The Efficiency of Direct Payments Versus Tax Reductions under Uncertainty

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JEL Classification: H21, H42, Q18, Q20.
Keywords: Uncertainty, Direct Payments, Income Tax Reductions, Agriculture.

1. Introduction

Agricultural policy reforms such as Agenda 2000 in Europe or the U.S. Farm Act, 1996, promoted direct payments, either as direct “green payments” or as compensatory payments as a means of income support for farmers. Previous income support for farmers was based on price supports for different commodities, but this was found to be inefficient for responding to the challenges agriculture is facing.

The OECD (1995) distinguishes between “pure” direct payments and “less economically distorting direct payments”, commonly referred to as decoupled or coupled direct payments, respectively. Decoupled payments are unrelated to past, future and present levels of output and production factors and free of any conditions or constraint on recipients. Coupled payments include measures that impose conditions on recipients or ones that may be linked to input, output or income levels, providing they are nearly neutral with respect to current and future production levels. Decoupled payments under environmental or regional assistance programs, or for income support, are classified as green box measures by the WTO Agreement, within the Uruguay Round (WTO, 2000) – which

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stipulates a 20% reduction in the Total Aggregate Measure of Support (Total AMS). Green box measures however, do not need to be included in the calculation of the Total AMS and are exempt from this 20% reduction. As such, they have a specific appeal to policy makers.

The majority of direct income measures, implemented in the OCED member countries fall into the category of coupled direct payments aimed at stabilizing and/or providing income. As such, they have a distorting effect on production. However, the literature also identifies problems with decoupled direct payments in the context of a stochastic environment. Sandmo (1971), and Pope and Just (1991) showed that decoupled direct payments which have a pure wealth effect will not alter production decisions if preferences are CARA (Constant Absolute Risk Aversion). If direct payments were stochastically independent from farm profits (i.e., profits obtained exclusively from farming), direct payments would induce a pure wealth effect and consequently lead to a change in production decisions for preferences other than CARA. Production would rise with an increase in pure wealth if preferences were DARA (Decreasing Absolute Risk Aversion) or it would decrease with an increase in pure wealth if preferences were IARA (Increasing Absolute Risk Aversion). For a stochastic environment, however, decoupled support often does not present a pure wealth effect because the farm profits and the magnitude of direct payments are stochastically dependent, e.g., by the weather or the market price. For such cases, Hennessy (1998) establishes sufficient conditions, in which an increase or decrease in decoupled direct payments increases or decreases production respectively.

This paper provides an empirical application of the theory of the farmer’s behavior under uncertainty in the presence of decoupled green direct payments in exchange for the provision of environmental public goods, or the production of positive externalities. We compare our results, obtained for the case of Switzerland, to the results of an empirical analysis for Iowa conducted by Hennessy (1998). This paper extends Hennessy’s previous work to the case where market price and crop yields are correlated, i.e. the case of a locally traded good or a small country with no free trade. Additionally, the Swiss direct green payment scheme presents the additional element of income support and income stabilization at the same time.

Finally, and most importantly, we analyze the effect of tax reductions on farm profits in exchange for the provision of environmental public goods, or the production of positive externalities. In contrary to the case of certainty where tax reductions do not affect the optimal level of output, Sandmo (1971) showed that this result does not hold in the case of uncertainty. However, the results presented by Sandmo (1971), obtained for the special case of full loss offset, do not show
The Efficiency of Direct Payments Versus Tax Reductions under Uncertainty

2. Direct Payments

Hennessy (1998) showed that even decoupled direct payments alter production decisions in the context of a stochastic environment. To quantify the magnitude of this distortion, we analyzed the effect of decoupled direct payments, as they were paid in Switzerland according to the Swiss Farm Bill 2000, Article 31b. As an example, we consider the case of wheat, where farmers received direct payments provided that they followed certain guidelines for its production. Moreover, the price of wheat was guaranteed, at the time this study was carried out, up to a certain national production total. Once the national production exceeded this total, the target price was not supported anymore, and farmers faced a negatively sloped, but still government supported, demand curve. Thus, the government provided income support and income stabilization. Additionally, our statistical analysis shows that there was a strong correlation between the individual crop yields at the farm level and the nationally produced amount of wheat. Thus, the farmer’s crop yield was not independent of the market price, due to a government price scheme that is based on the amount of nationally produced wheat. This scenario captures the case of locally traded goods or the case of a small country with no free trade with the rest of the world.

2.1. Empirical Analysis

The Swiss agricultural classification schemes for agricultural production distinguishes between 6 different zones. For our empirical analysis we used the data base of the Central Analysis of Accountancy Data of the Federal Research Station for Agricultural Economics and Engineering of Tänikon, (FAT, 1987–1996), and calculated the mean wheat yield per hectare, $\mu_F$, and the standard deviation of the wheat yields per hectare $\sigma_F$ for all farms which cultivated at least 0.5 ha of wheat throughout the period between 1987 and 1996, in a particular zone. Given these selection criteria our sample consisted of 34 farms.

Before calculating the two statistical parameters we estimated the time trend of the crop yields for the indicated time period. The trend captures the to which extent a tax reduction distorts the optimal output level. To determine the magnitude of the distortion an empirical analysis is proposed. Moreover, this empirical analysis allows to compare the distorting impact of direct payments and tax reductions. In this way it may guide policy makers to define policies with the least distorting impact.
changes in production technology, cultivation technique and climate. However, what is not captured is the effect of the weather. Hence, the residuals of this estimation process are interpreted as weather-induced yield variations (Goetz, 1993). The standard deviation and the mean of the crop yields were calculated based on the residuals and on the estimated crop yields respectively. To portray the economic process of production, we needed to calculate the minimum cost associated with the observed crop yields. Total costs were broken down, in line with the Gross Margin Catalogue of the Swiss Center for Agricultural Extension (LBL), into fixed cost per ha, cost proportional to the crop yield and cost proportional to the amount of fertilizer applied. The same catalogue also allowed us to determine what the fixed cost per ha was, as well as the cost proportional to the crop yield (Keusch, 2000). The cost proportional to the amount of fertilizer applied was determined with the help of a quadratic production function for this zone (Walter, 1994). This function allows us to calculate the necessary minimum amount of fertilizer to produce the observed crop yields. Once the total cost was calculated we were in the position to establish the cost function $C(x)$, i.e. the total cost as a function of the observed crop yield $x$ measured in dt. Additionally, we estimated the mean and the standard deviation of the nationally produced wheat yields per hectare, denoted by $\mu_{CH}$ and $\sigma_{CH}$ respectively, based on data collected by the SBS (1970–1999). Like in the case of the farm data we calculated the time trend and used the residuals and the estimated values of the national crop yields to calculate the national statistical parameters. The results of our calculations and estimations are presented in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Farm Level</th>
<th>National Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean crop yield</td>
<td>$\mu_F = 56.98$ dt/ha</td>
<td>$\mu_{CH} = 59.03$ dt/ha</td>
</tr>
<tr>
<td>Std. dev. of crop yield</td>
<td>$\sigma_F = \pm 9.64$ dt/ha</td>
<td>$\sigma_{CH} = 4.736$ dt/ha</td>
</tr>
<tr>
<td>Cost Function</td>
<td>$C(x) = 2378 + 2.2852 \times \exp(0.0786x)$</td>
<td>$-$</td>
</tr>
</tbody>
</table>

An increase in inputs such as nitrogen fertilizer, fungicide and pesticides would lead to an increase in the mean yield. However, an increase in the mean yield is accompanied by an increase in the variability of the yields. Regev, Gotsch and Rieder (1997) calculated the increase in the variance of the returns for wheat resulting from an increase in the three inputs mentioned above. This data allowed us to calculate the increase in the standard deviation of the crop yields.
per hectare at the farm level, $\sigma_F$, due to an increase in the mean yield $\mu_F$. The results are presented in Table 2.

Table 2: Changes in $\mu_F$ as a Result of a Change in $\sigma_F$ in dt/ha

<table>
<thead>
<tr>
<th>$\mu_F$ (dt/ha)</th>
<th>$\sigma_F$ (dt/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.531</td>
<td>7.513</td>
</tr>
<tr>
<td>41.432</td>
<td>7.827</td>
</tr>
<tr>
<td>46.069</td>
<td>8.079</td>
</tr>
<tr>
<td>50.299</td>
<td>8.617</td>
</tr>
<tr>
<td>54.528</td>
<td>9.203</td>
</tr>
<tr>
<td>58.758</td>
<td>10.066</td>
</tr>
<tr>
<td>62.217</td>
<td>11.046</td>
</tr>
<tr>
<td>67.216</td>
<td>12.698</td>
</tr>
<tr>
<td>68.516</td>
<td>13.573</td>
</tr>
<tr>
<td>69.716</td>
<td>14.380</td>
</tr>
<tr>
<td>70.445</td>
<td>15.544</td>
</tr>
</tbody>
</table>

The government-supported demand function $q$ for wheat for the years 1995 and 1996 was calculated based on data supplied by the SBS (1970–1999), which provides the inverse demand function expressed in terms of one hectare:

$$p(q) = \begin{cases} 
151.322 - \frac{q}{1.285} & , q > 39 dt \\
87.4105, & , q \leq 39 dt.
\end{cases}$$

(1)

Farm profits per hectare $\pi(x)$ can be calculated by $\pi(x) = p(q)x - C(x)$, where $q$ and $x$ are both stochastic. It is assumed that $x > 0$ and $q > 0$ have a truncated normal distribution with parameters $(\mu_F, \sigma_F)$ and $(\mu_{CH}, \sigma_{CH})$ respectively. However, $x$ and $q$ are not independent. Their linear dependency, expressed as the correlation coefficient $r$, was estimated based on the central evaluation of the accounting data for Swiss farms (FAT, 1987–1996). The value was found to be 0.63. Hence, they were modelled as a bivariate normal distribution taking into account the value of $r$.

We employ the same utility function as it was used in the study by Hennessy (1998). It is quite flexible and allows us to accommodate CARA and DARA preferences. For reasons of brevity, however, we limit our discussion to the case

1. The analysis does not incorporate years previous to 1995, since there were changes in the government support program.
2. In order to obtain the desired linear dependency between the stochastic variables $x$ and $q$, they were generated according to $x = \alpha_xz_F + \mu_F$ and $y = \alpha_xz_F + \mu_{CH}$, where $\alpha_1 = 0.63\sigma_{CH}$, $\alpha_2 = \sqrt{\sigma_{CH}^2 - \alpha_1^2}$ and $z_1, z_2$ are normal distributed variables with mean 0 and standard deviation 1.
3. More flexible utility specification, such as the expo-power function of Saha (1993), have been developed; however, it is often not quite clear how the choice of the parameter values relate to risk aversion attributes (Hennessy, 1998).
of DARA preferences since they are widely supported by the empirical literature (Binswanger, 1981; Chavas and Holt, 1990).

The utility as a function of the farm profit level, $\pi$, is presented by

$$U(\pi) = -\exp(-\gamma_1 \pi) + \gamma_2 \pi,$$

for $\gamma_1, \gamma_2 > 0$, and all $\pi$ (Lin and Chang, 1978). The coefficient of absolute risk aversion is given by

$$\rho(\pi) = \frac{\gamma_1 \exp(-\gamma_1 \pi)}{\gamma_1 \exp(-\gamma_1 \pi) + \gamma_2}.$$  

The chosen utility function is a polar case of the three-parameter function

$$U(\pi) = -\exp(-\gamma_1 \pi) - \alpha \exp(-\beta \pi),$$

originally suggested by Pratt (1964). For the original function the risk aversion measure is limited by $\lim_{\pi \to \pm \infty} = \min\{\lambda_1, \beta\}$ and $\lim_{\pi \to -\infty} = \max\{\lambda_1, \beta\}$, while in the polar case it holds that $\lim_{\pi \to \pm \infty} = 0$ and $\lim_{\pi \to -\infty} = \gamma_1$. In order to specify the parameters of the utility function we did not make use of the estimates reported in the literature. Often these values cannot be employed since neither the underlying distribution function nor the support (range) of the stochastic variable coincides with those of the problem analyzed. Instead, we employed the concept of the risk premium to specify the parameters of the utility function. Since its interpretation is much more intuitive it conveys more information than the pure risk aversion coefficient. The risk premium, $\theta(\pi)$, denotes the fraction of the standard deviation of an equiprobable two-point gamble that a risk-averse person would be willing to pay to avoid the gamble. Thus, we obtain:

$$\theta(\pi) = \frac{E(\pi) - U^{-1}\left[U(\pi + \sigma_x) + \frac{1}{2} U(\pi - \sigma_x)\right]}{\sigma_x},$$

where the two point gamble is in terms of $\pm \sigma_x$. To compare our result with those of Hennessy we also choose $\theta(0) = 0.5$ and $\theta(E(\pi)) = 0.25$. By using the two values of $\theta(\cdot)$ equation (6) can be solved for the values of $U^{-1}[\cdot]$ – the certainty equivalents $CE_i$ and $CE_{\pi}$. Thus the following $i$ equations, $i = 1, 2$ have to hold:

$$\frac{1}{2} U(\pi_i + \sigma_x) + \frac{1}{2} U(\pi_i - \sigma_x) = U[CE_i], \quad i = 1, 2,$$
where $\pi_1 = E(\pi)$ and $\pi_2 = 0$. The two equations were solved numerically in order to specify the parameters $\gamma_1$ and $\gamma_2$ of the utility function $U$. The results are presented in Table 3.

Table 3: Parameters and Risk Attitudes

<table>
<thead>
<tr>
<th>$\gamma_1$</th>
<th>$\gamma_2$</th>
<th>$\theta(\pi = 0)$</th>
<th>$\theta(\pi = \pi')$</th>
<th>$\rho(\pi = 0)$</th>
<th>$\rho(\pi = \pi')$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00247668</td>
<td>0.000381477</td>
<td>0.5</td>
<td>0.25</td>
<td>0.00214612</td>
<td>0.00080626</td>
</tr>
</tbody>
</table>

2.2. Simulation

Based on the data presented in Tables 1 to 3 we simulated for each of the eleven pairs of $\mu_F$ and $\sigma_F$ (Table 2) 30000 wheat yields per hectare. The high number of drawings ensured that the mean and standard deviation of the simulated values settled on the prespecified values. The results obtained allowed us to calculate the associated profits per hectare and the corresponding utility. We assumed that producers maximize their expected utility derived from the profits of agricultural production. The farmers choice variable is $\mu_F$, i.e. the intensity of production. Higher expected yields, however, are only obtained at the cost of high risk, i.e., an increase in $\sigma_F$. In accordance with the supposition that farmers maximize their expected utility we selected the pairs of $\mu_F$ and $\sigma_F$ that yielded the highest expected utility, thereby determining the optimal value of the choice variable $\mu_F$ of the farmer.

To evaluate the impact of direct payments on the production intensity we added 500, 1000, 2000 and 5000 Swiss Francs (CHF) to the farm profits per hectare. The altered values of the farm profits per hectare translate into different values of utility, and therefore the maximization of the expected utility may lead to farmers choosing a different production intensity. The outcome of these calculations is presented in Table 4.
Table 4: Optimal Intensity as a Function of Direct Payments

<table>
<thead>
<tr>
<th>Direct payment</th>
<th>Optimal intensity(*)</th>
<th>Farm profits</th>
<th>Farm profits plus direct payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>67.217 dt (0.0%)</td>
<td>1820</td>
<td>1820</td>
</tr>
<tr>
<td>500</td>
<td>69.717 dt (3.7%)</td>
<td>1820 + 75 = 1895</td>
<td>1895 + 500 = 2395</td>
</tr>
<tr>
<td>1000</td>
<td>69.717 dt (3.7%)</td>
<td>1820 + 75 = 1895</td>
<td>1895 + 1000 = 2895</td>
</tr>
<tr>
<td>1500</td>
<td>70.446 dt (4.8%)</td>
<td>1820 + 93 = 1913</td>
<td>1913 + 1500 = 3413</td>
</tr>
<tr>
<td>2000</td>
<td>70.446 dt (4.8%)</td>
<td>1820 + 93 = 1913</td>
<td>1913 + 2000 = 3913</td>
</tr>
<tr>
<td>5000</td>
<td>70.446 dt (4.8%)</td>
<td>1820 + 93 = 1913</td>
<td>1913 + 5000 = 6913</td>
</tr>
</tbody>
</table>

(*) The values in brackets indicate the increase in production in percent as a result of direct payments.

The results show that direct payments, as they were in place in Switzerland, enhance the optimal production intensity of a risk-averse producer by approximately 4.25%. However, the intensity effect decreases as direct payments increase. The first 500 Swiss Francs leads to an increase in production that increases profits beyond the amount of the direct payment by 74.91 CHF (distortion effect). Thereafter, the distortion effect decreases with an increase in direct payments to 18 CHF (75 + 18 = 93) and then to 0 CHF. In accordance with the definition used by Hennessey (1998), the Swiss direct payment scheme can be considered as decoupled since the governmental price support does not depend on the farmers’ output. Yet, they are linked stochastically. A comparison of our results with those of Hennessy, obtained for corn production in Iowa, confirms the production intensification effect of decoupled direct payment, and shows that this effect is even stronger for the case of wheat production in Switzerland, i.e. 4.8% versus 2.75%.

3. Tax Reductions on Farm Profits

A well-established result in the theory of the firm is that a change in a proportional rate of profit taxation will have no effect on the level of output. In line with this result, one could think of green tax reductions \( \tau \) on farm profits in exchange for the provision of environmental public goods or the production of positive externalities. However, Sandmo (1971) has shown that this result does not hold in the presence of uncertainty and that the level of output does indeed vary with a change in the tax rate. In the case of a farm which can always compensate losses
from one activity with gains from another in such a way that it never experience
a loss (full loss offset), Sandmo (1971) demonstrated that an increase in the tax
rate will either increase, leave constant or reduce output depending, respectively,
on whether relative risk aversion is increasing, constant, or decreasing.

While the theoretical results of the effect of direct payments or tax reductions
on the level of output are interesting, they do not allow to estimate the magni-
tude of this effect. In particular they do not allow to compare the effect of these
two policies. For this purpose we complemented our empirical study by calculating
the change in output as a result of a reduction in the tax rate. However, we
do not consider the limited case of full loss offset considered by Sandmo (1971),
since this situation is not typical for agricultural firms. However, we distinguish
between two situations. In the first case (partial loss offset) farmers receive a sub-
sidy that compensates in part for their losses. Hence, they may experience profit
losses. The amount of the subsidy corresponds to the product \(-\pi\), for \(\pi < 0\).
In the second case (no loss offset) farmers receive tax reductions only for the
case where farm profits are positive. In order to compare direct payments and
tax rate reductions the chosen tax rate reductions were the equivalents of direct
payment of 500, 1000, 1500, 2000 and 5000 CHF. For instance a direct pay-
ment of 500 CHF is equivalent to a tax reduction of 0.275 of the average farm
profits obtained with no government support (1820 CHF). The tax reductions
corresponding to the direct payments of 1000, 1500, 2000 and 5000 were cal-
culated likewise and are presented in Tables 5 (partial loss offset) and 6 (no loss
offset). The results show that tax reductions, contrary to initial expectations, are
equally as distorting as direct payments. Yet, tax reductions with loss offset are
more costly to the government than pure direct payment. For example tax reduc-
tions, equivalent to direct payments of 500 CHF, require government spending of
521.10 CHF. Evaluation of the remaining direct payments shows that tax reduc-
tions with loss offset increase government spending by 4–5%.

On the other hand, tax reductions without loss offset are less distorting than
direct payments or tax reductions with loss offset. For the most realistic case of
tax reductions equivalent to direct payments of 500 CHF, the distortion effect
even becomes zero if losses are not offset. However, tax reductions without loss
offset increases government spending by 0–4% compared to pure direct pay-
ments. From a social point of view an increase in government spending can be
considered as a transfer and does not affect efficiency. Hence, tax reductions with-
out loss offset are always superior to direct payments. However, this result may
change if one takes into account the transfer costs incurred by the government.
Thus, if transfer costs and tax reductions are very high, tax reductions without
loss offset may no longer be superior to pure direct payments.
Table 5: Optimal Intensity as a Function of Tax Reductions with Partial Loss Offset

<table>
<thead>
<tr>
<th>Tax rate reduction</th>
<th>Optimal intensity (*)</th>
<th>Farm profits</th>
<th>Farm profits plus tax reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>67.217 dt (0.0%)</td>
<td>1820</td>
<td>1820</td>
</tr>
<tr>
<td>0.275</td>
<td>69.717 dt (3.7%)</td>
<td>1820 + 75 = 1895</td>
<td>1895 + 521 = 2416</td>
</tr>
<tr>
<td>0.550</td>
<td>70.446 dt (4.8%)</td>
<td>1820 + 93 = 1913</td>
<td>1913 + 1578 = 3491</td>
</tr>
<tr>
<td>1.099</td>
<td>70.446 dt (4.8%)</td>
<td>1820 + 93 = 1913</td>
<td>1913 + 2104 = 4017</td>
</tr>
<tr>
<td>2.749</td>
<td>70.446 dt (4.8%)</td>
<td>1820 + 93 = 1913</td>
<td>1913 + 5260 = 7173</td>
</tr>
</tbody>
</table>

(*) The values in brackets indicate the increase of the production in percent as a result of tax reductions.

Table 6: Optimal Intensity as a Function of Tax Reductions with No Loss Offset

<table>
<thead>
<tr>
<th>Tax rate reduction</th>
<th>Optimal intensity (*)</th>
<th>Farm profits</th>
<th>Farm profits plus tax reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>67.217 dt (0.0%)</td>
<td>1820</td>
<td>1820</td>
</tr>
<tr>
<td>0.275</td>
<td>67.217 dt (0.0%)</td>
<td>1820 + 0 = 1820</td>
<td>1820 + 500 = 2320</td>
</tr>
<tr>
<td>0.550</td>
<td>68.517 dt (2.1%)</td>
<td>1820 + 41 = 1861</td>
<td>1861 + 1023 = 2885</td>
</tr>
<tr>
<td>0.825</td>
<td>68.517 dt (2.1%)</td>
<td>1820 + 41 = 1861</td>
<td>1861 + 1535 = 3397</td>
</tr>
<tr>
<td>1.099</td>
<td>68.517 dt (2.1%)</td>
<td>1820 + 41 = 1861</td>
<td>1861 + 2047 = 3908</td>
</tr>
<tr>
<td>2.749</td>
<td>69.717 dt (3.7%)</td>
<td>1820 + 75 = 1895</td>
<td>1895 + 5210 = 7105</td>
</tr>
</tbody>
</table>

(*) The values in brackets indicate the increase of the production in percent as a result of tax reductions.

4. Conclusions

This paper analyzes the optimal behavior of agricultural producers in the presence of direct payments and uncertainty. For the case of Switzerland, it empirically confirms previous results that even decoupled direct payments intensify agricultural production in the context of a stochastic environment. The intensification effect in Switzerland is even stronger than for the previously analyzed case of Iowa; the magnitude of the overall effect is not large but definitely not negligible. Additionally, we suggest tax reductions as an alternative means of income support or income stabilization in exchange for the provision of environmental public goods. However, only the case of no loss offset tax reductions leads to a
notable reduction in the distortion of production decisions. Tax reductions can be designed in line with the general tax system. For instance, in many countries, tax reductions are offered for families with children. One can think along this line of our proposal of tax reductions for the provision of public goods or the provision of positive externalities.

References


**SUMMARY**

This paper analyzes the optimal behavior of farmers in the presence of direct payments and uncertainty. With the help of an empirical analysis for Switzerland, it confirms previously obtained theoretical results and determines the magnitude of the theoretically predicted effects. The results show that direct payments increase agricultural production by between 3.7% to 4.8%. At the same time, the effect of tax reductions on production is evaluated in order to determine its magnitude. The empirical analysis corroborates the theoretical results of the literature and demonstrates that tax reductions are also distorting, but to a substantially lesser degree if losses are not offset. However, tax reductions, independently of whether losses are offset or not, lead to higher government spending than pure direct payments.

**ZUSAMMENFASSUNG**

Die Studie analysiert das optimale Verhalten von Landwirten unter Unsicherheit bei gleichzeitiger Leistung von Direktzahlungen. Basierend auf einer empirischen Analyse für die Schweiz können bisherige gewonnene theoretische Resultate

RÉSUMÉ

Ce document analyse le comportement optimal des paysans en présence de paiements directs et d’incertitude. Cette étude confirme, à l’aide d’une analyse empirique pour la Suisse, les résultats théoriques précédemment obtenus et détermine l’amplitude des effets théoriquement prédits. Les résultats démontrent que les paiements directs augmentent la production agricole de 3.7% à 4.8%. Les effets d’une réduction d’impôts sur la production sont également évalués pour pouvoir en déterminer leur amplitude. L’analyse empirique corrobore les résultats théoriques de la littérature et démontre que les réductions d’impôts incitent aussi la production agricole, mais à un moindre degré si les pertes ne sont pas compensées. Cependant les réductions d’impôts, indépendamment du fait que les pertes sont compensées ou non, provoquent des dépenses gouvernementales supérieures aux paiements directs.