * (1 + y'\tau)$ where p_0 is the

price that would occur if there was no consumption taxes at all. Hence, it appears that $\frac{\partial p}{\partial \tau} = (p_0 + x't)y'$.

Because $p_w = \frac{p}{1+\tau} - t$, $\frac{\partial p_w}{\partial t} = \frac{\frac{\partial p}{\partial t}}{1+\tau} - 1 = \frac{p_0 + x't}{1+\tau}y' - \frac{p}{(1+\tau)^2}$. Thus, the shifting on prices y of ad valorem

consumption taxes may be written as a function of the proxy parameter y' as in equation (3).

$$y = \frac{1 + \tau}{1 + y'\tau}y' \tag{3}$$

In a similar way, $\frac{\partial p}{\partial t} = (1 + y'\tau)x'$. Yet, $\frac{\partial p_h}{\partial t} = \frac{\frac{\partial p}{\partial t}}{1+\tau} - 1 = \frac{1 + y'\tau}{1+\tau}x' - 1$. Thus, the shifting on prices x of

per unit taxes may be written as a function of the proxy parameters x' and y' as in equation (4).

$$x = \frac{1 + y'\tau}{1 + \tau}x' \tag{4}$$

To estimate parameters x and y, different data are used. First of all, the fiscal legislation gives the rates τ_i

of ad valorem consumption taxes (actually, it is the full-rate of VAT, a value added tax) for each period.

Furthermore, alcoholic beverages are submitted in France to per unit excise taxes, which constitute the

tax t_i for each period. Concerning the prices, two data bases are used, both provided by INSEE, the

French statistical agency. There is time series of mean prices for some goods, and there is the IPC[1] time

series. The last one is more accurate and corrected from collection bias, but the mean prices (at least

the level at one period) are also needed to estimate the shifting on prices of per unit consumption taxes.

Appart from correction of collection biases, the price index I_i is linked to the mean price p_i by the formula

$I_i = Cp_i$ where C is constant over time. It is assumed that the price p_i^0 that would apply at time i on

the market in case of no tax at all is increasing at a regular rate g: $p_i^0 = p_0^0(1 + g)^i$. Therefore, the price

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[1]Indice des prix à la consommation, a price index harmonized at the european level, close to the COICOP international

reference.

index correspond to the formula (5).

$$I_i = C(p_0^0(1+g)^i + x't_i)(1 + y'\tau_i) \tag{5}$$

This price index should be regressed differently to estimate shifting on prices x of per unit consumption taxes and shifting on prices y of ad valorem consumption taxes. The simpliest case is the case of ad valorem consumption taxes, for which no information on the actual level of prices is necessary. The dependant variable should be the logarithm of the price index $\ln I_i$. The independant variables should be the time period and the tax rate variations. Indeed, the logarithm of the price index is $\ln I_i = \ln C + \ln(p_0^0(1 + g)^i + x't_i) + \ln(1 + y'\tau_i)$. With grouping all constant terms on one side, and all the terms depending on the tax rate on an other side, and with calling $\delta_i\tau = \tau_i - \tau_0$, it appears that the logarithm of the price index is $\ln I_i = \left[\ln C + \ln(1 + y'\tau_0) + \ln p_0^0\right] + \left[\ln\left(1 + \frac{y'}{1+y'\tau_0}\delta_i\tau\right)\right] + \left[i\ln(1 + g) + \ln(1 + \frac{x't_i}{p_o^0(1+g)^i})\right]$. Then, it should be noted that $\frac{y'}{1+y'\tau_0}\delta_i\tau$ and $\frac{x't_i}{p_o^0(1+g)^i}$ are very small compared to 1 (the order of magnitude is 0,02 for the first term). Consequently, the taylor expansions of the logarithm function is made at first or second order (in order to have an error inferior to 0.001). Furthermore, as g is also small (the order of magnitudede is 0,001), equation (6) gives the taylor expansion of the logarithm of the price index with an order of magnitude of the error inferior to 0.001.

$$\ln I_i = \left[\ln C + \ln(1 + y'\tau_0) + \ln p_0^0 + \frac{x't_i}{p_0^0} - \frac{1}{2}\left(\frac{x't_i}{p_0^0}\right)^2\right] + \left[\frac{y'}{1 + y'\tau_0}\right]\delta_i\tau + \left[g\left(1 - \frac{x't_i}{p_0^0}\right)\right]i \tag{6}$$

The parameter of the regression of $\ln I_i$ by the tax rate variations $\delta_i\tau$ is then the estimate of a function of the shifting on prices of ad valorem consumption taxes as presented by equation (7).

$$\beta_1 = \frac{y'}{1 + y'\tau_0} = \frac{y}{1 + \tau_0} \tag{7}$$

IPC time series is sufficient to estimate the shifting on prices of consumption taxes such as VAT. However, it is not enough to estimate shifting on prices of per unit consumption taxes, such as the excise taxes on alcoholic beverages. For those taxes, data giving the actual value of the goods concerned should be use, at least for one period. The global estimation may be done with an index time series (those data are more precisely collected an controled for biases). For shifting on prices of per unit consumption taxes, the dependant variable should be the absolute increase of the price index from one period to another $\Delta_i I$ (where the operator Δ_i applied to a time series X_i gives $\Delta_i X = X_{i+1} - X_i$). The value of that absolute

variation over a period is $\Delta_i I = C(1+y')p_0^0\left[(1+g)^{i+1} - (1+g)^i\right] + C(1+y')x'\Delta_i t$. Because the monthly

increase rate g (monthly time series are considered in the econometric sections) is small compared to 1,

the Taylor expansion of the function $(1+g)^{i+1} - (1+g)^i$ is $(1+g)^{i+1} - (1+g)^i = g + ig^2 + i(i+1)g^3 + ...$

and we can keep the approximation $(1+g)^{i+1} - (1+g)^i = g$ with an order of magnitude of the error

inferior to 0.0001 because the order of magnitude of g is 0.001 and we never consider more than 36 periods

$(i < 36)$ for the regressions. The regression is given by formula (8).

$$\Delta_i I = \left[C(1+y')p_0^0 g\right] + \left[C(1+y')x'\right]\Delta_i t + \left[C(1+y')p_0^0 g^2\right] i \tag{8}$$

The parameter giving the per unit consumption tax shifting is β_2, as shown by formula (9). Given any

period $i = u$, it is possible to calculate the acutal tax shifting on prices because $I_u = p_u C$.

$$\beta_2 = C(1+y')x' = C(1+\tau)x = (1+\tau)\frac{I_u}{p_u}x \tag{9}$$

To answer the original question - is shifting on prices of per unit consumption taxes larger than shifting

on prices of ad valorem consumption taxes? - it is then possible to compare directly the values of the

estimated tax shifting $x = \frac{\beta_2 p_u}{(1+\tau)I_u}$ and $y = \frac{\beta_1}{1+\tau_0}$.

3   Data

Alcoholic beverages are submitted to two different kinds of consumption taxes. First of all, they are sub-

mitted to the general consumption tax, VAT. In addition, they are submitted to excise taxes, defined per

unit for hectolitre of product - or hectolitre of pure alcohol depending of the kind of alcoholic beverage.

There is also another per unit consumption tax whose revenue is directly allocated to public health insur-

ance, but there has not been any change of this tax during the period considered for the empirical study.

Three reforms occured in France during the 1990's that affect indirect fiscality on alcoholic beverages. In

1993 and 1997, excise taxes - that are unit taxes for alcoholic beverages - increased. In 1995, the full-rate

of VAT - the rate that taxes those beverages - also increased. This provides three reforms - relatively close

in time - to compare shifing on prices of per unit and ad valorem consumption taxes.

I choose two alcoholic beverages among the categories for which the French CPI time series[2] gives a

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[2]Consumption price index (IPC, Indice des prix à la consommation), a price index series build by INSEE, the French

statistic agency.

specific monthly price index. This data base build each month a price index for 161 different classes of consumption goods. The classification of goods is based on the international standard COICOP (Classification of Individual Consumption According to Purpose), with some more details. Consumption goods are classified in twelve divisions, 86 groups and 161 classes. Montlhy price indexes are calculated from the collection each month of the actual prices of 1000 different goods in 2000 different selling points in 106 cities of more than 2000 inhabitants. Indexes are calculated as a linked chain of Laspeyres.

From the different price indexes for classes of alcoholic beverages, the one called *"brandy and liquors"* has been rejected from the empirical study. The beverages whose prices are collected to build this price index are very different in terms of consumption as in terms of excise taxes. In particular, it is not possible to calculate a global excise tax for those kind of alcoholic beverages. The index called *"champagne, sparkling wine and ciders"* has been rejected for the same reason. For similar motives, the *"rhum"* price index has also been rejected. Rhum beverages are submitted to different legislations depending mainly on two facts: the region of production - there is smaller excise taxes for rhum produced in the French antilles or in the Réunion island - and the quantity imported in continental France. Last, *"wine"* index has been rejected. This index collects prices of actual wine, but also of different beverages made of wine - fortified wine for exemple - that are submitted to different excise taxes. Furthermore, less reforms occured on wine excise taxes.

Two time series of price index are studied to compare incidence of ad valorem VAT and per unit excise taxes. First of all, the *"beer"* index corresponds to usual blond beers, sold in pack of 6*33 centillitres (a little more than 6*11oz) for a total of two litres (a little less than 68oz). They are beers with a small degree of alcohol; a degree of alcohol of 4.5% in volume is considered, which is quite high for the category of beers. As excise taxes on beers are proportional to the degree of alcohol, over-estimating the degree of alcohol leads to an under-estimation of the tax shifting on prices. As the aim of this paper is to test if excise tax shifting is indeed larger than VAT shifting on prices, a safety margin is taken to be sure not to over-estimate excise tax shifting, and that for not to under-estimate excise taxes and degree of alcohol.

Second, the time series of price indexes called *"aperitif"* is used for the econometrics. It consisted in the index of prices of anise aperitif and whisky. Those beverages are quite different the one from the other. However, they are submitted to similar excise taxes. For both beverages, the same excise tax is settle by

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hectolitre of pure alcohol. The degree of alcohol of anise aperitif is 45% in volume, and the collected prices are for bottles of one litre. The degree of alcohol of whiskies depend on the brand, but are close from one brand to another and close to the degree of alcohol of anise aperitif (a degree of alcohol of 42% in volume is considered for the empirical studies). INSEE collects prices of bottles of 75 centilitres. Figure 1 shows the price index of both kinds of goods all along the global period considered.
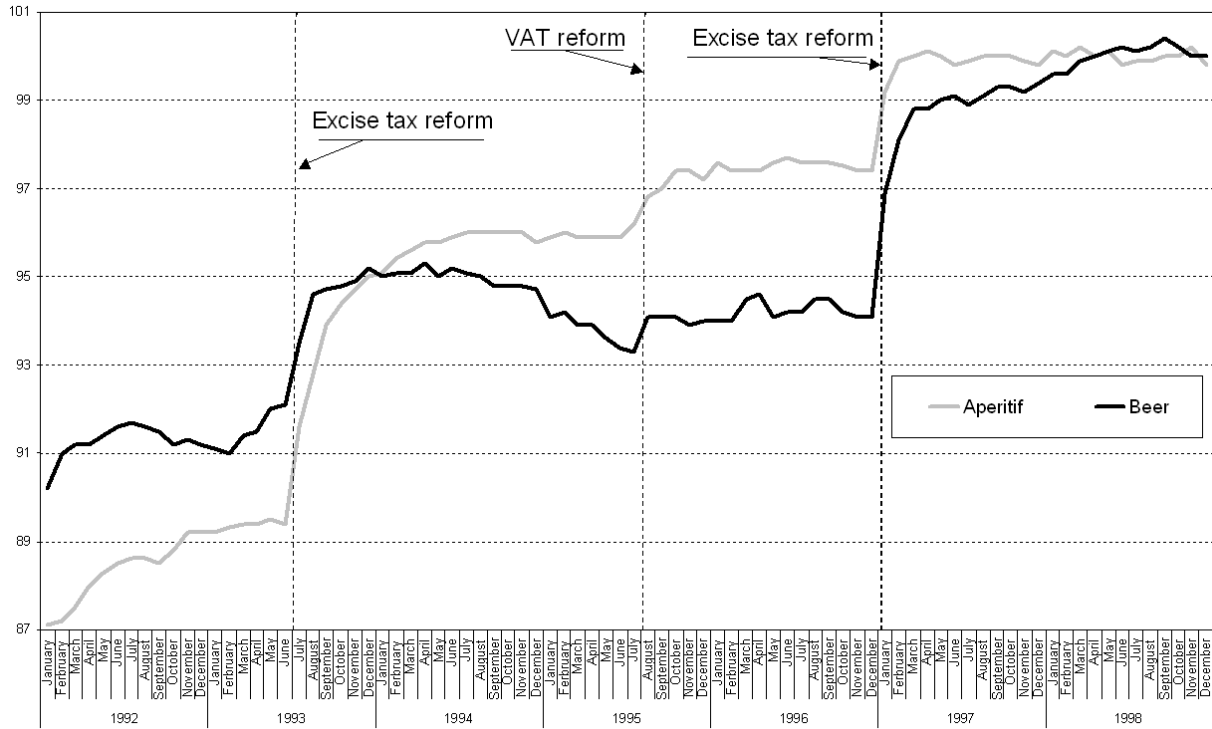

Figure 1: Price indexes of alcoholic beverages during the 1990's in France

Another time series data base is available at INSEE, which gives the mean prices every month instead of price indexes. These time series are less corrected for collection bias and other kinds of errors than the IPC time series. For that reason, these data base is not used for the actual estimations of tax shifting, which are implemented with the IPC data base. However, an actual price of the alcoholic beverages - and not only an index of prices - is need to estimate per unit excise tax shifting. For all those reasons, only one value of the time series of mean prices is used for each kind of beverages - it may be whatever month; actually, the last month before reform is used. This unique value is used to measure the value of the change of excise taxes due to the reform proportionally to the actual price of the good. Three time

series are used: on one hand time series for "*beer*" is used to calibrate price index for "*beer*", on the other hand both times series for "*anise aperitif*" and "*whisky*" are used to calibate price index for "*aperitif*".

Given these time series, specific attention is given to the different reforms. On August 1st 1995, the full rate of VAT increased from 18.6% to 20.6%. It also affected the market for alcoholic beverages as alcoholic beverages are submitted to this full rate of VAT. The tax increase with respect to retail price is then 1.69% (0.02/1.186), which is of the same order of magnitude as the variations of excise taxes - for beers it was about 0.83% in 1993 and 2.50% in 1997; for anise aperitif it was about 6.76% in 1993 and 2.22% in 1997; for whisky it was about 4.72% in 1993 and 1.66% in 1997. To show on a figure (figure 2) the magnitude of the tax shifting, we report on the same figure the actual price indexes around the 1995 reform and the price indexes that would occur if VAT shifted fully on prices. The calculation of that simulated indexes for full shifting is made by measuring the mean rate of inflation before the reform then applying this rate of inflation of prices all along the new time series. The only change to that linear time series is the multiplycaton by 1.0169 ($= \frac{1.206}{1.186}$) the month of the VAT reform.
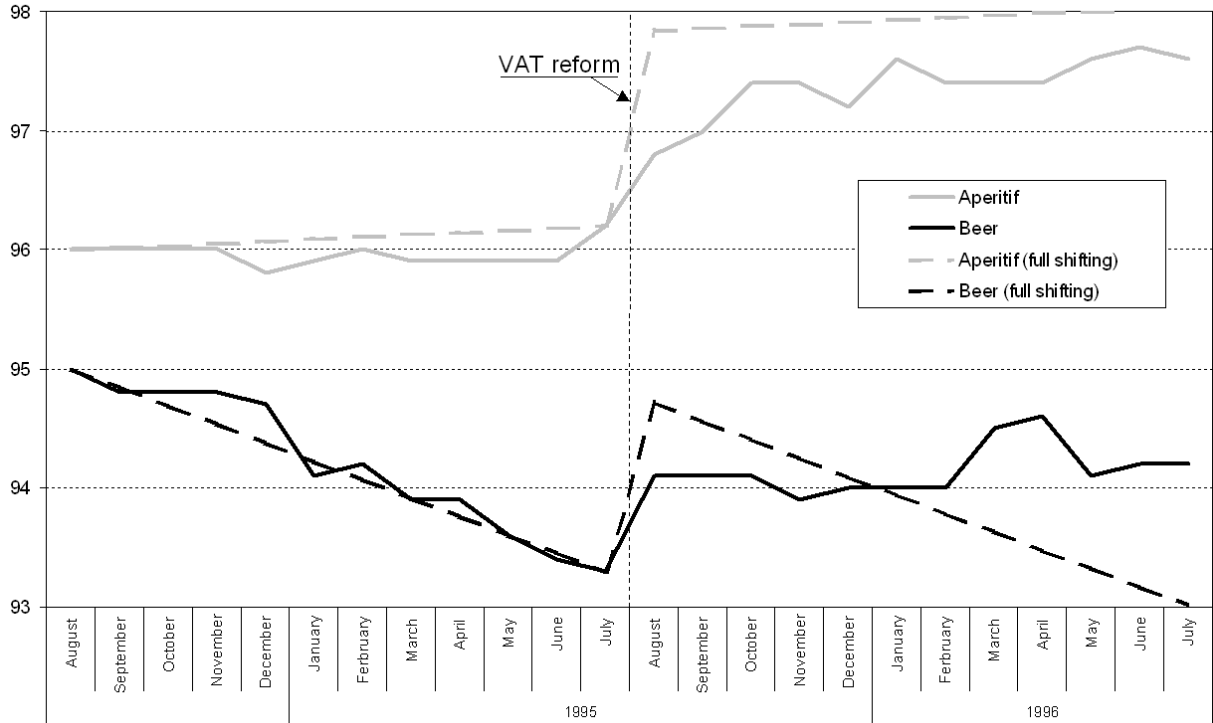

Figure 2: Prices of alcoholic beverages around the reform of the full rate of VAT in august 1995

It appears clearly that VAT is under shifted on prices, for both alcoholic beverages studied, "*beer*" and "*aperitif*". Concerning "*aperitif*", the rate of inflation of prices is close to zero before and after the reform - apart the last month before the reform. Therefore, the increase of prices due to the increase of the full rate of VAT is obvious, and stay obviously under the curve simulating full-shifting on prices. Concerning "*beer*", the rate of inflation of prices is negative before the reform, but stay close to zero after the reform. Therefore, the curve simulating full-shifting on prices pass under the curve of the actual price of beer six month after the reform. Nevertheless, this seems due to a change in the inflation of the price of beer and not to an over-shifting of VAT.

After looking at the impact of ad valorem VAT on prices, we focuse on the impact of per unit excise taxes on prices. First, on July 1st 1993, excise taxes on alcoholic beverages increase. For beers, it was eleven francs per degree of alcohol and per hectolitre of beverage and became 12.5 francs per degree and hectolitre. As we considered packs of 6*33cL of beer whose degree is 4.5% in volume, it correspond to an increase of 2.06 cents of euro per pack[3]. As the mean price the last month before the reform was 2.49 euros, it is an increase of the excise tax of 0.83% of the actual price, which correspond to an increase of 0.76 of the price index of "*beer*" (as the price index of "*beer*" is 92.1 the last month before the reform).

For alcohols, the excise duty was 7810 francs per hecolitre of pure alcohol and became 9060 francs per hectolitre of pure alcohol. As anise aperitif has an alcoholic degree of 45% in volume and the time series gives the mean price for bottles of one litre, it represents an increase of the excise tax of 85.75 cents of euro per bottle. The mean price was 12.69 euros the last month before the reform, thus the tax increase is of 6.76% of the price, which corresponds to an increase of 6.04 of the price index as it was 89.4 the last month before the reform. This gives the upper boundary for the curve simulating full shifting. The lower boundary of the simulation is given by whisky. As whiskies have a mean alcoholic degree of 42% in volume and the time series gives the mean price for bottles of 75 centilitres, it represents an increase of the excise tax of 60.03 cents of euro per bottle. The mean price was 12.73 euros the last month before the reform, thus the tax increase is of 4.72% of the price, which corresponds to an increase of 4.22 of the price index as it was 89.4 the last month before the reform. Figure 3 presents the curves of the actual price indexes for "*beer*" and "*aperitif*", and the curves simulating full-shifting for "*beer*", "*anise aperitif*" and

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[3]We convert all prices in euro because the time series of the mean prices build by INSEE are fully converted in euros.
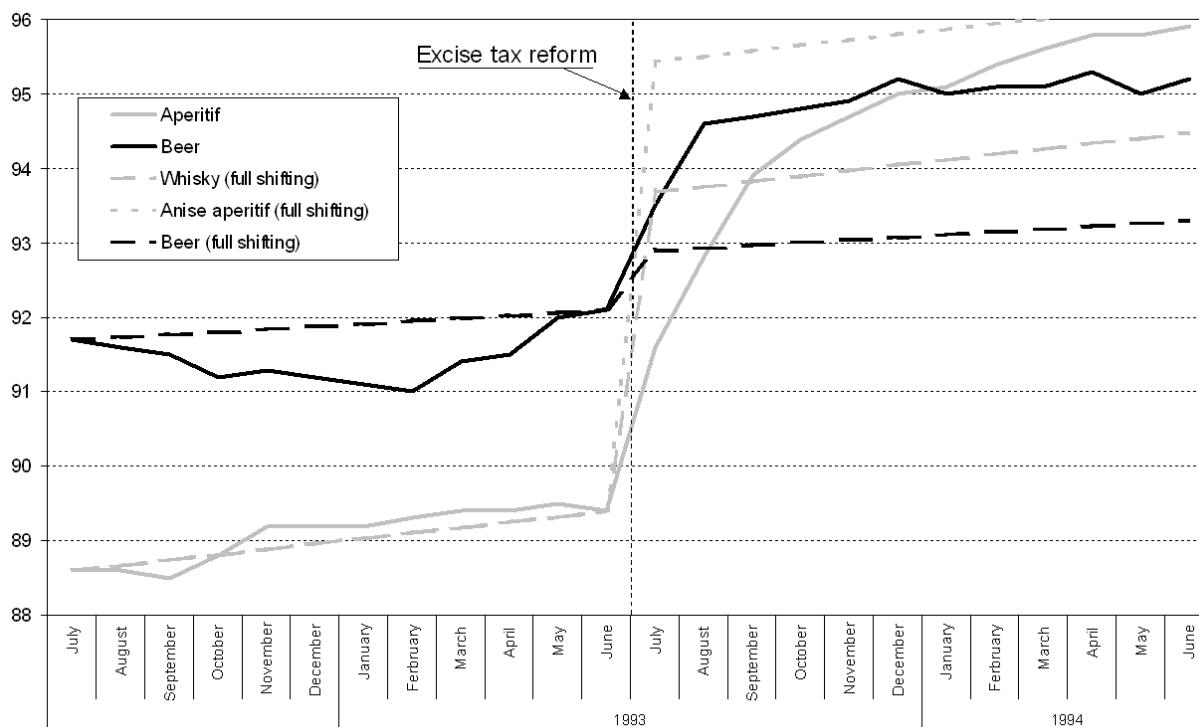
"*whisky*".

Figure 3: Prices of alcoholic beverages around the reform of excise taxes on alcohol in july 1993

It appears without any doubt that excise taxes are over-shifted on prices for "*beer*". However, it is not that simple for "*aperitif*". Indeed, the curve of the actual price index of "*apertif*" lies after the reform between the upper boundary and the lower boundary of the curve simulating full-shifting on prices. Hence, excise taxes may be either over-shifted or under-shifted on prices of aperitif. Undoubtly, it is close to full-shifting on prices of aperitif.

Second, on January 1st 1997, excise taxes increase one more time for alcoholic beverages. For beers, it was 12.5 francs per degree of alcohol and per hectolitre of beverage and became 17 francs per degree and hectolitre. It correspond to an increase of 6.17 cents of euro per pack. As the mean price the last month before the reform was 2.47 euros, it is an increase of the excise tax of 2.50% of the actual price, which corresponds to an increase of 2.35 of the price index of "*beer*" (as the price index of "*beer*" is 94.1 the last month before the reform).

For alcohols, the excise duty was 9060 francs per hecolitre of pure alcohol and became 9510 francs

per hectolitre of pure alcohol. For anise aperitif which gives the upper boundary of the full shifting, it represents an increase of the excise taxes of 30.87 cents of euro per bottle. The mean price was 13.93 euros the last month before the reform, thus the tax increase is of 2.22% of the price, which corresponds to an increase of 2.16 of the price index as it was 97.4 the last month before the reform. For whisky - which gives the lower boundary of full-shifting - it represents an increase of the excise tax of 21.61 cents of euro per bottle. The mean price was 13.01 euros the last month before the reform, thus the tax increase is of 1.66% of the price, which corresponds to an increase of 1.62 of the price index as it was 97.4 the last month before the reform. Figure 4 presents the curves of the actual price indexes for beer and aperitif, and the curves simulating full-shifting for beer, anise aperitif and whisky.
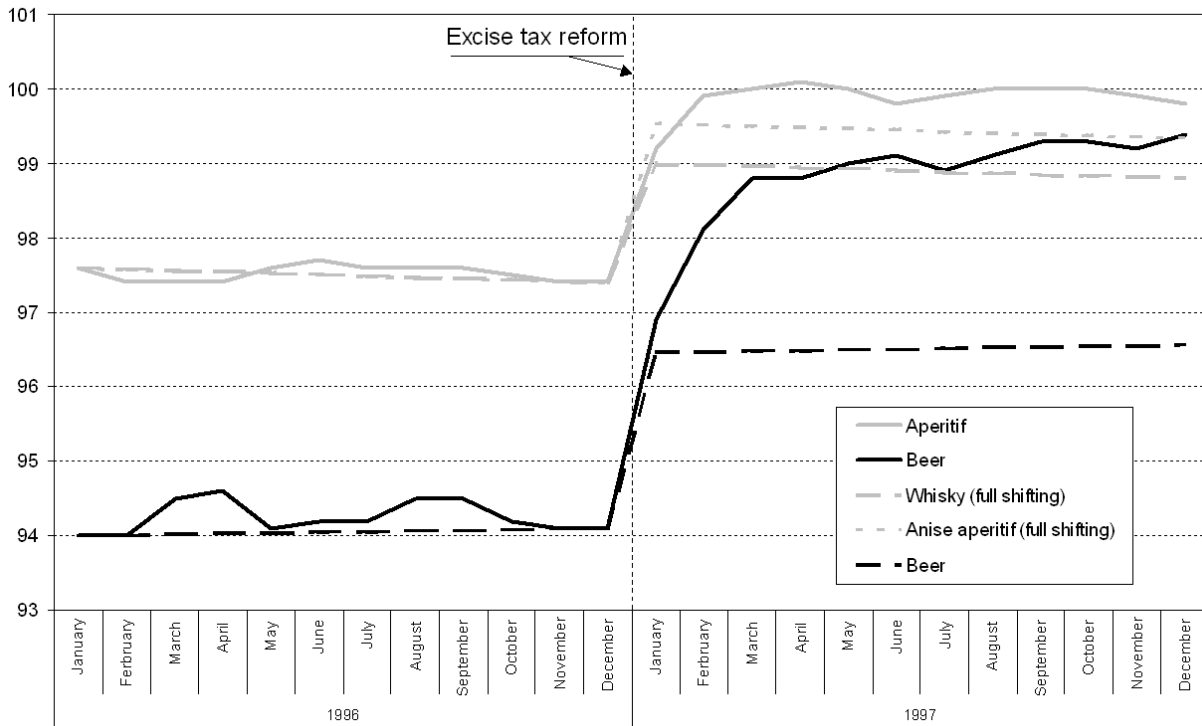

Figure 4: Prices of alcoholic beverages around the reform of excise taxes on alcohol in january 1997

It appears clearly that excise taxes are over-shifted on prices for both alcoholic beverages studied: "*beer*" and "*aperitif*". Hence, shifting on prices of per unit excise taxes in 1997 was doubtlessly larger than shifting on prices of ad valorem VAT in 1995 which was under-shifted on prices. Econometrics confirms this result in section 4, and gives the level of significance of the difference between tax sifting on

prices of ad valorem VAT and per unit excise taxes.

4 Empirical results

The empirical strategy is explained in section 2. I operate separetly estimations of tax shifting on prices for each reform. First, the shifting on prices of the change of full-rate of VAT in 1995 is estimated according to regression (6), which gives parameter β_1. VAT shifting on prices is calculated from this parameter β_1 according to equation (7). The results of these regressions and calculations for both "*beer*" and "*aperitif*" are reported in table 1.

	Beer	Aperitif
Tax shifting	41.14%**	63.83%***
Standart error	(16.78%)	(7.61%)
Parameter β_1	0.3469**	0.5382***
Standart error	(0.1415)	(0.0642)
Number of observation	36	36
R^2	44.0%	95.2%

Table 1: Estimation of the shifting on prices of the change of the full-rate of VAT in 1995

Notes: Parameter β_1 is the coefficient of independant variable $\delta_i\tau$ in the OLS linear regression according to equation (6). Tax shifting is calculated from this parameter β_1 according to equation (7). ***: estimate significant at the level of 1%; **: estimate significant at the level of 5%.

The results of these regressions confirm graphical evidences presented in section 3. Estimates of the tax shifting are significant, and their value is significantly lower than 100%. VAT is under-shifted on prices of both alcoholic beverages, "*beer*" and "*aperitif*". The producers bear a substantial share of the burden of VAT.

Concerning the estimation of the shifting on prices of per unit excise taxes, the regressions are implemented according to equation (8). For regressions with the time series of price index for "*aperitif*" as dependent variable, two estimations are made with two different values for the variation $\Delta_i t$ of the

excise taxes. The two values constitute boundaries for the variation of excise taxes for the class called "*aperitif*": the upper boundary is the variation of excise taxes for anise aperitif, the lower boundary is the variation of excise taxes for whisky. Tax shifting is calculated from the estimate of the coefficient of the $\Delta_i t$ independent variable according to equation (9). The results of these regressions and calculations for both alcoholic beverages studied, "*beer*" and "*aperitif*" are reported in table 2 for the 1993 reform and in table 3 for the 1997 reform.

	Beer	Aperitif	
		Anise aperitif	Whisky
Tax shifting	264.67%***	63.64%***	91.20%***
Standart error	(33.36%)	(4.29%)	(6.14%)
Parameter β_2	0.3540***	5.3173***	7.5961***
Standart error	(0.0446)	(0.3581)	(0.5116)
Number of observation	36	36	
R^2	66.3%	90.3%	

Table 2: Estimation of the shifting on prices of the change of excise taxes in 1993

Notes: Parameter β_2 is the coefficient of independant variable $\Delta_i t$ in the OLS linear regression according to equation (8). Tax shifting is calculated from this parameter β_2 according to equation (9). ***: estimate significant at the level of 1%.

The results are very different for "*beer*" and "*aperitif*", and for 1993 and 1997 reforms, but all results are very significant: at a level of 1%. Furthermore, robustness tests have been implemented, with changing the window of the time series for the regressions: the results stand. For "*beer*", the shifting on prices of the small increase of excise taxes in 1993 was larger than the shifting on prices of the larger increase of excise taxes in 1997. However, both tax shifting were substantially larger than 100%, and therefore substantially larger than the shifting on prices of the increase of the full-rate of VAT in 1995.

For "*aperitif*", the increase of excise taxes in 1997 has been over-shifted on prices: shifting is larger even of the upper boundary for full-shifting, which is calculated considering the upper boundary of increase of excise taxes, the increase of excise taxes for anise aperitif. However, the increase of excise taxes in 1993 was

	Beer	Aperitif	
		Anise aperitif	Whisky
Tax shifting	160.65%***	102.88%***	137.26%***
Standart error	(12.82%)	(12.11%)	(16.15%)
Parameter β_2	0.2251***	8.6750***	12.3928***
Standart error	(0.0180)	(1.0210)	(1.4585)
Number of observation	30	30	
R^2	89.5%	86.4%	

Table 3: Estimation of the shifting on prices of the change of excise taxes in 1997

Notes: Parameter β_2 is the coefficient of independant variable $\Delta_i t$ in the OLS linear regression according to equation (8). Tax shifting is calculated from this parameter β_2 according to equation (9). ***: estimate significant at the level of 1%.

under-shifted on prices, even for the upper boundary of tax shifting which is tax shifting estimated with the lower boundary for the increase of excise taxes, the increase of excise taxes for whisky. The difference with graphical evidences (which are small differences in value but spectacular difference because taxes were found graphically hardly over-shifted on prices and are found econometrically hardly under-shifted on prices) come from a graphical under-estimation of the rate of inflation of price index for "*aperitif*" after the reform.

To check if the differences between the shifting on prices of the ad valorem VAT and the per unit excise taxes are significant, the differences between the estimates and the standart errors of these differences are calculated. The results are presented in table 4.

For "*beer*", both shifting of the increase of excises taxes in 1993 and 1997 were significantly larger than the shifting of the increase of the full-rate of VAT in 1995. It confirms the theoreticall result that per unit consumption taxes should induce a larger increase of prices than ad valorem consumption taxes. For "*aperitif*", the results are less clear, and depend on the reform of excise taxes. In 1997, even the lower boundary of the shifting of excise taxes (the estimation of tax shifting with considering the case of anise aperitif to calculate the increase of excise taxes) is significantly larger than the shifting of VAT in 1995.

	Beer	Anise paeritif	Whisky
Difference between 1993 and 1995	223.53%***	-0.19%	27.37***%
	(37.34%)	(8.74%)	(9.78%)
Difference between 1997 and 1995	119.51%***	39.05%***	73.43%***
	(21.12%)	(14.30%)	(17.85%)

Table 4: Differences between shifting on prices of per unit and ad valorem consumption taxes

Note: ***: value of the difference significant at the level of 1%.

However, the lower boundary of the shifting of excise taxes after the reform of 1993 is not significantly larger than the shifting of VAT in 1995, it is equal (it should be noticed that it is not lower either). The upper boundary is 1% significantly larger. Calculating wheighted sums of both boundaries[4] - whith wheights corresponding to the share of each kind of beverage in the global index for "*aperitif*" - it appears that whisky prices should represent 57% of the global index of "*aperitif*" for the shifting of excise taxes in 1993 to be larger than the shifting of VAT in 1995 with a level of significance of 10%. Whisky prices should represent 68% of the global index of "*aperitif*" to obtain a level of significance of 5% and should represent 90% to obtain a level of significance of 1%.

5   Concluding comments

Economic theory states that on market with imperfect competition, per unit consumption taxes should induce a larger increase of prices than ad valorem consumption taxes. Thus, consumers should bear a larger share of the tax burden for per unit consumption taxes than for ad valorem consumption taxes.

The present papers aims at testing this theoretical result. It uses the French market for alcoholic beverages, which are submitted to both per unit (excise taxes) and ad valorem (VAT) consumption taxes. Econometrics is implemented on three reforms of consumption taxes affecting the French market for

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[4]For calculation of standart errors, the coefficient of correlation between the estimates for anise aperitif and whisky is set equal to 1 because both these estimates are estimated from the same time series (price index for "*aperitif*") with different values of the variations of per unit excise taxes.

alcoholic beverages. In 1995, the full rate of VAT increased from 18,6% to 20,6%; excise taxes on alcoholic beverages increased in 1993 and 1997. The econometrical results confirm economic theory. For *"beer"*, the shifting on prices of per unit excise taxes was significantly larger in 1993 and 1997 than the shifting of ad valorem VAT in 1995. For *"aperitif"*, the shifting on prices of per unit excise taxes was significantly larger in 1997 than the shifting of ad valorem VAT in 1995. The shifting on *"aperitif"* prices of per unit excise taxes in 1993 seems larger than the shifting of ad valorem VAT in 1995, but is not significantly larger.

One reason of this lack of significance for *"aperitif"* in 1993 could be the magnitude of the variations of taxes. The magnitude of the variation of the VAT in 1995 is of the same order as the magnitude of the variations of excise taxes for *"beer"* and *"aperitif"* in 1997. The magnitude of the variation of excise taxes in 1993 is much smaller for *"beer"* and much larger for *"aperitif"*. If elasticity of the demand with respect to prices depend on the magnitude of the variation of prices, the shifting on prices of consumption taxes should also depend on the magnitude of the variation of the consumption taxes. Particularly, if demand reacts proportionally more to large variations of prices than to small variations of prices (e.g.: Carbonnier, 2008), tax shifting should be larger for small variations of taxes than for large variations of taxes. This could explain why the shifting of excise taxes on prices of *"beer"* was larger in 1993 than in 1997, and why the shifting of excise taxes on prices of *"aperitif"* was lower in 1993 than in 1997.

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