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On the way of tobacco quitting: A VAR approach

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Abstract

In order to describe the process of tobacco quitting, we perform a VAR model and causality tests both on the monthly sales of tobacco products and nicotine dependence drugs in France, for the period going from February 2004 to April 2009. According to the path of tobacco quitting found out, it results that an upward harmonization of tax policy on the different tobacco products could accelerate the tobacco quitting process.

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1. Introduction

At least 60,000 premature yearly deaths are attributable to tobacco use in France (OFDT, 2009). The social cost of tobacco use was estimated at 47.7 billions Euros in 2003, far from the social cost of illicit drugs and alcohol abuses: respectively 2.8 and 37 billions of Euros (Kopp and Fénoglio, 2006).

In conformity with the WHO Framework Convention on Tobacco Control, French authorities try to curb tobacco epidemic. Several policies were implemented: policies of tobacco products tax increases, tobacco-free-air laws, tobacco advertising regulation, health warnings about tobacco use consequences, partial reimbursement of the cost of medical treatment of nicotine addiction… These policies have been more or less effective to decrease smoking [see, e.g., Lanoie and Leclair (1998), Sloan, Smith and Taylor (2002)].

In this research, we focus on the impact of nicotine substitution demand on tobacco consumption. More precisely, we use French monthly data, from February 2004 to April 2009, to estimate a Vector Auto-Regressive (VAR) model describing the interrelationships between cigarettes consumption, Roll-Your-Own (RYO) tobacco consumption and nicotine substitution medicines use. The rest of the paper is organized as follows. In Section 2 we describe the dataset and the empirical method. Estimation results and causality analysis are shown in Section 3. We discuss the implemented policies of fighting against tobacco in Section 4.

2. Empirical model and data

Our dataset is freely accessible from the website of the French Monitoring Centre for Drugs and Drug Addiction (FMCDDA, www.ofdt.fr). It is composed of three endogenous variables, depicted in Figure 1 in their logarithmic form, for the period February 2004 - April 2009 (63 observations).

Figure 1. Cigarettes sales (QC), hand-rolled tobacco sales (QR) and nicotine substitution drugs sales (QNS) (in log)

The first endogeneous variable is the monthly sales of nicotine-substitution drugs sold in pharmacy (QNS_t). For confidentiality convenience as regards market shares of different substitution products, the FMCDDA cannot deliver data of sales by products, which are given by a firm in charge of statistical information about the French drug market (GERS:

Groupement pour l'Elaboration et la Réalisation de Statistiques). Nicotine-substitution drugs are then expressed in figures of monthly-treatment. This latter variable is available according to the following daily dosage: 10 oral forms, 1 patch, 2 tablets of Zyban® or Champix® and finally 6 refills of inhaled medications.

The two other endogenous variables are the monthly sales of cigarettes and RYO tobacco in France, expressed in tons of tobacco (QC_t and QR_t respectively). These variables of tobacco sales are provided by ALTADIS, which is the unique firm in charge of delivering tobacco to retail shops in metropolitan France; a notable exception is Corsica, as there is no monopoly of tobacco distribution in this department.

Even if imperfect, we use tobacco products sales as a proxy of consumption. Tobacco sales could underestimate the level of tobacco use due to the opportunity for French smokers to get their tobacco products outside the French legal market. On the one hand, tobacco products issue from contraband are increasingly available on the black market (DGDDI, 2008); on the other hand, cross-border shopping of tobacco is an important way of getting tobacco for French people (Ben Lakhdar, 2008). Note that before our observation period, tobacco products price increased drastically, from 3 Euros per pack in September 2003 to 5 Euros in February 2005, leading French smokers to behave in that sense (Ben Lakhdar, 2008). Since, January 2004, tobacco prices increased but not as high as before. Consequently, it is likely to think that the level of contraband and cross-border shopping for tobacco is stable since, and will not disturb our time series data.

Descriptive statistics of the endogenous variables are shown in Table 1, as well as the ADF stationarity tests.

Table 1. Descriptive statistics (whole sample)

	Mean	SD	ADF (*level*)	Integration order
Log(QC)	8.42	0.072	-5.013***	I(0)
Log(QR)	13.29	0.075	-3.962***	I(0)
Log(QNS)	11.88	0.348	-3.561***	I(0)

***: Critical value at the 1%-level: -3.51.

The ADF statistics for these variables exceed the critical value in absolute terms, at the 1%-level of significance. In other words, $\log(QC_t)$, $\log(QR_t)$ and $\log(QNS_t)$ are stationary process. This implies that the estimation of a long-run cointegration model is excluded. Thus we use the vector autoregressive technique to estimate a short-run model. None of the endogeneous variables is seasonnaly adjusted; rather, estimated equations contain a set of j= eleven seasonal dummies and a constant term. Finally, three exogenous variables are introduced.

The price variables, expressed in their logarithmic form, are assumed to be the first two exogenous factors. The reason is that during the observation period, both the prices of cigarettes (PC_t) and RYO tobacco (PR_t) increased by thresholds: +6% in August 2007 for cigarettes; +3.8% and +9% for hand-rolling tobacco, respectively in July 2005 and August 2007. A last exogenous dummy variable is used for translating the legislation on free-tobacco-air decree concerning working places (FTA_t): this variable takes the value 1 from February 2007 to the end of the period, and 0 before. Although a second set of this law was implemented in January 2008, the first date was the most important in the public opinion, by representing the break point of the interdiction of smoking in the public places. So, only the first date is taken into account.

3. Estimation results and Granger-causality

We set the lag length of the vector auto-regressive model at three time periods, on the basis of the likelihood-ratio test (35.93), the final prediction error, (5.5e-08), the Akaike's

information criterion (-8.33), and the Hannan-Quinn criterion (-7.38), the Schwartz's Bayesian information criterion (-6.421). Estimation results are presented in Table 2.

Table 2. VAR estimates.

	$Log(QC_t)$		$Log(QR_t)$		$Log(QNS_t)$	
	Coef.	t value	Coef.	t value	Coef.	t value
Endogeneous						
$Log(QC_{t-1})$	-0.324	-2.040**	-0.264	-1.120	-0.409	-0.550
$Log(QC_{t-2})$	-0.161	-1.090	-0.321	-1.460	0.241	0.350
$Log(QC_{t-3})$	0.196	1.510	0.077	0.400	0.374	0.620
$Log(QR_{t-1})$	-0.272	-2.660***	0.066	0.430	-0.295	-0.620
$Log(QR_{t-2})$	0.079	0.750	0.194	1.250	-0.926	-1.900*
$Log(QR_{t-3})$	0.061	0.570	-0.054	-0.340	-0.238	-0.480
$Log(QNS_{t-1})$	-0.043	-1.400	-0.072	-1.580	0.283	1.980**
$Log(QNS_{t-2})$	-0.054	-1.840*	-0.059	-1.360	0.117	0.860
$Log(QNS_{t-3})$	0.041	1.660*	0.031	0.860	-0.054	-0.470
Exogeneous						
$Log(PC_t)$	-1.481	-4.050***	-0.977	-1.800*	-4.471	-2.620***
$Log(PR_t)$	0.270	2.040**	0.306	1.550	0.833	1.350
FTA_t	0.025	1.760*	0.036	1.680*	0.224	3.350***
Intercept	15.212	4.810***	17.044	3.630***	30.990	2.110**
Seasonal dummies						
Jan	-0.052	-2.480**	-0.107	-3.440***	0.524	5.350***
Feb	-0.130	-4.780***	-0.049	-1.210	0.162	1.290
Mar	-0.016	-0.620	0.087	2.290**	-0.083	-0.700
Apr	0.060	2.670***	0.062	1.850*	0.114	1.090
May	0.092	4.310***	0.063	2.010**	0.148	1.490
Jun	0.124	5.030***	0.125	3.410***	0.226	1.970**
Jul	0.143	4.580***	0.083	1.790*	0.087	0.590
Aug	0.071	1.700*	0.042	0.670	-0.334	-1.710*
Sep	-0.071	-1.670*	-0.033	-0.530	0.726	3.660***
Oct	-0.044	-1.240	-0.025	-0.480	0.348	2.090**
Nov	0.005	0.160	0.078	1.580	-0.003	-0.020

Note: ***: p<0.01; **: p<0.05; *: p<0.10;

In the short run (t-1), cigarette consumption is significantly diminishing when RYO tobacco consumption increases (e=-0.27). This result indicates a substitution between these products, which is confirmed when analyzing the estimated coefficients of the cigarette price and hand-rolling tobacco price variables (-1.48 and 0.27 respectively). Due to the VAR modeling used, these relations cannot be interpreted as direct elasticities, as pointed out by

Lütkepohl (1994) and theoretically solved by Johansen (2005). The substitution between these two products seems to be in one way only: from cigarettes to RYO tobacco. Causality tests presented in Table 3 will confirm this result. Finally, the 1-lag cigarette sales negatively and significantly affect the contemporaneous cigarette consumption (e=-0.32), indicating a diminishing trend of cigarette use, translating the idea of a change in the perception and in the social norms *vis-à-vis* of tobacco use (Alamar and Glantz, 2006).

The effects of the nicotine-substitution drugs sales (in t-1 and t-2) on cigarettes and RYO tobacco sales are negative, but not statistically significant at the 5% level. The fact that the variable $\log(QNS_t)$ is strongly auto-regressive (e=+0.283), indicates the increasing medicalization of tobacco quitting these past years. The use of substitutes does not depend on past values of RYO tobacco sales at the 5% level of significance, but is negatively affected by changes in cigarette price (e=-4.47). Such a result can be interpreted by the fact that the deterrent effect of price on cigarette demand is strong enough to incite smokers to quit without using nicotine-substitute. Finally, free-tobacco-air laws positively affect the nicotine dependence treatment, but do not present any significant impact on tobacco consumption, at the 5% level of significance. In other words, this kind of policy appears to favor more the will to quit than quitting itself.

Finally, to determine causality in the model, we use the causality test introduced by Granger (1969). The Wald-type test is characterized by testing for nonzero correlation between the error processes of the cause and effect variables. Results are shown in Table 3.

Table 3. Granger causality tests (Chi-2 test)

	Does not cause QC?	Does not cause QR?	Does not cause QNS?
QC	-	3.985	1.254
QR	7.255*	-	7.149*
QNS	9.035**	8.237**	-

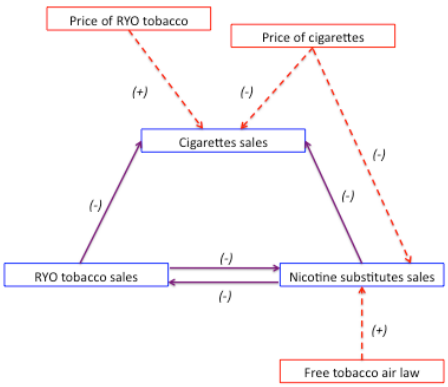
Note: ***: p<0.01; **: p<0.05; *: p<0.10;

According to the causalities found out at the traditional 5% level of significance, it appears that cigarette sales do not Granger-cause RYO tobacco sales and nicotine-substitutes sales, but the reverse is true. Moreover, there is a bidirectional relationship between log(QR) and log(QNS). These results reveal that cigarette quitting individuals substitute by either nicotine drugs or RYO tobacco.

4. Discussion

As a result, figure 2 depicts the causal relationships and shows the way of tobacco quitting in a context of implemented policies to curb smoking epidemic.

Figure 2. Tobacco quitting process.



According to our VAR and Granger causality analysis, and to the highlighted tobacco quitting path, it results that cigarette smokers facing a price increase either couple their cigarette use with RYO tobacco or definitively substitute cigarettes with hand-rolling tobacco. This dynamics leads them to use nicotine dependence treatment (partially reimbursed by social security) when they face again to anti-smoking policies as free-tobacco-air laws for instance. This process of tobacco quitting is complex but could be faster and more efficient if the intermediary step leading smokers to use RYO tobacco was erased. To this end, tax policy on RYO tobacco should equal the price per gram of cigarettes; currently, one gram of cigarette is worth 0.265€ while one gram of RYO tobacco is 0.13€.

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