Working Party on Agricultural Policies and Markets

DECOUPLING: ILLUSTRATING SOME OPEN QUESTIONS ON THE PRODUCTION IMPACT OF DIFFERENT POLICY INSTRUMENTS

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This paper analyses three issues that are related to the degree of decoupling of agricultural support measures and provides some illustrative examples for each of them. The issues are: the conditions attached to area based payments, expectations about future policies, and the level of expenditure on given support measures.

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EXECUTIVE SUMMARY

OECD work on decoupling has followed the analytical framework developed in the report “Decoupling: A Conceptual Overview” (OECD, 2001a) and has tried to estimate the degree of decoupling of different measures through empirical work (econometric estimations and simulation models like the PEM). The project has focused on bringing together all three types of effects of policy measures: static effects, such as those that occur when policies affect the incentive prices of inputs or outputs; effects under uncertainty that occur if farmers are risk averse and the measures taken reduce risk or increase farm income; and dynamic effects that occur over time, for instance, through investment or expectations.

Three sets of issues have been raised repeatedly in the debate on decoupling that seem not to be amenable to the types of analysis developed so far. The first relates to the impact of the different conditions attached to direct payments: Will conditions that require certain activities (such as maintenance) to be carried out, or that exclude others (such as the planting of fruits and vegetables) on lands receiving payments, affect the production, and entry and exit decisions of the farmer? The degree of policy-specificity needed to tackle this question is beyond that usually incorporated in simulation models such as PEM. Second, what is the impact on current production of farmers’ expectations about future government decisions on agricultural policy matters? If farmers expect future programmes to have an historical basis, for example, this expectation may create incentives to modify current production. Third and finally, what is the cumulative total impact of a given programme or set of programmes. Specifically, clarification is needed as to whether impacts at the margin, the most common type of output from the applied analyses used so far, can be safely generalised to enable conclusions to be drawn about the total effects of programmes that involve large outlays. None of these illustrative studies looks at policy instruments in the context of multifunctionality or non-commodity outputs provisioning.

All three issues are hard to address empirically because of the difficulty of obtaining the appropriate data with the appropriate sample of years. There are also some theoretical and conceptual difficulties in defining a robust framework to analyse some of the issues, such as the formation of expectations. This paper is not intended to provide quantitative responses to any of the questions raised, but rather to clarify and facilitate discussion on areas that are an important part of the decoupling debate. This has been done using standard economic techniques and some illustrative examples. Therefore, no particular conclusion can be drawn about specific measures in a particular country. Most of the analysis applied here to direct payments, particularly on expectations and on levels of support, can also be directly applied to coupled measures, such as market price support, with effects that are likely to be of larger magnitude. For the same programme conditions, the same expectations effects and the same levels of support, more decoupled measures are likely to have smaller impacts on production and trade.

The paper points out the real need to scrutinise the detailed conditions attached to “more decoupled measures” to ensure that the benefits of moving away from coupled support are fully realised. Conditions on the use of land, cross compliance conditions and the creation of expectations about future payments have been discussed and all found to be relevant conditions that can affect the degree of decoupling of direct payments. Moreover, if the payments are not fully decoupled, the level of support is found to be an important factor determining total impacts on production and trade.
INTRODUCTION

1. Significant changes have occurred in recent years in the types of policy instruments used to deliver support to producers. In the 1970s and 1980s, the policy mix was almost totally dominated by price-related measures. Prices were set by governments and maintained through a combination of border protection and domestic mechanisms, often involving purchases and sales by public agencies. While this type of measure still dominates the policy mix in many countries, there has been an expansion of new types of policy instruments, many of them in the form of budgetary support, paid directly to farmers. So called direct payments are now significant in the policy mix of a large number of OECD countries. Notable also has been the development of a complex range of implementation conditions and criteria governing these new instruments. They include restrictions on eligible quantities, environmental or other types of conditionality, payment limitations and varying requirements concerning what may or may not be produced. In recent years, a mix of current and past implementation parameters has come to characterise some measures. Another important development is that payments have become increasingly de-linked from production of individual commodities and increasingly linked to a specific factor, such as land, used in agricultural production or the production of a sub-set of commodities.

2. These changes present particular challenges to those engaged in trying to understand the impacts of different agricultural policy instruments. OECD has been engaged in a long term analytical effort in this domain. From the outset an effort was made to define a comprehensive framework that would allow both direct and indirect effects of different policy measures to be studied. Three types of effects were identified (OECD, 2001a): static effects, such as those that occur when policies affect the incentive prices of inputs or outputs; effects under uncertainty that occur if farmers are risk averse and the measures taken reduce risk or increase risk aversion; and dynamic effects that occur through expectations or investment.

3. The OECD’s work on decoupling attempts to classify measures from the least to the most decoupled, relying on measurement of production and trade impacts. This empirical approach is in contrast to an ex ante approach, which does not rely on measurement, but rather classifies measures based on implementation criteria. In the project of which this paper is a part, a notion of the degree of decoupling has been developed that relates the production and trade impacts of a given policy to those of a benchmark policy, usually price support.

4. Different tools and different methodologies have been employed in the effort to better understand and rank policy measures in terms of their production and trade effects. The PEM model has been central in much of the work on estimating production / trade impacts of marginal changes in PSE measures. This includes price effects (OECD, 2001b), impacts of quantitative constraints (OECD, 2003a) and risk effects (OECD, 2004a).

5. Attempts have also been made to estimate production and trade effects of different policy instruments using econometric analysis of data that are less aggregated than those used in PEM. Some studies have used farm level data. The purpose was both to try to answer the question about the degree of decoupling, but also to stimulate interest in academia and elsewhere in undertaking further research in the underlying issue. Issues related to risk and uncertainty of price support and area payments have been investigated in this way using data from Italy (OECD, 2003b) and Spain (OECD, 2003c). Additional econometric work has been carried out to deal with investment related effects in Italy (OECD, 2005a) and Canada (OECD, 2005b). Supporting these and other aspects of the work the Secretariat has also carried out
a literature review covering the whole range of different methods and data that have been used to tackle the empirical measurement of impacts of direct payments in the United States (OECD, 2005c). Finally, a specific model was developed that allows the impacts of a wide range of different risk-reducing measures to be estimated using a common analytical structure (OECD, 2005d).

6. Many of the policy changes giving rise to the need to investigate production and trade effects are relatively recent. Available time series are often not long enough for their effects to be estimated econometrically and panel data are rarely or never available. In general, analysing micro-economic data is technically difficult and resource intensive. The impact of changing from price support to area payments is a key question in the decoupling debate. It was discussed in (OECD, 2005e). With the passage of time, analysis of observed changes will allow a better understanding of the degree of decoupling of different measures, but this type of approach is still difficult.

7. As the decoupling project has evolved a number of questions have arisen that seem, currently, not to be amenable to the types of analysis developed so far. There has been strong demand for analysis of the issue of the impact on current production of farmers’ expectations about future government decisions on agricultural policy matters. But, there is no empirical basis whatsoever available in the literature that would clarify the nature of those expectations and how they are formed. There has been considerable debate about the impact of the different conditions attached to direct payments. To what extent, if at all, will conditions that require certain activities (such as implementing defined agricultural practices) be carried out, or exclude others (such as the planting of fruits and vegetables) on lands receiving payments affect the production and entry and exit decisions of the farmer? The degree of policy-specificity needed to tackle this question is beyond that usually incorporated in simulation models such as PEM. Moreover, many of the provisions are relatively recent, so that the micro data that might be used to estimate their impacts are not available. The frequency of significant changes in programme parameters and conditions also complicate the analysis in a world where panel data are rarely available. Finally, there has been growing interest in developing a better understanding of the total impact of a given programme or set of programmes. Specifically, clarification is needed as to whether impacts at the margin, the most common type of output from the applied analyses used so far, can be safely generalised to enable conclusions to be drawn about the total effects of a programme that involves large outlays.

8. In theory, a fully decoupled measure would not have any current condition or current parameter related to agricultural production or factor of production. A fully decoupled measure would not create any expectation that current production decisions could affect future payments. Under these circumstances and leaving aside investment effects, payments would be fully decoupled and no production impact would occur, making the level of support also un-important. Often however, real programmes do not reflect all the characteristics of this theoretical, fully decoupled payment. That is why the three issues raised above are often brought into the debate.

9. These issues present analytical and data challenges that are difficult to resolve. Nonetheless, given their importance, an attempt has been made in this report to increase understanding with respect to each of them. In each case, a framework is developed and then illustrated using synthetic data. The purpose is to explore the issues and to improve understanding of the channels through which different instruments operate and effect production and trade. To be plausible, the data used to illustrate the different examples are usually drawn from actual data, and missing parameter values are derived from the literature wherever possible. It should be stressed, however, that these studies remain illustrative in nature. They allow the issues to be explored in a way that is consistent with underlying economic theory, but they are not in themselves empirical and do not purport to inform about the actual impact of any given measure in any country or region.
10. Three illustrative studies are presented here. In the first, some farm-level data is used to illustrate and explain the ways in which different conditions applied to area payments may influence what the farmer decides to do. In the second, a range of hypotheses about the nature of farmers’ expectations is defined and the potential effect of those expectations on production is explored. Finally, the PEM model is used to illustrate the possibility of non-linearity in the effects of different programmes, following the development of a theoretical explanation for such a phenomenon. None of these illustrative studies looks at policy instruments in the context of multifunctionality or non-commodity outputs provisioning.
A. WHY AREA BASED PAYMENTS MAY INFLUENCE DECISIONS ON LAND USE

11. If it existed, a fully decoupled payment would not generate any price incentive to allocate resources in agricultural production. But, it may have an impact on production through the way it affects farm-household decisions on labour, leisure, savings and consumption. The payments increase the income or wealth of the household which may then decide to allocate its resources differently. Those are interesting questions requiring analysis using micro level farm household data, as argued in ERS (2004). The issues relate to decisions by the farm as a household rather than the farm as a firm. All types of government payments to households have this type of effect. However, the impacts on agricultural production are likely to be small in magnitude and may even be unclear in terms of their direction.

12. The main recent policy changes made in OECD countries towards more decoupled measures are the Single Farm Payment in the 2003 CAP reform, and, in the US, the Production Flexibility Contract (PFC) payments in the 1996 FAIR Act (followed by the Direct Payments in the 2002 Farm Act). If such payments were based exclusively on historical parameters with no relation to any current activity of the recipient, their effects on production would be limited to farm household resource allocation decisions. However, the movement towards more decoupled payments has been articulated through payments that are based on area. These payments require that each per hectare payment be associated with a current hectare of land. They also require that recipients carry out (or do not carry out) some activity on the land. In order to receive payment, the beneficiary must ensure that certain current “conditions” are met for an identifiable hectare of land, even though no production of any particular commodity is required.

13. There are two possibilities for each piece of land. First, the current conditions attached to an Area Based Direct Payment (ADP) may not be binding (the farmer would have observed them anyway) and have no impact at all on the decisions about what to do with a given hectare of land. Second, the conditions attached to the ADP oblige the farmer to take decisions he would not have taken otherwise and, therefore, have a direct impact on what he does with a given hectare of land. Everything depends on the nature of the conditions and on the specific structure of costs for alternative uses of a given piece of land. The purpose of this paper is to illustrate with some examples how these current conditions, attached to the ADP, can influence the farmer’s decision on what to do with a given hectare.

14. Many socio-economic factors affect individual farmers’ decisions on the use of land. Age, farm size and the possibility for off-farm work have been found to have an impact on the decision to exit farming [see Pietola and Vare (2003), Kimhi and Bollman (1999) and OECD (2001c)]. Crop rotation requirements, climatic and other location factors influence the choice of what to produce. This section, however, does not analyse any of these factors but rather concentrates on incentives ADPs create through changing relative returns from different land uses. An ADP can be seen as a subsidy to carry out (or not to carry out) certain activities on the land. It can reduce the implicit or explicit net cost of land and influence subsequent decisions on the use of that land. Furthermore, the analysis in this section is micro and partial. Any large shift in production would likely lead to adjustments in market prices, which would in turn influence partially offset the decision to shift from one crop to another.
How can area-based direct payments influence production?

15. First, if the ADP requires a given commodity to be produced, it is obvious that it can create an incentive to produce that commodity. This ADP will have an impact on production that is, in general, smaller than a payment per tonne since the ADP does not give an incentive to increase yields. If the ADP requires one out of a set of commodities to be produced, the likelihood of affecting the choice among products is reduced. However, an impact on product choice is certain whenever the conditions attached to the ADP forbid the most profitable alternative.

16. Second, an area-based direct payment can influence output by preventing farmers from exiting the market. According to Chau and DeGorter (2001) area payments may induce an inefficient farmer, who is not able to cover his fixed cost and who, without the payment, would exit the market in the long run to keep on producing. This is because the payments cover the losses from farming. However, the impact of area payments on total sectoral production is ambiguous: if a farmer exits the market it does not mean that the land will be idle and that production will fall. In the analysis by Chau and DeGorter it is assumed that the farmer loses the payment if he stops incurring the fixed cost, and that land cannot be taken over. However, fixed costs can differ for different land uses and the relevant incentives are created by the linkage between the payments and the costs incurred, regardless of whether they can be characterised as fixed or variable costs. It is these linkages between payments and costs that are examined in this section.

17. Additionally land can be sold or rented and farms can potentially be taken over by other farmers. For instance, Guyomard, Gohin and LeMouël (2000) introduce an efficiency parameter into the profit function which represents some farmers as more or less efficient in production than others. An inefficient farmer or some of his land can be taken over by a more efficient producer, or by a producer of other commodities with better returns. An ADP can have different impacts on this process. This section illustrates some of these impacts.

18. Finally, ADPs can reinforce or relax capital constraints relating to the purchase of agricultural land and influence take-over decisions and production. While the net cost of land decreases for those farming the land, the supply price for people willing to purchase the land will increase. This partial or total capitalisation of payments in land values may create a barrier to farmers willing to take over the land if they do not have enough savings and face credit constraints. ADPs can therefore not only hinder structural adjustment by allowing some farmers to stay in the market, but also by making the entry of new producers more difficult. However, it could also be argued that the payment may reduce the liquidity constraints of some farmers willing to take over other land. The existence of flexible rental and capital markets may reduce the significance of these barriers to entry.

An illustrative example

19. This paper attempts to illustrate the impact of area-based direct payments under different payment conditions. In order to do this five “virtual hectares” with different cost structures for different activities are created. They do not represent all possible types of farms or land in a specific country or region. They are included because they are illustrative of the type of incentives that ADPs with different conditions can create. For simplicity it is assumed that the revenue conditions are the same for all hectares. Since land is assumed to be heterogeneous, the cost structure differs as defined in Table A.1. The construction of these costs structures is arbitrary as explained in Annex A. The farmer can choose between five different activities for a given hectare, with different costs involved in each activity:

- Production of wheat.
- Production of potatoes.
- Production of Pasture (to be used for livestock feed).
- Production of set-aside (idling). There is no output but some well-defined minimum maintenance activities are carried out in order to keep the land in agricultural use, and there are costs associated.

- Producing nothing. There is neither output nor cost, as the land is completely unused and unmaintained.

### Table A. 1. Cost Structure of Five Virtual Hectares Used as Examples

<table>
<thead>
<tr>
<th>Revenue</th>
<th>Wheat</th>
<th>Setaside</th>
<th>Pasture</th>
<th>Potatoes</th>
<th>Nothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield (t./ha.)</td>
<td>8</td>
<td>0</td>
<td>9</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Producer Price (€/t.)</td>
<td>106</td>
<td>0</td>
<td>20</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td>Revenue (€/ha.)</td>
<td>798</td>
<td>0</td>
<td>180</td>
<td>2278</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Hectare A

- Variable (specific) cost (€/ha.)
  - 484
- Other specific cost (€/ha.)
  - 318
- Profits (€/ha.)
  - -4

#### Hectare B

- Variable (specific) cost (€/ha.)
  - 480
- Other specific cost (€/ha.)
  - 318
- Profits (€/ha.)
  - 0

#### Hectare C

- Variable (specific) cost (€/ha.)
  - 484
- Other specific cost (€/ha.)
  - 318
- Profits (€/ha.)
  - -4

#### Hectare D

- Variable (specific) cost (€/ha.)
  - 484
- Other specific cost (€/ha.)
  - 318
- Profits (€/ha.)
  - -4

#### Hectare E

- Variable (specific) cost (€/ha.)
  - 484
- Other specific cost (€/ha.)
  - 318
- Profits (€/ha.)
  - -4

#### Notes:

1. The yield for pasture is measured in t/ha of dry matter.
2. The specific cost includes the costs that can be attributed to specific lines of production. The specific variable cost of crop production includes the expenses for seed, fertilizer, crop protection, variable machinery cost, processing such as drying etc., interest on working capital.
3. The other specific cost of crop production includes salaries, fixed machine costs, rents, and other costs attached to land.

Source: Table AA1 in Annex A and ad hoc changes in the shadowed cells.

20. It is assumed that farmers will devote land to the activity that gives highest net returns. Then it is assumed that eligibility for an ADP has different conditions attached. These conditions may exclude some of the alternative activities or may require cross compliance. The payment modifies the net returns to the different activities, including the payment. The new set of net returns may result in the farmer changing his original decision on the activity for that hectare of land.
21. All payments are assumed to provide the same amount per hectare of eligible land, and the five selected hectares are assumed to be eligible. Seven different conditions are analysed, each defining a different type of ADP:

1. **No payment.** Irrespective of what he produces, the farmer will not receive any payment. This is the benchmark in order to determine if a given type of ADP would potentially modify the production decision on a given hectare.

2. **No condition:** Irrespective of what the farmer decides to do, he will always receive the area payment. Since the payment is area-based, he must be the owner or the renter of the selected hectare of land.

3. **Land has to be kept in agricultural use (agr. use).** In this case, the farmer will receive the payment as long as he keeps the land in a suitable condition for future agricultural use. Production is not required. This could mean producing any of the alternative commodities or setting the land aside, or carrying out some well defined maintenance activities, but it excludes producing “nothing”.

4. **Land has to be kept in agricultural use but an environmental cross compliance condition is required (agr. use plus cross compl.).** This is the same condition as in bullet 3, but with the additional cross compliance of a limit on the application of nitrogen. This condition is used as an example only.

5. **Land has to be kept in agricultural use but production of potatoes is excluded (agr. use excl. potat.).** This is the same condition as in bullet 3, but with the additional condition that potatoes cannot be produced on the land receiving the payment.

6. **Land has to be used to produce cereals, or set-aside (cer. & set-aside).** Production is not required to receive this payment.

7. **Land has to be used to produce wheat (Wheat).**

22. The different conditions that have to be fulfilled in order to receive the payment are summarised in Table A.2. The benchmark for comparison is Row 1: the production choice with no payment. Any deviation from the production decision under no payment can be interpreted as a potential effect on production in the corresponding virtual hectare.

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1. The exclusion of some commodities is part of the rules of the PFC and the direct payments in the United States, which exclude fruits and vegetables, and also of the most general case of the SFP in the European Union (non regionalisation).

2. This is similar to the conditions in area payments put in place by the EU under Agenda 2000.
Table A.2. Activities included in different examples of Area based Direct Payments (ADPs)

<table>
<thead>
<tr>
<th>Type of payment:</th>
<th>Wheat</th>
<th>Set aside</th>
<th>Pasture</th>
<th>Potatoes</th>
<th>Nothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 No payment</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>2 No condition</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>3 Agr. Use</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4 Agr. use plus cross compliance1.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>5 Agr. use excluding potatoes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>6 Cereals &amp; set-aside</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>7 Wheat</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Note: 1 This type of payment requires additionally that the farmer does not use more than 150 kg of Nitrogen per hectare.
Source: OECD Secretariat.

23. The cross compliance conditions in ADP number 4 is defined as a limit on the use of nitrogen. It is likely that this type of constraint will not affect all alternative activities equally. For instance, in our example this condition is binding only for the production of wheat, for which we assume that this limit reduces yields and costs, with a net effect of reducing returns.(see Annex A for a more detailed explanation). All other activities are assumed to be able to respect this limit without any change in costs and revenues.

What activity occurs on each hectare under different ADPs?

24. Our benchmark is a situation with no payment. In this case, hectares A, B, C, D and E will produce potatoes, wheat, nothing, pasture and nothing, respectively as shown in the first row of Table A.3. This production pattern reflects the cost advantage of each hectare of land. The introduction of payments may modify this pattern and, therefore, generate production impacts.

25. If payment 2 is introduced with no condition on current actions or activities by the farmer, and all hectares A to E are made eligible, no response could be expected in the use of land on any hectare. The payment is attached to the ownership of a given piece of land, with no particular action or prohibition imposed on the use of that land. This payment is highly decoupled since it generates no change in relative incentive prices of any input or output. If the payment is attached to a specific hectare, a high degree of capitalisation in the price of this hectare would be expected.

26. Payment 3, represented in row 3 of Table A.3, requires that land is maintained in agricultural use, even if no production is required. The conditions attached to this payment do not change the decision to produce potatoes, wheat and pasture on hectares A, B and D, respectively. Therefore, the condition attached to these payments is not binding for these hectares and does not alter the decision on the use of this land. On the contrary, hectares C and D would produce nothing in the absence of the payment. But this option is excluded by the conditions attached to the payment. Either the hectare continues to produce nothing without receiving payment (if the costs associated with maintaining agricultural use are higher than the value of the payment) or there is a change of activity on that hectare triggered by the payment. The latter occurs both in hectares C and E. The activity chosen in hectare C would be limited to the minimum maintenance required for agricultural use (set aside). That is, no production would occur, but there would

3. Other cross compliance conditions may impose different extra cost on different activities. For instance, cross compliance conditions related to animal welfare would increase the cost of pasture or other livestock activities only.
be maintenance of the land. Meanwhile, hectare E would be devoted to producing potatoes which in this case is more profitable than set aside. The production of potatoes is triggered by payment 3, even if potatoes are not profitable without the payment and the payment does not require any production.

Table A.3. Optimal land use for different ADPs in five example hectares

<table>
<thead>
<tr>
<th>ADP</th>
<th>Hectare A</th>
<th>Hectare B</th>
<th>Hectare C</th>
<th>Hectare D</th>
<th>Hectare E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No payment</td>
<td>Potatoes</td>
<td>Wheat</td>
<td>Nothing</td>
<td>Pasture</td>
<td>Nothing</td>
</tr>
<tr>
<td>2. No condition on land or input use</td>
<td>Potatoes</td>
<td>Wheat</td>
<td>Nothing</td>
<td>Pasture</td>
<td>Nothing</td>
</tr>
<tr>
<td>3. Land in agricultural use (production not required)</td>
<td>Potatoes</td>
<td>Wheat</td>
<td>Set-aside</td>
<td>Pasture</td>
<td>Potatoes</td>
</tr>
<tr>
<td>4. Land in agricultural use (production not required) plus cross compliance</td>
<td>Potatoes</td>
<td>Potatoes</td>
<td>Set-aside</td>
<td>Pasture</td>
<td>Potatoes</td>
</tr>
<tr>
<td>5. Land in agricultural use (production not required), excluding potatoes</td>
<td>Potatoes</td>
<td>Wheat</td>
<td>Set-aside</td>
<td>Pasture</td>
<td>Pasture</td>
</tr>
<tr>
<td>6. Land used to produce cereals or set-aside (production not required)</td>
<td>Potatoes</td>
<td>Wheat</td>
<td>Set-aside</td>
<td>Wheat</td>
<td>Set-aside</td>
</tr>
<tr>
<td>7. Land used to produce wheat</td>
<td>Potatoes</td>
<td>Wheat</td>
<td>Wheat</td>
<td>Wheat</td>
<td>Wheat</td>
</tr>
</tbody>
</table>

Source: OECD Secretariat.

27. Payment 4 requires that the land is maintained in agricultural use (no production is required) with an additional cross compliance condition that limits the application of nitrogen. Among the five hectares in Table A.3, this additional condition is binding only for land producing wheat⁴, that is, hectare B. In this hectare, the nitrogen limit is so costly for wheat production that the production of potatoes becomes more profitable. The activities in hectares A and D are not affected by the payment: they will continue to be devoted to potatoes and pasture and farmers will receive the payments in addition to the corresponding profits. Hectares C and E will move from producing nothing to land set-aside and producing potatoes, the latter due to the minimum maintenance requirements. The cross compliance conditions can, in some cases, modify the production decisions in some hectares of land and, in some other cases, it will modify the technology and yields of a commodity affected by the conditionality.

28. Payment 5 will be received whenever the land is used for an agricultural activity (including set-aside), but excludes the production of potatoes. That is, this exclusion is added to the conditions for payment 3. Excluding potatoes from the payment could affect production in hectare A since potatoes would be produced on this hectare in the absence of payment. However, this is not the case: the production of potatoes is so profitable in hectare A that it is preferable to continue producing potatoes and to renounce the payment. In hectare E, pasture becomes the next most profitable use of land and replaces the production of nothing without payments, or the production of potatoes if the payment had not excluded this commodity.

29. Payment 6 allows only the production of cereals and set-aside. This payment does not eliminate the production of potatoes on Hectare A, which continues to be a profitable activity, nor modify the

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⁴. Other cross-compliance conditions could be binding for other activities or even for all activities.
production of wheat in hectare B. This payment will push hectare D, however, to produce wheat instead of pasture (which is excluded from the payment), and hectare E which was producing nothing when there was no payment and pasture with payment 5 will be set aside.

30. Finally, payment 7 is exclusively designed for hectares producing wheat. This payment does not affect production in hectare A where potatoes are more profitable, or hectare B which would produce wheat anyway. But Hectares C, D and E would move from producing nothing or pasture to producing wheat supported by the ADP.

31. The current conditions attached to an ADP may not affect the production decisions in some hectares of land because the restriction is not binding (hectare B) or it is binding but the payment does not compensate for the difference in profitability (hectare A). Whenever restrictions imposed are binding (without the payment the farmer would not meet the conditions) and the payment fully compensates for the lower profitability, the conditional ADP will modify the production decisions on that hectare. This applies also to cross compliance conditions. The larger the freedom on the uses and practices on the land entitled for ADP payment, the lower the probability of affecting the production decision.

Is land buying or renting affected by ADPs?

32. In this sub-section, the unit of analysis is changed from the hectare to the farm. Cost structures B, C, D and E are retained and assigned to farmers B, C, D and E. These farmers own the corresponding hectares. It is then assumed that each farmer is able to replicate his own cost structure on land rented or purchased from any of the other farms. That is, it is assumed now that the differences in cost structures are embodied in the human capital of producers. If profits per hectare are higher in one farm, the farmer will take over the land of his less efficient neighbour. Farm A is not allowed to take over the other farms; its profit from producing potatoes is so large that Farm A would take over all the other hectares. This is an unrealistic situation. The other four farms included in the analysis have the same profitability with no payment. This is why there is no renting among them when no payment is received (see first row in Table A.4) or when the payment has no condition attached (payment 2 in second row of Table A.4).

<p>| Table A.4. Optimal land use for different ADPs with the possibility of selling |
|--------------------------------------------------|------------------|------------------|------------------|------------------|</p>
<table>
<thead>
<tr>
<th>ADP</th>
<th>Hectare B</th>
<th>Hectare C</th>
<th>Hectare D</th>
<th>Hectare E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No payment</td>
<td>Wheat</td>
<td>Nothing</td>
<td>Pasture</td>
<td>Nothing</td>
</tr>
<tr>
<td>2. No condition on land or input use</td>
<td>Wheat</td>
<td>Nothing</td>
<td>Pasture</td>
<td>Nothing</td>
</tr>
<tr>
<td>3. Land in agricultural use (production not required)</td>
<td>Wheat</td>
<td>Rented by Farm B or D</td>
<td>Pasture</td>
<td>Rented by Farm B or D</td>
</tr>
<tr>
<td>4. Land in agricultural use (production not required) plus cross compliance</td>
<td>Rented by Farm D</td>
<td>Rented by Farm D</td>
<td>Pasture</td>
<td>Rented by Farm D</td>
</tr>
<tr>
<td>5. Land in agricultural use (production not required), excluding potatoes</td>
<td>Wheat</td>
<td>Rented by Farm B or D</td>
<td>Pasture</td>
<td>Rented by Farm B or D</td>
</tr>
<tr>
<td>6. Land used to produce cereals or set-aside (production not required)</td>
<td>Wheat</td>
<td>Rented by Farm B</td>
<td>Rented by Farm B</td>
<td>Rented by Farm B</td>
</tr>
<tr>
<td>7. Land used to produce wheat</td>
<td>Wheat</td>
<td>Rented by Farm B</td>
<td>Rented by Farm B</td>
<td>Rented by Farm B</td>
</tr>
</tbody>
</table>

Source: OECD Secretariat.

33. Payments 3 (land in agricultural use) and 5 (agricultural use excluding potatoes) result in the production of set-aside on hectare C and potatoes or pasture on hectare E. However, the profitability in
these hectares becomes lower than with payments 2 (no condition), and more profitable farmers B and D would be willing to rent or buy these hectares and produce wheat and pasture on them. That is, when renting among these four farmers is possible, payments 3 and 5 induce the production of wheat or pasture on hectares where no production would occur otherwise.

34. Payment 4 requires cross compliance conditions (limit on nitrogen use) in addition to maintaining agricultural use of land. The limit on nitrogen used reduces the profitability of wheat production by farmer B. In this case farm D, producing pasture, would take over hectares B, C and E. This situation illustrates the potential of cross compliance conditions to affect not only the method but also the pattern of production. In fact, the type of cross compliance example we have developed discourages the production of wheat and favours other uses of land.

35. Payments 6 and 7 reduce the chosen alternatives to cereals and set-aside (row 6 in Table A.4) and to wheat (row 7). Under these circumstances farmer B, who has a comparative advantage in producing wheat, would be able to obtain greater profits from hectares C, D and E than their owners. Therefore, farmer B will rent these hectares to produce wheat. In this particular case, the possibility of renting the land increases the incentives created by payments 6 and 7 to produce wheat in some hectares that would not otherwise do so.

Some implications

36. Direct payments based exclusively on fixed, historical parameters do not create price incentives that affect the allocation of land. However, ADPs in OECD countries are often conditional even when eligibility is based on historical fixed parameters. If there are current conditions or restrictions imposed on land use and/or cross compliance, the payments can directly affect the production decision, including both on which commodities to produce and the choice to not produce at all (exiting the sector). The exact magnitude and direction of these effects needs to be estimated empirically. This paper has illustrated some of these potential effects without being exhaustive or representative of the distribution of cost structures across farms in any particular country or region:

- The broader the set of activities allowed on the eligible land, and the smaller the restrictions imposed, the lower the likelihood of effects on the choice of what to produce. There may be no impact on some hectares from excluding some activities, but exclusions may be binding on other hectares creating overall incentives against the excluded activities. The aggregate magnitude of these effects, however, is an empirical question.

- A payment excluding the most profitable use of a given hectare may induce the farmer to produce something he would not have otherwise produced if the payment did not cover a part of the costs. This can occur even if the payment does not require production (it allows for set-aside or idling).

- Imposing conditions on maintaining land in agricultural use may generate costs that make the “set aside” option less attractive than other alternative activities. This condition may have no production inducing impact on some hectares of land, but it may create incentives to produce on some other hectares where “set-aside” can be less profitable. These costs create overall incentives against idling, but the aggregate magnitude of these effects is an empirical question.

- Cross compliance can have asymmetric impacts on costs and revenues of different activities. For instance the nitrogen limit example reduced the profitability of wheat and favoured other commodities. In general, a payment with a cross compliance condition can potentially change production patterns and not only production technologies.
When there is a potential take-over, a change in payment conditions may induce a farmer to sell or rent the land to other farmers who are able to increase profitability under the new conditions. However, a farmer exiting the sector due to changes in payments does not necessarily result in a reduction of agricultural production.

37. Socio-economic factors, such as the age structure of farmers, are likely to be very important in determining the response of farmers to changes in payments. Additionally, payments will generate adjustments in prices in the different markets that will, in general, reduce the response of farmers to payments. These factors need to be taken into account when attempting an empirical estimate of production response to ADPs. This is beyond the scope of this paper which only illustrates the types of incentives that may be created.

38. Area based direct payments will increase the cost of land to the extent the payment is capitalised into land values. These high land values may create barriers to entry and affect production costs and profitability. The elimination of ADPs may make land cheaper and facilitate selling or renting of land to more efficient producers or to non-agricultural uses of land. The importance of this “facilitation effect” is an empirical question that has not been analysed in this paper.
B. THE IMPACT ON PRODUCTION OF POLICY EXPECTATIONS

39. Support to farmers can create expectations, perceptions or beliefs about the nature of the environment in which farmers are producing and will be producing in the future. These expectations about circumstances and parameters that remain uncertain can influence production decisions. This section tries to explore the economic rationale for such effects and the mechanisms through which they may work. All types of support measures can potentially create expectations about the production environment that can potentially affect producers’ decisions. This is particularly the case for price support measures that will very likely create expectations of higher and more stable producer prices. But, not only price support measures can create expectations effects. Different types of area payments can also create expectations that may affect current production decisions. The way price support generates expectations can differ very substantially from the way expectations are created for different area payments or other programmes. In fact, any agricultural policy and any change in policy is likely to generate some information that farmers will try to incorporate in their decision making to reduce the uncertainties in their production environment. Even a supposedly highly decoupled programme like the bond scheme (Tangermann, 1991, and Swinbank and Tranter, 2004) can potentially generate expectations of capitalisation of any agricultural programme that may be introduced in the future. This section looks at the literature to find the appropriate framework to deal with these policy expectations in agriculture and then develops three simple examples to illustrate this type of effect. It is not exhaustive, nor does it give empirical answers to specific questions.

The approach to expectations

40. The first challenge is to define the nature of the questions in order to develop an appropriate approach. Some of the issues on expectations have already been dealt with elsewhere in the project on decoupling (OECD 2003b, 2004a) and in other work (Nerlove and Bessler, 2001). This study looks at some additional aspects that have not been raised in other work.

Expectations about what?

41. The two obvious variables for which farmer’s expectations may be important in determining farmer’s production response are prices and payments. There is some uncertainty about both variables and both can potentially create production incentives. There are also other uncertain variables concerning which farmers may generate expectations that affect production decisions These include expectations about climate related variables, off-farm income opportunities, and inflation. We have selected prices and payments because they are closely related to agricultural policies and are generally part of any economic analysis of production decisions. Expectations will affect production decisions in three ways:

1. Effects on "current" prices and risks. This includes expectations of higher and less risky output prices that create incentives to produce more in the current period. Price support obviously affects both expected prices and distribution of prices. But, payments based on current area or payments based on current use of inputs can also generate this type of incentive on current production decisions. Those expectations are part of the relative price and risk related effects as defined in OECD (2001a) and that are studied in several papers, including OECD (2001b, 2003b, 2003c, and 2005d). There are relatively standardised techniques to deal with these types of expectations, the general lines of which are discussed in this section and developed elsewhere.
2. Effects on “future” prices and risks. Expectations may also relate to future price levels or their distribution. This would generate incentives to invest more in the current period to profit from expected higher and less uncertain prices in the future. These are investment effects which have a dynamic dimension. There are not many standardised techniques to deal with these effects, but some discussion and specific applications are analysed in papers (OECD, 2005a) and (OECD, 2005b).

3. Effects on linkage between current input/output use and future payments. Expectations of some dynamic linkage between current production decisions and the entitlement or the amount of payment in the future. These expectations can only exist for future payments since market prices cannot have this retro-active effect. This type of expectations may be more likely to exist when there is some historical base for the entitlement or for the amount of the payment, and when this base could potentially be updated.

42. Effects 1 and 2 create expectations of higher or less risky prices of outputs or inputs, both currently and in the future. These expectations relate to prices and marginal costs associated with inputs and outputs in each production period. They do not create an expectation of a linkage between output/input use in one period and prices/returns/costs in future periods. It is only the type of expectation described in bullet 3 that generates this dynamic connection that to date has remained relatively unexplored either in this project or in the literature. These effects are likely to be of second order magnitude, but this is an empirical question. The examples developed in this section refer to this third type of expectation that applies only to payments. However, expectations effects can occur for all types of programmes as analysed in other papers (OECD, 2003b, 2004a, 2004b and 2005f).

43. What is interesting for the purpose of estimating the production and trade impact of policies is the expected “linkage” between current decisions on production and future prices/returns plus payments. This linkage, which constitutes the “expectation”, is determined both by conditions and rules attached to current payments and by expected conditions and rules attached to future payments. Some expectations about future payments could be ill-founded and not due to any government action. In those cases one may be tempted to argue that those expectation effects are not due to government policy, but to farmer’s erroneous beliefs. On the other hand, it could also be argued that government has the responsibility to counter any “clearly erroneous” perception of future policies that could compromise the results of current policy decisions. But the opposite could also be argued because a government action or announcement made in this context can sometimes generate un-intended additional expectations.

What methodology to capture expectations?

44. Nerlove and Bessler (2001) review the literature on expectations in agricultural economics. These authors use the Nerlove and Soedjana (1996) simple model for sheep livestock dynamics to illustrate that expectations — regardless of the mechanism that is assumed to generate them — have potentially significant effects on farmers’ response. However, the role of expectations in farmers’ decision making and, therefore, their impact on production depends crucially on assumptions about the formation of these expectations. The types of expectations used in the agriculture literature are the same as in other areas of economics. Nerlove and Bessler classify them into five groups:

- Extrapolative or naïve expectations (Goodwin, 1947). Expectations about the value of a given variable are generated by extrapolating the value of that variable in the past. They can be equal to the lagged value of the variable or to a linear combination of several lags of that variable.
- Adaptive expectations. The expected value of a variable is assumed to be adapting to a defined “normal” value. Expected value at time t is equal to expected value at time (t-1) plus a correction
for the error made in (t-1). This error is already known when expectation t is generated. The reference for an early application of this type of expectations in agriculture is Nerlove (1956).

- **Implicit expectations.** These are expectations that are estimated implicitly from the actual behaviour of the farmer. It is an empirical concept of expectations and is not very useful to infer the impact of expectations in decision making.

- **Rational or quasi-rational expectations.** The expected value of a given variable is equal to its statistical expectation conditional on the information available at the time the expectation is generated. In order to obtain this expected value, the rational expectation hypothesis assumes that the farmer knows the right model structure generating the value of the variable. Since Muth (1961) published his pioneering work, most of the empirical work on expectations has been oriented to test the Rational Expectations Hypothesis (REH) or to apply it.

- **Future price based models for expectations formation.** When talking about price expectations the prices in futures markets can be used to generate the expectations.

45. The rational expectations hypothesis is crucial when dealing with variables that are endogenous to the economic model, such as prices. However, they are of particular interest only when the modeller has a good idea of the right model determining current values of the uncertain variables. If there is no knowledge about the process and forces determining current values of undetermined variables, then the REH hypothesis is not very useful and extrapolative and adaptive expectations are the only options. This does not mean that it is assumed that agents are not rational when generating their expectations, but just that they use the “most rational” methodology to generate these expectations in the absence of knowledge on the true model. It is a kind of bounded rationality assumption.

**What is the true model generating the policy rules and payments?**

46. In the case of future policy rules and payments, the political process is the framework that will determine the true values of these uncertain variables. However, it is difficult to find a single model explaining the outcome of this political process, in which farmers are often involved through their organizations. There are examples in the literature of models trying to explain this political process of decision making. This literature deals with the issue using slightly different approaches. Some studies underline the role of collective action and lobby groups in determining the policy decisions, very often in a game theory framework (Becker, 1983). Others try to construct a “political support function” and try to explain politicians’ decisions in terms of maximising the number of votes. More sophisticated analyses try to represent the strategic interaction between lobby groups and policy makers.

47. Several empirical studies try to measure the preferences revealed by the policy outcome, expressed in terms of different weights for different social groups or economic agents. Examples of this approach are Sarris and Freebairn (1983) and Paarlberg and Abbott (1986) who also try to develop an oligopolistic structure in wheat markets. This approach tries to explain the “rationality” of policy options that are observed even if they are not Pareto optimal. This approach has its limitations as explained in von Cramon-Taubadel (1992) and Bullock (1994), but has often been used to analyse domestic price policies. Other empirical models such as Swinnen et al. (2001) try to estimate equations explaining the levels or patterns of support across commodities and countries. However, all these empirical models are far from generating a well-accepted basis to predict future policy movements in a detailed manner. From a review of that literature in DeGorter and Swinnen (2002), there does not seem to be a reliable model explaining the determination of the details of rules governing future payments.

5. This type of expectation is called quasi-rational whenever the expected value is calculated recursively and just rational expectations when the expected value is calculated simultaneously with the whole model.
A pragmatic approach to expectations

48. An alternative way to investigate farmers’ expectations concerning policy would be to ask them directly in a survey. Swinbank and Tranter (eds., 2004) report the responses to a questionnaire in a farm survey made in the context of the Bond Scheme project. The only reported question on policy expectations asked about the farmer’s view on the continuation of Agenda 2000 provisions after 2006 (the question was posed in 2001). This question is too general to allow much to be learned about policy expectations and their impact. The average answer was not very illuminating: the mean score indicated an average expectation of maintenance of the status quo, but there was not a single view shared among the respondents. This could be a line for future research. However, the survey questionnaire needs to be well designed for that purpose and attention must be given to the risk that there are built-in incentives to misrepresent expectations. Another potential avenue for research in the area could come from applying some experimental economics.

49. Given the lack of a reliable model to generate the outcome of the political process determining future payments, farmers may generate their expectations by studying government decisions. Farmers can learn from their own government policy history, but also from the policy changes occurring in other countries with similar characteristics or problems. Decisions taken by governments in certain circumstances may be taken again in similar future circumstances. Farmers can also be aware of trends in the policy discussion in international forums, such as the Council of the European Union, the WTO or OECD. However, it is difficult to define the exact impact of this information on farmers’ expectations, particularly when we are interested in expectations about the details of the rules applied to specific payments.

50. The limited information available about the correct model generating the parameters of future payments and policies may lead farmers to use approximate rules of thumb to generate the most rational expectations possible. There is also much uncertainty about the way these “rules of thumb” can work. For all these reasons, the only way we can treat expectations at this stage is in an ad hoc manner without claiming any empirical value for our conclusions. The factors determining farmers’ expectations on future policies or payments are not studied in depth here, despite their importance. Following a pragmatic approach, effort is concentrated on investigating the nature and dimension of the production impact of a given “reasonable” expectation about future policies. That is, we assume that a certain expectation is created and then we try to estimate the potential production impact of such an expectation. Governments’ decisions and signals can contribute to the creation of these expectations even if they are not included in the legislation. In this section we do not investigate how past or current government decisions generate expectations. Instead the hypothesis is made that some specific expectations have been created.

Some illustrative examples

51. Two examples illustrate expectations about future payments, and particularly expectations concerning the links between current production decisions and future payments. The present analysis is made on the basis of three stylised examples that do not take into account many aspects related to the impact of expectations. For example, not all producers may have the same response to expectations due to individual characteristics that could create rigidities, limitations on land response, or differences in the relationship between expected costs and benefits. The pragmatic approach in this study is not able to capture the heterogeneity of the formation of expectations that is very likely to be observed in reality.

6. In some cases some empirical numbers could help to infer the dimension of this expectation of future policy. For instance quota values could be thought of as measuring the discounted stream of future profits including policy measures. The same could be argued for the market value of tradable rights for historical entitlements payments.
Farms are heterogeneous and can have different information sets on which expectations are constructed. Only a micro data approach could help to deal with this heterogeneity, which can be significant and create difficulties of aggregation.

52. This section illustrates some particular \textit{ad hoc} expectations that are relevant for policy discussions. The magnitude of potential production impacts of certain assumed expectations are calibrated using results from the PEM model for price support and area payments as a benchmark (OECD, 2001b). These results refer to a specific commodity and cannot be directly applied to programmes that are open to a large number of commodities. The production impact ratios that are used refer to the production of this specific commodity and they embed important cross effects with other commodities that are not directly represented by the ratios. The analytical framework developed in Annex B is used to deal with three situations of expectations that may not be written in law or in the rules governing the programmes. However, if expectations are created, some estimation could be made of their likely impacts on production. Expectations of future payments based on historical area/yield with base area and/or yield updating are first discussed. Then expectations that current farming decisions affect the probability of being entitled to future payments are defined. Finally, a credible announcement of the end of a support programme is discussed.

**Example 1: Expectations of future payments based on historical area/yield with base area and/or yield updating**

53. Imagine a payment based on historical cultivated area of a certain commodity. The right to receive the payment and the amount of the payment is not in any way related to current alternative uses of land and current production decisions and prices. The payment is determined only by production history up to time (t-1), and cannot have an impact on incentive prices at any time from t onwards. This is true for the current payment, but it may not be true for future payments for which there is some uncertainty about the rules. Will the payments in time (t+5) also be determined by production history up to (t-1) or, at a given moment, will the government decide to update the history on which payments are based? Since there is uncertainty about the future policy rules which will influence future production decisions, there is scope for expectations about them to develop. A similar argument is used in Sumner (2003) when analysing the provisions of the US 2002 Farm Bill. In fact, any new programme or policy can potentially be interpreted as an updating and can generate expectation of future updating, in particular if actual updating of the payment base was an explicit feature of a recent programme.

54. This illustrative example represents farmers’ expectation as a probability ‘\(p\)’ of base production history being updated at time (t+i) to reflect the production decisions of farmers at time t. This means that farmers expect that current productions decisions at time t will affect payments at time (t+i). There is, therefore, an incentive to currently produce or use land that is determined by the subjective probability of the updating occurring and the discount rate applied to future income flows as compared to present income. In reality, it is likely that the base for an updating is not a single year but a set of three or more consecutive years, and the period on which the update will be applied (duration of the update or the programme) is also longer than one year. Of course, the length of the updating period and the length of the application period are important determinants of the magnitude of the production effects. However, this simple model does not go into these details of the updating rules. Some hypotheses have been made in order to illustrate the case of optional updating. That is, in period t+i the farmer can update his yield using yields in period t, but

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7. The PEM model is a partial equilibrium model that considers the opportunity costs of planting decisions and adjustments in the land rental rates. It is assumed in this section that the same underlying response functions will prevail in the years to come, even if expected response may differ due to different expectations.
if he decides not to update, he will not lose the value of the payment calculated with the historical yield. The details are presented in the model developed in Annex B.

55. This model allows these expectations effects to be converted into price gaps. When it is expected that only the base area will be updated, a price gap is created in current land returns in the land market. When it is expected that both area and yields will be updated then the price gap has its initial incidence in the output market. The mathematical expression of these price gaps requires three main parameters to be calibrated: 1) a discount rate to be applied to future returns (3%, 5% and 10%); 2) the number of years between current farming decisions and payments or policy changes that take these decisions into account (for sensitivity analysis lags of 0, 10 and 20 years are used); and 3) a level of expected probability of receiving future payments. This latter is the “expectations” parameter for which no empirical information is available and probability values of 0.5 and 1 are used.

Figure B.1. Production impacts of payments with expectations of base area (A) and yield (Y) updating with different probabilities and discount rates

56. The first two columns in Figure B.1 present the average production impact ratios for payments based on current output and payments based on current area as estimated using the PEM model (OECD, 2001b). A production impact ratio is a calculated ratio between the impact on production of a given measure (payments based on output or payments based on area in this case) and the impact on production of price support, calculated for the same amount of support. The other columns correspond to estimations of the production impact ratios for future payments that are expected to be based on updated base area A or on optionally updated yields. Under probability equal to one, if the updating lag is zero, then the impact of these payments is equal to the impact of current area

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9. Yields are assumed to be calculated at the individual farm level. If the yield updates are calculated at a regional or national basis the production incentives would be much smaller.
payments (if only area is “updated”), to current output payments (if both area and yield are updated), and
to zero if updating is optional (zero gains in the yield trend).

57. Figure B.1 shows that, under similar conditions, expectations of updating of area and yields have
larger impacts on production than expectations of updating only the area. If the expectation refers to an
updating that is optional and no loss of payments occurs if the farmer does not produce, then the
expectations incentives to produce are significantly reduced.

58. The probability of updating is the key parameter for which there is no empirical information. This
subjective probability can be affected by government decisions that have already occurred, such as having
updated base area and yields in the past. Similar actions carried out by governments in countries with
similar circumstances could also contribute to these expectations. However, we have no reliable
measurement of the magnitude of these links. If this probability is zero, the production impact becomes
zero. For subjective probabilities in the order of 50%, the magnitude of the production effects associated
with expectations can still be relatively large, particularly for expectation of updating both area and yields
and lag length below ten years. For a given probability of updating that defines the level of expectations, a
large discount rate and/or a long time lag may significantly reduce the impact of expectations on
production decisions.

Example 2: Expectations of current farming decisions affecting the probability of future payments

59. Sometimes policy expectations are not as clear-cut as in example 1. Farmers may know that there
is some probability that the government will give some support in the future without any clear idea of what
form this support would take. This kind of loose expectations is by nature difficult to model. The farmer
is not certain about what will determine the payments in the future nor whether he will be entitled to
receive them. Can he do something to increase the probability of receiving the payments? Do current
production decisions affect this probability? If the farmer expects that this probability is affected by
information on current production decisions there will be production impacts.

60. Assume that farmers expect the probability of receiving the payment in time \((t+i)\) to be dependant
(normally increasing) on current area \((A)\) or current production levels \((Q)\). This function is defined as
\(\rho(t) = \rho(A_{t-i},Q_{t-i})\) and it represents a subjective probability function that determines the nature of the
expectations we assume in this example. This function is difficult to estimate empirically. The model
developed in Annex B finds a mathematical expression for the price gap created by this type of expectation
effect, as a function of the derivative \(\rho'\). This price gap will affect land rental rates if the probability
function depends on a past area, and output price levels if the probability depends on past production
levels. These price gaps do not depend on the probability level alone, but also on the derivative of this
function. The main parameters determining the mathematical expression of these wedges are then the
discount rate, the length of the time lag between production decisions and probability impacts and the
derivative of the probability function with respect to lagged area or production. Assumptions about the
derivative of the probability function are merely speculative. Figure B.2 includes a convenient value
calibrated at \(A^* \rho'_{A} = Q^* \rho'_{Q} = 0.3\).

61. It may happen that the subjective probability function \(\rho\) has a variable slope. For instance, the
derivative may be large for low production/area used, but very low for large levels of production. This
would mean that farmers believe they need to produce something if they want to have some probability of
continuing to receive payments, but no additional production would be required beyond a threshold. In this

10. This situation may create temporal uncertainty of the type described by Dixit and Pindyck (1994) for
investment decisions. The optimal response in this case may be the status quo wait and see. This could
mean continue producing as if support will continue in the same way as at the present time.
case, expectations may hardly create incentives to increase production at the margin, but would create stronger incentives not to reduce production or area. That is, the impact of expectations to increase production in the margin would be small, but expectations may prevent the farmer from moving to very small levels of production\textsuperscript{11}. There seems to be some rationale for this linkage between being a farmer and receiving support from the recent history of agricultural policies. If farmers believe that farming today increases their probability of receiving future payments, this expectation will generate production effects. However, the quantitative impact on farmers’ expectations is difficult to measure empirically.

\textbf{Figure B.2. Production impacts when there are expectations on the probability of receiving payment being influenced by past area (A) or production (Q) with a derivative of probability defined by }$A'Q=0.3$

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{production_impacts.png}
\caption{Production impacts when there are expectations on the probability of receiving payment being influenced by past area (A) or production (Q) with a derivative of probability defined by }$A'Q=0.3$
\end{figure}

\textit{Expectations effect of a credible announcement of the end of a support programme}

62. Payments that are open-ended create expectations about future payments. Both example 1 and example 2 show how these expectations work on base area or yields updating, and current farming decisions affecting the probability of receiving future payments. The linkage between government actions and these expectations is not completely clear and is difficult to quantify. It is clear, however, that these actions can be interpreted as signals that farmers will use —with other information — to build expectations. What can governments do to avoid undesirable expectations effects?

63. Governments can use their influence on farmers’ expectations to ensure that effects on production are minimised. Since it is the government that decides the policy, a clear and firm declaration that the historically based parameters in a given support programme will never be updated, or that a program is time-limited and will not be replaced by another programme, could have enough credibility to avoid the potential expectations effect. This is the underlying idea in the Bond Scheme proposal that makes payments, first de-linked from land and any other historical production parameter\textsuperscript{12}, and then limits their

\textsuperscript{11} The same type of “asymmetry” was found for the risk effects associated with counter-cyclical payments in Antón and LeMouël (2004).

\textsuperscript{12} A flat rate payment per hectare could help to break this linkage.
duration. The announcement of such a scheme could be credible if the government maintains a clear and firm position. However, the credibility of the government can be strongly influenced by the political process. Governments and Ministers change with time and new leaders may have different views.

64. This is the type of time consistency trap that has been analysed in the literature on monetary policy. We follow here a similar line of argument that is used for monetary policy in Kydland and Prescott (1977)\(^\text{13}\). Government may face a trade off between reducing undesired production effects of policy and responding to demands for support by farmers. Government may be willing to announce time-limited payments because rational farmers will incorporate this information into their decision making and avoid any production effects. But, once payments are ended, rational agents know that the government can be tempted through the political process to provide once again the support demanded by farmers. The announcement of time-limited payments to ensure minimum effects on production may not be credible. Farmers know that \textit{ex post} governments may not resist the temptation to use support measures.

65. Kydland and Prescott use their model to argue in favour of a stable monetary policy governed by rules and not by discretion as a way out of this inconsistency. Similarly, eliminating the expectations effects of policy may require a stable agricultural policy framework that is not influenced by the political cycle and that would allow credible time-limited programmes to be developed. This type of time-limited programme is preferable when a payment is designed to compensate for the elimination of a support programme. A time-limited compensation will avoid the perpetuation of production effects into the future and eliminate the possibility of expectations effects on current production. On the other hand, if the payment has other well defined objectives (environment, landscape, etc) its time frame will be determined by the time frame for achieving those objectives.

**Some implications**

66. This section tackles the role of policy expectations in determining farmers’ production decisions. These policy expectations affect all support programmes in one way or another. Price support measures generate expectations about the level and variability of prices both in the present and in the future. These expectations create production impacts through their relative expected price effects and through investment. These types of expectations effects have been studied in other papers. Their impacts are likely to be large given a relatively general agreement on how these expectations work. However, expectation effects can occur as well in more decoupled programmes, particularly if they have some linkage to historical production parameters. This type of expectation has rarely been studied in the literature and is the main focus here.

67. There is little scope for constructing a rational expectations framework to analyse this type of expectation about policy given the lack of a well defined true, underlying model generating policy decisions. In this context only a pragmatic approach can be used. This was done here by assuming that a certain “plausible” expectation about future payments had been created and then trying to estimate its

\(^\text{13}\) These authors were awarded the Nobel prize on Economics 2004 for their work on time consistency of economic policy. In this article they study the trade off between unemployment and inflation in the framework of a Philips curve analysis of macroeconomic policy. Government is willing to announce that it will not tolerate any inflation, because if agents have rational expectations, they will incorporate this information in to their decision making and expect zero inflation. This will move the Philips curve to lower inflation and lower unemployment positions. However once these expectations have been created in the form of a new Philips curve, rational agents may know that government has \textit{ex post} incentives to create some inflation to reduce unemployment. That is why these authors argue that optimal Government policy may be “time inconsistent” and it may be necessary to build a “reputation” by not yielding to pressures for high inflationary policy.
impact on production. Three illustrative examples have been presented with no ambition to be exhaustive in terms of the issues and without claiming any empirical validity. Reflecting this, the estimates of impacts that are presented in the form of sensitivity analysis for different parameter values, the following general conclusions can be extracted.

- All support programmes can potentially generate different types of expectations about the future of agricultural support programmes. This is particularly true for price support and other highly coupled programmes with an expected link between current production and current support.

- There are well founded economic reasons why expectations about future policies create impacts on current production. This is true whenever expectations create a linkage between current production decisions and future payments. An expected probability that a base area or a base yield that is used to determine a payment will be updated is a clear example of this: the farmer will include the stream of expected future payments in his current decision making.

- Expectations that updating of yields will be optional are likely to have much smaller impacts on production than “compulsory” updating. Under optional updating there is no risk of losing the whole historical value of the payment, but only the potential gain from the update.

- Once the expectation is well defined, there are economic techniques that allow the magnitude of these effects to be estimated. However, there are no standard economic techniques to estimate the nature and magnitude of these expectations or the mechanisms that generate them. Empirical work (including surveys) could try to solve this problem but would be very demanding in terms of the data and the historical policy frame that generates the data.

- A clear and firm declaration that the historically based parameters in a given support programme will never be updated could have enough credibility to avoid the potential expectations effect. Programmes that are time-limited and are believed to be time-limited could avoid the generation of unintended expectations effects on production. However, the credibility of these announcements will be strongly influenced by the history of government behaviour in that respect.
C. IMPACT ON PRODUCTION OF DIFFERENT LEVELS OF SUPPORT

68. The degree of decoupling of a given policy measure typically refers to its marginal impact on production. That is, a highly decoupled measure has a small impact on production per extra dollar spent as compared to the impact of the same dollar spent on market price support used as benchmark. The degree of decoupling is a generic characteristic of policy measures, but the total impact on production is, in general, also dependent on the total expenditure. The estimates of production and trade ratios obtained in all previous OECD papers on decoupling (OECD, 2001b, 2003a, 2003b, 2003c and 2004a) express impacts of a marginal change in support relative to the impacts of the same marginal change in market price support. When a payment is estimated to have some impact on production at the margin, i.e. it is not fully decoupled, it is also pertinent to ask what the total production and trade impact of the whole programme is in absolute terms and relative to our benchmark. This section explores the issues and difficulties associated with the extrapolation of marginal impacts into total impacts. In many OECD countries the level of support in the main agricultural programmes can be large14 and removing or changing the programme could not be described as marginal. How then is the total impact of a program related to its marginal impact?

Tackling three questions about the level of support

69. Underlying this question are three different interrelated sub-questions, each dealing with a different policy or modelling related issue:

1. Does a small marginal impact of a given support measure also imply a small total impact?
2. Can marginal impacts be different for different levels of support? If so, what are the implications for the total impact of a support program?
3. What are the modelling and estimation constraints and implications when analysing these issues?

70. These three questions are tackled successively using simple graphical analysis and mathematical calculus. The analysis is based on the impacts of an abstract support programme. Unless it is specified otherwise, marginal or total impacts are referred to in absolute terms, and not relative to price support as a benchmark. The implications drawn for the generic support programme may also apply to our benchmark market price support and is not exclusive of any type of payment or support.

71. Our main graphical tool is a representation of a functional relationship between the absolute level of expenditure in a given support programme (B) measured in monetary units (EUR), and the total level of production of the commodity or commodities concerned (Y) measured in tonnes.15 This representation makes it possible to abstract from the exact nature of the measure and the commodity involved. This can be expressed as Y(B,m1), meaning that the production Y is a function of the amount of support B, for a given type of support measure m1. Box C.1 gives definitions that may help to understand the discussion.

14. The term “large” implies here large total expenditure by a given country in agricultural support programmes. This section concerns total response for a country. A micro analysis of individual farmer’s response would have defined “large” in terms of payments per ton, per hectare or per farm.

15. For a set of commodities concerned a real value of production would be the most appropriate way of aggregation. In all the discussion in this section, we abstract from this technical issue.
### Box C.1. Definitions

**Marginal support** is a small additional amount of support provided through a given support measure. What is considered marginal is of course, subjective, but it can be safe to include changes with impacts up to 10% of the price of the affected input or output. In graphical terms the concept of “marginal” is neatly defined by the differential analysis.

**Total support** is the total expenditure in a given support measure in a country.

**Production – Support curve** is the graphical representation of the functional relation between the expenditure in a given support measure, B, and the level of production of the affected commodities (Y).

**Marginal impact** is the increase in production generated by a marginal increase in support. Geometrically this represents the slope of the Production – Support curve.

**Total impact** is the increase in production generated by the totality of the expenditure on a given support measure.

**Production ratio** for a given support measure m2, is the ratio between the marginal impact of m2 and the marginal impact of an identical marginal increase in market price support m1, used as a benchmark. Geometrically this corresponds to a ratio of the slope of the corresponding Production – Support curve for m2, over the slope for market price support.

**Degree of decoupling** with respect to a market price support benchmark is defined as unity minus the corresponding production ratio (see OECD, 2001a).

### 1. The relationship between marginal impacts and total impacts of a support measure

72. Even though the marginal impact of an additional payment granted may be small, the impact of a big amount of the same payment can be large. This is illustrated in Figure C.1 where the impact on production of two different measures of support m1 and m2 are represented. Measure 1 is assumed to be a measure of support with a relatively high marginal impact on production (the slope of the support-production curve is steep) as, for example, market price support (MPS). Measure 2 is a measure of support with a relatively small marginal impact on production (more decoupled) as, for example, area payments. Even though the marginal impact of an additional unit of m2 on production is small as represented by the slope $\beta_2$, a large amount of money granted through measure 2 can have as big an effect on production as a smaller amount of support granted through measure 1. Y₀ represents the level of production with no support, and Y₁ represents a higher level of production. The effect on production, the shift to final Y₁ from initial Y₀ level, can be reached either by granting the small amount B₁ of measure 1, or by providing the higher amount B₂ through the more decoupled measure 2. This makes clear that even support measures with a small marginal impact on production may influence production considerably if the total amount of support provided is large.

73. The slopes of the curves in Figure C.1 are positive, and equivalent slopes will be positive for any measure that is not fully decoupled. With constant positive slopes in Figure C.1 (even if small positive) it may be possible to achieve any level of production with a sufficient level of support. In general, if the level of support is high enough, even highly decoupled (but not fully decoupled) support measure can have a large impact on production$^{16}$. The first question posed is focused on the value of the slope $\beta$. The answer is

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16. Quantitative constraints attached to support programs can reduce or eliminate impacts on production beyond a certain limit. This will occur only if the constraint is individually binding and the lack of response is normally asymmetric (it may not operate for reductions in support). See OECD (2003a) for a discussion of the impact of quantitative constraints in the EU. In some cases it could be possible that the level of support is so high that its main incentive is associated with labour / leisure decisions in the farm household. This later incentive on production can potentially be negative (OECD, 2001c).
clear: small marginal impact of a support programme (highly decoupled) is not a sufficient condition for a small total impact on production. As illustrated in Figure C.1, if the level of support is large enough, a highly decoupled policy can potentially have a large total impact on production.

**Figure C.1. Two linear Production — Support curves**

2. Marginal impacts at different levels of support

74. With the constant slopes of Figure C.1, the production ratio as measured by the ratio of the slopes will be constant, as will the degree of decoupling. But the slope may not be constant for all levels of support. This second question is focussed on changes in the slope of the Production — Support curve and, therefore, on the convexity or concavity of this curve. In Figure C.2 different alternatives are represented. The starting point is the cluster of production — support observations around Y₁ and B₁, from which a slope β at the margin can be inferred. The question posed is how we can learn about the total impact of such a programme. The straightforward assumption, which is often used by modellers, consists of making a linear extrapolation represented by the middle, straight line in Figure C.2. This leads to a production level of Y₂ when the programme is eliminated. The total production impact of the programme is then estimated to be equal to (Y₁-Y₂)

75. However, the relation between the total amount of support and production is not necessarily linear. For instance, it could well be that the production-support curve is concave, that is the marginal impact of payments decreases with the level of support. The idea of decreasing marginal impacts is frequent in economics, applied, for instance, to decreasing marginal utility, decreasing marginal productivity or decreasing marginal returns. This situation is represented by the concave curve below the other two curves in Figure C.2. In this case, the elimination of the support programme would lead to production Y₃, and the total production impact that can be assigned to the whole programme is Y₁-Y₃, larger than under the linear assumption (Y₁-Y₂).

76. It could also be the case that the relationship between payments and production is convex as drawn in the upper curve in Figure C.2. In that case, the total impact on production (Y₁-Y₄) is lower than in

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17. Concavity of the Production — Support curve is defined by a negative second derivative \( \frac{\partial^2 Y}{\partial B^2} < 0 \). This is equivalent to concavity from below in the figure, and decreasing marginal impacts of support.
the linear case. However, this would imply an increasing marginal impact of payments, behaviour for which it is difficult to find an economic rationale\textsuperscript{18}.

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**Figure C.2. Alternative shapes of the Production-Support curve**

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77. It has often been assumed that the marginal production impact of support provided to farmers is constant; that is, the production-support curve is linear. But there is an economic rationale for decreasing impact of support. The idea is that a one Euro payment will generate a production response which is larger if the starting payment is small or zero, than if the same amount was added to an already existing payment of, for example EUR 1 000.

78. Additional support goes to two distinct components of production; that production already in place before the additional support is provided (infra-marginal), and any new production drawn into the market because of the increase in support (marginal). Current production already receives existing support, but any new production must be paid the previous level of support as well as the new support which prompted it; the expense of doing so drains away some of the expenditure on additional support, and so reduces its effect. Consider the following example: a market where there are ten units of production and no current support is given support totalling EUR 11, which draws in one more unit of production. This results in a rate of support of one Euro per unit and total production of 11 units. Imagine now that the previous ten units of production received already a rate of support of EUR 10 per unit. To achieve the additional rate of support of one Euro per unit and 11 units, production would cost EUR 21, EUR 1 for each existing unit of production, plus EUR 11 for the new unit of production which must receive the existing rate of support as well as the new. More funds are required to provide the same change in marginal incentive and the same production increase when there is pre-existing support.

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\textsuperscript{18} Nevertheless, under certain circumstances, individual entry/exit decisions may explain such a situation.
Despite the strength of this economic argument contributing to the concavity of the production-support curve, some simple mathematical calculations in Box C.2 illustrate that, in general, economic theory does not constrain the convexity or concavity of the production-support curve. However, if the economic response is represented by either linear or constant elasticity supply equations, the shape of the production-support curve is concave and there are decreasing marginal impacts of support. Most assumptions and estimations of parameters made in economics are either linear or constant elasticity, for which decreasing marginal impacts of support can be proved. We cannot exclude the possibility of a convex curve, the empirical question being hard to disentangle.

Box C.2. A Mathematical derivation of the concavity of the production – support curve

The inverse supply schedule of the relevant input or output for which the support generates an incentive can be expressed as \( p = f(q) \). Total support provided can be written as \( B = (f(q) - p_0)q \), where \( p_0 \) is the price without support and \( f(q) \) is the supported price. This function represents how total support is related with different levels of \( q \). When \( q \) represents output, double differentiating this function we can obtain the “concavity/convexity” of the relationship “production (vertical axis) / support (horizontal axis)”. This is the production-support curve that is represented in Figures 1, 2, 3 and 4.

\[
\frac{\partial B}{\partial q} = f - p_0 + qf'' > 0
\]

\[
\frac{\partial^2 B}{\partial q^2} = f'' + qf'' + f'' = 2f'' + qf''
\]

Whenever the supply function \( f \) is upward sloping (\( f'' > 0 \)), the production – support curve will also be upward sloping \( \frac{\partial B}{\partial q} > 0 \). If the second derivative of \( B \) is positive, then the production - support curve is concave from below. It can be easily shown that if the inverse supply function \( f \) is positive, \( f'' = 0 \), then concavity of the curve holds for any upwards sloped linear supply curve. If the inverse supply function \( f \) corresponds to an iso-elastic supply, \( f'' \) can be negative and the concavity needs to be proved. However, it can be easily shown that regardless of the value of the elasticity, an iso-elastic supply curve can only generate \( \frac{\partial^2 B}{\partial q^2} > 0 \) and, therefore concave production – support curves. However, counter-examples can be found of upwards sloped inverse supply curves non linear and non iso-elastic that lead to situations of convexity of the production - support curve.*

* For instance if \( f(q) = a^3 + \frac{1}{3}(q - a)^3 \), with derivatives \( f'(q) = (q - a)^2 \) and \( f''(q) = 2(q - a) \), then \( \frac{\partial^2 B}{\partial q^2} = 2(q - a)(2q - a) \), which it is not always positive. In fact it is negative for \( \frac{a}{2} < q < a \). In this interval the production - support curve would be convex.

What are the implications of the likely non linearity of the production – support curve? The production ratios calculated in order to estimate the degree of decoupling are simply the ratio of the slope of the production – support curve of a given measure over the corresponding slope for market price support. The dependence of the curve’s slope on the level of support affects all support measures including price support. This makes the production ratio potentially very sensitive to the initial levels of support in...
each type of measure. For instance, if both production support curves of price support and measure $m_2$ are concave and the level of support in the form of market price support is large while the level of $m_2$ is near zero, we would obtain a production ratio for $m_2$ that is much larger than if the ratio was calculated when the level of support of $m_2$ was high and price support was almost zero. An example of this type was discussed in Box 1 in OECD (2001b): using the PEM model, the production ratio of wheat area payments in the EU was estimated to be 0.6 in 1987 when price support was the main form of support, and 0.2 in 1998 when area payments were the main form of support.

3. Modelling and estimation issues

81. Empirical estimates of the degree of decoupling typically measure the impact of relatively small increases in payments, that is, they measure the impact of payments at the margin. Where the observed variability in the level of payments is low, econometric estimations have no alternative to estimating marginal impacts. Sometimes there are discrete jumps in the amount of the payments when a new payment is introduced. However, this one-off change of regime is usually better captured by variables representing a structural change rather than average impacts of the payment. Simulation models also tend to be limited to marginal changes, the only changes these models are typically well calibrated to handle. That is, most empirical work needs to rely on data and estimates compiled in the context of relatively small changes in the level of support, so reaction to big changes can only rarely be appropriately estimated. This makes most of the estimates valid only for small changes around the observed equilibrium with current levels of support.

82. For example, let us assume that for a certain programme there are some hypothetical pairs of production and support observed after modest changes in the payment (the points in Figure C.2). In this context answering the two questions we have posed would require two steps:

- Estimating, directly or indirectly, the marginal impact of the payments as equal to $\beta$, the slope of the corresponding regression line. In principle, there is no certainty about the impact of a big change. Observed levels of payments are around $P_1$ and the corresponding observed production levels are around $Y_1$. If the marginal impact $\beta$ is constant for all levels of support (the relationship remains linear), then production if payments were eliminated (other things being equal) would be $Y_2$, and the total production impact that could be assigned to the policy measure would be $Y_1-Y_2$. This impact can be large even with a small $\beta$, whenever the level of support is very high. This procedure of using estimated equations to simulate changes is standard in economics, but it is strictly valid only for not too big changes (for instance up to 10% changes in prices of the inputs or outputs affected).

- Inferring the shape of the curve. In some cases, when the data variability allows this, the curvature of the support-production curve may also be estimated. However, most of the estimated parameters in the literature represent linear or log linear underlying response curves, even when the observed variability is larger. These estimated parameters are often used to calibrate simulation models that allow policy changes to be analysed. The structure imposed on these models determines the curvature of the corresponding support-production curve. For the reasons explained in Box C.2, it is often the case that the curve is concave and it is always the case if the underlying supply equations are linear or iso-elastic. This happens to be the case of the PEM model, and of most economic models used for policy analysis.

83. No empirical estimation of the shape of the production support curve for any kind of programme has been found in the literature. This type of empirical work is difficult to envisage. However, we can use available economically consistent structures to illustrate the nature of the curvature of the production – support curve.
An illustration using the PEM Model

84. The PEM is a simulation model that can analyse the impact of policy changes. The model is calibrated based on estimated parameters that are expressed as coefficients in log-linear supply and demand equations. This section uses PEM to illustrate the potential importance of the level of support. Starting from the year 2000, a simulation is carried out in which the amount of money spent for hypothetical wheat area payments is increased in successive steps and the impact on production is estimated at each step. For each step a new equilibrium of the PEM model is calculated and the new equilibrium quantities produced are computed. Then, the impact on production quantities is graphed against the payment levels. This exercise is done for four countries (the European Union, the United States, Canada and Mexico) and three assumptions about the value of the elasticity of land supply (high, base and low). The corresponding twelve production – support curves are plotted in Figure C.3.

85. As expected all the curves in Figure C.3 are concave, even if the degree of concavity depends on the country and elasticity assumptions. This exercise helps to understand that the marginal impact of any support measure can be very dependent on the initial levels of support. However, there are many parameters and assumptions determining the shape of the curves.

Figure C.3. Production – Support curves from the PEM model. Sensitivity analysis of impacts of wheat area payments: Four OECD countries and three land supply elasticity values

Source: OECD Secretariat.

86. Figure C.4 takes one of the curves from Figure C.3 to illustrate numerically the implications of this curvature. In this example, USD 200 mn of area payments to wheat cause wheat production to increase by 1 million tonnes. The marginal impact of support in the form of area payments is measured by the slope.

20. The example refers to the base elasticity values in Mexico, but there is no intention to make any specific qualification for any specific country or programme.
of this curve. This means a marginal impact of 0.7 tonnes per USD 100, when initial support is zero, but only 0.3 tonnes per USD 100 when the initial area payments are USD 200 mn. The estimated total impact of this amount can differ by up to 60% from the linear extrapolation.

**Figure C.4. An example of Production – support curve from PEM results**

Area payments to wheat

<table>
<thead>
<tr>
<th>Area payments (million USD)</th>
<th>Change in quantity produced (million tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.37</td>
</tr>
<tr>
<td>50</td>
<td>0.37</td>
</tr>
<tr>
<td>100</td>
<td>0.40</td>
</tr>
<tr>
<td>150</td>
<td>0.40</td>
</tr>
<tr>
<td>200</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Source: OECD Secretariat.

**Some implications**

87. Three main implications can be drawn from this discussion about the levels of support:

1. Highly decoupled support programmes may have a large total impact on production if the total level of support is high. When trying to estimate the total production impact of support programmes that are not fully decoupled, the level of support typically matters. However, this argument applies even more forcefully to the most coupled forms of support and does not reverse the result that high levels of highly coupled support will have larger production impacts than the same high levels of more decoupled support.

2. There is an economic rationale for a decreasing marginal impact of support measures by which is meant that the first dollar of support may be less decoupled than the marginal dollar when the total level is high. However, it is in theory mathematically possible that marginal impacts of support measures do not decrease with their level of support.

3. Estimation and simulation results on decoupling have to be interpreted in the context of the whole production — support curve. The estimation of the total impact of a support programme using extrapolations of estimated or simulated impacts at the margin may induce erroneous conclusions. For instance, if marginal impacts are decreasing as in the illustration made in this paper and the level of support is high, extrapolations normally underestimate total production impacts. On the contrary, if the marginal impacts are increasing, the extrapolation would overestimate total impacts.
CONCLUDING REMARKS

88. This paper has discussed three sets of issues that have repeatedly been raised in the debate on decoupling. All three issues are hard to handle empirically because of the difficulty of obtaining the appropriate data with the appropriate sample of years, whether aggregate data or micro information on farmers. There are also some theoretical difficulties in defining a robust framework to analyse some of the issues, such as the formation of expectations. This paper is not intended to provide quantitative responses to any of the questions raised, but rather to clarify and facilitate discussion on areas that are an important part of the decoupling debate. This has been done using standard economic techniques and some illustrative examples. Therefore, no particular conclusion can be drawn about specific measures in a particular country. None of the three illustrative studies looks at policy instruments in the context of multifunctionality or non-commodity outputs provisioning.

89. By design, this paper does not provide precise conclusions on the magnitude nor the direction of the effects analysed. Neither does it cast any doubt on the advantage of moving to more decoupled forms of support. Most of the analysis applied to direct payments, particularly on expectations and on levels of support, can also be directly applied to coupled measures, such as market price support, with effects that are likely to be of larger magnitude. For the same programme conditions, the same expectations effects and the same levels of support, more decoupled measures are likely to have smaller impacts on production and trade.

90. On the other hand, the paper points out the real need to scrutinise the detailed conditions attached to “more decoupled measures” to ensure that the benefits of moving away from coupled support are fully realised. Conditions on the use of land, cross compliance conditions and the creation of expectations about future payments have been discussed and all found to be relevant conditions that can affect the degree of decoupling of direct payments. If the payments are not fully decoupled, the level of support is found to be an important factor determining total impacts on production and trade.
Annex A.

The design of the illustrative examples in Section A

Brandenburg data

1. In order to illustrate the effects of ADPs on farms with different cost structures, various examples of farm or land types have been created. The calibration of these illustrative examples does not purport to be representative of real farms or land types. However, in order to use realistic numbers data on cost structures for producing wheat, potatoes, pasture and set-aside are taken from a study conducted by the former “Landesanstalt für Landwirtschaft Brandenburg” (LLB) in Germany. The hypothetical hectares are constructed using average values from the Brandenburg region in 2001 (Table Annex A.1).

Table AA.1. Brandenburg Data on Production Revenue and Costs

<table>
<thead>
<tr>
<th>Revenue</th>
<th>Winter wheat</th>
<th>Potatoes</th>
<th>Set-aside</th>
<th>Pasture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield1 (t./ha.)</td>
<td>8</td>
<td>30</td>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td>Producer Price (€/t.)</td>
<td>106</td>
<td>77</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Revenue (€/ha.)</td>
<td>798</td>
<td>2278</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Variable cost (€/ha.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>32</td>
<td>507</td>
<td>0</td>
<td>13</td>
</tr>
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<td>Fertilizer</td>
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<td>124</td>
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<td>89</td>
</tr>
<tr>
<td>Crop protection</td>
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<td>176</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Machinery</td>
<td>132</td>
<td>258</td>
<td>32</td>
<td>39</td>
</tr>
<tr>
<td>Other variable cost**</td>
<td>53</td>
<td>334</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Interest</td>
<td>11</td>
<td>21</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>484</td>
<td>1420</td>
<td>39</td>
<td>180</td>
</tr>
<tr>
<td>Other specific cost (€/ha.)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages</td>
<td>60</td>
<td>158</td>
<td>17</td>
<td>86</td>
</tr>
<tr>
<td>Fixed cost machinery</td>
<td>128</td>
<td>277</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td>Rents, other cost associated with land</td>
<td>129</td>
<td>129</td>
<td>129</td>
<td>79</td>
</tr>
<tr>
<td>Total</td>
<td>318</td>
<td>563</td>
<td>172</td>
<td>194</td>
</tr>
<tr>
<td>Total cost €/ha</td>
<td>801</td>
<td>1984</td>
<td>211</td>
<td>374</td>
</tr>
</tbody>
</table>

Notes:
1. The yield for pasture is measured in t./ha of dry matter.
2. The specific cost, as opposed to general farming overhead, includes the costs that can be attributed to specific lines of production. The specific variable cost of crop production includes the expenses for seed, fertilizer, crop protection, variable machinery cost, processing such as drying, interest on working capital.
3. The other specific cost of crop production includes salaries, fixed machine cost, rents and other costs attached to land.
Source: Calculations on base of LLB Data.

21. This institution has been integrated into the “Landesamt für Verbraucherschutz und Landwirtschaft”. It is a sub-organization of the Ministry for Agriculture and Environment of the federal state of Brandenburg, Germany. The data was obtained from the experimental farm network of Brandenburg, basically obtained by farm surveys in 2001.
2. In the original data there is no revenue for pasture. This is assumed to be 180 €/ha, which is the variable cost which makes production viable. The activity of producing “nothing” has been introduced. If the farmer decides to produce “nothing”, it is assumed that no work will be done on the land, so the cost of producing “nothing” is zero. The opportunity cost of labour is not available in the data. In reality, however, the possibility of off farm work can be an important factor when deciding whether to stay in farming or not. In Table Annex A.1, the details of the items included in variable costs and other specific costs are shown. For the activity “wheat” winter wheat is used. “Potatoes” are potatoes intended for human consumption. “Set-aside” is where the farmer does no sow anything on the land. The data for “pasture” refers to pasture which is used for grazing as well as for mowing.

**Building five examples of hectares or farms**

3. As a result of this exercise the cost structure obtained is arbitrarily assigned to Hectare A, whose cost structure is defined at the top of Table A.1 in Section A. This resulting Hectare A is not representative of any real hectare or farm. It has a comparative advantage in the production of potatoes as shown by the much higher profits obtained. In fact, Hectare A would obtain negative profits in any other activity except when producing nothing.

4. The other four examples are obtained by modifying the starting cost structure. In all four examples, the variable costs of producing potatoes are assumed to be much larger than in hectare A. These differences in costs relative to hectare A are shown in the shaded cells in Table A.1. In addition to these higher variable costs, each hectare has other particularities as compared to hectare A. The cost structure of hectares B to E is constructed to ensure that the most profitable activity gives zero net profits to the farm, as if there was no initial incentive to exit/entry the sector.

5. Hectare B has slightly smaller variable costs to produce wheat and would produce wheat in the absence of any payment. Hectare C has smaller costs for set aside and the farmer would produce nothing. Hectare D has a slightly lower cost for pasture for livestock, and this would be its preferred use. Finally, hectare E has a slightly lower cost for set aside and pasture, but the optimal activity without any payment is to produce nothing.

**The amount of the payment**

6. In 2001 in the Bradenburg area, farmers also received an area payment for COPs and set-aside as defined in Agenda 2000 of 285 €/ha. The area payment per hectare is assumed to remain unchanged, i.e. it will be 285 €/ha whatever the type of payment and the commodity being analysed.

**The cross compliance condition**

7. In order to illustrate the potential impact of cross compliance a limit on the amount of nitrogen applied per hectare of 150 kg is assumed. Only wheat is affected by this limit. Therefore, the only change in the cost structure occurs for wheat. From the same data source it can be calculated that the fall in fertilizer use necessary to qualify for the payment corresponds to a reduction in cost of 9.24 € per hectare. The production function is unknown, but, a decrease in wheat yield of 0.9 tonnes per hectare due to the reduction in fertilizer input is assumed, so that the net effect of the cost reduction and the reduction in yield is a reduction in profit of 86 €/ha. This estimate is used to calculate the optimal decision under ADP number 4 that includes cross compliance conditions.
Annex B.

An Analytical Framework for the Examples in Section B

1. Assume one farmer producing one output and two inputs in a dynamic context. The farmer maximises the expected value of the discounted stream of profits. The optimisation problem for the farmer can be generalised using the following expression:

\[
\max_{\delta \in (0,1)} E\left[ \sum_{t=1}^{T} \delta^{t-1} \left( \bar{P}_t \cdot Q_t - r_t \cdot A_t - w_t \cdot I_t + \tilde{g}_t(B_t) \right) \right] \quad \text{s.t.} \quad Q_t = f(A_t, I_t)
\]

where, \( E[\cdot] \) denotes statistical expectation, \( t = 1..T \) are the time periods representing the temporal horizon of the farmer, \( \delta \in (0,1) \) is the time discounting factor, \( \bar{P}_t \) is the price of the output, \( \tilde{g}_t(B_t) = \tilde{g}_t(B_t, Q_{t-i}, A_{t-i}, P_{t-i}) \) is the stochastic payment function which represents the policy scheme, where \( B \) is the amount of support and the other arguments potentially apply to different policy schemes, \( Q_t = f(A_t, I_t) \) is the production function with two factors considered: area \( A \) and other variable inputs \( I \), \( r_t \) and \( w_t \) are the implicit or explicit prices of the two production factors area \( A \) and other inputs \( I \).

2. The expectation mechanism would be represented by a specific form of the stochastic function \( \tilde{g}_t \). The potential consequences of inter-temporal expectations of receiving a direct payment are examined through a brief analysis of the first order conditions. Three kinds of uncertain direct payments are included in profits: a truly lump sum transfer \( \bar{Y} \) in each period with non-negative probability, a payment \( \text{“a”} \) dollars per hectare \( a \cdot A_{t-i} \) (\( A_{t-i} \) being the land used in period \( t-i \)) with the same probability of being paid, and a payment of \( \text{“q”} \) dollars per ton \( q \cdot Q_{t-i} \) (\( Q_{t-i} \) being the production in period \( t-i \)). We assume that the perceived probability of the payment (or the base update) depends on the level of production or area use in a previous period \( t-i \) \( \rho(t) = \rho(A_{t-i}, f(A_{t-i}, I_{t-i})) \) and we impose a binomial distribution with this probability. It would be more realistic to assume that there is a complete probability distribution of a direct payment associated with current production. This is just a simplified example of how farmers’ beliefs about future payments may affect current production decisions.

3. The expected payment and the farmer’s production problem can be written as:

\[
E[\tilde{g}_t] = \rho(t) \cdot (\bar{Y} + a \cdot A_{t-i} + q \cdot Q_{t-i})
\]

4. Using dynamic programming results (the Euler condition), we obtain first order conditions for each period that can be written as:

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22. See also Annex IV in OECD (2001a) for a similar development.

23. This is a binomial distribution is defined as: \( g_t = \bar{Y} + a \cdot A_{t-i} + q \cdot Q_{t-i} \) with probability \( \rho \) and \( g_t = 0 \) with probability \( (1-\rho) \).
5. In this context, the uncertain future direct payments have three different kinds of effects on production decisions:

- They reduce the effective marginal cost of land used in production due to the additional expected payments generated by an additional unit of land used in production. The amount of this reduction is \( \delta'(\rho(t) \cdot a) \). This is a generalised version of the relative price effect of area payments. The per hectare payment “a” is reduced by the discount factor \( \delta \) and the probability of the payment or the update \( \rho \).

- They increase the effective incentive output price received by the farmer by an amount equal to \( \delta'(\rho(t) \cdot q) \). This effect will exist for the area payment if there is a probability \( \rho \) that both the base area and yield are updated.

- There may be an additional effect creating incentives to use the land or to produce more. This effect is related to the expectation of an additional probability of receiving the payments/update induced by current area \( \delta'(\rho_q'(\bar{Y} + a \cdot A_i) + q' \cdot Q_i) \) and with an expectation effect created by farmers who believe that the probability of receiving a payment in the future is positively related to current production \( (\rho_q' > 0) \): \( \delta'(\rho(t) \cdot q + \rho_q' \cdot (\bar{Y} + a \cdot A_i) + q' \cdot Q_i) \). This expectation effect will occur even if the expected payment is a truly lump sum that is not related to any production variable in any period.

6. The expressions in the Euler equation above are used in the examples in the main text to recalibrate the production ratios obtained with the PEM model. The production ratios from PEM are assumed to correspond to the case of current production linkage \( i=0 \), complete certainty of receiving the payment \( (\rho=1) \) and zero additional probability \( (\rho'=0) \). Area and area plus yields updates are then calibrated with the corresponding discount rates and probabilities.

7. Analogous methodology is applied to illustrate the case of optional updating of yields. Additional assumptions are made for this exercise. It is assumed that farmers staying in production would benefit from a trend increase in yields at an annual rate of 1%. It is also assumed that the production impact of this yield update is proportional to the impacts of market price support and to the total percentage increase in yields that can be optionally updated.
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