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Static and Dynamic Distributional Effects of Decoupled Payments: Single Farm Payments in the European Union

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Abstract

This paper analyses the distributional effects of decoupled Single Farm Payments (SFP) in the European Union. In a static world the SFP benefit only farmers, irrespective of the implemented SFP model and irrespective of whether entitlements are tradable or not, except when the size of the allocated entitlements is larger than the eligible area and/or if entrants are eligible for the SFP. Then the SFP gets either partially or fully capitalized into land values and landowners benefit. In a dynamic world the effects depend on the nature of structural change, on the tradability of entitlements, and on the implementation model.

Key words: Land market, agricultural policy rents, decoupled subsidies, land capitalization.

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1 Introduction

There is an extensive literature on the distributional effects of agricultural policy, or what Alston and James (2002) refer to as the “incidence of agricultural policy”. An influential OECD (2001) study came to the conclusions that only 20% of all market and price support in the OECD countries resulted in net farm surplus gains; the rest was dissipated to others, including owners of production factors.¹ Studies have analyzed how these effects differ among policies (Alston and James, 2002; de Gorter and Meilke, 1989; Dewbre, Anton and Thompson, 2001; Gardner 1983; Guyomard, Mouel and Gohin, 2004), how the results change if one includes more agents along the vertical chain (Desquilbet and Guyomard, 2002; Sheldon, Pick, and McCorriston, 2001) or if one takes into account imperfect competition (McCorriston and Sheldon, 1991 and Salhofer and Schmid, 2004), imperfections in factor markets (Ciaian and Swinnen, 2006; 2007), or transaction costs and constraints in the implementation of the policies (OECD, 2007; de Gorter, 1992; Munk, 1994; and Vatn, 2001).²

Initially, most of these studies focused on policies affecting production decisions, e.g. price support or quotas. With the decision to decouple a substantial share of the subsidies in the US in the late 1990s and in the EU with the 2003 Fischler reforms, recent studies have analyzed the impact of decoupled subsidies. By their definition, fully ‘decoupled’ policies should not affect agricultural markets. However, the details of policy implementation matters importantly. Most

¹ The classical model for analyzing income distributional consequences of agricultural support policies is Floyd (1956), who used a simple output and two input model and showed that price support increases the price of a factor if its supply is not perfectly elastic. The income distribution of agricultural support policies depends largely on input supply and input substitution elasticities.

² There are also important empirical studies measuring the impact of agricultural policies on land markets (Goodwin, Mishra and Ortalo-Magné, 2003; Lence and Mishra, 2003; Latruffe and Le Moël, 2006)

studies have therefore, in the perspective of the current WTO negotiations, analyzed whether ‘decoupled’ policies are really decoupled (e.g. Chau and de Gorter 2005; de Gorter 2007; Goodwin and Mishra, 2006; Hennessy, 1998; OECD, 2001, 2004; Serra et al, 2005; Sckokai and Moro, 2006).

Few studies have looked at the income distributional effects of decoupled payments. Kilian and Salhofer (2008) focus on the EU’s Single Farm Payment (SFP) and show that its income distributional effects depend on the implementation model (e.g. historical versus regional model). Ciaian and Swinnen (2006; 2007) focus on the Single Area Payment Scheme (SAPS) system in the New EU Member States (NMS) and analyze how the effects are influenced by land and credit market imperfections.

The two important elements of the analysis of decoupled payments are the tradability of entitlements and the time schedule of the effects. First, the distributional effects of the payments will depend on whether entitlements are transferable, and, if so, whether they are freely transferable separately from land or other assets. In their analysis Kilian and Salhofer (2008) assume full tradability of SFP entitlements in the EU. In contrast, Ciaian and Swinnen (2007) assume that the SAPS entitlements are non-tradable in the NMS. In reality, the EU and national regulations often allow trade with SFP entitlements, but only under certain conditions (see table 1). For example, the entitlements cannot be sold in the first year of the SFP implementation. Trade is not allowed among member states (MS) and several MS further impose constraints on trade among regions.³ Hence, it is important to analyze how the tradability of entitlements affects the distributional impacts of the SFP.

Second, regarding the temporal scale of the effects, both Kilian and Salhofer (2008) and Ciaian and Swinnen (2007) adopt a static framework. However, the allocation of entitlements is

³ There is a large related literature on the effects of tradability of production quota (Alston, 1981; Burrell, 1989; Babcock and Foster, 1992; Guyomard, et al, 1996; Sumner and Wolf, 1996; Boots, Oude Lansink, and Peerlings, 1997; Bureau et al, 1997; Bureau, Guyomard, and Requillart, 2001).

likely to have important dynamic effects. On the one hand, subsidy payments may induce structural changes in the economy, such as productivity growth and exit/entry of farms. On the other hand, structural changes may affect the distributional effects of subsidies. Hence, it is important to analyze the distributional impacts of the SFP both from a static and dynamic perspective.

The objective of this paper is to develop a general model and to analyze the impact of decoupled payments, such as the EU's SFP, by explicitly considering the impact of entitlement tradability and looking both at dynamic and static effects.

The paper is organized as follows. We begin by briefly introducing the Single Farm Payment policies in the EU. Next, we present the underlying land market model which we use for analyzing the distributional impacts of the SFP. In sections three and four we analyze the distributional impacts of the SFP under different implementation models and entitlement tradability conditions from static and dynamic perspectives. Section six concludes by summarizing the key findings of the study.

2 Single Farm Payments in the EU

Until recently most of the CAP subsidies were coupled to farm production. The CAP was fundamentally re-organized in 2003, when it was decided that in the future farm subsidies will be given as a fixed set of payments per farm, the so-called single farm payments (SFP). The SFP is an entitlement, which depends on the amount of "eligible hectares" of farmland (equivalent to the size of the entitlement). The number of entitlements equals the average eligible hectares the farm has cultivated in the reference period.

2.1 SFP implementation models

The EU member states can choose between three SFP implementation models: *the historical*

model, the regional model, and the hybrid model (see table 2). Under the historical model, the SFP payment is farm-specific and equals the support the farm has received in the “reference” period. Under the regional model, an equal per hectare payment is granted to all farms in the region.

The hybrid model is a combination of the historical and regional models. Some member states initially implemented one SFP model and then moved to another model. For example, Finland and Germany implemented the dynamic hybrid model and then moved to the flat rate model. Some member states, such as the UK, implement different SFP models in different regions within the country.

2.2 The tradability of entitlements

In the EU member states, the tradability of entitlements can be constrained by two types of constraints: regulatory constraints and market imperfections. Both types of tradability constraints may have distributional implications of the SFP benefits.

The SFP entitlements are tradable but only within EU member states, not among them, and under certain conditions. The EU regulations specify that lease and similar market transactions with entitlements are allowed only if the transferred entitlements are accompanied by an equivalent number of eligible hectares of land. A farmer may transfer his payment entitlements without land only after (s)he has used at least 80 % of his payment entitlements during at least one year or, after (s)he has voluntarily given up to the national reserve all the payment entitlements (s)he has not used in the first year of the SFP application. If more than 20% of the value of SFP is allocated from the national reserve then the entitlement cannot be transferred for 5 years.

EU member states can impose additional restrictions on the transfer of entitlements. For example, a member state may decide that payment entitlements may only be transferred or used

within the region. Member states may also require that in the case of sale of payment entitlements without land up to 50% and in the case of sale of payment entitlements with land up to 10% must be reverted to national reserve. In terms of entitlement tradability Portugal is one of the most restrictive countries. Table 1 summarizes the tradability of entitlements by the EU member state.

In addition to regulatory constraints, the tradability of entitlements may also be constrained by market imperfections; for example by imperfectly functioning rural credit markets. Given that the SFP gives the right to a future stream of subsidies, in competitive markets a potential buyer would need to pay the net present value of the future stream of subsidies to the seller. If the buyer is credit constrained then his/her ability to pay this price is reduced. The effect is a lower market price of entitlements which reduces the owner willingness to sell their entitlements. Hence, imperfect credit markets may affect trade in entitlements.

3.4 Conditional SFP payments

In the EU the farm eligibility for the SFP is subject to cross-compliance. A farmer receiving the SFP support must respect Statutory Management Requirements (SMR) (i.e. public, animal and plant health, environment, animal welfare requirements) and maintain land in Good Agricultural and Environmental Condition (GAEC). The SMRs are based on pre-existing EU Directives and Regulations, such as the Nitrates Directive. Maintaining agricultural land according to the GAEC is a new requirement, which aims to prevent abandonment and severe under-management of farmland. Farmer failure to respect these conditions can lead to reduction or complete cancellation of the SFP.

According to the European Commission, the cross-compliance requirements do not introduce substantive new obligations to farmers. Its main objective is to enforce the existing EU and national legislation. However, before the 2003 CAP reform, the cross compliance policies had environmental focus. Farmers were expected to comply with environmental protection

requirements as a condition for benefiting from the CAP support. The 2003 CAP reform made cross-compliance compulsory and extended the coverage of requirements in the fields of environment, public, animal and plant health and animal welfare.

2.3 Static versus dynamic effects

Theoretically, a truly decoupled policy affects agricultural markets neither in the short-run nor induces long-run structural adjustments in the agricultural sector. In reality, however, the SFP may affect agricultural markets both in the short run and in the long run. For this reason, we first analyze the effect of the SFP on land markets and on the distribution of policy rents from a static perspective. We define “static effects” as adjustments that do not include “structural changes”, where structural changes are defined as changes in farm productivity or in farm population. The effects with structural changes are defined as “dynamic effects” of the SFP, and are analyzed in section 4.

3 Static effects of the SFP

In this section we analyze the SFP impacts from a static perspective with respect to the tradability, conditionality and size of entitlements. First, we briefly introduce the model, which we use for the analysis.

3.1 The model

Consider an agricultural economy with two farms.⁴ We assume that farm 1 represents n farms of the same type and farm 2 represents m farms of the same type. The output of each farm is assumed to be a continuous and increasing function of the amount of land used (A^i with $i = 1, 2$).

⁴ The model is based on Ciaian and Swinnen (2006; 2007).

The output price (p) is assumed fixed and the same to all farms. The entire land is owned by land owners, which rent it to farmers.⁵ Farms maximize their profits (Π^i) which is the difference between sales revenue and land rent:

$$(1) \quad \Pi^i = pf^i(A^i) - rA^i$$

where r is rental rate and $f^i(A^i)$ is a well-behaved production function with $f_A^i > 0$, $f_{AA}^i < 0$, for $i = 1, 2$. Farms compete for land by renting the amount of land that maximizes their profits:

$$(2) \quad pf_A^i = r \quad \text{with } i = 1, 2$$

Figure 1 illustrates the land market. The horizontal axis represents the amount of land. The total agricultural land (A^T) is assumed to be fixed. Land rented by farm 1 (A^1) is shown from the left to right on the horizontal axis and land rented by farm 2 (A^2) is shown from the right to left with $A^2 = A^T - A^1$. The vertical axis measures the rental price and subsidies. The land demand of farm i is D^i .⁶ The equilibrium rent is r^* and the equilibrium land allocation is A^* . Farm 1 rents A^* hectares of land ($A^1 = A^*$) and farm 2 rents $A^2 = A^T - A^*$ hectares of land.

The regional model SFP implementation model is illustrated in figure 1. We define E^1 (area FH) as the total SFP payment for farm 1, and A_E^1 as the maximum amount of eligible area for the SFP payments.⁷ The payment per eligible hectare (the entitlement), e^1 , is equal to $e^1 = E^1/A_E^1$. Analogously, $e^2 = E^2/A_E^2$, where E^2 is the total SFP payment for farm 2 (area GK in figure 1), A_E^2 is the eligible area for payments,⁸ and e^2 is the entitlement. Under the regional SFP model, the per hectare value of entitlement is the same for all farms, $e^1 = e^2 = e$.

⁵ This distinction between landowners and farmers is convenient for our explanation but is not essential for the analysis and the derived results.

⁶ D^1 is an aggregation of land demands over all farms of type 1, and D^2 of type 2.

⁷ A_E^1 corresponds to the maximum number of entitlements which farm 1 can receive.

⁸ A_E^2 corresponds to the maximum number of entitlements which farm 2 can receive.

Under the historical SFP implementation model, the variation in the entitlement value between farms depends on the variation of subsidies which farmers received in the reference period. The historical model is shown in Figure 2, where we assume that the per hectare entitlement value of farm 1 is higher than of farm 2, $e^1 > e^2$.

Proposition 1: *In a static framework and with all land eligible for the SFP, the SFP benefit farms with and without tradability of entitlements and with implementation of either historical model, regional model, or hybrid model. In other words, the SFP is not capitalized into land values.*

First considered that the entire land which farms used before the introduction of the SFP is eligible for the SFP. Figure 1 illustrates this situation.⁹ Before the introduction of the SFP, the equilibrium set of land allocation and rent is (A^*, r^*) . This implies that the eligible area of farm 1 is equal to A^* ($A_E^1 = A^*$) and the eligible area of farm 2 is equal to $A^T - A^*$ ($A_E^2 = A^T - A^*$). First, we consider the case when entitlements are non-tradable, and afterwards we analyze what changes with trade in entitlements.¹⁰

3.2 Non-tradable entitlements

Under the regional SFP model the value of entitlement is equal for both farms, $e^1 = e^2 = e$.

Farms do not receive payments for land that they rent above the eligible area, A_E^1 and A_E^2 in

Figure 1 respectively. First consider the case when farm 1 wants to rent more land than the

⁹ For the sake of brevity, the paper reports the graphical analysis results. The formal proofs can be obtained from the authors upon request.

¹⁰ In reality entitlements may not be fully tradable due to regulatory constraints. However, partial tradability of entitlements does not change the equilibrium distribution of land and rental price compared to fully tradable entitlements or non-tradable entitlements, and hence the partial tradability is not analyzed separately.

In this section we show that in the static framework in the two extreme cases regarding the tradability of entitlements (i.e. with non-tradable entitlements and with fully tradable entitlements) the SFP benefit farms. The same holds with partial tradability of entitlements, which is a more realistic assumption.

eligible area (A_E^1). Given that the total land supply is fixed, in equilibrium farm 2 has to rent less land than its eligible area (A_E^2). In this case, i.e. over the domain $A^* - A^T$, the respective land demand functions are determined by:

$$(3) \quad pf_A^1 = r$$

$$(4) \quad pf_A^2 + e = r$$

For the additional land without entitlements farm 1 cannot pay more than the marginal profitability of land. In contrast, farm 2 is willing to pay a higher rent up to e .

Next, consider the inverse case when farm 2 wants to rent more land than its eligible area (A_E^2). In this case the corresponding demand functions over the domain $0 - A^*$ are defined by:

$$(5) \quad pf_A^1 + e = r$$

$$(6) \quad pf_A^2 = r.$$

In this case the reverse logic holds. The SFP payments increase the land demanded by farm 1. The rent that farm 1 is willing to pay is increased by e .

Equations (3) and (5) for farm 1 and equations (4) and (6) for farm 2 imply kinked land demand functions with the SFP. This is illustrated in figure 1. Starting from the right hand side in figure 1 and following the thick lines, the land demand of farm 1 is given by $D_e^1 D^1$ whereas land demand of farm 2 is given by $D^2 D_e^2$. At A^* the land demand for both farms coincide, which is represented by thick vertical line.

The land market equilibrium with the SFP is (A_e^*, r^*) . Compared to the equilibrium situation before the SFP implementation, both land allocation, $A^* = A_e^*$, and equilibrium rent is the same. If farm 1 wants to rent marginally more land than A^* , it is willing to pay only r^* (determined by D^1). Similarly, if farm 2 wants to rent marginally more than $A^T - A^*$, then the rent that farm 2 is willing to pay is r^* (given by D^2). Hence, the equilibrium land rent is r^* . Given that no farm is willing to pay more than its marginal profitability for additional land, farmers gain all SFP subsidies, equal to area $FGHK$ in figure 1, which represents the total value of the SFP. Gains

of farm 1 are equal to area FH and gains of farm 2 are equal to area GK .

Under the historical SFP model, the value of entitlements may differ between farms. In figure 2, the per hectare entitlement value of farm 1 is larger than the per hectare entitlement value of farm 2, $e^1 > e^2$. As above, assume that the entire land, which farms used before the introduction of the SFP is eligible for subsidies. Similar to the regional model, in equilibrium, the marginal willingness of renting additional land is not affected by e . Given that farms are not eligible for more entitlements than their eligible area ($A_E^1 = A^*$ for farm 1 and $A_E^2 = A^T - A^*$ for farm 2), the equilibrium is at (A_e^*, r^*) which is equal to the regional model and equilibrium before the SFP implementation. All SFP benefits accrue to farms (area FGH in figure 2), which is equal to the total SFP value. The gains of farm 1 are equal to area FG and the gains of farm 2 are equal to area H . The only difference from the regional model is that farm 1 gains more from the SFP than farm 2.

3.3 Tradable entitlements

The tradability of entitlements does not affect these static results. Also with tradable entitlements farms will retain the entire benefit from the SFP. In other words, the SFP will not be capitalized into land values. First we explain the impact of entitlement tradability for the regional model and then for the historical model.

As shown in figure 1, when farms want to rent more land than the eligible area, in equilibrium they are willing to pay a rent equal to land productivity. Their marginal willingness to pay for rented land is not affected by e . This is because farms are not eligible for additional entitlements for rented land exceeding the eligible area. However, if the entitlement price (say p_{el}) is lower than the value of the entitlement ($p_{el} < e$), the marginal gains of buying additional entitlements are positive (equal to $e - p_{el} > 0$), implying that farms want to rent more land and buy additional entitlements. Competition for land driven by competition for entitlements will bid

the market price of entitlements up to $p_e^* = e$. In equilibrium neither land allocation nor equilibrium rent will be affected (A_e^*, r^*) and the equilibrium price of entitlements will be $p_e^* = e$. The entire SFP benefits will accrue to the owners of entitlements. However, given that farms do not have incentives to adjust their amount of rented land, there will be no trade in entitlements even though the entitlement price will be $p_e^* = e$.¹¹

As in the regional model, the SFP does not affect the equilibrium marginal profitability of land under the historical model. Hence, allowing for tradability in the historical model will not change the above results that all benefits accrue to farms. In equilibrium, the market price of entitlements (p_e^*) will be equal to the entitlement value. However, the market price will not be the same for all entitlements, because the per hectare value of entitlement differs between farms ($e_1 > e_2$ in figure 2). Potential buyers of entitlements will be willing to pay a price up to the value of the entitlement. The equilibrium price of entitlement of farm 1 (p_{e1}^*) will be equal to e^1 ($p_{e1}^* = e^1$) and the equilibrium price of entitlement of farm 2 (p_{e2}^*) will be equal to e^2 ($p_{e2}^* = e^2$). As above, trade in entitlements will not take place in this static case.

3.4 Conditional SFP payments

Depending on the nature of the conditions, farm gains from the SFP may be reduced. If the additional requirements imposed by the SFP were not present before implementation of the SFP and are not required for non-participating farms, then net benefits from the SFP may be squeezed by the cross-compliance implementation costs.

Proposition 2: *Conditional SFP payments may reduce farm benefits from the SFP, depending on the nature of the conditions, but they do not affect land capitalization (which is equal to zero).*

¹¹ Note that in a multi-period model perfect credit market may be required to allow tradability. The farmer can activate the purchased entitlement on a yearly basis. In competitive markets the value of the entitlements will be equal to the net present value. The farm must have access to capital (equal to the price of the entitlement) in order to be able to finance the purchase of entitlements.

If cross-compliance does not cause additional costs to farms ($c=0$), then farm benefits from the SFP are not affected. However, the evidence from the study Alliance Environment (2007), which is based on expert survey on cross-compliance in the EU Member States, indicates that in most cases cross-compliance is expected to have a significant effect on compliance with SMRs and GAEC obligations. Evidence further suggests that cross-compliance results in significant additional costs for both farmers and the public administration in most Member States. Moreover, the cross compliance costs vary between the EU Member States, regions, and the cross-compliance instruments.¹²

To show the impact of cross-compliance on farm benefits, we model cross-compliance as an additional cost (c) which farms face to be eligible for the SFP.¹³ First, consider the regional SFP implementation model with positive compliance costs for each eligible hectare, $c>0$. The effect of positive compliance costs is illustrated in figure 1. As shown above, the rented area and the rental price equilibrium with and without the SFP is (A_e^*, r^*) . However, because of compliance costs c for each hectare, the net benefit per entitlement reduces to $e - c$. Compared to the case with zero cross-compliance costs, the net farm benefits from the SFP are reduced by area HK . The net farm gains from SFP with compliance costs are equal to area FG in figure 1: farm 1 gains area F and farm 2 gains area G .

If entitlements are allowed to be traded, then the SFP compliance costs also affect the market price of entitlements. Buyers are willing to pay a reduced price because of the compliance costs. In the case of the regional model, the equilibrium price of tradable entitlements is $p_e^* = e -$

¹² According to the European Commission (2007), farmer's administrative costs of SFP in Denmark, France, Germany, Italy and Ireland were calculated in the range 5-29 euro/ha. This represents between 3 and 9% of the total CAP payments.

¹³ Alternatively, one can endogenize the compliance costs. For example Bartolini, et al (2008) develop a principal-agent approach under moral hazard where farmers can choose the degree of compliance. In equilibrium, the optimal level of compliance (hence compliance cost) depends on monitoring, the size of sanction and the size of SFP.

c.

In addition, the enforcement of cross-compliance is an important issue (Bartolini et al. 2008). The net effect of cross-compliance requirements on farm gains from the SFP depends on how strictly they are enforced. If the enforcement is weak, then the effective compliance costs (c) might be lower and gains from the SFP higher for the deviating farms. In the extreme case, when there is no enforcement ($c=0$), the SFP gains are unaffected.

3.5 Relative size of allocated entitlements

In this section we will relax the assumption that the size of the allocated entitlements is equal to the total eligible land area. As above, we analyze how the size of the allocated entitlements affects equilibrium rent distribution under different SFP implementation models and tradability assumptions.

Proposition 3: *If the total size of allocated entitlements is larger than the eligible area, then the SFP gets capitalized into land values. Under the regional model the SFP is then fully capitalized into land values. Under the hybrid and historical models the SFP is then partially capitalized into land values.*

Non-tradable entitlements

Assume that farms receive entitlements such that $A_E^1 > A^*$ and $A_E^2 > A^T - A^*$. The effect of the excess supply of entitlements under the regional model is illustrated in figure 3. Given that the total number of entitlements is larger than the total eligible area $A_E^1 + A_E^2 > A^T$, and farms need land to activate their entitlements, farms will not be able to activate all their entitlements. Profit maximizing farms will compete for land in order to activate their unused entitlements. Competing farms will underbid the market price for land until its marginal profitability. As a result, the entire

SFP will be capitalized into land rents. The equilibrium rented area and rental rate are A_e^* , $r^* + e$.

This result is driven by the assumption of competitive markets where a large number of farms compete for land, implying that if a farm would not be willing pay rent $r^* + e$, then landowners could always find another farm with unused entitlement willing to pay this rent. Hence, under the excess supply of entitlements all benefits from the SFP (area FG in figure 3) accrue to landowners.

Under the historical model the entitlements may be distributed differently between farms. First, assume that farms receive entitlements such that $A_E^1 = A^*$ and $A_E^2 > A^T - A^*$. Hence, the total number of entitlements is larger than the total eligible area $A_E^1 + A_E^2 > A^T$. In figure 4 the equilibrium set is (A_e^*, r_{eh}^*) . Farm 2 cannot use all its entitlements and, as a result, will bid the rent up to r_{eh}^* ($= r^* + e^2$). As above, if farms would not pay this rent, then landowners could always find another farm with unused entitlements who is willing to pay rent r_{eh}^* . Part of benefits from the SFP (area GH in figure 4) accrue to landowners. Gains of farm 1 are equal to area F . Farm 2 does not benefit from the SFP.

Next, assume that farms receive entitlements such that $A_E^1 > A^*$ and $A_E^2 \geq A^T - A^*$. The land allocation will change compared to the equilibrium land allocation without the SFP, which is given by A^* in figure 5. Because farm 1 has entitlement with a higher value than farm 2 ($e^1 > e^2$), it can offer a higher rent for additional land than farm 1. As a result, the amount of rented land by farm 1 increases whereas the land rented by farm 2 declines. In figure 5 the equilibrium set is (A_e^*, r_{eh}^*) . Part of benefits from the SFP (area $FMHKL$) accrue to landowners. Gains of farm 1 are equal to area BG . Farm 2 loses (does not gain) area KL . Thus, the SFP is partially capitalized into land values.

Tradable entitlements

First, we analyze how entitlement tradability affects the distributional impacts, if the total number

of entitlements is larger than the eligible area, under the regional model. If farms own more entitlements than the total area A^T , then trade in entitlements will not emerge. Given that farms have unused entitlements, they are willing to sell them. However, farms are not willing to buy additional entitlements because they cannot be activated. Hence, the distributional effects with tradable entitlements are the same as in the case with non-tradable entitlements.

Under the historical model we consider two different entitlement distribution schemes. When $A_E^1 = A^*$ and $A_E^2 > A^T - A^*$, the results are equal to the regional model and non-tradable entitlements: trade in entitlements will not emerge, as there are no buyers of entitlements.

When $A_E^1 > A^*$ and $A_E^2 \geq A^T - A^*$, the equilibrium will shift from (A_e^*, r_{eh}^*) to (A^*, r_{et}^*) in figure 5. However, the set (A_e^*, r_{eh}^*) cannot be a long run equilibrium. Given that at rent r_{eh}^* the marginal benefit of additional entitlement for farm 2 is positive (it gains $r^* + e^1 - r_{et}^* > 0$), farm 2 is willing to bid for entitlement e^1 from farm 1 up to price $r^* + e^1 - r_{et}^*$. The marginal entitlement benefit of farm 1 is zero at A_e^* . Because there are mutual gains from trade in entitlements, farm 2 will buy entitlements from farm 1 that exceed A^* , i.e. $(A_E^1 - A^*)$. Hence, farm 2 will exchange its lower valued entitlements for higher value entitlements from farm 1. Competition for entitlement e^1 will drive the equilibrium price of entitlement to $p_e^* = r^* + e^1 - r_{et}^*$. Also farm 1 will benefit from trade in entitlements. Compared to a situation without the SFP, the land allocation is not affected while the land rent is higher. The land market equilibrium is at (A^*, r_{et}^*) .

4 Dynamic effects of the SFP

In this section we investigate how distributional effects change if the SFP implementation induces structural adjustments in the economy. We consider two dynamic effects: the effect of a change in the productivity of incumbent farms, and the effect of a change in farm population

through farm entry and exit.

4.1 Distribution of SFP benefits with productivity change¹⁴

Up to now we assumed that the introduction of the SFP does not induce a change in farms' productivity. However productivity is likely to change, either because of technological or institutional innovations, or in the presence of imperfect rural credit markets, the SFP itself may reduce farms' credit constraints and thereby increase productivity (see Ciaian and Swinnen 2008). We now analyze how the SFP in combination with productivity changes affect land values and the distribution of the SFP benefits. The analysis considers two key dimensions: symmetry in the productivity changes and tradability of entitlements.

Symmetric productivity change and the SFP

Productivity changes cause a shift in farmland demand. When productivity change causes the same shift in the demand for all farms – which we refer to as a “symmetric change” – the effect is shown in figure 6. The initial land demand of farm 1 is D^1 and the initial land demand of farm 2 is given by D^2 . The equilibrium rented area and rental price are (A^*, r^*) . A symmetric productivity change implies an equal shift in land demand of both farms. Assuming a symmetric technological improvement, the land demand of farm 1 shifts to D_1^1 and of farm 2 to D_1^2 . The new equilibrium set is (A^*, r_1^*) . Land allocation is not affected. Land rent increases from r^* to r_1^* . The rent increase is driven by productivity increase.

¹⁴ In this section we consider a situation when the SFP entitlements are allocated based on land allocation equilibrium at the time of the SFP introduction and then analyze the SFP effect with productivity changes. Similar results hold for the situation when the allocation of the SFP entitlements among farms is not based on the land allocation equilibrium at the time of the SFP introduction, but on a past land allocation equilibrium. Indeed, the SFP allocation was started in 2005, whereas the allocation of entitlements was based on land distribution in the reference period 2000-2002.

Proposition 4: *With symmetric productivity changes the SFP only benefit farms, with or without tradability of entitlements and under all SFP models.*

To show this, consider first the regional SFP model with non-tradable entitlements. As shown above, farms' land demand is kinked with the SFP. This is illustrated in figure 7. Without productivity change, farm 1's land demand is given by $D_e^1 D^1$ and farm 2's demand is given by $D_e^2 D^2$. At A^* the land demand of both farms is represented by thick vertical lines, which coincide. The equilibrium with the SFP without productivity change is (A_e^*, r^*) . Productivity change shifts land demands up to $D_{e1}^1 D_1^1$ for firm 1 and to $D_1^2 D_{e1}^2$ for firm 2. Again, at A^* land demands of both farms are represented by vertical lines, which coincide.

The SFP does not affect farm profitability at the margin with symmetric productivity change. The new equilibrium (A_e^*, r_{e1}^*) is equal to equilibrium without the SFP and with productivity change. Land allocation is not affected and the rent increase is driven solely by the productivity increase. The SFP does not affect the equilibrium land rent. Farmers gain all SFP subsidies, which is equal to area FG in figure 7. The gains of farm 1 are equal to area F and the gains of farm 2 are equal to area G .

This result is general. It is not affected by the tradability of entitlements or by the SFP implementation model.¹⁵

Asymmetric productivity change and the SFP

If productivity change affects different farms differently, the land demand shifts asymmetrically between the farms. For simplicity, we assume that only farm 1 experiences a productivity increase. In figure 6 the land demand of farm 1 shifts from D^1 to D_1^1 . The land demand of farm 2

¹⁵ For the sake of brevity we do not include proofs of this result. However, both the graphical analysis and the formal proofs can be obtained from the authors upon request.

is not affected and stays at D^2 . The new equilibrium set is (A_1^*, r_2^*) . Because of higher productivity, farm 1 expands its rented area in detriment of farm 2.

Proposition 5: *With asymmetric productivity changes and with non-tradable entitlements it holds that:*

1. *part of the SFP benefit landowners (i.e. the SFP is partially capitalized into land values);*
2. *the SFP constrain restructuring;*
3. *historical and hybrid models may or may not have stronger effect than the regional model on the SFP capitalization and restructuring.*

Again, first consider the regional SFP model. The effect of asymmetric productivity change is illustrated in figure 8. The benchmark equilibrium with the SFP and no productivity change is (A_e^*, r^*) . For simplicity we consider the extreme case, when only farm 1 experiences a productivity change.¹⁶ With asymmetric productivity increase the land demand of farm 1 shifts up from $D_e^1 D^1$ to $D_{e1}^1 D_1^1$. The upward shift in land demand results in a significant increase in the rental rate, but does not change land allocation. The new equilibrium set is (A_e^*, r_e^*) . The increase in the rental price ($r_e^* - r^*$) is identical to the demand increase for land of farm 1 due to higher productivity. Because the increase in productivity is insufficient to overcome the gap in subsidies between farm 1 and farm 2 for renting additional land beyond A_e^* , there is no land reallocation. Even with increased productivity, the marginal value of additional land for farm 1 at A_e^* is equal to r_e^* , which is less than $r^* + e$, the marginal value of land for farm 2 at A_e^* .¹⁷

Without the SFP and with asymmetric productivity change, the equilibrium rented area and rental rate would be (A_1^*, r_1^*) . Hence, the SFP constrains land reallocation (restructuring) from farm 2 to farm 1 ($A_1^* > A_e^*$), and part of the SFP is capitalized into land values. The

¹⁶ However, the derived results are more general and hold for any asymmetric productivity shock.

¹⁷ Only if the increase in productivity is larger than the per unit subsidies (e) there will be restructuring.

equilibrium land rent with asymmetric productivity change and with SFP is r_e^* , while the equilibrium land rent with asymmetric productivity change and without SFP is r_l^* , where $r_e^* > r_l^*$. The total value of the SFP is given by area FGK in figure 8. Landowners' gains are equal to area HK . Area H is productivity gain and area K is gain from the SFP. The total gains to farms are equal area FG . Farm 1 gains the full SFP (area F) while farm 2 gains less than the total allocated SFP (area G). Part of the SFP (area K) farm 2 uses to compete for land with farm 1.

In contrast to the symmetric case, both the non-tradability of entitlements and the SFP implementation model can change the results with asymmetric productivity change. The mechanisms of the effect under the historical and hybrid models are similar to the regional model, but the magnitude of the effects is different. The variation in the value of entitlements between farms may cause a larger or smaller effect on the SFP capitalization into land values and on agricultural restructuring. The net effect depends on which type of farms have higher value of entitlements. If farms whose productivity increases less own entitlements with higher value compared to farms whose productivity increases more, then there will be a stronger capitalization of the SFP into land values and the SFP will constrain restructuring more. Otherwise, if farms, whose productivity increases less own entitlements with lower value, than farms experiencing a stronger productivity increase, the impact on the SFP capitalization into land values and on restructuring is smaller.

Proposition 6: *With asymmetric productivity changes and with tradable entitlements it holds that:*

1. *all SFP implementation models benefit farms;*
2. *the SFP does not constrain restructuring;*
3. *there is no difference between the SFP models.*

First, consider the regional SFP model. In the previous analysis it was shown that, when entitlements are tradable, the equilibrium price of the entitlement is $p_e^* = e$ (see figure 8). However, with asymmetric productivity changes, tradable entitlements and the SFP, the set (A_e^*, r_e^*) cannot be a long run equilibrium. Both farms would profit from land market transactions. At land allocation A_e^* the net benefit per hectare of farm 2 is $r^* + e - r_I^*$. If farm 2 sells one entitlement and reduces the rented area by one hectare, its net gain per hectare is e obtained from the entitlement sale, where $r^* + e - r_I^* < e$ (see figure 8). Hence, for farm 2 it is profitable to reduce the rented area by $A_I^* - A_e^*$ and to sell the equivalent number of entitlements. Farm 1 will have an incentive to rent more land (to take over land $A_I^* - A_e^*$ from farm 2) because with asymmetric productivity change its land profitability has increased compared to farm 2. Hence, the equilibrium with tradable entitlements, with SFP and with asymmetric productivity change is (A_I^*, r_I^*) , which corresponds to the equilibrium without SFP and with asymmetric productivity change. Restructuring is not affected and the entire SFP benefits accrue to farms (area FGK in figure 8). Landowner gains are given by HK , which are driven solely by productivity increase but not by the SFP.

This result holds in general, for all SFP models.¹⁸

4.2 Distribution of SFP benefits with farm entry

The results derived in the above analysis are conditional upon support linked to the current farms.¹⁹ The entrants (who are potentially more dynamic and productive and therefore a source of productivity growth) are excluded from the SFP support system. To address these concerns, it

¹⁸ For the sake of brevity we do not include proofs. However, both the graphical analysis and the formal proofs can be obtained from the authors upon request.

¹⁹ In the static analyzes only the incumbent farm 1 could use e to bid up the rent up to the land area $A_E^1 (=A^*)$, while for the rest of the area, $A_E^2 (=A^T - A^*)$, only the incumbent farm 2 was able to do so. Entrants were not eligible for e .

was decided to create a ‘reserve’ of subsidy entitlements for entrants.²⁰ In this section we analyze how these reserve entitlements affect the SFP rent distribution.

Proposition 7: With new farms entering the sector it holds that:²¹

1. *If entrants are not eligible for entitlements: then the SFP benefit incumbent farmers both in static and dynamic frameworks and with tradable and non-tradable entitlements. Only with asymmetric productivity change and non-tradable entitlements do part of the SFP also benefit landowners.*²²
2. *If entrants are eligible for entitlements: then the SFP benefits will shift to landowners with and without tradability of entitlements. The extent of SFP capitalization into land values depends on the implementation model and on the extent to which entrants are eligible for entitlements.*

Non- tradable entitlements

In this section we illustrate the effect of entitlement non-tradability in a static framework.

However, the presented results are general, they hold for both static and dynamic framework. The effect of non-tradable entitlements under the regional SFP implementation model is illustrated in figure 1. Granting the SFP entitlement to entering farms will induce a rise in land rent from r^* to r_{er}^* .²³ The increase in land rent is equivalent to the per hectare payment e . Because of higher demand for land at the margin, landowner may rent their land to the entering farm if the

²⁰ There are also other cases when entitlements can be allocated from the reserve. For example, entitlements from the reserve can be granted to farmers located in areas subject to restructuring to avoid farms abandoning land.

²¹ Here we consider the case when the total number of the allocated entitlements is smaller than or equal to the eligible area.

²² This was shown in Propositions 1, 4, 5, and 6 where it was assumed that entrants were not eligible for SFP.

²³ It is assumed that new farms enter the sector if their profits from farming are higher than the opportunity costs. A marginal farm which does not enter the sector without the SFP earns just less in farming than the opportunity costs. If the SFP increases farm profits then this farm will have an incentive to enter farming.

incumbent farm does not pay this rent. If new farms are eligible for the SFP, then their marginal benefit of cultivating land equals the marginal value product of land plus the per hectare payment e . As a result, they can offer a higher rental price for land. The incumbent farms are willing to bid the rent up to $r^* + e$ (see figure 1). Hence, farms will bid for land until the rental rate will reach $r_{er}^* = r^* + e$. Thus, the reserve entitlements granted to entering farms makes the effects of the SFP very similar to the effects of the area payments (Ciaian and Swinnen, 2006). Hence, under the regional model with entrant eligibility for entitlements, the SFP is fully capitalized into land rents and all subsidies accrue to landowners. Landowner gains are equal to area $FGHK$ in figure 1.

Next, we consider the historical SFP implementation model. In this case the impact of the SFP on land capitalization depends on the value of entitlement (e^R) which entering farms receive from the reserve. The SFP may be partially or fully capitalized into land values. Under the historical SFP implementation model the value of entitlement may differ between farms, e.g. $e^1 > e^2$. If $e^R \leq e^1$ then the SFP is partially capitalized into land values. In this case the entrant can bid the rent up to $r_{eh}^* (= r^* + e^R)$. This is illustrated in figure 2 where it is assumed that $e^R = e^2$. Landowners' gains are equal to area GH in figure 2. Only farm 1 with high value of entitlement benefits from the SFP - it gains area F . Farm 2 does not benefit from the SFP.²⁴

If $e^R = e^1$ then SFP is fully capitalized into land values. In this case farms that own entitlements with a value smaller than e^R (farms of type 2) will be competed out by the entrants. Given that the entering farms can obtain an entitlement with a higher value $e^R > e^2$, they will compete out the incumbent farms for land. Entrants will bid the rent up to $r^* + e^R$ and the SFP will be fully capitalized into land rents.

Tradable entitlements

The tradability of entitlements will not affect the results obtained above, as tradability does not

²⁴ If $e^R < e^2$ then also farm 2 gains from the SFP.

change farms' marginal conditions. Hence it does not affect farm willingness to pay for land use. The market price of tradable entitlements (p_e^*) will be zero, $p_e^* = 0$ under the regional model, because the SFP is fully capitalized into land values. Given that farms do not benefit from the SFP, they are not willing to pay for entitlements. Moreover, the entrants can obtain entitlements for free. A farm buying the entitlement would therefore be unable to compete for land with the entrant. As a result, making entitlements available for free from the reserve eliminates market for entitlements and makes the issue of tradability irrelevant.

Under the historical SFP model the price of entitlements will be positive only when the SFP is partially capitalized into land values (i.e. when $e^R < e^1$) and only entitlements with value larger than e^R will have a positive market price (i.e. entitlements of farm 1 in figure 2). Only entitlements with value larger than e^R benefit farms²⁵. The rest of entitlements will have zero market price.²⁶ However, tradability does not change farms' marginal conditions. Hence the tradability of entitlements does not affect the results obtained for the case when entitlements from the reserve are allocated to the entrants.

Full versus partial eligibility for entitlements

In reality, new entrants may not be eligible for entitlements for the entire area that they want to rent. If only part of the entrant land is eligible for entitlements, the SFP benefits both farmers and landowners, i.e., the SFP rents will be shared between landowners and farmers. The more constrained is the entitlement acquisition to entering farms, the more the SFP benefits farms.

²⁵ In equilibrium shown in figure 2, the benefits of farm 1 per entitlement are equal $e^1 - r_{eh}^*$.

²⁶ However, even though the price of the entitlements with the highest value (e^1) will be positive under the historical model, the entitlements will not be traded in the static framework with symmetric productivity change, because the land rented by farm 1 with the entitlements e^1 will not change in the static framework with symmetric productivity change. Only the entrants may acquire entitlements from the reserve.

On the other hand, the more constrained is the distribution acquisition to later entering farms, the more unequal is the rent distribution from the inter-generational perspective. Hence, the optimal policy of entrant eligibility for entitlements faces a trade-off between benefiting resource owner versus users on the one side and inter-generational equity on the other side.

Table 3 summarizes the key results of the SFP capitalization into land values in a static framework, for full, partial and zero entrant eligibility for entitlements and under different SFP implementation models. The SFP is fully capitalized into land values with full entrant eligibility for entitlements under the regional model (see table 3). The SFP may be fully capitalized into land values either under the historical model or the hybrid model when the value of entitlement which new entrants receive from the reserve equals the highest value of the incumbent farms' entitlements. Otherwise, the SFP is partially capitalized into land values under the historical model and hybrid models with full entrant eligibility. Under the other extreme, when no entrants' have access to entitlements, there is no SFP capitalization into land values and the SFP benefit farms.

In all other cases there is a partial SFP capitalization into land values. Everything else equal, for a given value of entitlement which entrants receive from the reserve, the capitalization is stronger under the regional model than the historical or hybrid models. Between the two latter, the capitalization is stronger under the hybrid model than under the historical model. This result is due to a stronger variation in the value of entitlements under the historical model than under the two other models.

Table 4 summarizes the effect of the SFP on land capitalization with asymmetric productivity change for full, partial and zero entering farm eligibility for entitlements under different SFP implementation models. The effects with asymmetric productivity change are similar to the effects shown in table 3 for the static framework. However, with asymmetric

productivity change the tradability of entitlements does not affect the results. Given that productivity change triggers land reallocation and adjustment in land rent, this was less important in the static framework. If entitlements are non-tradable, then less productive farms will use the SFP to compete for land and induce distortions in the land markets including capitalization of the SFP into land values. With fully tradable entitlements less productive farms would choose to sell entitlements because of higher benefits from selling compared to making use of entitlements and continuing renting equivalent amount of land.

Figure 4 reports zero SFP capitalization into land values in the case with tradable entitlements and with no new entrant eligibility for entitlements. Full capitalization occurs with full entrant eligibility for entitlements. In other cases there is partial capitalization of the SFP into land values.

Additionally, with asymmetric productivity change and constrained tradability of entitlements, the SFP may constrain restructuring. The entrants' eligibility for entitlements has an opposite effect on restructuring. Given that entrants can use the entitlements they receive from the reserve and compete out less productive farms which use the SFP to compete for land, entrant eligibility for entitlements will stimulate restructuring. Hence, with non-tradable entitlements, the restructuring is more constrained the more entrants are constrained to obtain entitlements. However, with full tradability, restructuring is not constrained irrespective of whether the entering farms are or are not eligible for entitlements.

4.3 Distribution of benefits from the SFP with farm exits

The effect of farm exits from the agricultural sector is analogous to the effect of a negative productivity change. With farm exits there is a downward shift in the aggregate land demand rather than an upward shift with productivity growth. If this effect is symmetric (i.e. if farm exit is equal between farms of type 1 and type 2), then the SFP will benefit farms both with tradability

and without tradability of entitlements. The effect is similar to a symmetric productivity change.

The SFP will affect land values only if there is an asymmetric shift in land demand, which takes place e.g. when farms of one type exit more than farms of the other type. This asymmetric shift leads to changes in the relative willingness to pay for the rented land between farms, which triggers land reallocation and adjustments in land rent. The relative willingness to bid for land of the more exiting type farms will decrease compared to the less exiting type farms. Hence, without the SFP, the land demand of the more exiting type farms will decrease and the equilibrium land rent declines. However, the SFP payments may hamper these adjustments and the SFP may be capitalized into land values. Similarly to asymmetric productivity change (proposition 5), this will be the case with non-tradable entitlements and with asymmetric shift in land demand induced by farm exit. Part of the SFP will benefit landowners and the restructuring will be constrained. With tradable entitlements SFP will benefit farms and restructuring will not be constrained, which is equivalent to the case shown in proposition 6.

6 Summary

In this paper we study the distributional effects of decoupled Single Farm Payments in the European Union. The main findings of the paper can be summarized in the following results:

- In a static world the SFP benefit only farmers, irrespective of the implemented SFP model and irrespective of whether entitlements are tradable or not. In other words, the SFP is not capitalized into land values.
- However, if the total number of the allocated entitlements is larger than the eligible area, then the SFP gets capitalized into land values and benefit landowners.
- Conditional SFP payments may reduce farm benefits from the SFP, depending on the nature of the conditions.

- If new entrants are eligible for the SFP, then under the regional (historical and hybrid) model the SFP is fully (partially) capitalized into land values.
- With symmetric productivity change, the SFP benefit farms with or without entitlement tradability under all three types of the SFP models.
- With asymmetric productivity change and with non-tradable entitlements: part of the SFP benefits landowners; the SFP constrains restructuring; and the historical and hybrid models may or may not have stronger effect than the regional model.
- With asymmetric productivity change and with tradable entitlements: all SFP implementation models benefit farms; the SFP does not constrain restructuring; and in terms of land rents there are no differences between the historical, hybrid and regional models.
- With asymmetric productivity change and with new entrant eligibility for entitlements: all SFP models benefit landowners; the SFP may constrain restructuring only with historical or hybrid models; and the historical model is fully capitalized into land values; the hybrid and regional models are partially capitalized into land values.

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Tables and Figures

Table 1. Tradability of entitlements

Tradability of entitlements	
Austria	Yes, within Austria but entitlements are only <i>transferable</i> and in no case <i>tradable</i> , but only from owner of those entitlements to the tenant of the respective areas.
Denmark	Yes - entitlements are tradable within the Member State
France	Entitlements are tradable with or without land; tradable within French departments.
Germany	Entitlements are generally tradable, but only within regions. Single Payments can be traded and do not have to be attached to land. Further restrictions apply
Netherlands	Entitlements are tradable across the whole country and do not have to be attached to land. In 2006, the first year of the scheme almost 10% of all rights to farm payments were traded.
Portugal	Yes, entitlement attached to land (if not, 10% are retained to the national reserve)
Sweden	Entitlements are tradable within regions
UK	Entitlements are tradable within member state and within region
Belgium, Finland, Greece, Ireland, Italy, Luxembourg, Slovenia, Spain	Not available

Source: Research project: The Implementation of the CAP and Visions of its Future Role across 27 EU Member States, <http://www.rlg.nl/cap/>

Table 2. SFP model by member state

SFP model	Country
Historical	Austria, Belgium, France, Greece, Ireland, Italy, Netherlands, Portugal, Spain
Regional	Malta, Slovenia
Static hybrid	Denmark, Luxemburg, Sweden
Dynamic hybrid moving to flat rate	Finland, Germany
Mix	UK

Source: European Commission

Table 3. SFP capitalization into land value

		<i>SFP model</i>		
		Regional	Historical	Hybrid
<i>New entrant eligibility for entitlements</i>	Full	Full, $\alpha_r^f = 100\%$	Partial or full, $\alpha_h^f \leq \alpha_r^f$	Partial or full, $\alpha_m^f \geq \alpha_h^f$
	Partial	Partial, $\alpha_r^p < \alpha_r^f$	Partial, $\alpha_h^p < \alpha_r^p$	Partial, $\alpha_m^p > \alpha_h^p$
	No	Zero, $\alpha_r^n = 0$	Zero, $\alpha_h^n = 0$	Zero, $\alpha_m^n = 0$

Notes: α_i^j measures SFP capitalization into land value. If $\alpha_r^f = 100\%$, this implies full capitalization of SFP into land values. Subscripts $i = r, h, m$, denote the implementation model: r stands for regional model, h stands for historical model and m stands for hybrid model. Superscripts $j = f, p, n$, denote new entrant eligibility for entitlements: f stands for full new entrant eligibility for entitlements, p stands for partial new entrants eligibility for entitlements and n stands for stands for no new entrants eligibility for entitlements.

Table 4. SFP capitalization into land value and effects on restructuring with asymmetric productivity change

		SFP model			Restructuring	
		<i>Regional</i>	<i>Historical</i>	<i>Hybrid</i>		
Entrant eligibility for entitlements		<i>Full</i>	Full	Partial or full	Partial or full	May be constrained, with historical and hybrid M.
		<i>Partial</i>	Partial	Partial	Partial	Constrained
	<i>No</i>	<i>Non-tradable entitlement</i>	Partial	Partial	Partial	Constrained
	<i>No</i>	<i>Tradable entitlement</i>	Zero	Zero	Zero	Not constrained

Figure 1. The effect of the regional SFP model on the land market

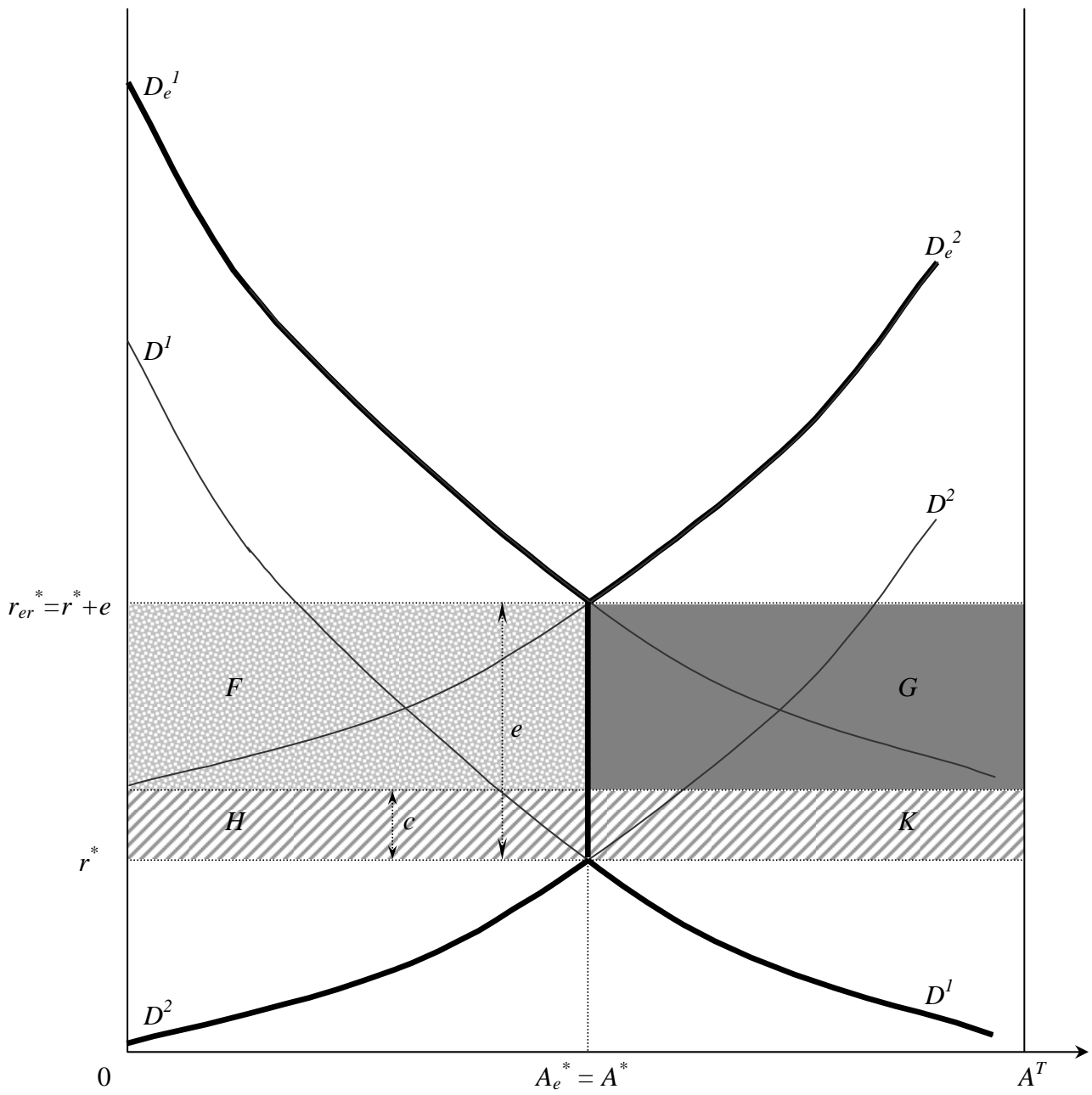


Figure 2. The effect of the historical SFP model on the land market

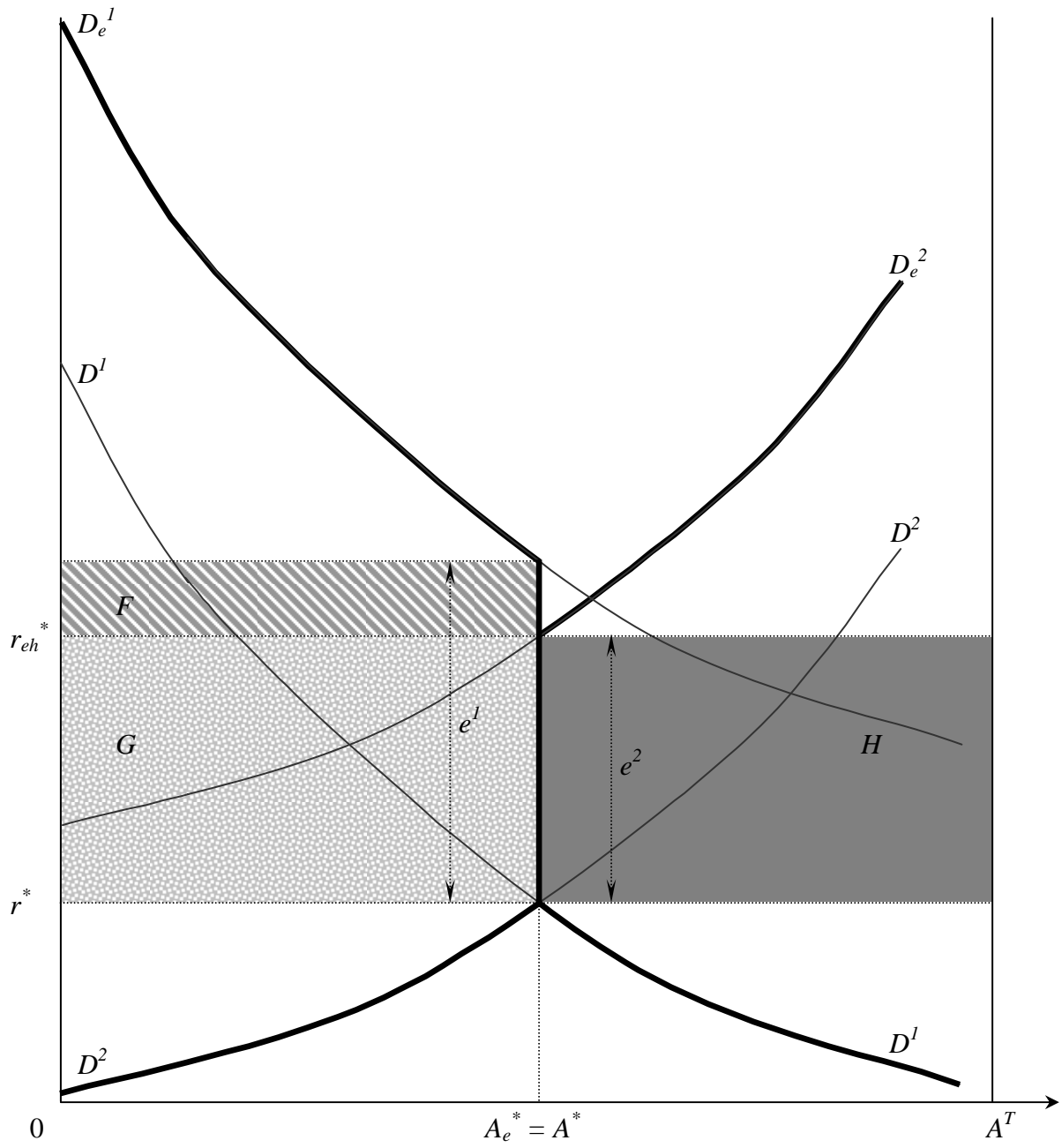


Figure 3. The effect of the regional SFP model on the land market with the size of allocated entitlements larger than the eligible area

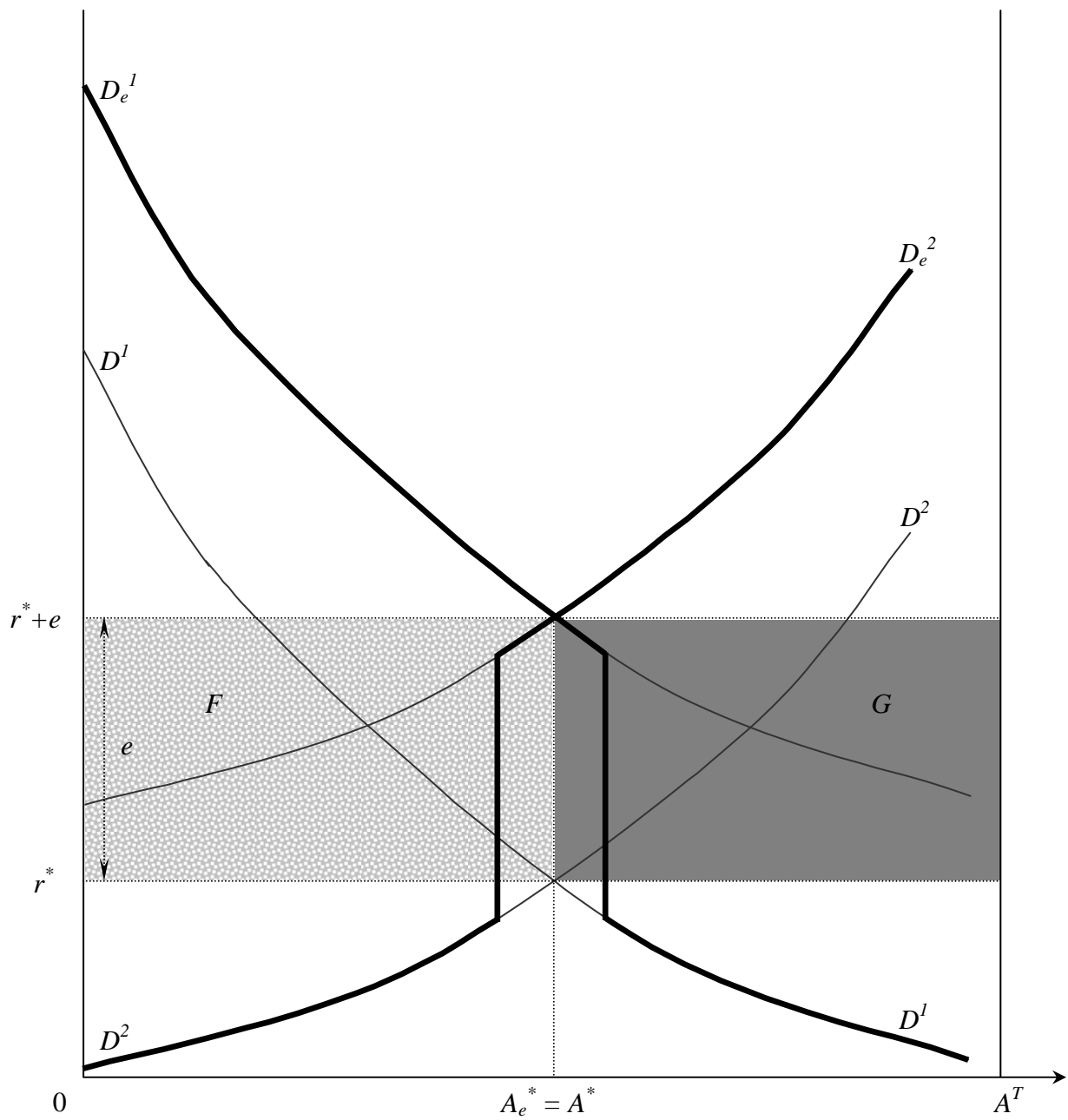


Figure 4. The effect of the historical SFP model and entrant eligibility for the SFP

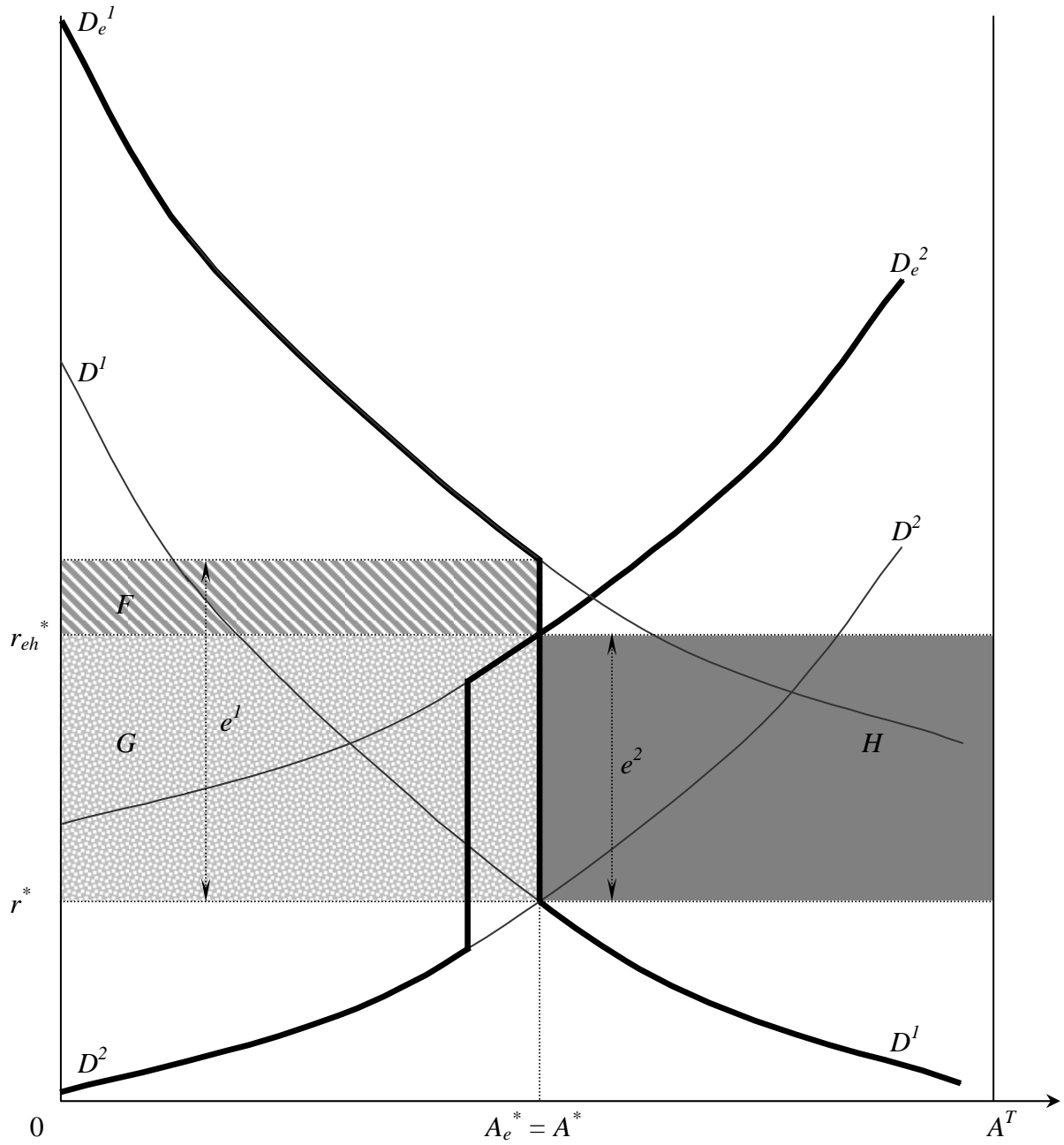


Figure 5. The effect of the historical SFP model and entrant eligibility for the SFP

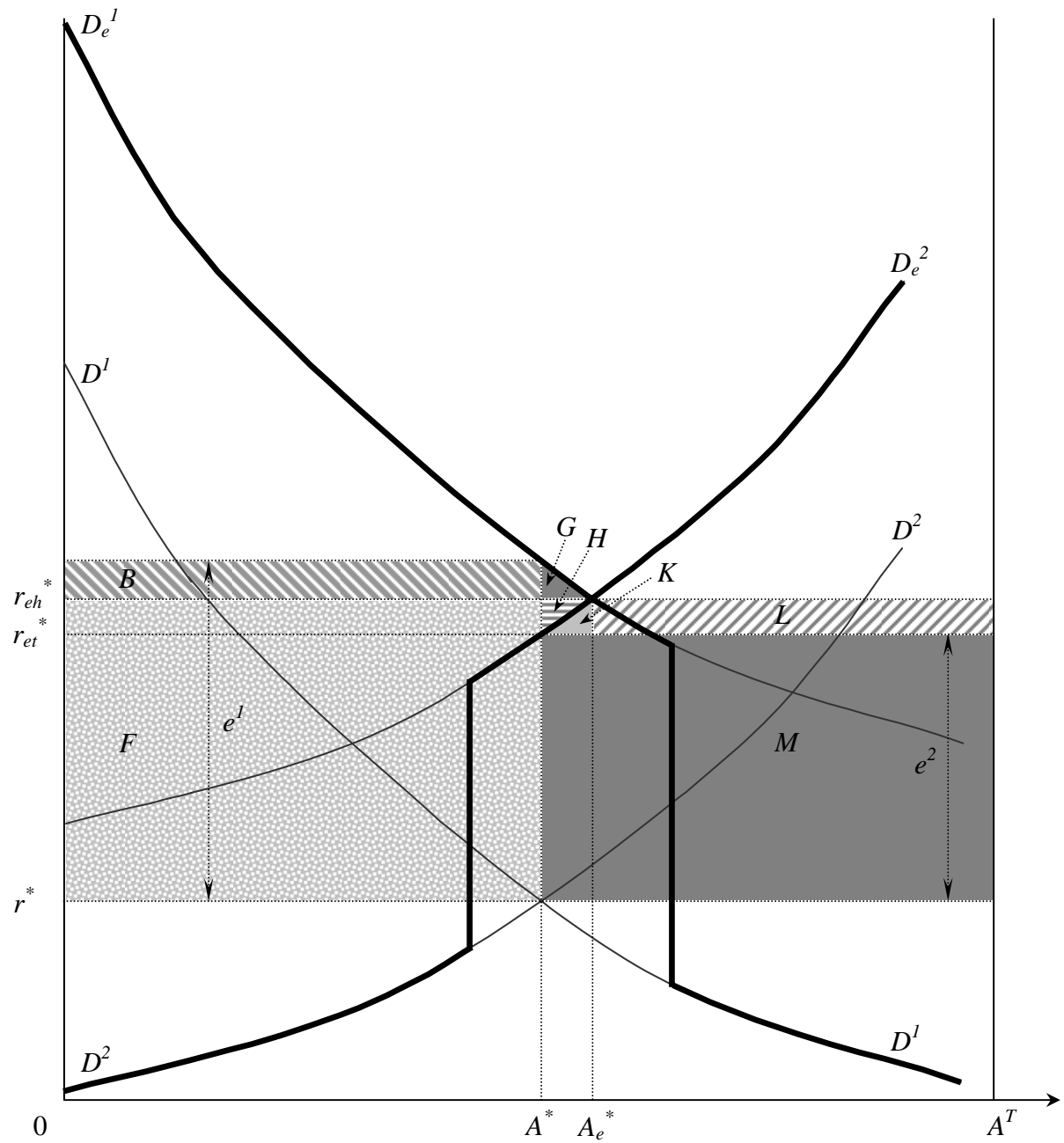


Figure 6. The effect of productivity changes on the land market

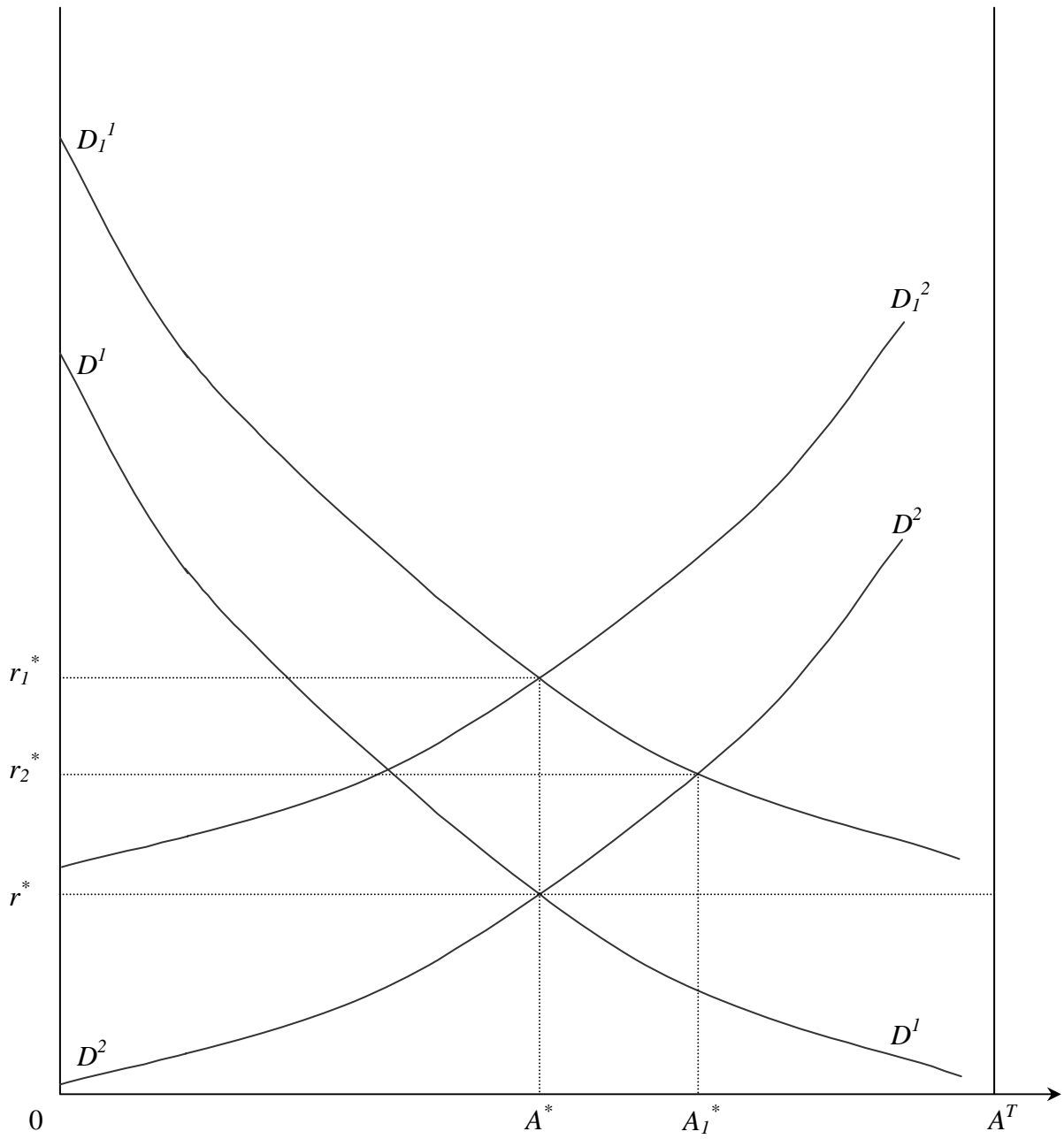


Figure 7. The effect of symmetric productivity change and regional SFP model on the land market

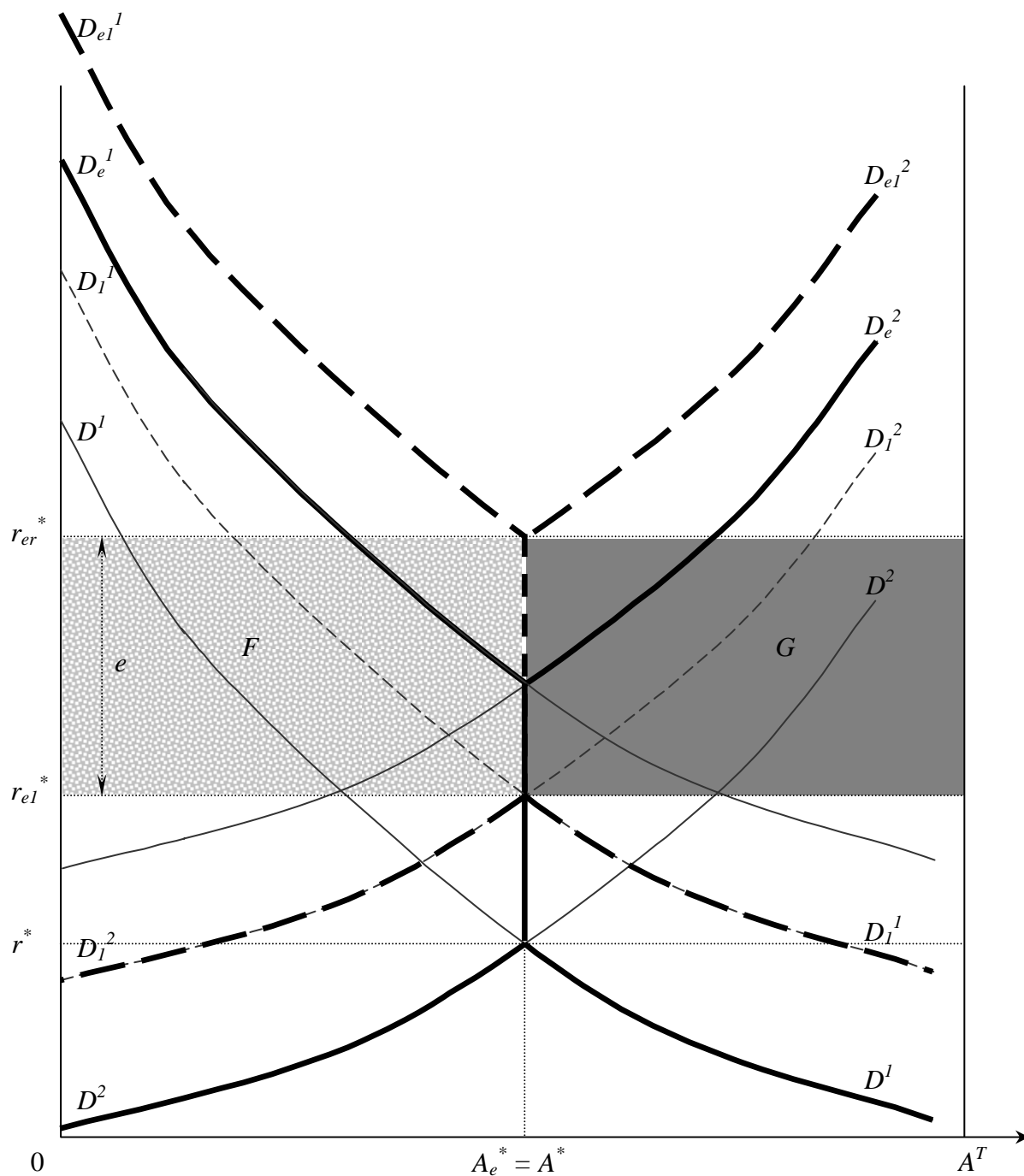


Figure 8. The effect of asymmetric productivity change and the regional SFP model on the land market

