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Genetically Modified Wine-New Economic Issue

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Abstract

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The aim of this paper is to evaluate the potential influence of genetically modified organism (GMO)-vine resistant on Grape Fan Leaf Virus (GFLV)-on international wine economy. The research has been based on some presumption and literature's data. The European community which is the biggest wine economy around the world has been taken as a model. The mass introduction of nowadays known GMOs in EU winemaking will supposedly change the prices of wines, EU consumer's surplus, EU wine producer's surplus, the surplus of rest of the world wine producers (ROW) and rest of the world consumer surplus.

Key words: Wine, market, elasticity, genetically modified organisms (GMO), economy

Abbreviations: EU-European union, ROW-rest of the world, P-price, Q-quantity, Z-relative price difference, K-relative price reduction, S-supply, C-consumption, k-vertical shift of supply function, η-demand elasticity, ε-supply elasticity

Introduction

The European Union (EU) is a world market leader in terms of: wine production, world's wine-growing areas, consumption and trade. European wine-growing covers very different realities from one Member State to another, and even from one region to another (European Commission 2006a; European Commission, 2006b), but in general the basic problem in wine sector in EU is a surplus of table-wine production.

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As a result of this structural imbalance, substantial quantities of table wine have to be distilled (Table 1). The cascade market effects are also observed and for this reason market surpluses of quality wines are transformed into table wines (Beckett, 2000; Tender, 2002).

The average EU import price in year 2004 was 215 Euro/hl and average export price was 325 Euro/hl, but the EU table wine export price is around 150 Euro/hl and for quality wines is around 500 Euro/hl (special wines are not included). The prices and quantities in EU have been reduced when the year 2005 has been compared with year 2004 by around 10 %. It should also be mentioned that the share of wine in EU-25 overall output at producer prices in agricultural products is 5.6 % in 2004 (Szabó and Milella, Eurostat 2006). EAGGF (European Agricultural Guidance and Guarantee Fund) budget for all vine/wine products was 1,228 million € in year 2005 with upwards trend. In EU were excise duties very different by country to country (from 0-273 Euro/hl and VAT from 12-25 %; Directive 92/84 EEC, 77/388/EEC, 92/83/EEC). In this very complex situation on EU wine market, the potential improvements by GMO in vine growing and wine technology could be very important in the future, because of benefits for producers (the decreased use of pesticides from modifying agronomic traits, higher yields from reduced crop losses and more productive animals) and consumers (specific quality traits such as improved nutritional content or disease resistance) (Caswell et al., 1996; Kalter and Tauer, 1987; Ghadim and Pannell, 1999; Pretorius, 2000). It should also be taken into consideration that profitability is not the only factor which is important in the evaluation of a new technology adoption. Estimation of economic impacts of such a significant technological shift as introduction of GMO in winemaking are of a great interest to producers, policy makers and researchers, however they are not easy to perform. These types of technological changes induce a wide spectrum of influences which cannot always be sufficiently studied (Duffy and Ernst 1999; Bullock and Desquilbet, 2001; Commission of the European Communities, 2001). Existing studies do not give a consistent evidence of economic impacts from biotechnology adoption (Stefanides and Tauer, 1999, Carpenter and Gianessi, 2000; Falck-Zapeda et al., 2000; Moschini et. al., 2000). Traditionally, the impact of technological change in agriculture is measured following the perfect market model (Griliches, 1957; Arrow, 1962). The innovation, after being adopted by producers, lowers the marginal costs of production and leads to a shift in supply. Depending on the elasticity of the demand the price of the product where the innovation has been introduced will decrease. The more elastic the demand is more of the benefits is expected to go to the producers (Caswell et al., 1996).

The aim of the research presented in this paper is to evaluate economic consequences of technological change in winemaking on global wine market. The European Union market has been taken as a model market since it has an important role in global wine production and consumption. The fact of high fragmentation and differentiation level of the EU wine market has been overcame by modeling only the table wine. This market segment is rather homogeneously perceived globally – commodity type of good.

Material and Methods

For the purpose of our study an economic model has been developed according to the basic paradigm of the perfect market and technology-induced supply shift effect (Griliches, 1957; Arrow, 1962) and specifically adopting the contribution by Falck-Zepeda et al. (2001). The introduction of GM vine resistant on grape fan leaf virus (GFLV) in a large economy of the European Union has been modeled. General assumptions include linear supply and demand curves and a parallel shift in supply caused by new technology. Adoption of the GFLV resistant vine in the EU induces a shift in supply curve from $S_{EU,0}$ to $S_{EU,1}$. Due to the fact that the EU is a major net exporter of wine in the World and thus affects directly world prices, the shift in the EU supply curve will induce a shift in the excess supply curve. Consequently, a decrease in price from P_0 to P_1 is expected. Our model includes a modification from the existing research (Falck-Zepeda et al., 2001) by proposing the spillovers of the technology.

The counter-factual world price (P_0), and the relative price change (Z) can be calculated in elasticity from as:

$$P_0=P_1/(1-(\boldsymbol{\varepsilon}_{EU}K/(\boldsymbol{\varepsilon}_{EU}+S_{EU}\eta_{EU}+ +(1-S_{EU})\eta^{EB})) \quad (1)$$

$$Z=-(P_1-P_0)/P_0=\boldsymbol{\varepsilon}_{EU}K/(\boldsymbol{\varepsilon}_{EU}+S_{EU}\eta_{EU}+ +(1-S_{EU})\eta^{EB})) \quad (2)$$

where $K=k/P_0$ converts the absolute price shift to a percentage reduction in price, $\boldsymbol{\varepsilon}_{EU}$ is EU elasticity of supply for wine, η_{EU} is the absolute value of the EU demand elasticity, η^{EB} is the absolute value of the elasticity of export demand (the ROW excess demand elasticity), and S_{EU} is the share of EU production consumed domestically. Separately, vertical shift of the supply function is estimated (indicated by *k*) as a proportion of the initial equilibrium price for the EU and the rest of the world (ROW). This implies that the variable measuring the price reduction relative to the initial equilibrium price (indicated by Z) estimated in the "no-technology spillovers" differs from one that allows spillovers. A counter-factual price reduction must be calculated to isolate the effect of the technology-induced supply shift from other exogenous changes in supply and demand. This price change differs from the observed change in the world price in that it represents what the world price would have been in 2005 if all supply and demand conditions had been identical except for the introduction of the new technology. Because all EU countries face the same world price, the relative price change is the same and, by invoking the Law of One Price, regional prices differ only by the transportation costs.

EU and the rest of the world (ROW) supply and demand are modeled as:

$$\text{EU supply} = QEU = \alpha EU + \beta EU (P+k)=(\alpha EU+\beta EUk)+\beta EUP \quad (3)$$

$$\text{EU demand}= CUS = \delta US-\beta USP \quad (4)$$

$$\text{ROW supply} = QROW = \alpha ROW +\beta ROWP \quad (5)$$

$$\text{ROW demad} = CROW = \gamma ROW- -\delta ROWP \quad (6)$$

where *k*- is vertical (price) shift in the supply function due to the introduction of the technology, P is the World price of wine; ROW is Rest of the World, C is consumption and Q indicate production.

Trade equilibrium is defined as:

QT0 = C ROW,0 –Q ROW,0 = Q EU,0 –C EU,0’ (7)

The technology-induced wine supply shift was estimated on the basis of presumptions using data on yield, cost savings net of increased seed costs and adoption rates by expert consultation.

Changes of the domestic and ROW producer and consumer surplus are defined as:

$$\Delta CS_{EU}=P_0 C_{EU,\,0} Z(1 + 0.5\ Z\ \eta_{EU}) \quad (8)$$

$$\Delta PS_{EU}=P_0 Q_{EU,\,0}(K - Z)(1+0.5\ Z\ \varepsilon_{EU}) \quad (9)$$

$$\Delta CS_{ROW}=P_0 C_{ROW,0} Z(1 + 0.5\ Z\ \eta_{ROW}) \quad (10)$$

$$\Delta PS_{ROW}=-P_0 Q_{ROW,0} Z(1+0.5\ Z\ \varepsilon_{ROW}) \quad (11)$$

$$\Delta ROWS= \Delta PS_{ROW} + \Delta CS_{ROW}, \quad (12)$$

where ΔCS_{EU}-is the change in consumer surplus in EU, ΔPS_{EU}-is the change in producer surplus in EU, Z-relative price change $Z=-(P_1-P_0)/P_0$, P_0-the pre-innovation price, ΔPS_{ROW} -is the change in producer surplus for the foreign sector, ΔROW-is the change in the rest of the world surplus, η_{ROW}-is the absolute value of ROW demand elasticity, ε_{ROW}-is ROW supply elasticity, S_{EU}-part of domestically consumed wine (in EU), $K=k/P_0$-relative price.

Thus total monopoly profits can be estimated by the formula:

$$\text{Monopoly profit}=Q_{gmv}\,(P_{gmv}-Pc) \quad (13)$$

where, Q_{gmv} is quantity of GM vine, Pv is the price of GM table vine, Pc is the price of conventional vine or marginal costs for producing GM vine. Profit in the upper formula is gross without marketing, administrative or intellectual property rights (Nelson, 2001).

Since the market situation differs for table wines and for quality wines, additionally two separate balances are drawn up. Consumer behavior for table wines – this category is consumed young; was included, therefore the time-lag after production is shorter and hence the structural surplus problem is more noticeable.

Input data

Quantities

In Table 1 are input data.

Prices

As a model case EU table wine was used representing economic environment for vine growing and winemaking. Table wine including both red and white type has been taken and the reference price was also assumed as a composite. There is no world prices for wine and as a result of the 1999 CAP (Common Agricultural Policy) reform the Common Market Organisation (CMO) for wine no longer requires comparable market prices for different types of table wine as defined in the old CMO. To permit a long time span comparison the prices quoted are those public available by trade organizations or other publications. They are only available for the three main producer countries. A great disparity and variability of prices can be seen in the EU wine sector (European Commission, 2006b).

Table 1

	Wine year 2004/2005 all wines EU-25	Wine year 2004/2005 uality wines EU-25	Wine year 2004/2005 other (table) wines[2]
Initial stocks	160.4	96.2	64.1
Production vinified	183.2	75.1	108.0
Imports	12.1	0.0	12.1
Volume available	**355.7**	**171.3**	**184.2**
Direct consumption	133.3	60.0	73.3
Destillation	5.1	0.4	4.7
Other (vinegar, losses…)	4.8	0.4	4.4
Exports	12.1	6.0	6.0
Normal uses	**155.3**	**67.8**	**88.4**
EAGGF financed destilation	**26.7**	**3.8**	**22.9**
Dual purpose destillation - Crisis destillation	1.3	0.0	1.3
Dual purpose destillation - Potable alcohol destilation	8.0	1.2	6.8
By product destillation	11.0	0.0	11.0
	6.4	0.6	3.8
Final stocks[3]	**173.7**	**100.7**	**72.8**

[2] Table wine (table wine and dual purpose wine)

[3] Wine destilled by cirsis destillation is deerned to have left storage befored the end of the year

Results and Discussion

Simulated introduction of the GFLV in EU is assumed to decrease marginal costs of production and induced shift in supply[1]. Experiment results are presented as a relationship between consumer and producer surpluses and, as relative price differences at hypothetical elasticity levels. The results presented confirm that the surplus of producers and consumers in the European Union is strongly influenced by relative price change (Z) and demand or supply elasticity (η and ε) in EU and ROW. In the case of EU production surpluses (Figures 2 and 3) are directly influenced by K ($K=k/P_0$). The consumer surplus is negative when the GM vine introduction rises the wine prices (Z>0). The situation is comparable in the EU and ROW and the differences are only in the quantity of wine production and the price

[1] Comparable experiment was executed for the ROW region; however it is not presented in this paper. The results for rest of the world (ROW) are only discussed in the text.

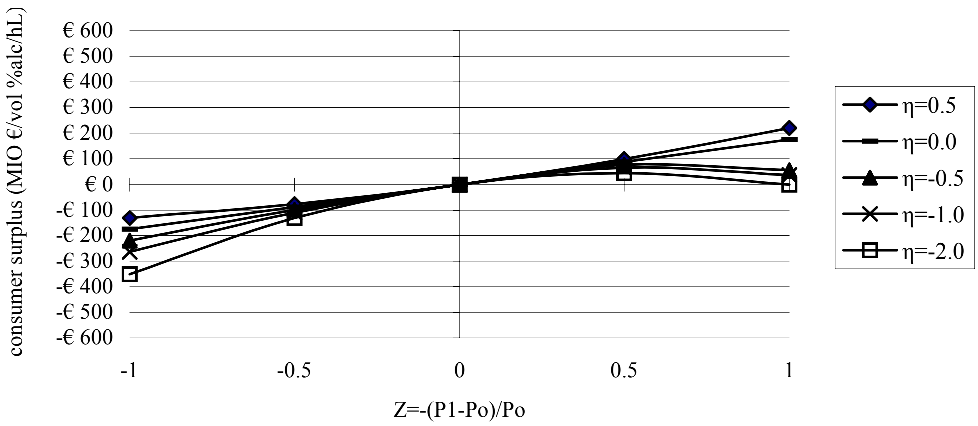

Fig.1. Influence of relative price change on EU consumer surplus after GM vine introduction in EU market

levels. This two last variables influence the magnitude of negative or positive surplus. Price levels for wine EU and the production volume are higher, so results are more negative in absolute terms. On the other hand results show that the profits of wine producers will be higher when the prices will rise (Z<0). This situation is rather questionable, however possible. It is proofed that when the value of Z=0 there are no changes in surplus at any level (EU, ROW, consumer, producer). The producer surplus is reduced in case GMO introduction lowers price levels. In the experiment for ROW the conclusion is rather straightforward since the parameter Z ranges between 0 and 1 the surplus is lower than before the introduction or equal 0. Producer surplus in the EU is consequently lower when the price of wine

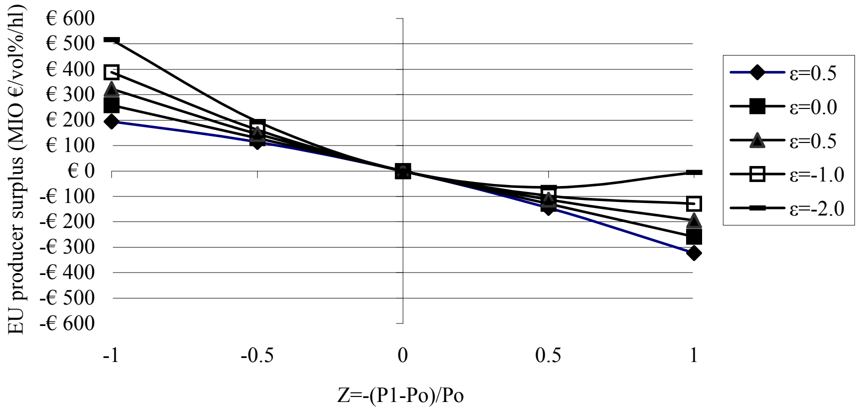

Fig. 2. Influence of relative price change on EU production surplus after GM vine introduction in EU market at different K (relative vertical price shift, K=k/Po, graph for K=0)

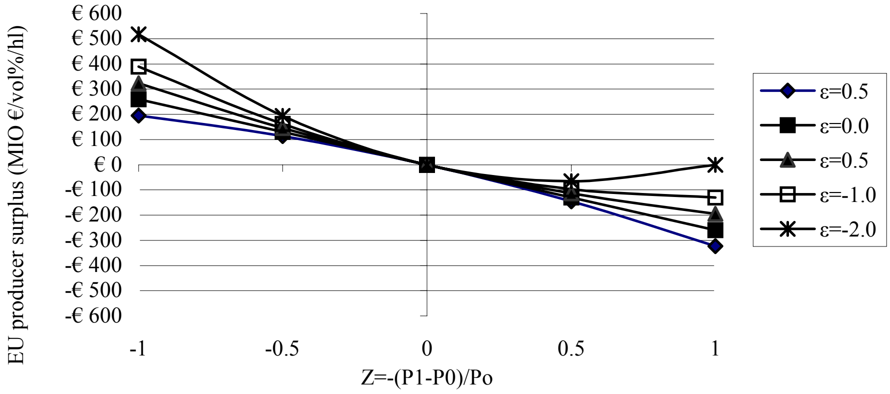

Fig. 3. Influence of relative price change on EU production surplus after GM vine introduction in EU market at different K (relative vertical price shift, K=k/Po, graph for K=0.5)

after GMO introduction decrease, however in some cases the producer surplus is higher, also when Z>0. This phenomenon might be explained by the value of $K=k/P_0$, which represents vertical shift of the supply function estimated as a proportion of the initial equilibrium price (P_0). This implies that the variable Z which measures the reduction in price relative to the initial equilibrium price due to the supply curve shift estimated in the no-technology spillovers model clearly differs from one that allows for spillovers (Falck-Zepeda et al., 2001). For this purpose the K is included only in the equation for EU where we have foreseen the GMO implementation in winemaking. In our case (Figures 2 and 3) K is intercept on abscise axis (X) and it ranges between K=0 and K=0.5. Furthermore, the producer surpluses are positive. When the value of Z>K, the surpluses are negative after technology change (Figures 2 and 3).

The elasticity of demand (η) and supply (ε) also have influences on the surplus of producers and consumers. In the case when the producers surpluses is compared (Figures 2 and 3), the most favorable results for producers are obtained when supply elasticity is lower (ε). No effect is revealed regarding the Z value (positive or negative). The situation is opposite when the consumer surplus is analyzed. The most favorable results are obtained (the lowest negative result and the highest surplus), when the demand elasticity (η) is higher, regardless of Z is positive or negative. It can be therefore concluded that in the case of inelastic demand (-1<η<0.4) the consumer surplus is higher comparing the results with elastic demand. In both cases consumer and producer surplus in EU are higher than in the ROW. This conclusion is not surprising, due to the larger production volume.

More structural consequences of the wine economy someone can expected in the regions and countries where table wine production predominate, because of casade effect (Tender, 2002) and because the profitability of wine production is not very high. Entering of GMO into winemaking will probably have very different consequences on economy of vinegrowing regions and holdings: if the producer surplus will rise after GMO introduction, the consequences on socio-economic situation will be very positive for subjects with low profits at that moment, and negative if the suplus will go down. The consequences for regions and holdings with good economic situation will not be so extreme, because of high accumulation in the past and because they produce quality wine, where the better price difference is observed. We can also predict that first GMO will be entered in to table wine production. In fact, wine production is highly variable from one year to the next and profitability, although on the whole increasing, is very varied depending on the region and type of wine produced. The more concise analysis is impossible, because general data for table-wine demand and supply elasticity in EU do not exist in literature. But on the basis of the some official data of EU production, consumption and price of wine (European Commission 2006a, European Commission 2006b) and personal communication (Terpin, S. personal communication, 2004) we can conclude supply for table wine are moderate inelastic, because EU subsidies for distillation of surplus wine into potable spirits (Schäfer-Elinder et al., 2006). The price elasticities of demand for wine is -1.0 (Leung and Phelps, 1993), what suggests that demand for wine is very responsive to price. From the Figure 1 could be concluded that EU consumer surplus will be positive after GMO introduction and it is depends on relative price diference (Z). As someone can expect that price reduction of GMO wine wil be in the range 8-46.7 % (Noussair et al., 2004) the EU consumer positive surplus in EU-25 will be in the range between 10-50 million Euro. On the other hand the wine supply is inelastic and the EU producer surplus is negative in the range 20-100 million Euro. In one simillar analysis has been found out that if 5-25 % of consumers prefer non-GMO foods in such situation the consumer surplus is negative (Golan and Kuchler, 2000). The very important role could have also global retail chains and probably some positive surplus the will retain as additional margin after GMO introduction. Assuming that the position of retailers in the process of globalization is very strong and consequently it is normal that the purchase and retail prices go down (http://www.dfat.gov.au/publications/agrifoodasia/execsumm.pdf).

On national economies the introduction of GFLV restistant GM vine will not have any important consequences, because wine represent very low part of GDP, but in agricultural regions, especially vinegrowing, very dramatic economic changes could be present. In terms of employment, in addition to the large number of wine producers, we also need to take into account the direct or indirect jobs in the production regions. In particular, alongside the permanent jobs on the vineyard there is the seasonal employment on the harvest and jobs linked to vinification. It is either done directly on the holding, in a co-operative's cellars or by a private enterprise, but always near to the production area, for reasons both technical and legal. Wine production therefore offers an example of an activity where processing takes place on the spot, so the added value remains in the production region. That value can also be increased to the benefit of the producers if they sell direct from the holding. Wine-growing can also offer economic and tourism development opportunities as can be seen in the numerous 'wine road' experiments (GMO introduction change this philosophy), which have become development priorities for rural communities. For this reason overall economic analysis after GMO introduction is very difficult performed. When someone would like to explain the results of this analysis should have in mind that the branding is not key issue in the case of table wine. The relevance of our analysis is strongly based on the same starting-point and the influences of brands and wine provinience are excluded from the after GMO introduction simulation. The table wines which are included in this research are not the subject of advertising in general and this moment is excluded from research.

Conclusions

Our research confirmed that the introduction of GM vine resistant on GFLV in European Union might have direct effects on world wine prices and therefore shift of supply is expected. The effects are mainly due the importance of EU in total world production of wine. Clearly, any planned expansion in winemaking (introduction of GMO) output needs to consider the demand elasticity as a primary determinant of what will happen to total revenue and to a potential profitability. Our research indicates that surplus will be probably on the side of consumers and retailers. Nevertheless the importance of grape and wine production is not measured solely in terms of wine market share and direct profit. The economic and social function of wine production extends well beyond the production and marketing of wine: its knock-on effect, on tourism for example, produces a contribution to the rural development of the regions. The economic effects of GMO introduction on consumers and producers are very important, but also wider consequences would be taken into consideration before to generally evaluate all effects.

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