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The Economics of Planting Rights in Wine Production

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The Economics of Planting Rights in Wine Production

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Abstract. Almost half of the world's vineyards are in the EU and the EU produces around 60% of the world's wine. The EU is also the world's most regulated wine market. In 2007, the European Union decided on a major reform of its wine policy, the so-called Common Market Organization (CMO) for wine. A crucial element was the abolishment of a system of planting rights to regulate planting of vineyards in the EU. However, before its implementation opponents of the liberalization of planting rights are lobbying EU governments to reverse the decision. Our paper provides the first theoretical analysis of the economic effects and the welfare implications of planting rights. Our model integrates the markets for land, planting rights and wine to analyze the efficiency and distributional effects. We analyze the impact of enforcement problems, trade restrictions, and the use of government reserves in the planting rights system.

Keywords: planting rights, wine, Common Agricultural Policy, Common Market Organization, policy analysis

JEL: Q18

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1. Introduction

Almost half of the world's vineyards are in the EU and the EU produces and consumes around 60% of the world's wine. The EU is not only the largest global wine producing (and trading) region, it is also the world's most regulated wine market.[2] In 2007, the European Union decided on a major reform of its wine policy, the so-called Common Market Organization (CMO) for wine. Perhaps the most important change was the abolishment of the planting rights system, first implemented in 1976. By 2018 at the latest, the ban on new plantings, which underlies the planting rights system, would be lifted throughout the EU. Because of the EU's size, the liberalization of planting rights is not only important for wine producers in the EU. It is important for wine consumers throughout the EU and to wine producers and consumers throughout the world.

Although the reform was approved by a qualified majority in the European Council of Ministers, opponents of the liberalization of planting rights have been organizing themselves in recent years and have been able to collect support from many Member States for their plans to have the decision altered. Opponents claim that abolishing planting rights will have several negative effects. In particular, it is claimed that small producers would be driven from the market, leaving large and powerful producers with the incentive to delocalize vineyards to higher-yield areas (where production costs are lower). It is argued that this would increase production, decrease wine prices and producers' income and lower quality (loss of reputation through standardization) (Copa-Cogeca, 2012).

On the other hand, the European Commission's communication "Towards a sustainable European wine sector" (2007) motivates the liberalization by pointing out that "*successful wine*

[2] For a discussion of wine regulations in the EU from a political economy perspective, see Meloni and Swinnen (2012).

makers are currently hamstrung by their inability to expand their vineyards – an expansion that would greatly increase their competitiveness by offering economies of scale. … Since the EU will no longer buy up surplus wine, growers are expected to be more market orientated when planning their production." Thus, the Commission sees the liberalization as a move to improve competitiveness of the sector.

Despite its importance and its long existence, the literature on planting rights is relatively limited. There exist a few insightful reports discussing the effects of liberalization. For instance, a study by Montaigne et al. (2012) provides a discussion of several issues and presents anecdotal evidence and summary statistics. A recent report by the European Parliament presents other arguments, again using summary statistics. A more elaborate empirical study by Bogonos et al. (2012) focuses on Rheinland-Pfalz. However, so far none of the studies use or provide a conceptual or theoretical framework to study the effects of planting rights.

Our paper is the first to conceptually analyze the likely effects of planting rights in the wine sector and the effects of their reforms. Our model and analysis is related to several studies on the impact of policies in other agricultural sectors. There is an extensive literature on the effects of production quota in agriculture: for theoretical analyses of welfare effects of quotas, see e.g. Gardner (1987) and Alston and James (2002); for empirical studies of sugar and dairy quotas, see e.g. Gohin and Bureau (2006) and Lips and Rieder (2005). The analysis of planting rights is different since planting rights impose a constraint on the use of land in viticulture while conventional quota systems limit output, such as the EU sugar and dairy quotas. Because planting rights impose a constraint on the use of land, the system not only has an impact on the market for wine but also direct effects on the land market. Hence, one needs to simultaneously consider the markets for output (wine), inputs (land), and quotas (planting rights). In that sense,

our analysis is related to that of acreage controls, an instrument which is used extensively in US agricultural policy (see e.g. Gardner, 1987 and Gisser, 1993), and set-aside requirements used in EU agricultural policy (e.g. Bourgeon et al., 1995). However, the analysis of planting rights in wine differs since acreage controls and set-aside requirements do not allow trading in the rights to use the land for specific purposes.

The paper is organized as follows. The next section provides a brief explanation of the regulations concerning planting rights in the EU wine sector. Section 3 develops an integrated theoretical model of the market for land, for planting rights and the market for wine which allows us to analyze the welfare effects and distributional effects of the planting rights system by taking into account both the effects on land markets and in the wine market. Section 4 discusses the impact of enforcement problems in implementing planting rights. In Section 5, we analyze how trade in planting rights affects the supply of wine and the welfare effects, and we analyze the impact of trade restrictions. These effects are analyzed first for the case of a small open economy with perfectly elastic demand for wine and then for the case of a large economy with more inelastic demand. Section 6 discusses the system of regional and national reserves of planting rights. Our final section draws some conclusions with regard to the likely impact of liberalization on the EU wine sector.

2. The System of Planting Rights in the EU

Basic Principles

The system of planting rights, first introduced at the European level in 1976, aims to control the production of wine grapes in Europe. Under the system, the planting of all new vineyards is strictly forbidden unless the grower has a permission (a "planting right") to do so.

Such planting rights can derive from three sources.[3] So-called *new planting rights* are awarded for experimental purposes or for vineyards which are intended for the consumption of the grower's own household, and are therefore of limited practical importance. *Replanting rights* are granted to a grower who has grubbed up a vineyard.[4] The grower can either use the replanting right on his own vineyard or transfer this right to another grower. Such transfers are subject to some general principles laid down by the EU as well as by national rules which can be stricter than the EU regulations. Finally, planting rights can also be obtained from a *reserve* organized at the national or sub-national level. Such reserves receive replanting rights which were not used by producers in the prescribed time frame. They can also buy replanting rights directly from producers, depending on the specific rules set by the national governments. The reserves can in turn grant these planting rights to producers, either for free in the case of young producers (under 40) who fulfill certain requirements or against payment for others.

Replanting rights are by far the most important source of planting rights in the EU. In 2010-2011, of all available planting rights in the EU, 76% were replanting rights, 20% were planting rights held in reserves, and 4% were planting rights allocated to producers from a reserve but not yet used. Replanting rights dominate in the "old" member states (Austria, France, Germany, Greece, Italy, Luxembourg, Portugal and Spain), where they account for 82% of all planting rights. By contrast, in the new member states (NMS) (Bulgaria, Cyprus, Czech Republic, Hungaria, Malta, Romania, Slovakia and Slovenia) replanting rights only account for 44% of the total. In the NMS the reserves play a more important role (European Commission 2012, p. 23).

[3] See Articles 90 to 97 of Council Regulation (EC) No 479/2008.

[4] Growers do not, however, obtain replanting rights if they made use of the grubbing-up premiums provided by the EU to growers who permanently abandon vineyards.

The Regulations

Both planting rights issued from reserves and replanting rights transferred between producers are subject to general rules on the European level and additional rules on the national or subnational level.

For planting rights granted from a reserve, two EU-wide principles apply. The first, qualitative principle states that the reserve should grant the planting right in such a way that the location, the varieties and the cultivation techniques used are "adapted to market demand". The second, quantitative principle stipulates that the plot of land receiving the planting rights must have yields which are "typical of the average in the region" (European Commission 2012, p. 11).

Replanting rights, which are the most important source of planting rights for producers, cannot be transferred between different countries. In addition, transfers of replanting rights are also subject to a quantitative and a qualitative rule. The quantitative rule in this case stipulates that member states must ensure that the transfer of planting rights does not lead to an increase in overall production potential, for instance when planting rights are transferred from a non-irrigated to an irrigated area. The qualitative rule states that replanting rights can only be used by the buyer to plant a new vineyard intended for the production of wines with a protected designation of origin (PDO) or a protected geographical indication (PGI).

National governments have considerable flexibility to customize the planting rights regime, both with respect to the organization of the reserve system and with respect to the restrictions on the transferability of replanting rights. Member states are left free to define the price or extra requirements for purchasing planting rights from the reserve. Moreover, national governments are free to decide whether the reserves are organized on the national or sub-national

level. For instance, France has a national single reserve (managed by a single body, FranceAgriMer), while in Italy the reserves are organized at the regional level.

For transfers of replanting rights, national regulation can prohibit transfers between different regions or between producers (thus forcing producers to use replanting rights on their own land). In principle, member states could even stipulate that replanting rights can only be used to replant the exact same plot of land (thus completely stifling transferability), although in practice most rules are not this strict. Other possibilities include restrictions on the maximum number of replanting rights that can be acquired by an individual grower or by an entire region in a given year; qualitative restrictions on transfers (e.g. restrictions depending on the soil type or the slope gradient); or restrictions on the type of applicant that is allowed to buy replanting rights (for instance, rules favoring small family farms over large economic groups) (European Commission 2012, p. 14).

3. The Model

In this section we develop a formal framework for analyzing the impact of the liberalization of planting rights, both in terms of general welfare (economic efficiency) and in terms of the distribution of costs and benefits between various groups in society. To analyze these effects, we make several simplifying assumptions to derive some basic results. We then relax these assumptions to make the analysis more realistic. Throughout, however, we will focus on the quantity effects of liberalization, assuming quality remains constant.[5]

To keep the analysis tractable, throughout we distinguish four different agents or interest groups: consumers of wine, owners of land, owners of planting rights, and producers. In reality,

[5] Opponents of the liberalization of planting rights sometimes claim that liberalization threatens the quality of wines in the EU, while those in favor of liberalization claim the opposite. This question is studied in Deconinck and Swinnen (2012).

this distinction is not so clear since (a) some of these interest groups overlap, and (b) there are important distinctions within the groups. The structure of the wine sector and its supply chain is quite complex and can vary importantly between countries, regions, and even within regions. Some households produce bulk wine which is sold to commercial enterprises which bottle and market the wine. Others produce wine through a cooperative. Yet other families produce and bottle their own wines and sell them directly to wine retailers or consumers all over the world. Most current grape producers are also owners of their vineyards, and own the land and the planting rights; however, when they want to expand they need to buy new land and new planting rights. This description illustrates the large variety and complexity in production structures.

However, for both analytical and policy reasons it is important to distinguish between these interests. The evaluation of a policy should take into account its effect on future producers; in this perspective, there is much less overlap between producers and planting rights owners. Many potential future producers do not own planting rights, and for them planting rights represent a cost, not an asset. Therefore, we choose to analyze these aspects separately to obtain a clear picture of the different mechanisms at work in the wine market, the land market and the market for planting rights. Likewise, in reality growers may only produce grapes, and sell the grapes to others who then produce the wine. We have opted to start with the assumption that the grape grower produces and sells the wine directly to the consumers, thus combining this part of the supply chain of wine. Another starting assumption is that in the baseline model we focus on replanting rights only, leaving the role of the reserves for later.

Consider therefore a region consisting of a large number of farms which can produce either wine or an alternative crop. For simplicity, we assume that land is the only input in the production process. Each farm has an initial holding of land $\bar{L}_i$, with the total area of the region

denoted by $\bar{L}$. The farm allocates an amount of land $L_{i,W}$ to wine production and an amount $L_{i,A}$ to production of an alternative crop, where the total land used may be smaller or larger than the initial land holdings. Land can be freely bought and sold on a land market for a price p_L which is given to the individual farmer.[6] The production of wine is given by a farm-specific production function $W_i(L_{i,W})$ and can be sold at a price p_W, again exogenously given to the farmer. The production of the alternative crop is likewise given by $A_i(L_{i,A})$. The price of the alternative crop is normalized to one. For both crops, we assume diminishing returns to the use of land, hence $W_i', A_i' > 0$ and $W_i'', A_i'' < 0$.

Thus, the objective function of the farm is

$$\max_{L_{i,W}, L_{i,A}} \left[p_W W_i(L_{i,W}) + A_i(L_{i,A}) - p_L(L_{i,W} + L_{i,A} - \bar{L}_i) \right] \tag{1}$$

The first-order conditions defining optimal land use for the individual producer are given by

$$p_W W_i'(L_{i,W}^*) = p_L \tag{2}$$

$$A_i'(L_{i,A}^*) = p_L \tag{3}$$

These farm-specific first-order conditions define the optimal area of land used in wine production $L_{i,W}^*(p_L, p_W)$ and land for use in producing the alternative crop $L_{i,A}^*(p_L)$. Both are a negative function of the price of land p_L; in addition, the optimal area of land used in wine production depends positively on the output price of wine p_W. We can interpret these expressions as the farm's "gross demand" for grape-growing land and alternative-crop land, and we obtain the farm's "net demand" for land by subtracting its initial land holding $\bar{L}_i$ from the sum of $L_{i,W}^*(p_L, p_W)$ and $L_{i,A}^*(p_L)$. For our purposes, however, it is more useful to look at the gross demands instead. By horizontally summing the first-order conditions across farms in the region, we obtain the total demand for grape-growing and alternative-crop land. The demand

[6] Throughout, we are working with a one-period model; hence renting or buying are equivalent here.

functions then represent the region-wide value marginal productivity of land in producing wine or the alternative crop, and we denote them by $p_W W'(L_W)$ for wine and $A'(L_A)$ for the alternative crop. Given our assumption of diminishing returns, both are downward-sloping. Since total land use must equal the total area of the region $\bar{L}$, we can depict these demand schedules as in the upper left panel of Figure 1, with land used in wine production measured from left to right, and land used in growing the alternative crop measured from right to left.

Farmers will buy additional land as long as they can profitably use it in producing either wine or the alternative crop. Conversely, farmers for whom the value marginal productivity of land in either crop is below the market price of land will sell their land. The equilibrium is where both demand functions cross; that is, at the point where the value marginal productivity of land is the same for both crops. At this point, the equilibrium price of land p_L^* is determined, and this price equals the marginal productivity of both crops. The equilibrium also determines the region-wide allocation of land to producing wine L_W^* and to growing the alternative crop L_A^*.

With any amount of land used for wine production corresponds an aggregate output quantity of wine $Q_W = W(L_W)$. However, an increase in p_W corresponds to an upward (clockwise) rotation of $p_W W'(L_W)$. Hence, different output prices p_W correspond to different optimal allocations L_W^* and different output levels of wine Q_W. This allows us to trace out the supply curve of wine in the upper right panel of Figure 1. The upper left panel shows for a given price of wine p_W the allocation of land to the production of wine. In this panel, we have rescaled the vertical axis such that $W'(0) = 1$.[7] With this convention, the intercept of $p_W W'(L_W)$ equals the output price of wine p_W. The bottom left panel of our graph plots the aggregate (region-wide) production function of wine $W(L_W)$. Given an allocation of land L_W this panel gives the

[7] This is merely a rescaling of the vertical axis of the drawing, not an assumption on the functional form of the production functions. The rescaling allows us to read the output price of wine p_W on the vertical axis of the upper-left panel.

resulting output of wine $Q_W = W(L_W)$. The lower-right panel is merely the 45°-line, projecting the output of wine Q_W on the horizontal axis of the upper right panel, which depicts the market supply of wine as a function of p_W. By varying this price in the upper-left diagram, we can trace out the resulting supply of wine in the upper-right diagram and so obtain the supply curve of wine, here denoted by SS. By adding the market demand for wine we would be able to find the equilibrium price of wine p_W^*. The corresponding demand curve for land $p_W^* W'(L_W)$ would then determine the equilibrium price of land $p_L^*(p_W^*)$.

Now, consider how planting rights will affect the equilibrium. We assume that the government fixes a total number of planting rights equivalent to an area $\bar{R}$ which can be used for wine production. We focus on the interesting case where this area is below the "laissez-faire" optimum L_W^*.[8] We assume that these planting rights are distributed arbitrarily among the farms, each farm receiving a certain endowment of planting rights R_i. Planting rights can be freely traded at a price p_R, exogenously given to the farmer.[9] (We later analyze how these assumptions of tradable planting rights affect the results). The objective function of the farm becomes:

$$\max_{L_{i,W}, L_{i,A}} \left[p_W W_i(L_{i,W}) + A_i(L_{i,A}) - p_L(L_{i,W} + L_{i,A} - \bar{L}_i) - p_R(L_{i,W} - R_i) \right] \tag{4}$$

And the first-order conditions are now:

$$p_W W_i'(L_{i,W}^*) = p_L + p_R \tag{5}$$

$$A_i'(L_{i,A}^*) = p_L \tag{6}$$

[8] If $\bar{R} > L_W^*$, then the planting rights constraint would not be binding and there would be no effect.

[9] An alternative assumption which would yield the same equilibrium allocation is that planting rights are initially auctioned off by the government at a price p_R. In the objective function, this would imply that R_i drops out, but it would leave the first-order conditions unchanged.

Effects of Planting Rights in a Small Open Economy

An important issue in deriving the effects of planting rights is how the price of wine responds to a decline in supply. For didactic purposes, we first consider the case where the price of wine remains unchanged at p_W^* after the introduction of planting rights, as would be the case for a small open economy where the demand for wine is perfectly elastic. In this case, the upper panel of Figure 2 graphically illustrates the effect of planting rights on the land market. Planting rights effectively restrict the area used in wine production to $\bar{R}$ (i.e. $L_W^R = \bar{R}$) and lead to an expansion of the area planted with the alternative crop (from L_A to L_A^R). As a result, in equilibrium the value marginal productivity of land is higher for wine than for the alternative crop. The value marginal productivity of land in its alternative use determines the new price of land p_L^R, which is lower than the land price without planting rights p_L^*.

We can now trace out the impact of planting rights on the wine market in Figure 3. The amount of land that can be used to produce wine is constrained at $\bar{R}$. The constraint is not binding for output prices lower than $\tilde{p}_W$. Below this price, the "laissez-faire" allocation of land to wine production would be below $\bar{R}$. For all prices higher than $\tilde{p}_W$, supply is effectively constrained, and the upper-right panel shows the resulting restricted supply curve SS^R. For prices below $\tilde{p}_W$, this curve coincides with the unrestricted supply curve SS derived earlier, but above $\tilde{p}_W$ the restricted supply curve becomes vertical.

As we assumed that planting rights can be traded, there will be a market in planting rights. What will be the equilibrium price in the market? The price of planting rights p_R is determined by the "wedge" between the marginal productivity of land in wine production and in growing the alternative crop, as shown in Figure 2. This can be seen as follows. From aggregating the first-order conditions, we have that $p_W^* W'(L_W^R) = p_L + p_R$ and $A'(L_A^R) = p_L$. For

the region as a whole $L_W^R + L_A^R = \bar{L}$. Moreover, land used for producing wine L_W^R must equal the amount of planting rights if these are binding. Hence, for different binding levels R of the total amount of planting rights, we have $L_W^R = R$ and we can combine the previous equations to arrive at:

$$p_R = p_W^* W'(R) - A'(\bar{L} - R) \tag{7}$$

This equation defines the price of planting rights p_R as a function of the level of planting rights R. If planting rights are binding, their price equals the difference in value marginal productivity between wine production and growing the alternative crop. The expression can also be seen as the inverse demand curve for planting rights. We plot this demand curve in the bottom panel of Figure 2, which shows how the price of planting rights is determined for a given supply of planting rights $\bar{R}$.

We can now identify the welfare effects of the introduction of planting rights (and the effects of liberalization, which are just the opposite). Since the price of wine is not affected in a small open economy, we only need to consider the effects on producers and owners of land and planting rights. Figure 4 illustrates these effects of planting rights, and a summary of the effects is provided in Table 1. Before the introduction of planting rights, farmers received an area $z + y + u$ as surplus from producing wine, and an area l as surplus from producing the alternative crop. The introduction of planting rights depresses the land price and landowners lose $(p_L^* - p_L^R)\bar{L}$, which is represented by areas $x + t + s + n + k$. Planting rights induce an expansion of the area used in growing the alternative crop. For producers of alternative crops, the expansion of production leads to extra surplus $s + k + n$.[10] However, wine producers who do not own land or planting rights are definitely worse off: their surplus declines by $y + u$ as their

[10] For simplicity, we assume that the demand for the alternative crop is always perfectly elastic, so that we can abstract from the impact of increased production of the alternative crop on its price level.

production is restricted to $\bar{R}$ and as they have to pay land prices and planting rights which together are more expensive than land prices before the introduction of planting rights. Wine producers' surplus is now equal to an area z, and the area $y + x$ represents total payments on planting rights. Finally, area $u + t$ represents the social deadweight costs (economic inefficiencies) caused by the planting rights system.

The benefits from planting rights depend on who owns them. If wine producers need to buy the planting rights from the government or from others, the area $y + x$ would be a transfer to the government or other agents. However, if wine producers initially received these planting rights for free (as is the case in the European Union), this represents profits for the producers. The net effect on their surplus would then be $x - u$, which could be positive or negative. The net effect is thus the combination of the decrease in land prices due to planting rights, x, and the efficiency loss u as a result of reduced output. The decrease in land prices depends in large part on the marginal productivity of the alternative crop, $A'(L_A)$. If we suppose that the alternative crop has a constant productivity, this curve would be a horizontal line and planting rights would not have an impact on land prices. In Figure 4, if we assume that the marginal productivity schedule of the alternative crop coincides with the horizontal line at p_L^*, the introduction of planting rights would still lead to a welfare loss u, but the reduction in land prices x (and the efficiency loss t) would not occur. As a result, producers of wine who received planting rights for free would still lose from the introduction of planting rights.

By contrast, we can imagine the case where $p_W^* W'(L_W)$ is flat and coincides with p_L^* while $A'(L_A)$ is still downward-sloping. In that case, producers originally earn zero profits: at the market equilibrium, their entire production accrues to landowners as rent. Introducing planting rights in this scenario would not lead to the welfare loss u (although there would be an efficiency

loss t) while it would lead to a lower land price at p_L^R and a corresponding transfer from landowners to planting rights owners, x. Hence, in this scenario, if producers had received the planting rights for free initially, they would receive a net gain of x from the introduction of planting rights.

Hence, whether the wine producers gain from the introduction of planting rights when they receive the planting rights for free depends on the relative steepness of the productivity schedule of wine and the alternative crop. In general, if the marginal productivity of wine production declines only slowly, while the marginal productivity of the alternative crop declines strongly, wine producers gain from lower land prices while efficiency losses are limited. By contrast, if marginal productivity of wine is steep while that of the alternative crop declines only slowly, efficiency losses are much larger while the decline in land prices is small. In that case, wine producers lose from the introduction of planting rights even if they receive the rights for free.

Effects in a Large Economy

Let us now analyze how the results change if the introduction of planting rights does affect the price of wine. This assumption is reflected in a downward sloping demand function as in Figure 5. This downward sloping demand function may reflect global demand in a large open economy, or domestic demand in a closed economy.

Planting rights restrict output at Q_W^R and cause an increase in wine prices to p_W^R. As a consequence, consumers lose. Their surplus declines by area $a + c$. The wine sector gains from higher prices (area c), but loses because of the constrained production (area b). Hence, c represents a transfer from consumers to the wine sector, while $a + b$ are deadweight costs.

However, note that the surplus of the wine sector we are describing in Figure 5 does not just include the surplus of wine producers, but also that of landowners and owners of planting rights. For the wine sector as a whole, the net surplus change $c - b$ can be positive or negative, depending on the size of the price effect. This price effect will be determined by the elasticity of demand. With a very elastic demand, the price effect will be small and producers are likely to lose from planting rights as their reduced output is not offset by gains from increased prices. If demand is more elastic, the price effect will be larger and the gains for producers (and losses for consumers) are also larger. To disaggregate the costs and benefits of planting rights for the different actors on the production side, we need to analyze the factor markets again.

Figure 6 shows the impact of planting rights on the markets for land and planting rights when the demand for wine is not perfectly elastic. Since in equilibrium the price of wine increases (from p_W^* to p_W^R), the demand curve for land for wine production rotates upward. In addition to the "pure" effects of the introduction of planting rights analyzed earlier, we can now analyze the effects caused by an increase in the price of wine, summarized in Table 1.

Interestingly, compared to our previous analysis, an increase in the price of wine leads to a higher price of planting rights from $p_R(p_W^*)$ to $p_R(p_W^R)$, but the price of land is unaffected (at p_L^R), as is the allocation of land (at L_W^R and L_A^R). As a consequence, the wine price increase does not change our conclusions regarding the effects of planting rights on producers of other crops or landowners. The increased wine price only affects wine producers and planting rights owners. From Figure 6 we can see that the increase in the gains for planting rights owners due to the additional price effect is $z + i$. Their total benefits from the planting rights thus equal $x + y + z + i$. Compared to the introduction of planting rights in a small open economy, wine producers also benefit from the increased wine price, but their additional gains are smaller than those of

planting rights owners. The additional benefits for wine producers equal $h - z$ (which is always greater than zero).

In a small open economy, wine producers who do not own planting rights lose under the planting rights system. As we have seen, in a large open economy the increase in prices due to planting rights improves the position of wine producers compared to the case of planting rights in a small open economy. Does this positive effect merely mitigate the losses of wine producers, or can it actually result in a net increase of their surplus? Compared to a situation without planting rights, wine producers who do not own planting rights lose an area u (efficiency loss due to lower production) and $i + z + y + x$ (costs of planting rights), while they gain area x (reduced land prices) and area $h + i$ (due to increased wine prices with reduced supply). The net effect is $h - (z + y + u)$. Can this net effect be positive? The answer depends on the elasticity of demand.

Area $z + y + u$ equals the total value of wine production before planting rights, minus payments for land. Thus $z + y + u = p_W^* W(L_W^*) - p_L L_W^*$. Moreover, we know that the price of land in this situation equals the marginal productivity of land in both uses, so $p_L = p_W^* W'(L_W^*)$, and we have

$$z + y + u = p_W^* W(L_W^*) - p_W^* W'(L_W^*) L_W^* \tag{8}$$

Area h is given by total wine production at $\bar{R}$, valued at the higher price p_W^R, minus payments for land and payments for planting rights: $h = p_W^R W(\bar{R}) - (p_R^R + p_L^R)\bar{R}$. Together, the price of land and the price of planting rights equal the marginal product of land used for wine production at $\bar{R}$. Thus, we can write

$$h = p_W^R W(\bar{R}) - p_W^R W'(\bar{R})\bar{R} \tag{9}$$

We would like to know under which conditions $h-(z+y+u)>0$. Combining the previous expressions we have:

$$h-(z+y+u)=p_W^R[W(\bar{R})-W'(\bar{R})\bar{R}]-p_W^*[W(L_W^*)-W'(L_W^*)L_W^*] \quad (10)$$

This expression is greater than zero if

$$\frac{p_W^R}{p_W^*}\geq\frac{W(L_W^*)-W'(L_W^*)L_W^*}{W(\bar{R})-W'(\bar{R})\bar{R}} \quad (11)$$

The ratio on the left-hand side is greater than or equal to one. Its size depends on the elasticity of demand and the size of the supply reduction caused by the planting rights regime. The term on the right-hand side depends on the aggregate production function, optimal land use L_W^*, and the planting rights $\bar{R}$. The term must be larger than one given our assumptions on the production function.[11] Whether this inequality is satisfied thus depends on the exact functional forms, in particular on the elasticity of demand. As demonstrated in the appendix, under some assumptions and if demand is sufficiently inelastic, then $h-(z+y+u)>0$ and hence wine producers gain from planting rights even if they are not owners of the planting rights.

In terms of Figure 5, a more inelastic demand implies a stronger increase in the price of wine with the supply restrictions imposed by $\bar{R}$. Hence, the price of wine under planting rights increases more and the curve $p_W^R W'(L_W)$ rotates upward more strongly. A rotation has a larger effect on the size of the triangle h than it has on the size of total payments for planting rights $i+z+y+x$. As a result, for strong enough price increases, the triangle h can be larger than the triangle $z+y+u$, and all actors in the wine sector gain from the introduction of planting rights. Of course, this gain comes at the expense of consumer surplus and economic efficiency: given

[11] To see this, note that $W(x)-W'(x)x$ is increasing in x, since its derivative is $-W''(x)x$ which is positive since $W''<0$: we have assumed that all individual production functions satisfy $W_i''<0$ and this property carries over to the aggregate production function.

that this effect requires that demand is sufficiently inelastic, it results in a considerable deadweight loss in the form of lost consumer surplus.

Table 1 summarizes the welfare effects of planting rights in a small open economy and in a large economy for the different stakeholders. If planting rights are originally given for free to the producers, we can add the effects for wine producers and owners of planting rights to arrive at the combined effect. In a large economy, this total effect equals $h + i + x - u$ compared to $x - u$ in a small open economy. Of course, if producers and planting rights owners separately gain from planting rights, as in the case discussed earlier, then clearly producers also gain if they receive planting rights for free. However, they also gain in less extreme situations. For instance, if producers with free planting rights would gain from the introduction of planting rights in a small open economy ($x - u > 0$), they would also gain in a large economy. But even if $x - u < 0$, producers with planting rights might still gain if the effect of higher prices ($h + i$) is sufficiently large.

4. Problems of Enforcement

There are serious problems with the enforcement of the planting rights system. To properly manage the planting rights system, a reliable register of vineyards is needed in order to verify that a replanting right offered for sale indeed corresponds to a grubbed-up vineyard, and that all new plantings are justified by planting rights. In the absence of a reliable vineyard register, there is scope for fraud. Planting may occur without planting rights, or replanting rights may be issued for a vineyard which has not been grubbed up.

There is considerable uncertainty about the total area under vines in the EU. In 1986, the European Union decreed that MS had to set up a vineyard register to manage planting rights by 1992. In several MS, the implementation of the register was seriously delayed. Italy and Greece

still had not complied by 2004, when they were forced to repay EU subsidies as a fine. Available data sources showed large differences depending on the MS and the data source used. For instance, different sources put Greek vineyard area at somewhere between 51,000 ha and 112,000 ha in the period 1997-2000. There were also major discrepancies in the data for Italy, Portugal and Spain. It is not clear what explained these differences (European Commission, 2004). The situation has not much improved since then.

In June 2012, the European Commission fined Greece, Italy and Spain for a total of 250 million euros because of illegally planted vineyards. The European Commission estimated that these three countries had almost 120,000 hectares of illegal vineyards. Thus, it is clear that control and enforcement of the planting rights system has been less than perfect.

What does this imply for our analysis? Throughout, we have implicitly assumed that the level of planting rights $\bar{R}$ set by the government is also the effective level of planting rights in the economy. With imperfect enforcement, however, this is not necessarily the case. If replanting rights are issued while vineyards were not grubbed up, or if vineyards are planted without planting rights, this would result in the *de facto* stock of planting rights $\bar{R}_{actual}$ being greater than the official stock of planting rights $\bar{R}_{official}$. We can evaluate the impact of enforcement problems by comparing a low level of $\bar{R}$ and a high level of $\bar{R}$ in our previous analyses. Compared to the lower $\bar{R}_{official}$, the actual stock of planting rights $\bar{R}_{actual}$ leads to lower prices of planting rights (as the actual constraint imposed by planting rights is weakened), higher prices of land (as more land can now be used to plant vineyards rather than the less profitable alternative crop), a larger supply of wine and thus in general a lower price of wine than would be the case with perfect enforcement. As a result, the efficiency losses described earlier are smaller when the planting rights system cannot be perfectly enforced.

There are, however, distributional issues when enforcement is not perfect. Figure 7 depicts the land market of a small open economy when the actual stock of planting rights $\bar{R}_{actual}$ is greater than the official stock of planting rights $\bar{R}_{official}$. The price of planting rights $p_{R,actual}$ is lower than the price p_R which would obtain with perfect enforcement; likewise, the price of land $p^R_{L,actual}$ is higher than the price p^R_L under perfect enforcement. The extra vineyards reduce the welfare loss due to planting rights by area $c + d + e$.

To study the distributional consequences, we assume that planting rights have been created illegally and are sold or rented to unsuspecting producers. The surplus of producers increases by $a + c$ because of the lower price of planting rights and the increase in production. The original owners of planting rights lose $a + b$ because of the lower price of planting rights. The landowners gain $b + e + f + g + h$ due to higher land prices. The sale of illegal planting rights leads to revenues d for the forgers. Thus, owners of planting rights unequivocally lose while other groups gain. If producers also own the planting rights, their net welfare changes by $c - b$, which could be positive or negative depending on the specific circumstances.

Alternatively, instead of creating and selling illegal planting rights, enforcement problems could take the form of illegal plantings, with producers buying land and starting a vineyard without buying planting rights. These producers then capture $c + d$, while honest producers gain a. The effects for other groups are unchanged. If these honest producers are at the same time owners of the planting rights, they now face a net loss of b due to higher land prices.

In addition, in a large economy extra production from illegal plantings or from illegal planting rights would depress the output price of wine. While this would again reduce the efficiency loss associated with the planting rights regime, it would create an additional negative effect on producers' income.

5. Trade Restrictions in Planting Rights

The framework developed in the previous section allows us to study several aspects of the current planting rights regime in the EU in more detail. In this section, we study the effects of restrictions on the tradability of planting rights either among producers in a region or between regions. In the next section, we discuss how the existence of a national reserve affects our results.

There exist several restrictions on the trade in planting rights. EU regulations forbid the transfer of planting rights across the borders of MS. In addition, several MS have introduced restrictions on the trade in planting rights within the MS. In Spain, for instance, planting rights are organized at the level of the regions (the seventeen "autonomous communities" such as Catalonia, Valencia, or Basque Country), and the transfer of planting rights between different regions is strictly regulated. A region can only transfer a maximum of planting rights equal to 0.4% of its total area of vineyards each year, and such transfers must be authorized by the national Ministry of Agriculture (Montaigne et al., 2012). Moreover, even transfers of planting rights inside the region must be authorized by the regional government, which also imposes extra limits on how the planting rights can be used (European Parliament, 2012).

France has even more regulations. Planting rights are not the only requirement for planting new vines. In addition to the planting right, producers also need an additional "authorization" to use the planting right. Producer organizations set an annual quota of new plantations for wines with a geographical indication. In addition to this quota on the level of the geographical indication, there is a limit to how much new vineyards a single producer can add in a given year: for wines with a geographical indication, the limit is set at 3 ha of new vineyards per producer per year and at 1 ha for wines with a protected designation of origin. Requests for

authorizations are handled by the Institut National des Appellations d'Origine (INAO) for PDO wines and by FranceAgriMer for all other categories of wines (Montaigne et al., 2012).

A well-known result of the literature on output quotas is that when output quotas cannot be traded among producers, extra inefficiencies arise (Alston, 1981; Burrell, 1989). At first sight, the logic would seem to carry over to the present case. Whatever the initial allocation of planting rights, trade allows less efficient wine producers to sell their planting rights to more efficient wine producers, until the point where the price of planting rights equals their marginal value for every farmer. Hence, trade in planting rights leads to an efficient allocation of planting rights regardless of the initial allocation.

The result that trade in planting rights leads to an efficient allocation holds independent of the initial allocation mechanism (e.g. random distribution, historically based, or auctioned off by the government), although the resulting income distribution will be different. If planting rights are allocated based on historical ownership of vineyards (as is the case in the EU), over time there is a transfer from new entrants to existing producers (who initially did not have to pay for planting rights). If planting rights are initially auctioned off, farmers would bid up the price of planting rights until the point where price equals marginal value for everyone and the state would benefit from the revenues. In this case there is a transfer from existing producers to the state budget.

The effect of trading restrictions in planting rights crucially depends on how they are associated with trading in land and with differences in land quality. For example, if one cannot trade planting rights separately, but one is allowed to trade existing vineyards (and thus the trade in planting rights is implicit in the trade in vineyards), this will mitigate the efficiency losses from restrictions on trade in planting rights.

To illustrate this: in the model we have used so far, when regulations prohibit the transfer of planting rights (without vineyards) between producers but it is still permitted to buy existing vineyards (with implicit planting rights), there would be no effect of the trading restrictions. This is because of our assumption that land is homogeneous. If there are no quality differences between vineyards operated by different producers, diminishing marginal returns are due to producers' capacity for managing vineyards, not to land quality. Producers with more vineyards (with implicit planting rights) than is optimal will sell these vineyards to producers with a sub-optimal allocation of vineyards. In this way, trade in vineyards with planting rights leads to an efficient outcome. Hence, with homogeneous land, trade in vineyards has the same effect as transfers of planting rights as it leads to an efficient allocation.

In reality, of course, all land is not homogeneous and there are also extra costs involved in managing dispersed vineyards. When the quality of land is heterogeneous, an existing vineyard can be uprooted and its planting right transferred to better land. When planting rights cannot be traded, this is impossible, and inefficient allocations may arise.

Trade Restrictions Between Regions

The most important restriction is on trade in planting rights between regions. We analyze this formally. Consider the case of two wine regions which are identical in all respects except for their initial endowment of planting rights. For simplicity we assume two small open economies selling wine at the same constant output price p_W^*.[12] Figure 8 demonstrates what happens if these two regions can trade planting rights.

The upper left panel of Figure 8 depicts the land market in Region 1, with the derived demand for planting rights in this region shown in the bottom left panel. Likewise, the upper

[12] Relaxing this assumption would not fundamentally alter our main conclusions.

right panel of Figure 8 shows the land market in Region 2, but measuring the amount of land used for vineyards $L_{W,2}$ from right to left. The bottom right panel gives the derived demand for planting rights in Region 2. The thin vertical lines on these panels show the initial endowment of planting rights in both regions. As drawn, Region 1 has less planting rights than Region 2. As can be seen from the bottom left and bottom right panels, in the absence of trade this results in a higher price of planting rights in Region 1 ($p_{R,1} > p_{R,2}$).

Since the total amount of planting rights in the economy is constant, we can analyze trade between regions by combining the derived demands for planting rights in the central panel. Measured from left to right is the amount of planting rights allocated to Region 1, while the amount of planting rights in Region 2 is measured from right to left. If trade between regions is possible, owners of planting rights in Region 2 will sell some of their planting rights to producers in Region 1. By doing this, owners of planting rights in Region 2 can make a profit as long as producers' willingness to pay in Region 1 is higher than in Region 2. Likewise, by buying planting rights and expanding the production of wine in Region 1, producers can make a profit as long as the price of planting rights is smaller than the marginal value of producing wine in Region 1. Thus, trade will continue until the resulting price equalizes the marginal value of producing wine in both regions. In equilibrium, producers in Region 1 buy a total of R_T planting rights at the equilibrium price p_R^* from the owners of planting rights in Region 2. The resulting payment is given by the grey-shaded area in the bottom central panel of Figure 8. Exactly the same area is indicated in the other panels. As a result of trade, the price of planting rights is equalized in both regions and the amount of planting rights in Region 1 expands while that in Region 2 falls. The new allocation of planting rights is indicated by the thick line in the panels.

To analyze total welfare effects and distributional implications, we now turn to the situation in the land markets of both regions, shown in more detail in Figure 9 (now showing the land market in Region 2 in the more usual way measuring L_W from left to right). Initially, Region 1 has a smaller endowment of planting rights than Region 2 ($\bar{R}_1 < \bar{R}_2$). As a result, in the absence of trade between regions, in Region 1 production of wine is lower, the price of planting rights is higher ($p_{R,1} > p_{R,2}$), and the price of land is lower ($p_{L,1}^R < p_{L,2}^R$).

Trade increases total welfare, as well as welfare in both regions. A summary of the welfare effects is given in Table 2. As a result of the transfer of planting rights, in Region 1 an area R_T is transferred from the production of the alternative crop to the production of wine. The value of the decrease in production of the alternative crop is given by the area $d + e$, while the value of the increased production of wine is given by $a + b + c + d + e$. The net increase in output is thus given by $a + b + c$. The payment to owners of planting rights in Region 2 is given by area b. Hence, total welfare in Region 1 increases by $a + c$. In Region 2, the area devoted to the production of wine decreases by R_T, leading to an output loss of $k + l + m + n + o$. Production of the alternative crop expands; the value of this extra production is given by area $n + o$. Total output thus decreases with $k + l + m$. Since the owners of planting rights in Region 2 receive $j + k + l + m + n$, there is a net welfare gain in Region 2 of $j + n$. In both regions, welfare increases as trade allows producers to reap efficiency gains by transferring planting rights to the most efficient users. The total efficiency gains are $a + c + j + n$.

However, while welfare increases, there are winners and losers in both regions. The transfer of planting rights leads to an increase in the price of land in Region 1 (from $p_{L,1}^R$ to p_L^R) and a decrease in the price of planting rights. The lower price of planting rights means that producers gain $f + a$ where f is part of the surplus which used to go to the owners of planting

rights and a is part of the efficiency gain associated with the increase in production. Owners of planting rights in Region 1 lose by area $f + g$. As a result of higher land prices, the areas $g + c + d + h + i$ are transferred to land owners, where g is a transfer of surplus from owners of planting rights, c is part of the efficiency gain due to the expansion of production, and $d + h + i$ is a transfer from producers of the alternative crop, who are losing out because of lower production (area d) and higher land prices ($h + i$).

In Region 2, the transfer in planting rights causes the price of land to decrease and the price of planting rights to increase. Thus, the distributional consequences are the mirror image of those in Region 1. Wine producers lose $p + k$ because of the higher price of planting rights (area p) and surplus lost because of the reduction in output (area k). Owners of planting rights gain $p + q$ because of the higher value of planting rights in Region 2; in addition, they receive $j + k + l + m + n$ from the sale of planting rights to producers in Region 1 but they lose area l (the old value of the transferred planting rights). Landowners lose $q + m + n + r + s$ because of declining land prices. Producers of the alternative crop gain from lower land prices (area $r + s$) and increased output (area n).

To summarize, transferability of planting rights across regions establishes a single price for planting rights equal to its marginal value. This allows the most efficient producers to use the planting rights and leads to efficiency gains in both regions and in the aggregate. However, the distributional consequences depend on whether the region is a "net exporter" or a "net importer" of planting rights. For "importing" regions, wine producers gain from lower planting rights prices, while owners of planting rights lose. Landowners gain because of higher land prices, while producers of the alternative crop lose because of lower output and higher land prices. For "exporting" regions, the opposite effect is at work, with wine producers losing because of higher

prices of planting rights, while planting rights owners gain; landowners lose because of lower land prices and producers of the alternative crop gain because of increased output and lower land prices. These effects are summarized in Table 2.[13] Importantly, allowing trade in planting rights between different regions leads to efficiency gains compared to a situation where trade is prohibited. When trade is restricted, the price of planting rights will in general not be equalized across different regions, and the dispersion of the price of planting rights can be used as an indicator of efficiency losses.

In the case of Spain mentioned earlier, where trade in planting rights between different regions is strictly regulated, the dispersion in prices of planting rights is spectacular. In 2006-2007, prices of planting rights varied between 500 euros per hectare and 30.000 euros per hectare: they traded at 500 euros per hectare in Castilla-La-Mancha, at 2000 euros per hectare in Catalonia, at 4000 euros per hectare in Castilla y León, and at 30.000 euros per hectare in La Rioja (Montaigne et al. 2012).

6. The Reserve System

Transfers of replanting rights are the most important source of planting rights in the EU. However, planting rights from reserves play an important role in some MS (e.g. planting rights from reserves dominate in the New Member States such as Romania and Bulgaria) and for some groups of producers (e.g. young producers in most MS). Table 3 gives an indication of the importance of the reserve in different MS. The table gives for every MS the relative importance of replanting rights exchanged among producers, planting rights available in the reserve and planting rights from the reserve allocated to producers but not yet used. In general, a reserve can

[13] By simply summing the amounts in the different categories, the summary in this table also allows us to calculate effects on income if wine producers are at the same time owners of planting rights and/or land.

freely buy and sell planting rights, although MS can again introduce their own rules to govern the reserve.

Reserves can be installed at the regional level, as in Spain, or at the national level, as in France. In theory, regional reserves may exchange planting rights with each other or with a national reserve, although this seems to be rare in practice.[14] To simplify the analysis, we assume that countries use either a regional reserve which does not interact with other regional reserves, or a single national reserve. In what follows, we first discuss the effects of a regional reserve, and then the effects of a national reserve.

A Regional Reserve

A reserve cannot simply create planting rights out of thin air. Rather, it acquires planting rights by buying them from producers who grub up their vineyards.[15] In what follows, we assume that the reserve buys and sells at the same price $p_R^{reserve}$ set by the reserve.

The fact that a regional reserve cannot alter the total stock of planting rights available in the region implies that the market price of planting rights should not be affected by the existence of the regional reserve. In a competitive market, the price of planting rights is determined by its marginal value, which in turn depends on its relative scarcity; since this scarcity is unchanged, the price $p_R^{reserve}$ set by the reserve will not alter the equilibrium market price p_R^* which clears the market for planting rights.

Figure 10 analyzes the case where a reserve sets its price $p_R^{reserve}$ below the equilibrium price p_R^*. We assume that the reserve initially owns the entire stock of planting rights. As shown in the bottom panel, at $p_R^{reserve}$ the total demand for planting rights from the reserve $R_{demanded}$

[14] Spain also has a national reserve in addition to the regional reserves, although the national reserve plays only a minor role.

[15] In addition, under EU rules, planting rights which are not exercised after some years return automatically to the reserve.

exceeds the available stock of planting rights $\bar{R}$ in the region. Only an amount $\bar{R}$ can be allotted to producers. Competition subsequently pushes up the price of planting rights to p_R^*. Hence, in terms of total efficiency the existence of a regional reserve selling at a low price makes no difference for our analysis. There is, however, a distributional effect. Since at the low price $p_R^{reserve}$ the demand for planting rights exceeds the supply, the reserve will need to ration the allocation of planting rights. This might be done by using criteria for preferential treatment, such as giving priority to younger producers. Those who have been able to buy planting rights paid $p_R^{reserve}$ while the market value is p_R^*. Compared to a reserve selling planting rights at the equilibrium price p_R^* this amounts to a transfer to those who managed to obtain planting rights from the reserve. This transfer is indicated by the grey shaded area in Figure 10.[16]

Alternatively, the reserve may set a price $p_R^{reserve}$ which is higher than the equilibrium price p_R^*. Since we assume that the reserve buys and sells at this price, there will be producers who find it profitable to grub up their vineyards and sell the planting rights to the reserve at this price. As a result, the total area under vines in the region will decrease and the market price of planting rights will increase to $p_R^{reserve}$.

Analytically, this case is similar to what happens in a region which becomes a "net exporter" of planting rights, as in the lower panel of Figure 9. The area under vines decreases by an amount R_T, which is equal to the number of planting rights transferred to the reserve. There is a reduction in the production of wine, an increase in the production of the alternative crop, a decrease in the price of land and an increase in the price of planting rights. In terms of welfare effects for the different stakeholders, the same conclusions apply as for Region 2 in Table 2. However, in this case the shaded area $j + k + l + m + n$ represents payments from the reserve

[16] It is straightforward to relax our assumption that the reserve initially owns all planting rights. Assuming that the reserve initially owns a smaller stock $\bar{R}_{reserve} < \bar{R}$ would merely result in a horizontal shortening of the grey shaded area in Figure 10, without any impact on the market price p_R^* or total efficiency.

to producers, instead of payments from producers in a different region. That is, this area now represents costs to the taxpayer. Total income in the region has increased by $j + n$, while taxpayers now pay $j + k + l + m + n$. So, the total efficiency loss to society is given by $k + l + m$. Hence, in contrast to the case where a reserve sets the price of planting rights below the equilibrium price, setting the price above the equilibrium price results in efficiency losses.

A National Reserve

The above conclusions are also valid when instead of regional reserves there is a single national reserve. If the national reserve sets prices below the equilibrium price, it will need to ration the allocation of planting rights and the allocation of cheap planting rights from the reserve creates a transfer. If the national reserve sets prices above the equilibrium price, it creates efficiency losses and a reduction in the area under vines.

However, the existence of a national reserve has some additional implications. When a national reserve sets one price at which it freely buys and sells planting rights, producers in all regions will adjust production to match the value marginal productivity of vineyards to the price of land plus the price of planting rights as set by the reserve. That is, even if planting rights cannot be traded across regions, the existence of a national reserve might lead to an efficient allocation of planting rights across regions, as planting rights will be "transferred" through the reserve instead of through direct trade. This appears to be the case in France, where the price of planting rights in regional markets has closely followed the price set by the national reserve, even though trade in planting rights is severely restricted by regulations. By contrast, Spain does not rely on a national reserve but on regional reserves; in combination with the restrictions on trade between regions this may explain the enormous disparities in prices of planting rights across different regions.

7. Discussion and Conclusion

In this paper we have developed a model to study the effects of planting rights. Since planting rights impose a constraint on land use, our model simultaneously considers the market for wine, land and planting rights. Using this theoretical framework we examined the efficiency and welfare effects of planting rights and we analyzed the effects of imperfect enforcement, trade restrictions, and regional and national reserves of planting rights.

Our conceptual framework makes it possible to evaluate the effects of the proposed liberalization of planting rights in the European Union. Our model shows that, as with any policy reform, the end of planting rights creates both winners and losers. Among the winners are consumers, who benefit from larger supplies of wine at lower prices. Owners of land other than vineyards also gain, because of the increase in land prices. A third group of winners are the new entrants into the sector, who will have the opportunity of planting vineyards while they were unable to do so before the liberalization. The losers are the original vineyard owners, as the total value of their vineyards decreases and additionally they face lower prices for their wines.

With our model we have determined the sign of these effects. The magnitude of the quantity and price effects after liberalization depends on the curvature of demand and supply, as well as on how restrictive planting rights are. Table 4 summarizes the determinants of the size of the effects. A region will experience large negative effects from liberalization if the area under vines is currently far below the "laissez-faire" equilibrium, if supply can be easily expanded, and if demand is very inelastic so that an increase in supply leads to a strong decline in prices. On the other hand, a region will only experience moderate effects if its current area under vines is close to the post-liberalization equilibrium, if supply cannot be easily expanded (if at all), and if demand for its wines is elastic so that increases in supply have little effect on price.

Although the restrictiveness of planting rights cannot be measured directly, the price of planting rights in different regions gives some indication of how binding planting rights are at the margin. If planting rights were allocated efficiently across wine-producing regions of the EU, their price should be the same everywhere. In reality, there are large differences both between MS and between regions within each MS. In Spain, for instance, prices of planting rights in 2006-2007 varied between 500 and 30.000 euros per hectare. In contrast, in France, the existence of a national reserve has led to a near-uniform price of around 1500 euro in the same period (Montaigne et al. 2012).

The supply response is determined by physical characteristics of the region, by the presence of profitable alternative crops and by remaining other regulations. In some regions, the most suitable land is already planted with vines, or vines compete against a profitable alternative crop. As a result, an expansion of vineyards may only happen at strongly increasing costs. In other cases, the supply response is limited by geographical indications which will not be affected by the liberalization (as e.g. in the Champagne region). In this case, the supply curve of wine after liberalization would become vertical at some point. An indicator that is useful here is the share of vineyards in the total area under the geographical indication. As shown in Table 5 for selected French wine regions, the share of the total available land under the geographical indication which is currently planted with vineyards varies considerably. For instance, only 10% of available land is used in Cognac. In Beaujolais, Bordeaux and Burgundy, the share is around one-half of all available land, while in the Champagne region practically all available land is planted with vineyards. Of course, these aggregates hide considerable heterogeneity. The Bordeaux region contains some fifty sub-appellations; in some of these (e.g. Pomerol), the share

of land under vines is as binding as in Champagne. All else equal, when expanding the area under vines is difficult, the expansion of output and the reduction in price will be more modest.

On the other hand, in some regions there may be plenty of suitable land available. In this case it might be possible to expand the area under vines at relatively constant costs. This situation might characterize some northern regions where grape growing is only now becoming feasible due to climate change (Jones et al., 2005); in some of these regions there may be few existing vineyards and few alternative crops, which makes it easy to expand the area under vines. All else equal, when expanding the area under vines can be done easily and at relatively low costs, the expansion in production and the reduction in price will be larger.

A key factor in determining the change in wine prices with expanding production is the elasticity of demand. This elasticity is closely related with the fact whether the price of the wine is mostly determined by the local market or is driven more by international markets. In regions which face strong competition with New World wines, the price is more or less determined by the world price. Changes in production in such regions will only have a small effect on price, as the expansion of production only has a moderate effect on the total (global) supply of wine. As a result, the demand curve for the region is almost horizontal and liberalization will only have a small effect on the price. On the other hand, an expansion of production in regions which produce mostly for local or domestic consumption will probably lead to a much larger negative effect on price. This case corresponds to a downward-sloping demand curve, and liberalization may lead to lower wine prices.

Interestingly, these two categories do not neatly coincide with the usual distinction between high-quality and low-quality wines. Regions producing table wine for the local market would face a strong negative price effect if production expanded, while regions producing cheap

wines for export may have more opportunities to sell extra output without a strong reduction in price. Regions producing high-quality wine which are mostly sold on the domestic market will face a stronger negative price effect than similar regions which export a sizeable part of their production. For instance, some top wines in Bordeaux which are in high demand in the emerging economies might be able to expand production without any negative effect on the output price. The same holds for wines such as Chianti Classico, which already exports around 80% of annual production. Regions where the elasticity of demand is low (such as regions where the price is determined by the world market) will experience smaller price decreases as production expands. Regions where the elasticity of demand is high (such as regions where most of production is sold locally) will face stronger price effects of increased production.

Finally, for the analysis of the effects of liberalization one should consider both the elasticity of wine as a category and the elasticities of wines of particular regions. The first matters for the effects of a general increase in wine production on prices in the EU or MS, the second for the effects on specific regions and producers. By construction, the estimated demand elasticity of a *category* of products ("wine") will be lower than for a specific *brand* within that category (Fogarty, 2010). When one brand increases its price, consumers might switch to competing brands. On the other hand, if the average price of a category of products increases, the opportunities for substitution are more limited and the resulting change in quantity will be smaller. To our knowledge detailed studies on the elasticity of wines from different European wine regions are not available, although the fraction of production exported abroad might be used as a good alternative measure: regions exporting most of production are probably more dependent on the world price and will therefore undergo smaller price effects from increased output.

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Appendix: Demand Elasticity and Producer Gains from Planting Rights

As demonstrated above, when producers do not own planting rights they may still gain from the introduction of planting rights provided that

$$\frac{p_W^R}{p_W^*} \geq \frac{W(L_W^*) - W'(L_W^*)L_W^*}{W(\bar{R}) - W'(\bar{R})\bar{R}}$$

The fraction on the left-hand side depends on the elasticity of demand and on the magnitude of the reduction in supply caused by the introduction of planting rights. The expression on the right-hand side depends only on the aggregate production function $W(L)$, optimal land use L_W^* in the absence of planting rights, and the amount of planting rights $\bar{R}$.

To illustrate that producers may gain if demand is sufficiently inelastic, assume that $W(L)$ is quadratic and can be represented by $W(L) = aL^2 + bL$, in which case the marginal product is $W'(L) = 2aL + b$. Further assume that planting rights are set at one-half of the optimal amount of land: $\bar{R} = \frac{1}{2}L_W^*$. In this case, the expression on the right-hand side equals four:

$$\frac{W(L_W^*) - W'(L_W^*)L_W^*}{W(\bar{R}) - W'(\bar{R})\bar{R}} = \frac{a{L_W^*}^2 + bL_W^* - (2aL_W^* + b)L_W^*}{a\left(\frac{L_W^*}{2}\right)^2 + b\left(\frac{L_W^*}{2}\right) - \left(2a\left(\frac{L_W^*}{2}\right) + b\right)\left(\frac{L_W^*}{2}\right)} = \frac{-a{L_W^*}^2}{-a\left(\frac{L_W^*}{2}\right)^2} = 4$$

In this situation, producers can thus gain from the introduction of planting rights if the price corresponding with the lower quantity is at least four times as great as before. We can calculate the implied arc-elasticity of demand which would correspond to such an increase in price:

$$\varepsilon_D^{arc} = \frac{\Delta Q}{\Delta P}\frac{P}{Q} = \frac{\Delta Q}{Q}\frac{P}{\Delta P}$$

By assumption, $\frac{\Delta P}{P} = 3$.[17] Moreover, $Q_W^* = aL_W^{*2} + bL_W^*$ and $\Delta Q = Q_W^R - Q_W^* = -\frac{3}{4}aL_W^{*2} - \frac{b}{2}L_W^*$. Hence,

$$\varepsilon_D^{arc} = \frac{\Delta Q}{Q}\frac{P}{\Delta P} = -\frac{1}{6}\left(\frac{\frac{3}{2}aL_W^{*2} + bL_W^*}{aL_W^{*2} + bL_W^*}\right)$$

The expression in brackets is greater than one. In particular, if $b = 0$ then this term becomes $\frac{3}{2}$ and the corresponding arc-elasticity is $-\frac{1}{4}$. At the other extreme, if b is large but a is small, the term in the brackets would be close to one and the arc-elasticity would be around $-\frac{1}{6}$ or about -0.17. Thus, for sufficiently inelastic demand producers can indeed gain from the introduction of planting rights, even taking into account the larger payments made to owners of planting rights.

There exist several studies which shed some light on the elasticity of the demand for wine. A meta-analysis by Gallet (2007) of 132 studies gives an elasticity of the demand for wine of -1.11. A meta-analysis by Fogarty (2010) reports estimates between +0.82 and -3.00, with the median estimate at -0.55; the majority of the studies surveyed (83%) indicate that the demand for wine is inelastic (i.e. the absolute value of the elasticity is smaller than one). These studies used aggregate data on alcohol consumption and hence look at the elasticity of wine as a category. By contrast, some studies looking at the elasticity of specific types of wine find larger elasticities. For instance, Dahlströhm and Asberg (2009) look at elasticities for white and red wine in different price categories using data from the Swedish government monopoly and obtain elasticities from around -1.00 for the cheapest red wine to around -2.75 for the most expensive; and from around -1.00 for the cheapest white wine to around -3.00 for the most expensive.

[17] The ratio of the new price over the old price must equal four, which means that the new price is 300% higher than the old price.

While these estimates give us some information on the elasticity of the demand for wine, their use in analyzing specific situations may be rather limited for two reasons. First, studies typically estimate the elasticity of demand for small changes in supply, whereas major changes in policy can lead to large changes in supply. Second, different wine regions and different types of wine will face different demand curves, making the effect dependent on specific circumstances. In particular, to achieve the effect described here requires a very inelastic demand curve. Since most wine regions compete both with other European wine regions and with producers in the New World, it seems unlikely that the effect described here is typical of European wine regions.

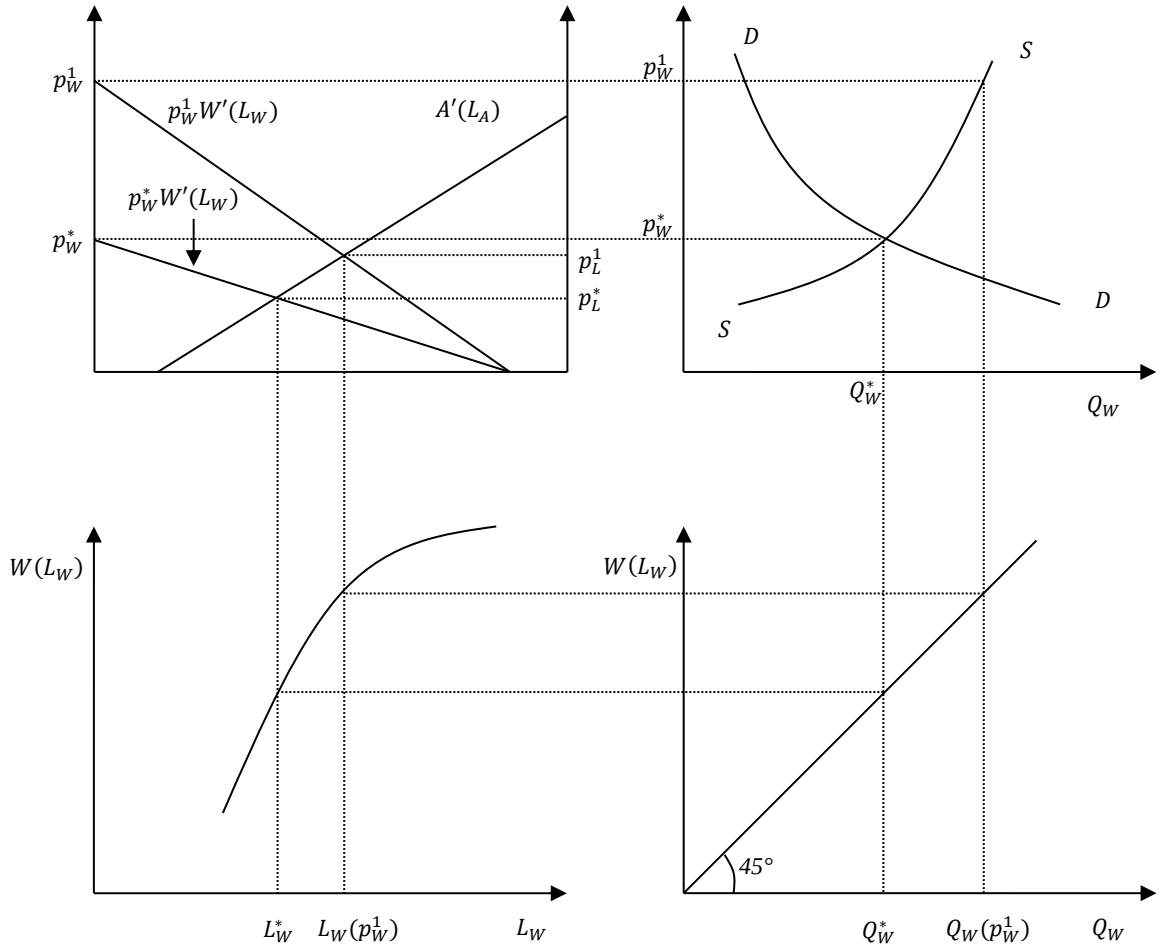

Figure 1. Equilibrium in the Wine and Land Market

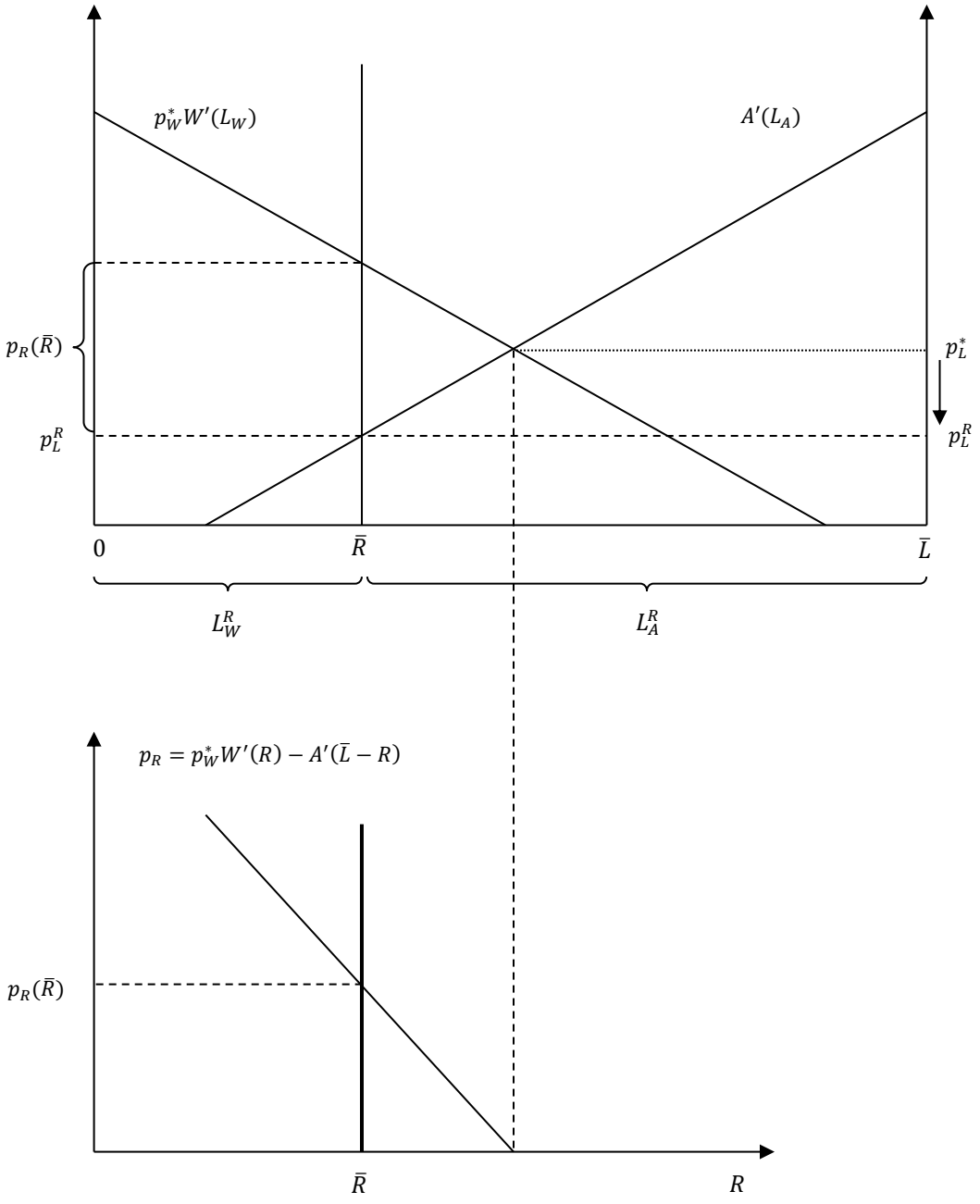

Figure 2. The Market for Planting Rights

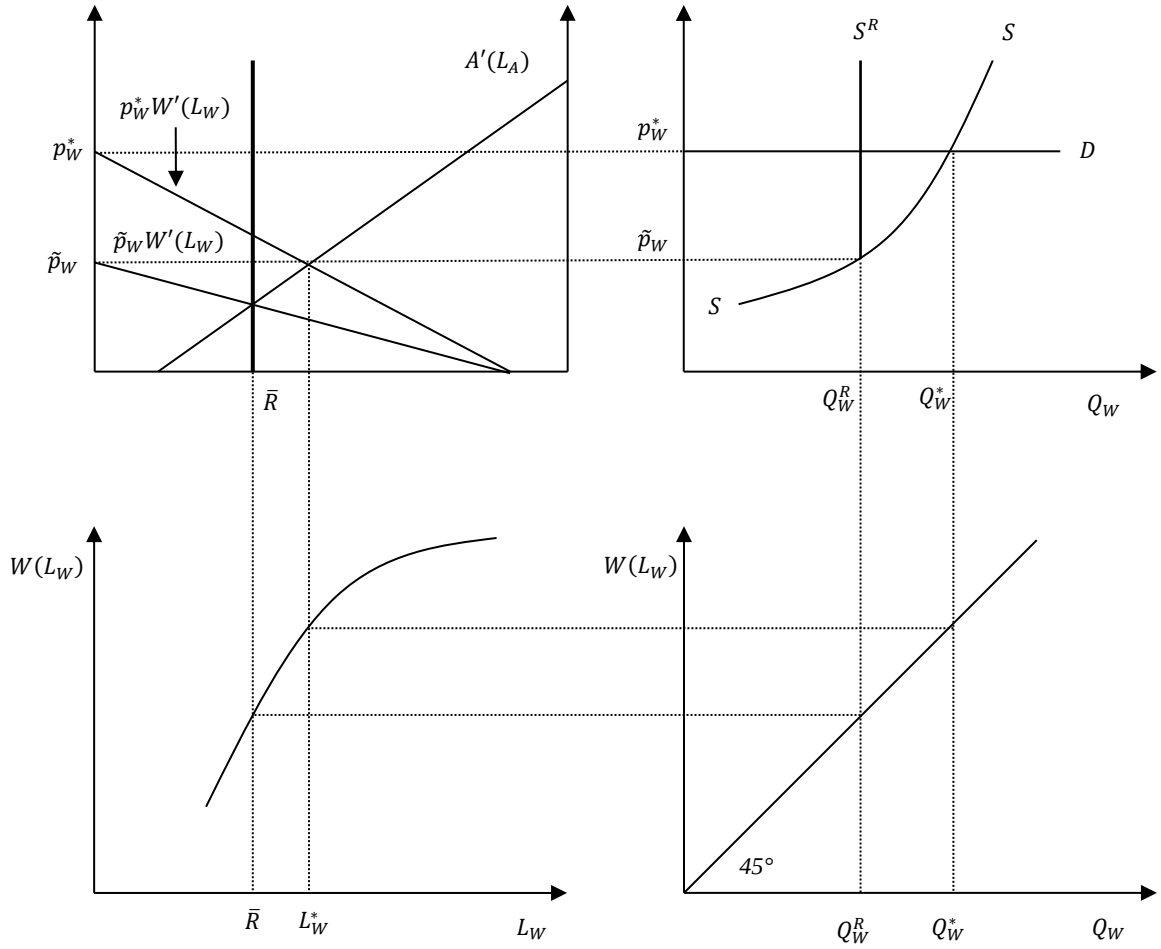

Figure 3. Equilibrium in a Small Open Economy with Planting Rights

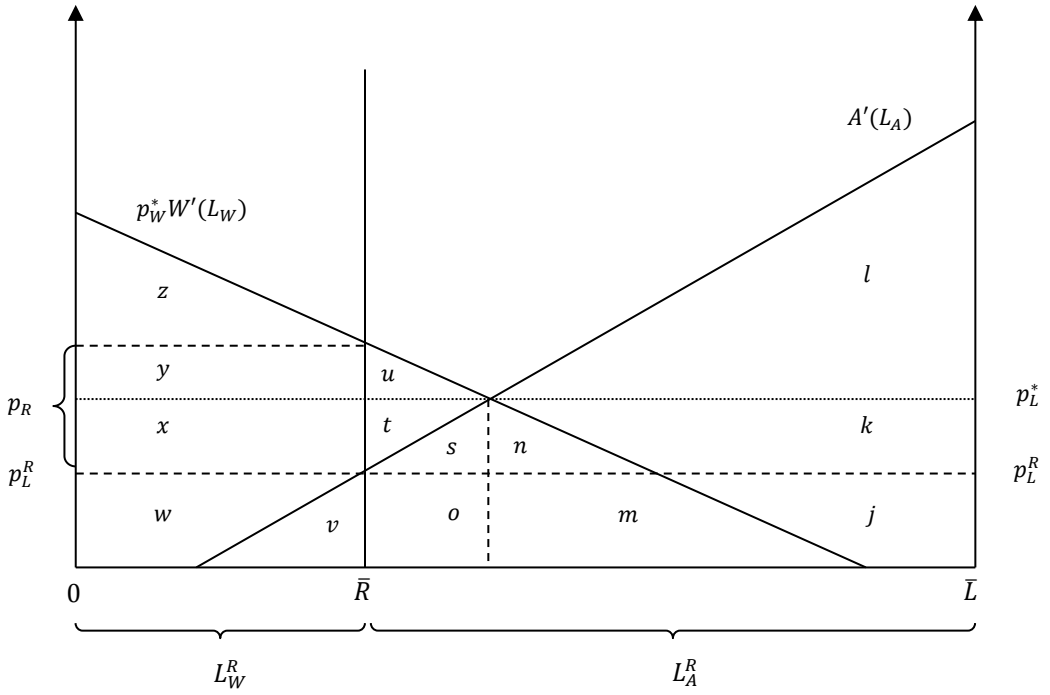

Figure 4. Welfare Effects of Planting Rights in a Small Open Economy

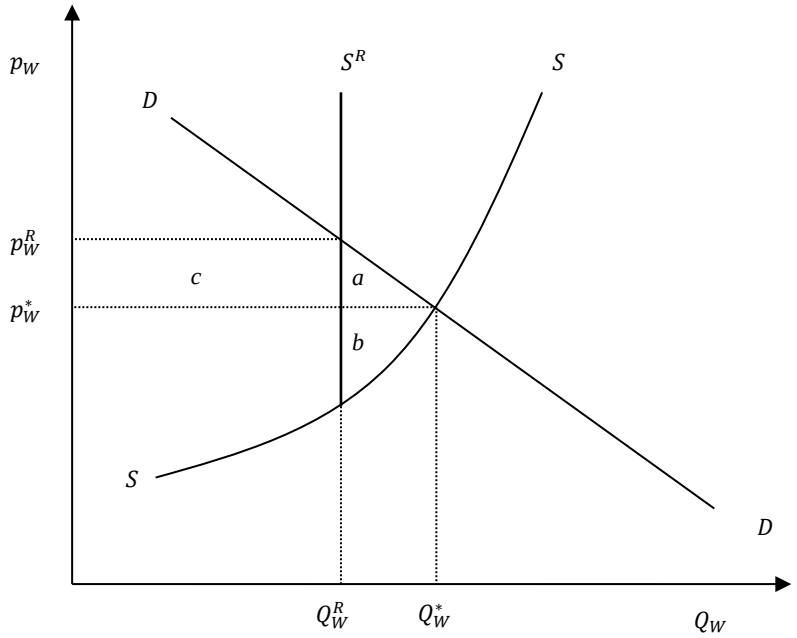

Figure 5. Wine Market in a Large Economy

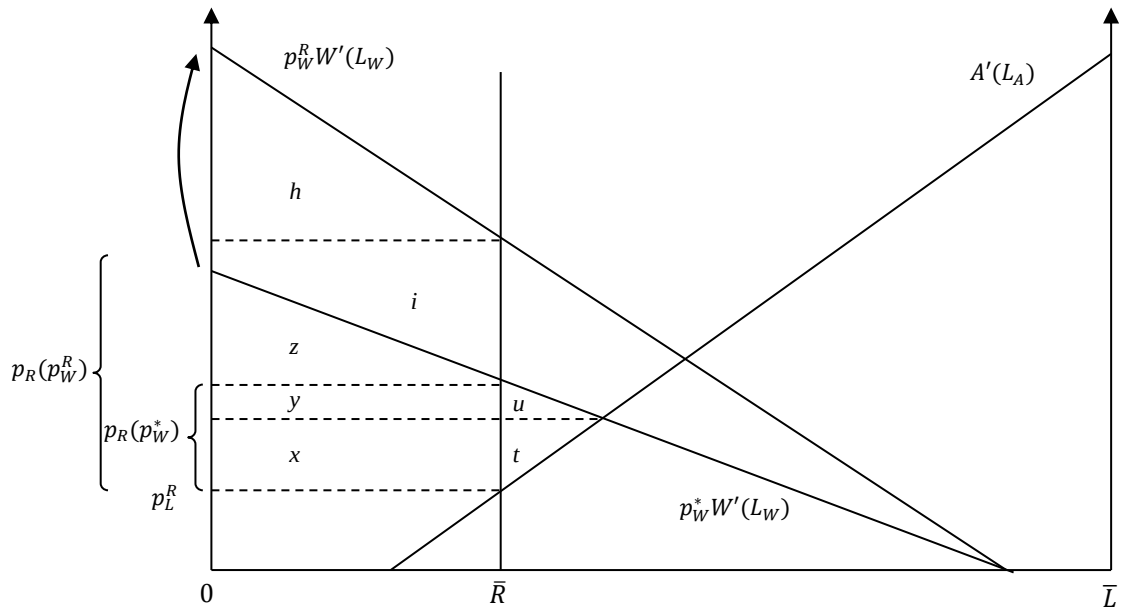

Figure 6. Welfare Effects of Planting Rights in a Large Economy

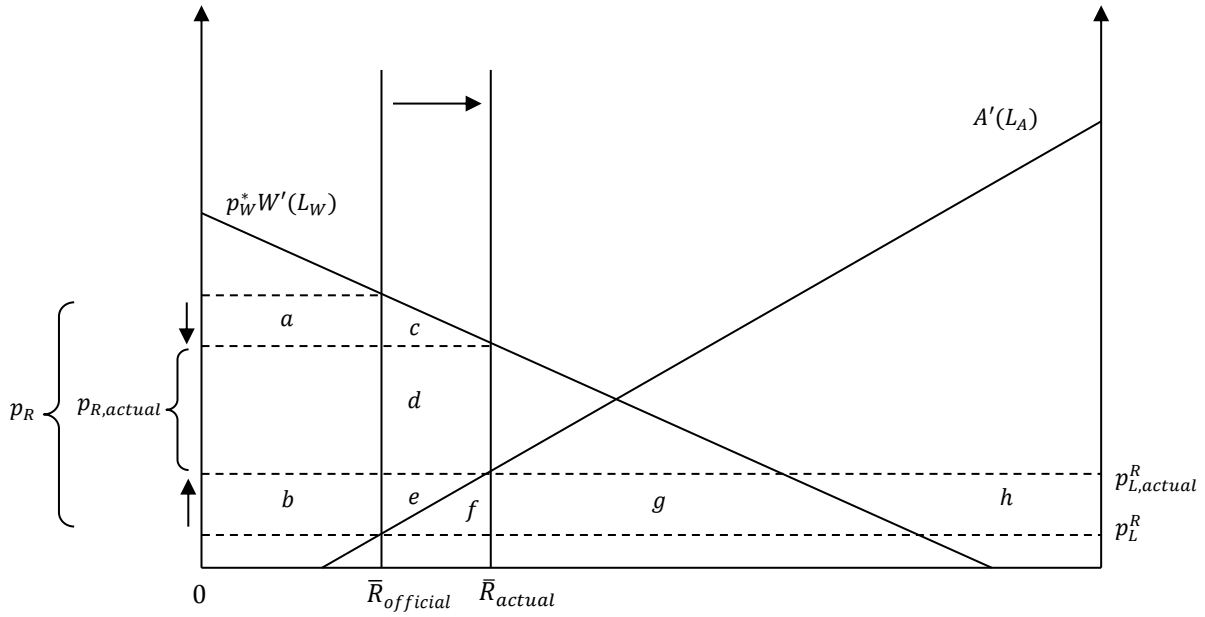

Figure 7. Effects of Illegal Plantings

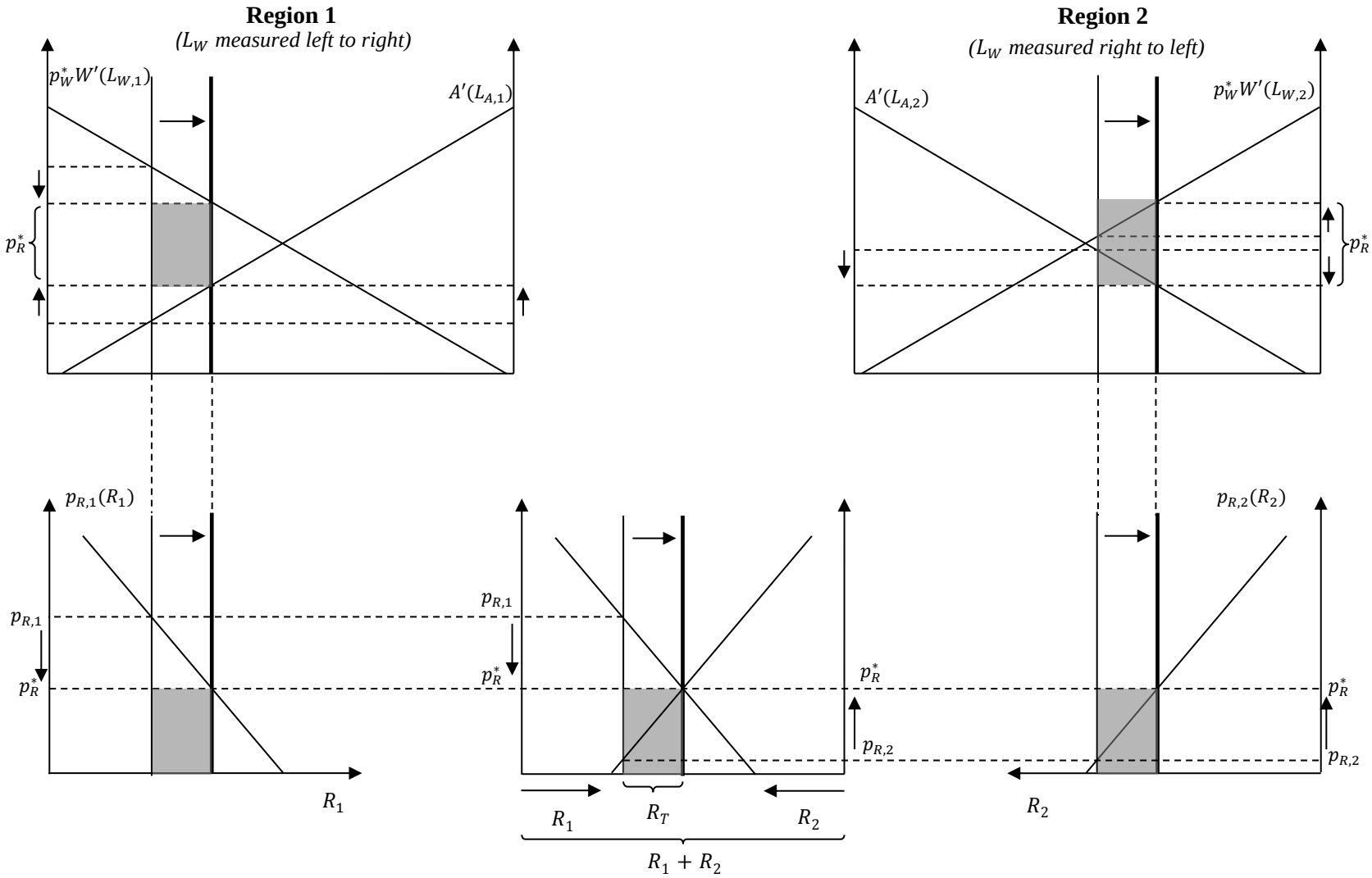

Figure 8. Trade Between Regions

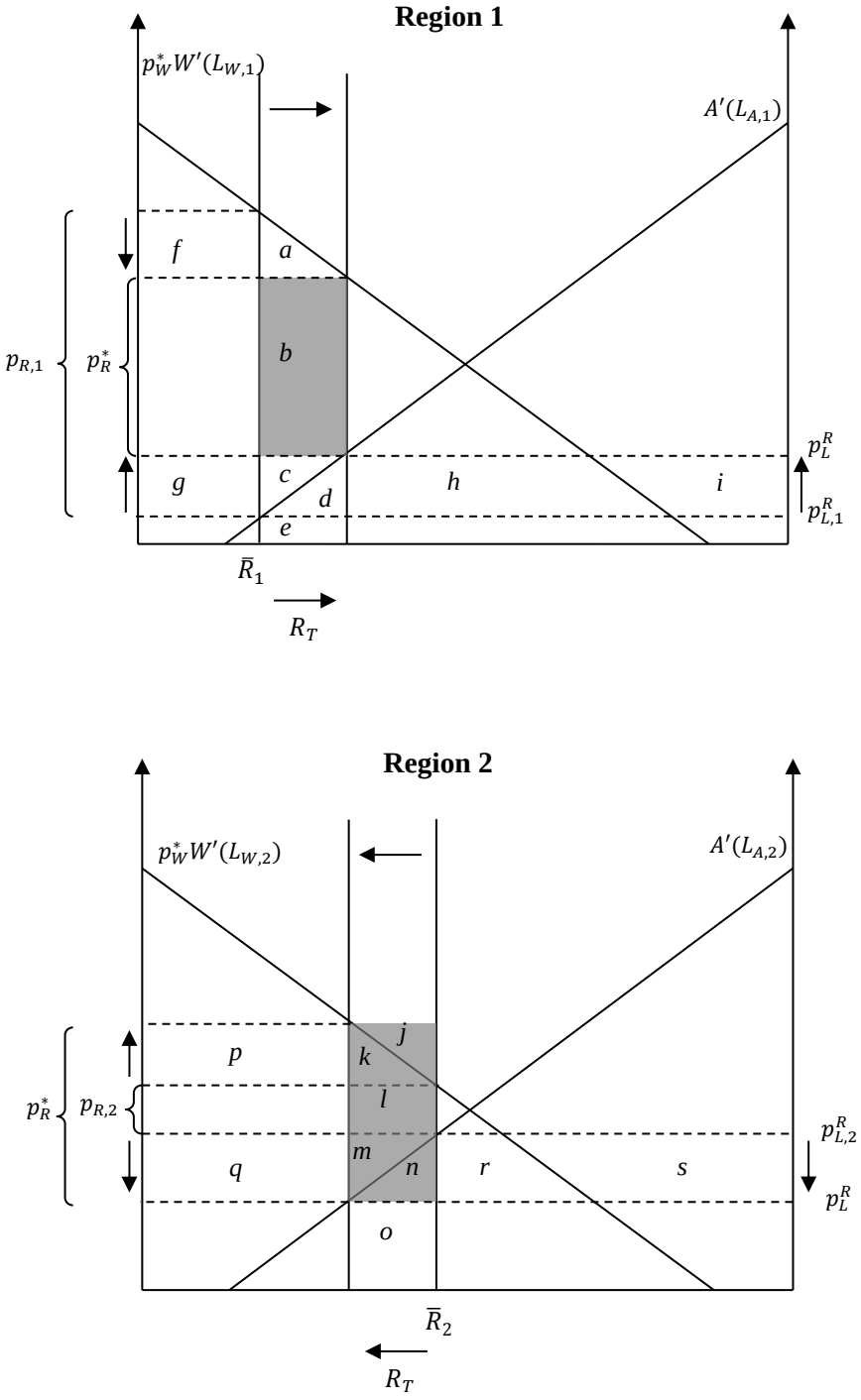

Figure 9. Effects of Transfers of Planting Rights

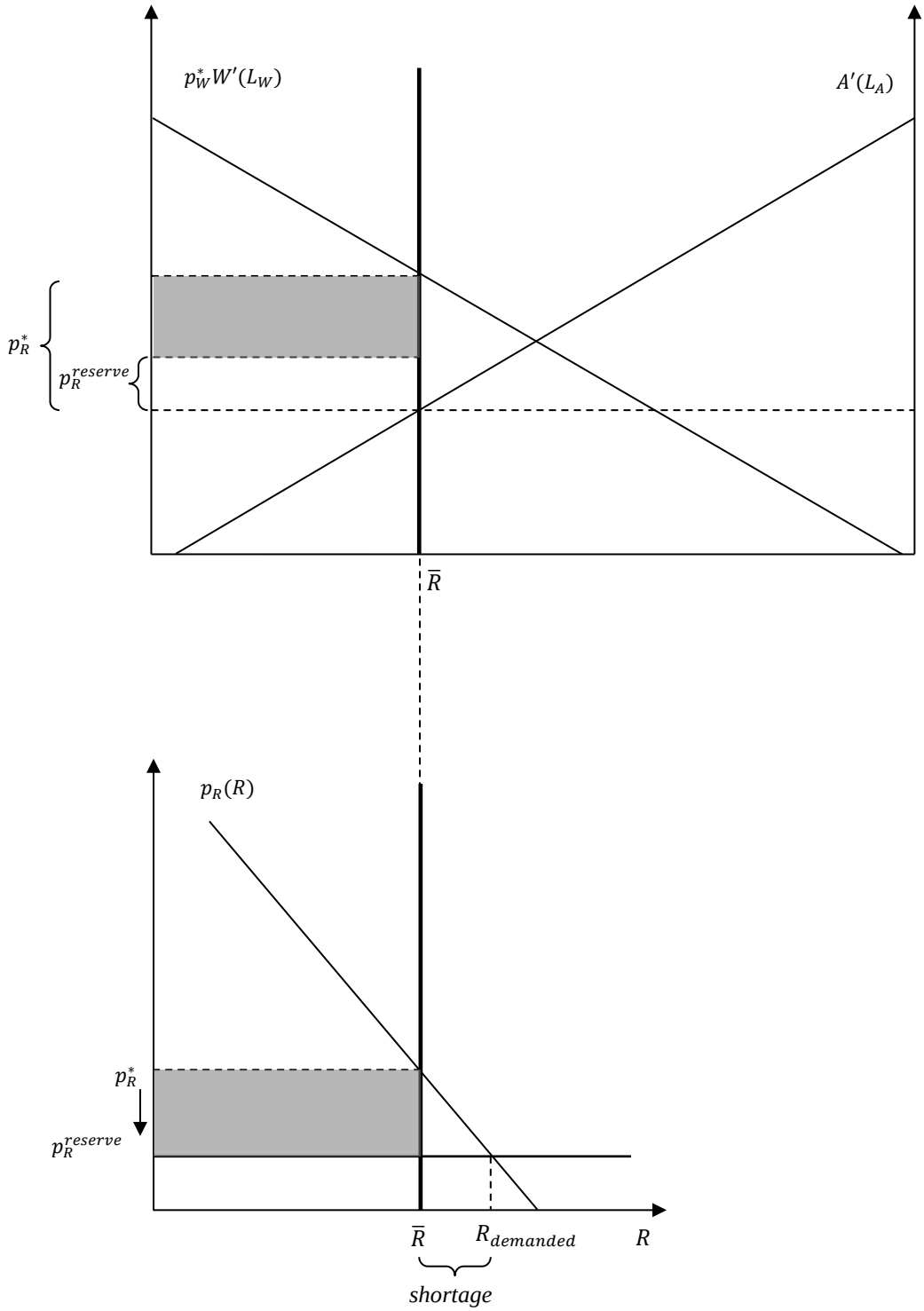

Figure 10. A Reserve Setting Its Price Below the Equilibrium Price

Table 1. Welfare Effects of Planting Rights

	Small Open Economy (Figure 4)	Large Economy (Figure 6)
Wine producers	$-y-u$	$h-z-y-u$
Owners of planting rights	$x+y$	$x+y+z+i$
Landowners	$-x-t-s-n-k$	$-x-t-s-n-k$
Producers of alternative crop	$s+n+k$	$s+n+k$
Net change in total income of producers	$-u-t$	$h+i-u-t$
Efficiency loss on producer side	$-u-t$	$-u-t$
Transfer from consumers to wine sector	*(none)*	$-h-i$ $=-c$ *(see Figure 5)*
Efficiency loss on consumer side	*(none)*	$-a$ *(see Figure 5)*
Total change in consumer welfare	*(none)*	$-a-c$
Total efficiency loss	$-u-t$	$-u-t-a$

Table 2. Welfare Effects of Trade Between Regions

	Region 1 *"importer" of planting rights*	Region 2 *"exporter" of planting rights*
Changes in production		
Change in wine production	$a+b+c+d+e$	$-k-l-m-n-o$
Change in production of alternative crop	$-d-e$	$n+o$
Net production change	$a+b+c$	$-k-l-m$
Transfer to/from other region	$-b$	$j+k+l+m+n$
Net change in total income	$a+c$	$j+n$
Distributional Effects		
Wine producers	$f+a$	$-p-k$
Owners of planting rights	$-f-g$	$p+q+j+k+m+n$
Landowners	$g+c+d+h+i$	$-q-m-n-r-s$
Producers of alternative crop	$-d-h-i$	$n+r+s$
Net change in total income	$a+c$	$j+n$

Table 3. Sources of Planting Rights

Member State	Replanting rights held by producers but not yet used	Planting rights available in the reserve	Planting rights from the reserve allocated to producers but not yet used
Spain	84%	16%	0%
France	81%	19%	0%
Italy	91%	3%	6%
Portugal	99%	1%	0%
Germany	90%	9%	1%
Greece	34%	27%	38%
Austria	36%	64%	0%
Luxemburg	100%	0%	0%
8 Old MS (EU-8)	*82%*	*16%*	*2%*
Hungary	70%	30%	0%
Slovakia	60%	39%	1%
Czech Republic	50%	44%	7%
Slovenia	11%	80%	8%
Cyprus	81%	18%	2%
Malta	0%	100%	0%
6 New MS (EU-6)	*56%*	*42%*	*2%*
Romania	55%	6%	39%
Bulgaria	17%	80%	3%
2 New MS (EU-2)	*37%*	*41%*	*21%*
EU Total	**76%**	**20%**	**4%**

Source: European Commission (2012).

Table 4. Effects of Liberalization

Characteristics		
Current output compared to free-market output	Close	Far
Possibility of expanding supply	Difficult or impossible	Easy
Demand	Elastic (determined by world prices)	Inelastic (small domestic market)
Effect of liberalization on wine price	*Small negative effect*	*Large negative effect*

Table 5. Available Land in French Wine Regions

	Delimited area in hectares	Area planted in hectares (2008)	Area under vines
Beaujolais	38 000	20 000	53%
Bordeaux	222 000	120 200	54%
Cognac	699 000	73 000	10%
Burgundy	59 000	28 000	48%
Champagne	34 000	33 500	99%
Languedoc-Rousillon	342 000	60 000	18%

Source : Vautrin (2010)