FACEPA

Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture

Ex-Ante Evaluations Using Flexible Cost Functions with FADN data

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With contributions by

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Executive Summary

This report presents the results of the application of the simulation model developed in work package 9 of the FACEPA project and described in Henry de Frahan et al. (2011a) and Henry de Frahan et al., (2011b).

For **Germany**, the model was applied to analyse the effect of an abolishment of the milk quota on dairy farms in Bavaria and Lower Saxony, and the effect of an end of the sugar quota regime on crop farms in Lower Saxony. In Lower Saxony, milk production is set to increase by approximately 5%, if milk prices do not fall by more than 20%, while production is falling drastically if milk price decreases by more than 40%. Only few differences between the regions are observed. In Bavaria, the increase of milk production if milk price remains stable is higher (+8%) than in Lower Saxony. However, reaction to a fall in prices is much more pronounced, and production is projected to decrease strongly for milk prices of 20% or more. Some differences between the regions are observed, with the relative increase of milk production ranging from 5.5% in Schwaben to 12.2% in Mittelfranken, if the milk price remains stable.

The comparatively small impacts of a milk quota abolishment on milk output at the sectoral and regional level hide the large changes occurring at farm level. While many farms increase their production, others reduce it considerably as a consequence of the increased competition on the land market. In the Weser-Ems region in Lower Saxony, the abolishment of the quota leads to a much more homogenous farm size (in terms of milk output), indicating an 'optimal' farm size that the model farms converge to in the equilibrium process enabled by the quota abolishment. In contrast, in Oberbayern in Bavaria, the share of farms with a larger milk output increases, leading to more heterogeneous farm sizes. In Lower Saxony, significant input changes are only observed in the scenario with a milk price decrease of 50%, and a significant share of the land is not used anymore. However, in general the change in other input demands as a reaction to product price seems rather small.

If the milk quota is abolished and prices remain constant, farm income increases by 9% in Lower Saxony and 1% in Bavaria, reflecting the different levels of quota rents in the reference year. In both regions, income decreases by 11-13% if milk prices fall by 10%, while for higher prices decreases, income falls more drastically in Lower Saxony, reflecting the stronger specialization of dairy farms, whereas in Bavaria income losses are partly cushioned by the higher importance of beef output in total output.

As sugar beet prices have fallen after the implementation of the last sugar market reform, the simulation of the impact of an end to the sugar quota regime has been carried out based on two different reference years (2005 and 2007). The results highlight that that the impact of sugar quota abolishment is strongly reduced by earlier sugar market reforms. Using 2005 as reference year, an end of the quota regime would lead to a strong expansion of sugar beet production unless prices fell by 30%. Using 2007 as reference year, the increase of sugar beet production at constant prices is smaller, and results indicate that with a sugar beet price decrease of 10%, sugar beets would lose their profitability in all sample farms. Results for both reference years show that with low sugar beet prices, sugar beets would be replaced by oilseeds and other cereals, which is line with expectations.

The ex-ante model proved to be capable of projecting the impact of policy reform and market changes on production, input demands and farm incomes, providing a complete picture of variability of impacts across farms. Due to its econometric base, the model may underestimate technology flexibility for “extreme” scenarios. In the future, further developments could improve land market modelling by taking into account that all farm types in a region compete for land simultaneously.

For **Austria**, the ex-ante model of calculating changes in a policy change bound to terminate the dairy quotas in EU shows an insignificant change in the output, input and income. This conclusion applies to the two regions surveyed, the country as a whole and to some extent the farm level. It means that the current situation is very close to pure market scenario, where the quota rent is close to 0. Moreover, the market will not be subject to any significant changes and the curve of supply will keep likewise the quota situation. Austrian dairy sector will be not affected sensitively from an eventual change in the policy and the national production will not be pushed out by import. Only at farm level, changes in the price level of output lead to proportional changes in the farm output price. As to the value of the input and profit, they remain unchanged and the farmers are indifferent and neutral to them. Selected reduction in the price of output does not affect the level of output, input and profit in each year of the three chosen reference period.

The simulation results indicate that for Austrian cattle farms, the chosen scenarios, as a whole, do not have impact on the Output, Input and Profit changes. This conclusion is valid at a regional and at a sub-regional level, as well at a farm level and wholly for the country. It is one of the distinctive results from the simulation as little exceptions are observed at the regional level. In this relation, in two NUTS2 regions in Austria are noted some changes. As for the profit level, the model identifies some fluctuations that are proportional with the output price movements. For the period 2004-2006, the Farm Profit decreases is preceded by Output prices reduction.

The crop simulation model shows heterogeneity and discrepancy in the reaction and changes in the output and input price and profit in Austria. This discrepancy and fluctuations are determined to the great extent by the price increase of energy inputs (energy and fertilizer). The prescribed increase in crop prices as Oilseeds, Coarse grains, and Wheat (PW120, PW140 and PW180) also is noticed and specified. Altogether, the levels of Output Price and Input Price Profit at regional, subregional and country level as a whole in 2006 compared to their levels in scenario P100 are subject to different movements. Most sensitive to changing scenarios are selected group of Pulses, Oil seed crops and Non-wheat Cereals (a) and Wheat (d) of the Output and Fertilizers (1) and Pesticides (2) Input. Without any modification remains Profit level in 2006. at regional and subregional level and for the country as a whole .

For **Italy**, the model was applied to assess the impact of a milk quota scheme on dairy farms in Piemonte. If milk price remains constant, the quota abolition has a very low effect. This result seems to depend to the low convenience of the milk activity in the region. Breeders cannot expand the production due to economic and physical restrictions, i.e. a low marginal profit associated to this activity and a rigidity in farm structures (available land). The quota removal associated to a reduction of the milk price by 10% reduces the milk output of more than 30%. This results might be attributed to the decision of small farms to abandon the sector. The progressive reduction in milk price produces a reduction in milk production but with lower marginal effects. The scenarios with reduction in milk price highlight a progressive reduction in the level of income up to -60% for the 2005 reference year. The lower impact on the other reference year can be due to the higher starting milk prices observed in 2006 and 2007.

Contents

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The model was applied to analyse the effect of an abolishment of the milk quota on dairy farms in Bavaria and Lower Saxony, and the effect of an end of the sugar quota regime on crop farms in Lower Saxony. In Lower Saxony, milk production is set to increase by approximately 5%, if milk prices do not fall by more than 20%, while production is falling drastically if milk price decreases by more than 40%. Only few differences between the regions are observed. In Bavaria, the increase of milk production if milk price remains stable is higher (+8%) than in Lower Saxony. However, reaction to a fall in prices is much more pronounced, and production is projected to decrease strongly for milk prices of 20% or more. Some differences between the regions are observed, with the relative increase of milk production ranging from 5.5% in Schwaben to 12.2% in Mittelfranken, if the milk price remains stable.

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The ex-ante model proved to be capable of projecting the impact of policy reform and market changes on production, input demands and farm incomes, providing a complete picture of variability of impacts across farms. Due to its econometric base, the model may underestimate technology flexibility for “extreme” scenarios. In the future, further developments could improve land market modelling by taking into account that all farm types in a region compete for land simultaneously.

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Abbreviations and Acronyms

EU	European Union
FACEPA	Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture
FADN	Farm Accountancy Data Network

List of Figures and Tables

1 Introduction

This report uses the simulation model developed and described in Henry de Frahan et al. (2011a) and Henry de Frahan et al., (2011b), and applies it to EU FADN data for Germany. Specifically, costs functions are estimated for dairy farms in Lower Saxony and Bavaria (as these are the two most important regions for milk production in Germany) and crop farms in Lower Saxony (some parts of which have very good soils and a high share of sugar beets in the crop rotation), following the methodology described in De Blander and Frahan (2011) and De Blander et al. (2011). The ex-ante model is used to separately analyse the impact of dairy and sugar quota abolishment for different scenarios of accompanying price decreases of milk and sugar beet.

2 Ex-ante evaluation of dairy reform

2.1 Data

The cost function estimates are based on EU FADN data for 1990-2007 in Lower Saxony (5335 observations) and Bavaria (7460 observations). Mean marginal cost for milk output were estimated to be 268 €/ton (85% of the observed farm gate price) for Bavaria and 157 €/ton (52%) for Lower Saxony. Details on the estimation of cost functions for Germany are given in Bahta and Offermann (2011) and Bahta et al. (2010).

2.2 Reference years, calibration method and calibration success rate

2.2.1 Lower Saxony

The model was applied for the years 2005, 2006 and 2007. A parallel shift of cost curves was used for calibration. Calibration success was almost 100% for 2005 and 2006, and 100% for 2007.

Table 2.1: Number of farms, number of calibrated farms and calibration success rate, region, member state, reference years for dairy farms in Lower Saxony

Reference year	**Number of farms in the sample**	**Number of farms calibrated in the sample**	**Calibration success rate (%)**
2005	251	250	99.6%
2006	242	241	99.6%
2007	233	233	100.0%

2.2.2 Bavaria

The model was applied for the years 2005, 2006 and 2007. A parallel shift of cost curves was used for calibration. Calibration success was almost a 100% for all years.

Table 2.2. Number of farms, number of calibrated farms and calibration success rate, region, member state, reference years for dairy farms in Bavaria

Reference year	**Number of farms in the sample**	**Number of farms calibrated in the sample**	**Calibration success rate (%)**
2005	541	541	100%
2006	553	553	100%
2007	523	523	100%

2.3 Simulation results at regional level

For dairy farms, an abolishment of the milk quota was simulated. As milk prices are expected to fall (Institut d'économie industrielle, 2008), this simulation is performed for six different price levels on dairy products from 0 to 50% price decrease: P100, P90, P80, P70, P60 and P50.

2.3.1 Changes in output levels

In Lower Saxony, milk production is set to increase by approx. 5%, if prices do not fall by more than 20% (Table 2.3). Production is falling drastically if milk price decreases by more than 40%. Only few differences between the regions are observed.

Table 2.3: Change in milk output with quota abolishment in Lower Saxony

	Region			Total sample
	Hannover	Lüneburg	Weser-Ems	Lower Saxony
Milk price	% change to reference scenario (2007)			
no change	3.5	5.7	5.3	5.2
-10 %	3.4	5.5	5.1	5.1
-20 %	3.3	5.4	4.8	4.9
-30 %	3.1	5.2	4.4	4.6
-40 %	1.3	0.1	3.8	2.0
-50 %	-38.8	-43.6	-43.7	-43.0

In Bavaria, the increase of milk production if milk price remains stable is higher (+8%) than in Lower Saxony (Table 2.4). However, reaction to a fall in prices is much more pronounced, and production is projected to decrease strongly for milk prices of 20% or more. Some differences between the regions are observed, with the relative increase of milk production ranging from 5.5% in Schwaben to 12.2% in Mittelfranken, if the milk price remains stable.

Table 2.4: Change in milk output with quota abolishment in Bavaria

	Region							Total sample
	Ober-bayern	Nieder-bayern	Ober-pfalz	Ober-franken	Mittel-franken	Unter-franken	Schwa-ben	Bavaria
Milk price	% change to reference scenario (2007)							
no change	6.2	9.5	10.6	10.2	12.2	12.0	5.5	8.4
-10 %	4.1	5.5	6.0	6.1	7.3	7.1	3.7	5.2
-20 %	-43.6	-53.6	-51.1	-49.2	-53.6	-49.6	-34.5	-45.6
-30 %	-51.2	-69.5	-63.4	-60.7	-66.0	-60.1	-39.6	-55.3
-40 %	-51.9	-72.9	-66.0	-63.8	-69.5	-63.4	-40.9	-57.4
-50 %	-51.9	-74.3	-67.3	-65.1	-70.9	-63.5	-41.4	-58.2

2.3.2 Changes in input levels

In Lower Saxony, significant input changes are observed only in the scenario with a milk price decrease of 50%, and a significant share of the land is not used anymore (Table 2.6). However, in general the change in other input demands as a reaction to product price seems rather small.

2.3.3 Changes in income levels

If the milk quota is abolished and prices remain constant, farm income increases by 9% in Lower Saxony and 1% in Bavaria, reflecting the different levels of quota rents in the reference year (Table 2.5). In both regions, income decreases by 11-13% if milk prices fall by 10%, while for higher prices decreases, income falls more drastically in Lower Saxony, reflecting the stronger specialization of dairy farms, whereas in Bavaria income losses are partly cushioned by the higher importance of beef output in total output.

Table 2.5: Change in farm income with quota abolishment in Lower Saxony and Bavaria

	Lower Saxony	Bavaria
Milk price	% change of income	
no change	9	1
-10 %	-11	-13
-20 %	-31	-27
-30 %	-50	-34
-40 %	-70	-40
-50 %	-85	-45

Table 2.6: Output, input and income responses to dairy reform in Lower Saxony by dairy price decline and region (% change to reference)

Variable description	Scenario	Hannover (902)	Lüneburg (903)	Weser-Ems (904)	Total sample Lower Saxony
Milk output for sale (a)	P100	3.5	5.7	5.3	5.2
	P90	3.4	5.5	5.1	5.1
	P80	3.3	5.4	4.8	4.9
	P70	3.1	5.2	4.4	4.6
	P60	1.3	0.1	3.8	2.0
	P50	-38.8	-43.6	-43.7	-43.0
Other animal outputs for sale (b)	P100	0.9	3.9	1.6	2.5
	P90	1.0	4.0	1.7	2.6
	P80	1.1	4.1	1.7	2.7
	P70	1.1	4.2	1.8	2.8
	P60	2.7	3.5	1.8	2.6
	P50	-7.3	-9.4	-7.3	-8.2
Other animal specific inputs (1)	P100	0.3	0.3	0.5	0.4
	P90	0.3	0.3	0.5	0.4
	P80	0.3	0.3	0.4	0.3
	P70	0.3	0.2	0.4	0.3
	P60	-0.7	-2.6	0.3	-1.1
	P50	-21.4	-25.9	-26.9	-25.7
Crop specific inputs (2)	P100	-0.7	-1.3	-1.5	-1.3
	P90	-0.7	-1.3	-1.5	-1.3
	P80	-0.7	-1.2	-1.4	-1.2
	P70	-0.6	-1.2	-1.3	-1.1
	P60	-0.8	-2.2	-1.1	-1.5
	P50	-7.4	-10.9	-11.3	-10.5
Cows (3)	P100	0.3	-0.1	0.3	0.2
	P90	0.3	-0.1	0.3	0.1
	P80	0.2	-0.1	0.3	0.1
	P70	0.2	-0.1	0.2	0.0
	P60	-1.7	-4.0	0.1	-1.9
	P50	-35.4	-35.1	-36.6	-35.6
Other intermediate inputs (4)	P100	0.1	0.2	0.2	0.2
	P90	0.1	0.2	0.2	0.2
	P80	0.1	0.2	0.2	0.2
	P70	0.1	0.2	0.2	0.2
	P60	-0.8	-2.6	0.1	-1.2
	P50	-22.7	-26.0	-27.3	-26.1
Purchased feeds (5)	P100	-0.7	-0.7	-0.8	-0.7
	P90	-0.6	-0.7	-0.7	-0.7
	P80	-0.6	-0.6	-0.7	-0.7
	P70	-0.5	-0.6	-0.6	-0.6
	P60	-0.6	-2.1	-0.5	-1.2
	P50	-13.1	-16.0	-11.9	-13.6
Grassland (6)	P100		0.0	0.0	0.0
	P90			0.0	0.0
	P80		0.0	0.0	
	P70		0.0	0.0	0.0
	P60	-0.4	-2.4	0.0	-1.0
	P50	-12.0	-22.8	-20.5	-20.2
Cropland (7)	P100	0.0		0.0	
	P90	0.0		0.0	0.0
	P80	0.0	0.0	0.0	0.0
	P70	0.0		0.0	0.0
	P60	-2.1	-3.7	0.0	-1.5
	P50	-48.7	-34.1	-23.7	-28.9
Farm incomes	P100	6.3	10.3	8.2	8.9

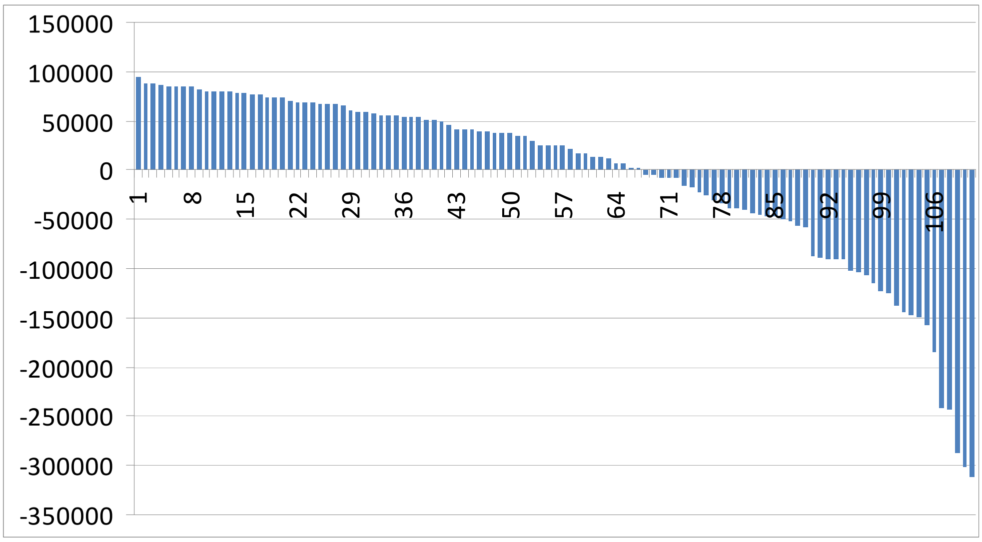
	P90	-13.8	-9.5	-11.6	-10.9
	P80	-33.9	-29.3	-31.4	-30.6
	P70	-53.9	-49.0	-51.1	-50.3
	P60	-73.9	-68.6	-70.8	-69.9
	P50	-89.6	-83.3	-86.7	-85.2

2.4 Simulation results at farm level

2.4.1 Changes in output levels

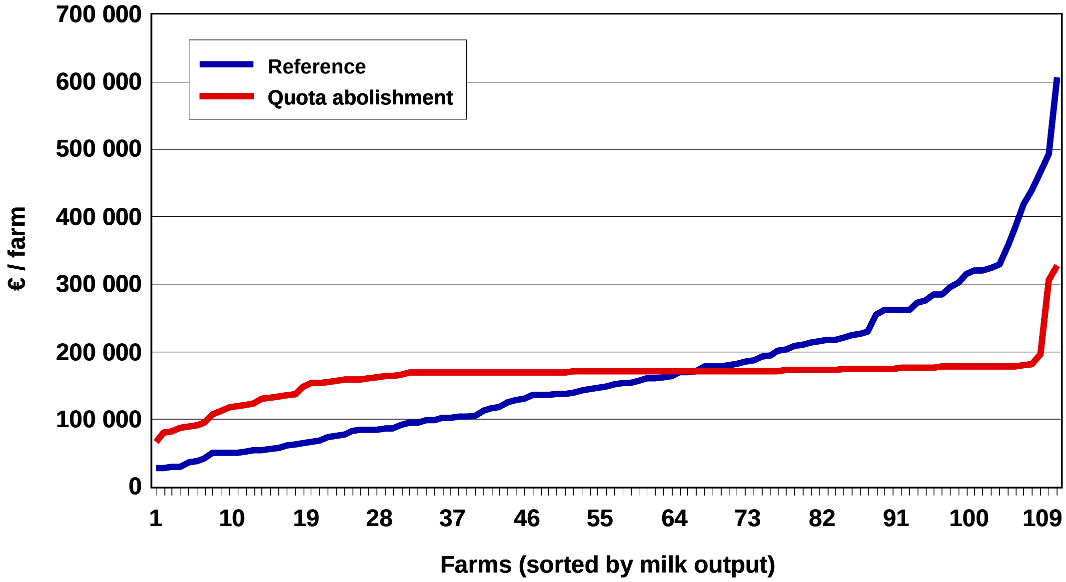
The comparatively small impacts of a milk quota abolishment on milk output at the sectoral and regional level hide the large changes occurring at farm level. Figure 2.1 provides an overview of the changes in milk output (€/farm) in Weser-Ems region in Lower Saxony under the dairy reform scenario (P100) compared to the reference scenario. While many farms increase their production, others reduce it considerably as a consequence of the increased competition on the land market.

Figure 2.1: Changes in milk output (€/farm) in Weser-Ems region under the dairy reform scenario (P100) compared to the reference scenario



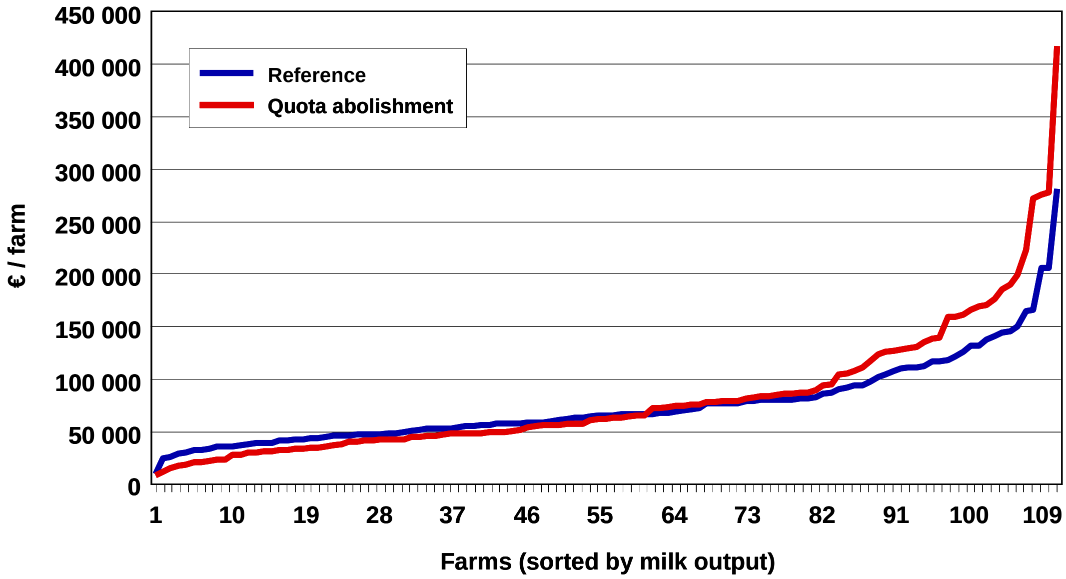
Quite interesting is also a comparison of the farm level distribution of milk output between the reference and the reform scenario in the Weser-Ems region in Lower Saxony: As Figure 2.2 highlights, the abolishment of the quota leads to a much more homogenous farm size (in terms of output), indicating an ‘optimal’ farm size that the model farms converge to in the equilibrium process enabled by the quota abolishment.

Figure 2.2: Milk output (€/farm) in Weser-Ems region in the reference scenario and the dairy reform scenario (P100)



In contrast, in Oberbayern in Bavaria, the share of farms with a larger milk output increases, leading to more heterogenous farm sizes (in terms of output) (Figure 2.3).

Figure 2.3: Milk output (€/farm) in Oberbayern in the reference scenario and the dairy reform scenario (P100)



3 Ex-ante evaluation of sugar market reform

3.1 Data

The cost function estimates are based on EU FADN data for 1990-2007 in Lower Saxony (4022 observations). Mean marginal cost for sugar beet were estimated to be 33 €/ton (70% of the observed farm gate price). Details on the estimation of cost functions for Germany are given in Bahta and Offermann (2011) and Bahta et al. (2010).

The model was applied for the years 2005, 2006 and 2007. A parallel shift of cost curves was used for calibration. Calibration success was almost 64% for 2005, and 100% for 2006 and 2007.

Table 3.1: Number of farms, number of calibrated farms and calibration success rate, region, member state, reference years for crop farms in Lower Saxony

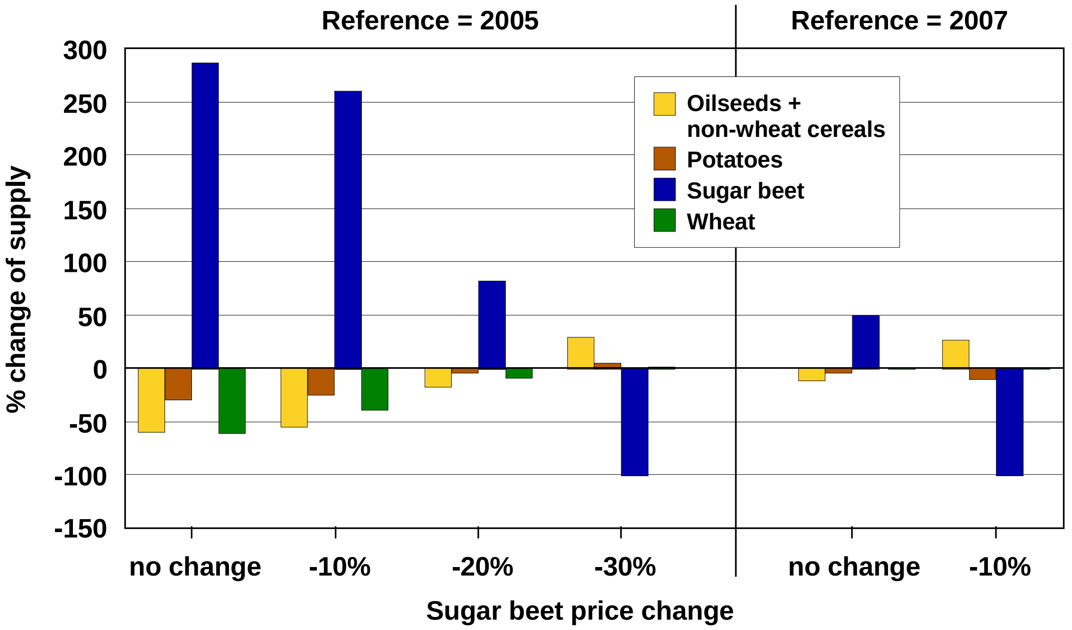
Reference year	Number of farms in the sample	Number of farms calibrated in the sample	Calibration success rate (%)
2005	199	128	64.3%
2006	203	203	100.0%
2007	193	193	100.0%

3.2 Simulation results

For crop farms, an abolishment of the sugar quota regime was simulated. This simulation is performed for six different price levels of sugar beets, from 0 to 50% price decrease: P100, P90, P80, P70, P60 and P50. As sugar beet prices have fallen after the implementation of the last sugar market reform, the simulation has been carried out based on two different reference years (2005 and 2007).

The results highlight that the impact of sugar quota abolishment is strongly reduced by earlier sugar market reforms. Using 2005 as reference year, an end of the quota regime would lead to a strong expansion of sugar beet production unless prices fell by 30%. Using 2007 as reference year, the increase of sugar beet production at constant prices is smaller, and results indicate that with a sugar beet price decrease of 10%, sugar beets would lose their profitability in all sample farms. Results for both reference years show that with low sugar beet prices, sugar beets would be replaced by oilseeds and other cereals, which is line with expectations.

Figure 3.1: Impact of sugar reform on supply of sugar beet in Lower Saxony, depending on reference year



4 Conclusions

The model results point to a modest increase of milk supply in Germany (Lower Saxony, Bavaria) if the milk quota is abolished. However, the effects on farm income are negative if the milk price decreases by 10% or more. Results also highlight that there are large difference of impacts between farms.

The comparison of results using different reference years show that the impact of sugar quota abolishment is strongly reduced by earlier sugar market reforms. The results indicate that the supply base of sugar beet may disappear in Lower Saxony if prices fall further.

The ex-ante model proved to be capable of projecting the impact of policy reform and market changes on production, input demands and farm incomes, providing a complete picture of variability of impacts across farms. Due to its econometric base, the model may underestimate technology flexibility for “extreme” scenarios. In the future, further developments could improve land market modelling by taking into account that all farm types in a region compete for land simultaneously.

5 References

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Working paper for WP9

September 2011

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The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under *grant agreement* n° 212292.

Executive Summary

The ex-ante model of calculating changes in a policy change bound to terminate the dairy quotas in EU shows an insignificant change in the output, input and income. This conclusion applies to the two regions surveyed, the country as a whole and to some extent the farm level. It means that the current situation is very close to pure market scenario, where the quota rent is close to 0. Moreover, the market will not be subject to any significant changes and the curve of supply will keep likewise the quota situation. Austrian dairy sector will be not affected sensitively from an eventual change in the policy and the national production will not be pushed out by import. Only at farm level, changes in the price level of output lead to proportional changes in the farm output price. As to the value of the input and profit, they remain unchanged and the farmers are indifferent and neutral to them. Selected reduction in the price of output does not affect the level of output, input and profit in each year of the three chosen reference period[1].

[1] The content of this report reflects only the author's views. The European Community is not liable for any use that may be made of the information contained therein.

Contents

Abbreviations and Acronyms

EU	European Union
FACEPA	Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture
FADN	Farm Accountancy Data Network

List of Figures and Tables

Figures

Tables

1. Introduction

In the application of calibration and simulation procedures are used the results of cost function, as the most appropriate form of Austria is quadratic. The specified time horizon of the estimation is long term (LT).

For the simulation as a reference year, as selected according to the instructions 2004, 2005 and 2006. It is implemented at regional level or region1 Nuts1 3 area of sub-sub-region with a total of 8 or region 2 or nuts2 for the country as a whole. The regions are subdivided into the following subregions: For the first region 101, 102, the second 201, 202 and the third 301, 303, 303 and 304. Also for the country as a whole using code Nuts1. The analysis of changes in Output, Input and Income used averaged values of the regional and subregional level. The average values at national NUTS1 level and of the regional NUTS2 are used while the lower territorial units and divisions are not scrutinized due to the unknown territorial administrative outlining of Austria unto production specialization of the farms.

The selected scenarios for different types of farms are different.

At the dairy farms they are associated with a change (decrease) in prices of output, by 10% (P90) by 20% (P80), 30% (P70), with 40% (P60), 50% (P50). Also are done and scenarios in which the price level of output does not change (P100). These scenarios apply when it is in effect the Dairy reform, when the milk quota is removed.

At the cattle farms selected scenarios are: P100, P90, P85, P80, P75, P70. With the exception of the first scenario (P100) in which the price of output remains unchanged, other scenarios reflect a reduction in the price of output, by 10%, 15%, 20%, 25% and 30%.

For crop farms is developed variant "HighPricesCrop & EnergyCropFarms", where crop and energy prices increase like this: P100, PW120 (+10% for price of oilseeds and coarse grains (Ya) and +7.5% for price of wheat (Yd)), PW140 (+20% price of Ya and 15% for price of Yd), PW180 (+ 40% for price of Ya and +30% for price of Yd).

2. Ex-ante evaluation of dairy reform

2.1. Data description and statistics

2.1.1 Data preparation

The evaluation is estimated using quadratic specification of the cost function. The outputs include dairy (Ya), animal outputs (Yb) and crop outputs (Yc) while the input side includes animal specific inputs (X1), crop specific inputs and farm land (X2), cow inputs (X3), intermediate inputs (X4), purchased feeds (X5), grassland (X6) and Cropland (X7).

2.2.2 Sample specification

Sample of dairy farms are present from 1995 to 2007.

2.2.3 Descriptive statistics

Outputs are rescaled.

Table 2 1. Descriptive statistics of the dairy farms in Austria

Variable	Obs	Mean	Std. Dev.	Min	Max
Cost	464838	45261.36	25328.88	10677.21	322373.4
ya	464838	1.980539	1.602563	0	23.86251
yb	464838	0.8409579	0.8217769	0	24.93866
yc	464838	0.5962073	2.539562	0	64.09676
px1	464838	0.9483043	0.0456498	0.877	1.01317
px2	464838	0.9387208	0.0650874	0.794	1.0750
px3	464838	0.8069593	0.2157236	0.5069	1.144094
px4	464838	0.9438739	0.0404402	0.8617	1.05544
px5	464838	1.001213	0.0711709	0.906	1.215081
pya	464838	1.03912	0.0831892	0	1.274941

```
         pyb |    464838    0.8265862   0.2084452     0       3.288949
         pyc |    464838    0.3486758   0.5701264     0       2.196579
          x1 |    464838    2808.509    2701.211      0       46888.93
          x2 |    464838     5942.131   6733.936      0.241   171568.6
          x3 |    464838    2638.123    1502.984    343.3333  18110.01
-------------+------------------------------------------------------
          x4 |    464838    29257.13    15554.94   7046.352   201711.2
          x5 |    464838    4615.468    6021.712        0     237593.3
```

2.2. Empirical specification of the cost function

The fit of the model is a quadratic specification with fixed-effect and global positive restriction on marginal costs.

2.3. Input demand and marginal cost elasticities

2.3.1 Input demands

Almost all the demand inputs are positive and the percentage of negative input demands except the cow inputs is close to zero.

2.3.2 Own input demand elasticities

Medians of input demands are inelastic, in particular for animal specific inputs (X1) and intermediate inputs (X4). For cow inputs median of demands is relatively more less inelastic.

Table 2 2 *Own input demand elasticities for Austria*

	Min	Max	Median
E1x1_px1	-23,6507	-0,003222	-0,054775
E1x21_px21	-1795,39	-0,004266	-0,141669
E1x3_px3	-6,19132	-0,042354	-0,879358
E1x4_px4	-0,305979	-0,002631	-0,04274
E1x5_px5	-65,1766	-0,006313	-0,456407

2.3.3 Own marginal cost elasticites

The marginal cost elasticities dairy, as it is shown in table 1.3 , are positive indicating dairy farms are on their upwards sloping curve of marginal cost. However, these elasticities are on average close to zero.

Table 2 3 *Own marginal cost elasticities for the dairy farm sample*

	Min	Max	Median
ElMCya_ya	2.8e-09	.000048	1.5e-06
ElMCyb_yb	1.2e-07	33.7124	.002897
ElMCyc_yc	3.1e-08	.004929	.000018

2.4. Marginal costs, average costs and quota rents

2.4.1 Marginal costs

The mean observed absolute marginal cost for Ya (milk output) amounts to 188 €/ton (62.5% of the observed farm gate price), for Yb (animal outputs) amounts to 87 €/ton (10% of the observed farm gate price) and 45 €/ton (33% of the observed farmgate price) for Yc (crop outputs).

The marginal cost of milk and crop outputs slightly increase in the years from 1995 to 2006. In 2006 they to reach the maximum (about 225 €/ton or 78% of the farm gate price) and about 86 €/ton or 70% of the farm gate price for milk and crop outputs respectively. Then start to decrease slightly. The marginal cost of animal outputs for all years shows an increasing trend. The maximum marginal cost of animal outputs is 227 €/ton (22% of the observed farm gate price) for the year 2007.

2.4.2 Average costs

The mean observed average variable cost for the all outputs (Ya , Yb and Yc) amounts to 187 €/ton (62% of the observed farm gate price), 74 €/ton (8% of the observed farm gate price) and 45 €/ton (33% of the observed farm gate price), respectively. For the three types of outputs, the average variable cost has the same pattern as the marginal cost.

2.4.3 Quota rents

Table 2 4 Prices, estimated marginal costs, quota rents and marginal cost elasticities for milk output from the long-run augmented SGM specification of Austria (€/1000 litres)

Region	**Variable**	**Mean**	**Standard**	**Minimum**	**Maximum**

		deviation			
Austria Nuts1	Milk price				
	Marginal cost	224,78	71,28	44,20	499,88
	Quota rent	65,41	70,16	-134,72	292,07
	Rent/Milk price (%)	0,121	0,0032	4,30E-08	0,033783
	Marginal cost elasticity				

2.5. Reference years, calibration method and calibration success rate

2.5.1 Selected reference years

The selected reference years are 2004, 2005 and 2006.

2.5.2 Selected calibration method

Selected calibration method is based on the quadratic model in the mathematical programming.

2.5.3 Calibration success rate

Since the values of both criteria (ShareProfitCal and ShareOutputCal) to pass through the Calibration not known, was used as a criterion

Since the values of both criteria (ShareProfitCal and ShareOutputCal) to pass through the Calibration not known, was used as a benchmark indicator FarmProfitDiffC. To limit above which is not considered that the farm has passed Calibration considered ± 0,09. For example farms which FarmProfitDiffC has a value less than or equal to 0.09 and greater than -0.09 is assumed that passed successful the Calibration. Obviously, at a higher value as FarmProfitDiffC ± 0,1, the number of farms successfully pass Calibration will be greater. Then share in Table 2.5. will be 13.7, 85.9% and 55.1% respectively for 2004, 2005 and 2006.

From the perspective of the value of the requirement FarmProfitDiffC be sufficiently close to zero value is chosen equal to ± 0,09.

Table 2 5 Number of farms, number of calibrated dairy farms and calibration success rate

Reference year	**Number of farms in the sample**	**Number of farms calibrated in the sample**	**Calibration success rate (%)**
2004	862	117	13,6
2005	871	738	84,7
2006	922	496	53,8

The degree of Calibration success is unsatisfactory for all three reference years. Highest, but missing the required threshold of 90% is 2005.

2.6. Simulation results at regional level

As already noted the following scenarios are selected P100, P90, P80, P70, P60 and P50. They correspond to the percentage reduction in output prices in the removal of milk quota. As for Austria, there is no information on Output, Input and Income in terms of milk quota, the reference scenario that is selected is R100. At regional level, the results show that the years do not change the levels of Output, Input and Income in a scenario when compared with other selected P100 scenarios.

2.6.1 Changes in output levels

The value of output levels did not change in three regions (1,2 and 3) by Nuts1 code and in the three years of the reference period, regardless of the chosen scenario. This conclusion is valid for both types of output: Ya and Yb. At the subregional level (Nuts2) and in 8 sub-regions, each year there are constant values of output no matter which scenario from selected is used. As at Nuts1, and at Nuts2 above conclusion is valid for the Ya and Yb. At the country level is the same: there were no changes in output in the forward across scenarios for Ya and Yb for each of the three reference years.

2.6.2 Changes in input levels

The value of Input levels did not change in three regions (1,2 and 3) by Nuts1 code and in the three years of the reference period, regardless of the chosen scenario. This conclusion is valid for both types of output: Ya and Yb. At the subregional level (Nuts2) and in 8 sub-regions, each year there are constant Input values no matter which scenario from selected is used. As at Nuts1, and at Nuts2 above conclusion is valid for the Ya and Yb. At the country level is the same: there were no changes in the input event of divergence scenarios for Ya and Yb for each of the three reference years.

2.6.3 Changes in profit levels

In this part of the analysis due to lack of data on changes in percentage or absolute number of Variables of column in Table 2.6. compared to a scenario that is valid milk quota, were used absolute levels of the profit levels.

The value of the profit levels did not change in three regions (1,2 and 3) by code Nuts1 during the three year reference period, regardless of the chosen scenario. This conclusion is valid for both types of output: Ya and Yb. At the subregional level (Nuts2) and in 8 sub-regions, each year there are constant values of profit no matter which scenario from selected 6 is used. As at Nuts1, and at Nuts2 above conclusion is valid for the Ya and Yb. State level is the same: there were no changes in profit to P100 with other scenarios, both Ya and Yb for each of the three reference years.

Table 2 6 Output, input and income responses to dairy reform by dairy price decline, region, member state, reference year-2006 (1000000 nominal euros)

Variable description	**Scenario**	**Average per region1 (1,2 and3)**	**Average per region2 (101,102,201,202, 301,302,303and304)**	**Total sample (Austria)**
JMilk output for sale (a)	P100	17,78	4,92	45,77
	P90	17,78	4,92	45,77
	P80	17,78	4,92	45,77
	P70	17,78	4,92	45,77
	P60	17,78	4,92	45,77
	P50	17,78	4,92	45,77
Other animal outputs for sale (b)	P100	8,47	3,18	29,95
	P90	8,47	3,18	29,95
	P80	8,47	3,18	29,95
	P70	8,47	3,18	29,95
	P60	8,47	3,18	29,95
	P50	8,47	3,18	29,95
Other animal specific inputs (1)	P100	667,12	250,17	5,66
	P90	667,12	250,17	5,66

	P80	667,12	250,17	5,66
	P70	667,12	250,17	5,66
	P60	667,12	250,17	5,66
	P50	667,12	250,17	5,66
Crop specific inputs (2)	P100	0,94	0,35	2,82
	P90	0,94	0,35	2,82
	P80	0,94	0,35	2,82
	P70	0,94	0,35	2,82
	P60	0,94	0,35	2,82
	P50	0,94	0,35	2,82
Cows (3)	P100	1,59	0,59	4,76
	P90	1,59	0,59	4,76
	P80	1,59	0,59	4,76
	P70	1,59	0,59	4,76
	P60	1,59	0,59	4,76
	P50	1,59	0,59	4,76
Other intermediate inputs (4)	P100	25,84	9,69	77,5
	P90	25,84	9,69	77,5
	P80	25,84	9,69	77,5
	P70	25,84	9,69	77,5
	P60	25,84	9,69	77,5
	P50	25,84	9,69	77,5
Purchased feeds (5)	P100	3,75	1,41	11,25
	P90	3,75	1,41	11,25
	P80	3,75	1,41	11,25
	P70	3,75	1,41	11,25
	P60	3,75	1,41	11,25
	P50	3,75	1,41	11,25
Grassland (6)	P100	1695,63	635,86	5086,9
	P90	1695,63	635,86	5086,9

	P80	1695,63	635,86	5086,9
	P70	1695,63	635,86	5086,9
	P60	1695,63	635,86	5086,9
	P50	1695,63	635,86	5086,9
Cropland (7)	P100	2940,17	1102,56	8820,52
	P90	2940,17	1102,56	8820,52
	P80	2940,17	1102,56	8820,52
	P70	2940,17	1102,56	8820,52
	P50	2940,17	1102,56	8820,52
Regio profit	P100	536,33	3770,55	10000
	P90	536,33	3770,55	10000
	P80	536,33	3770,55	10000
	P70	536,33	3770,55	10000
	P60	536,33	3770,55	10000
	P50	536,33	3770,55	10000

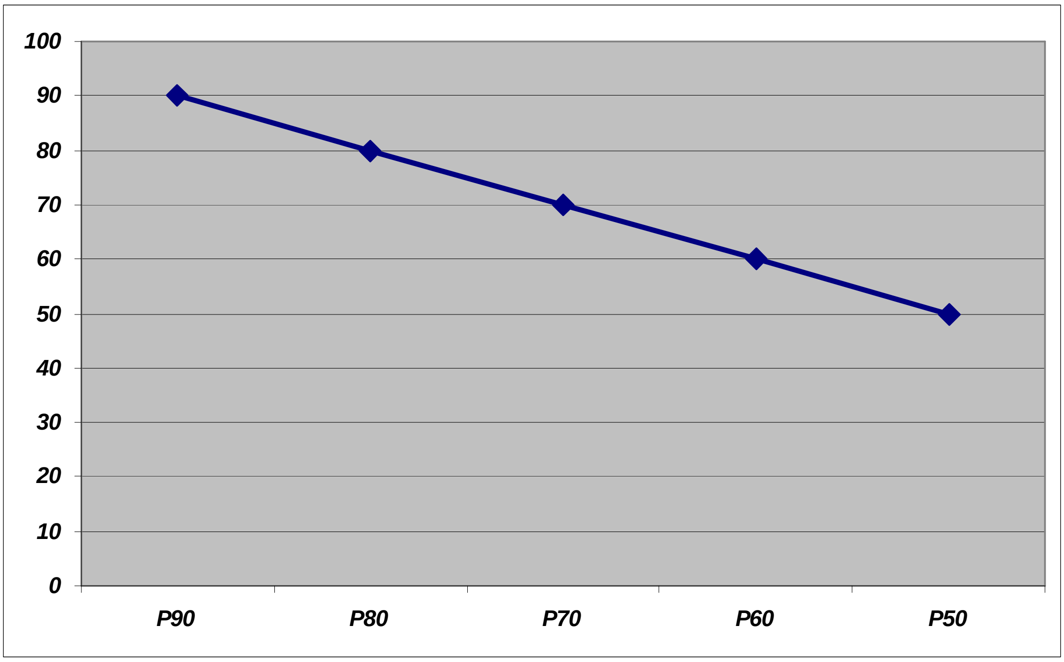
2.7. Simulation results at farm level

At farm level simulation results show that setting aside differences between scenarios were observed only at changes in the level of output. In terms of other variables (farm input price and farm profit), their modification does not depend on the selected scenarios.

2.7.1 Changes in Farm output price

Nearly half of all farmers (50%) who have gone through the simulation level of output is affected by the selected scenarios. Changes in this level is proportional to the changes that are covered in different scenarios. Farm output price decreases by 5% from scenario to scenario P50 P100.

Figure 2.7.1. Changes in Farm output price by different price in milk output (a) under the Dairy Reform, 2006 year (%)



2.7.2 Changes in Farm Input Price

In this case the changes in the price level of output does not have any impact on the changes in input price.

2.7.3 Changes in Farm Profit

In this case, as in the previous paragraph the profit level remains constant for different scenarios.

Conclusions

The selected scenarios reflecting any changes (decrease) in the level of output in Dairy Reform (removal of milk quota) in most cases do not have any influence on changes in the value of output, input and income. This conclusion applies to the two regions surveyed, the country as a whole and to some extent the farm level. Only at farm level, changes in the price level of output lead to proportional changes in the farm output price. As to the value of the input and profit, they remain unchanged and the farmers irrespective of the scenario. Selected reduction in the price of output does not affect the level of output, input and profit in each year of the three chosen reference period.

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Annex 1

Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture
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Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture

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Ex-Ante Evaluations in Cattle Using Flexible Cost Functions with FADN data for Austria

Working paper for WP9

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Executive Summary

The simulation results indicate that the chosen scenarios, as a whole, do not have impact on the Output, Input and Profit changes. This conclusion is valid at a regional and at a sub-regional level, as well at a farm level and wholly for the country. It is one of the distinctive results from the simulation as little exceptions are observed at the regional level. In this relation, in two NUTS2 regions in Austria are noted some changes. As for the profit level, the model identifies some fluctuations that are proportional with the output price movements. For the period 2004-2006, the Farm Profit decreases is preceded by Output prices reduction.[1].

[1] The content of this report reflects only the author's views. The European Community is not liable for any use that may be made of the information contained therein.

Contents

Abbreviations and Acronyms

EU	European Union
FACEPA	Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture
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List of Figures and Tables

Tables

3. Ex-ante evaluation of cattle farms

3.1 Data description and statistics

3.1.1 Data preparation

The evaluation is estimated using quadratic specification of the cost function. The outputs divided into two categories: the first of them (Ya) includes other animal outputs and second one (Yb) covers aggregated dairy animal output and crop output. The input side includes animal specific inputs (X_1), crop specific inputs and farm land X_2), cow inputs (X_3), intermediate inputs (X_4), purchased feeds (X_5) and grassland (X_6).

3.1.2 Sample specification

Austrian sample of cattle farms covers period from 1995 to 2007.

3.1.3 Descriptive statistics

Table 3 1 Descriptive statistics of the cattle farm sample

Variable	Obs	Mean	Std. Dev.	Min	Max
Cost	36234	48912.46	23436.94	17044	191806
ya	36234	2.368292	2.812827	0	20.76
yb	36234	1.994855	4.287897	0	35.60
px1	36234	0.9648118	0.0439697	0.88	1.01
px2	36234	1.013926	0.1459302	0.48	1.25
px3	36234	0.8945447	0.1426751	0.62	1.12
px4	36234	0.9761037	0.0369416	0.87	1.04
px5	36234	1.024118	0.0794232	0.89	1.22
pya	36234	0.9125981	0.3412694	0	3.20
pyb	36234	0.6254667	0.6193715	0	2.24
x1	36234	1606.452	1279.173	0	8442.24
x2	36234	6979.38	6669.597	56.85	64659.3

```
         x3 |     36234      2041.82     846.059         0       7391.08
-------------+---------------------------------------------------------
         x4 |     36234     34622.67     16828.2   12312.89    159267.2
         x5 |     36234      3662.14    28437.09          0     31555.5
```

3.2 Empirical specification of the cost function

The fit of the model is a quadratic specification with fixed-effect and global positive restriction on marginal costs.

3.3 Input demand and marginal cost elasticities

3.3.1 Input demands

The percentage of negative input demands is very high. More than 80% of the observations for cow inputs and more than 40% of the observations for intermediate inputs are negative. For the rest inputs the percentage of negative demands is less than these two inputs, but it remains relatively highly.

3.3.2 Own input demand elasticities

Medians of input demands are inelastic, in particular for X1 (livestock-specific inputs) and X4 (intermediate inputs).

Table 3.2. Own input demand elasticities for the cattle farm sample

	Min	Max	Median
Elx1_px1	0,000	0,007	0,000
Elx2l_px2l	-2,214	0,000	-0,074
Elx3_px3	-13,981	0,000	-0,105
Elx4_px4	-0,351	0,000	-0,044
Elx5_px5	-14,825	0,000	-0,107

3.3.3 Own marginal cost elasticites

Although the average marginal cost elasticities for both outputs are positive which indicates that livestock farms are on average on their upwards sloping curve of marginal costs, these average elasticities are very close to zero.

Table 3.3. Own marginal cost elasticities for the cattle farm sample

	Min	**Max**	**Median**
ElMCya_ya	4,30E-08	0,033783	0,000678
ElMCyb_yb	7,70E-06	0,367523	0,007478

3.4 Marginal costs, average costs and quota rents

3.4.1 Marginal costs

The mean observed absolute marginal cost for Ya (other animal outputs) amounts to 45.3€/head (3.3% of the observed farm gate price). Yearly averages steadily rise from 8.65€/head in 1995 to 104.73€/head in 2007. The yearly average observed relative marginal cost for Ya (other animal outputs) steadily increases little by little to 2000, then drops in 2001 followed by a gradual increase of more than 14% each year until 2007.

Dynamic of the marginal cost changes for Yb until 2001 is the clozy to this one for Ya. Yearly averages rise from 40.5€/head in 1995 to 44.3€/head in 2000. Differences between two curves are appeared after 2001. The yearly average observed relative marginal cost for Yb increases from 2001 to 2007 with less tempo (4.4%) per year than the gradual increasing of the yearly average marginal cost for Ya.

3.4.2 Average costs

The mean observed average variable cost for Ya (other animal outputs) is similar to that of marginal cost, 43.9 €/ton (3.2% of the observed farm gate price). The mean observed average variable cost for Yb differs from that of marginal cost. It amounts to 33.4€/ton (21.5% of the observed farm gate price).

3.5 Reference years, calibration method and calibration success rate

3.5.1 Selected reference years

The selected reference years are 2004, 2005 and 2006.

3.5.2. Selected calibration method

Selected calibration method is based on the quadratic model in the mathematical programming.

3.5.3. Calibration success rate

We can see from the Table 3.4 that the Calibration success rate is unsatisfying. This is particularly pronounced for 2004, where fewer than 8 % of all cattle farms excerpt have been passed successfully the calibration. In the next two years the success rate shows a sharp increase, but it is still under the necessary threshold of 90 %.

As the two criteria values (ShareProfitCal and ShareOutputCal) for successful pass over the Calibration are not known, the index FarmProfitDiffC has been used as a criterion. For admissible limit, over which the farm can be considered successfully passed the Calibration, is ±0,09. Thus, the farms with FarmProfitDiffC value is less or equal to 0,09 and bigger than -0,09, is accepted as successfully passed the Calibration. It is evident that at higher FarmProfitDiffC value, for instance ±0,1, the farms number, successfully passed the Calibration, will be bigger. From the point of view of the requirement for the FarmProfitDiffC value to be sufficiently close to zero, the chosen value is ±0,09.

Table 3.4 Number of farms, number of calibrated cattle farms and calibration success rate

Reference year	**Number of farms in the sample**	**Number of farms calibrated in the sample**	**Calibration success rate (%)**
2004	65	5	7,7
2005	70	52	74,3
2006	95	72	75,8

3.6. Simulation results at regional level

As it has been mentioned, the chosen scenarios are the following: P100, P90, P85, P80, P75 and P70. They correspond to the diminution rate of the output prices.

3.6.1.Changes in Profit levels

At a regional level (NUTS 1) and as a whole, at a sub-regional level (NUTS 2), results show that the Profit stimulation values remain unchanged in the different years, according to the chosen scenarios. There is an exception, at an insignificant degree, in 2006, for two sub-regions of NUTS 2: 303 and 304. Following the Profit Stimulation level changes, from scenario P100 to scenario P70, it becomes clear that with the output prices reduction, the Profit level diminishes insignificantly. For the two sub-regions it is identical – barely 0,01%.

3.6.2 Changes in Subsidy levels

At a regional (NUTS 1) level and wholly at a sub-regional (NUTS 2) level, results show that in different years the Subsidy Stimulation values do not change, in dependence on the different scenarios. This conclusion is valid for the three referent years.

3.7. Simulation results at farm level

At a farm level, the simulation results show that differences between the different scenarios have been observed only at the Farm Profit level changes. We must notice that these changes are insignificant. Regarding the Farm Input Price and Farm Output Price, they remain unchanged.

3.7.1 Changes in Farm output price

For each year of the reference period 2004-2006, the change rate in the Farm Output Price from scenario P100 to scenario P70, is zero.

3.7.2 Changes in Farm Input Price

As above, in this case, the Farm Input Price change rate is equal to zero for the different reference years.

3.7.3 Changes in Farm Profit

In this case only has been observed a weak difference between the scenarios for 2005 and 2006. For 2004, there is not change under the different scenarios. For the last two years of the referent period, 2004-2006, the Farm Profit decreases barely perceptibly with the Output prices reduction. For 2005 the decrease is of 5,97E-04%; 8,96E-04%; 1,194E-03%; 1,49E-03% and 1,79E-03% respectively for the scenarios P90, P85, P80, P75 and P70. For 2006 the reduction at the different scenarios is the same as for 2005.

Conclusions

The Calibration results for the Cattle farms show that the success rate is relatively low.

The simulation results indicate that the chosen scenarios, as a whole, do not have impact on the Output, Input and Profit changes. This conclusion is valid at a regional and at a sub-regional level, as well at a farm level and wholly for the country. An exception, in a very small degree, has been observed in two sub-regions of NUTS 2 only: 303 and 304 for 2006.

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Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture

Ex-Ante Evaluations in Crop Using Flexible Cost Functions with FADN data for Austria

Working paper for WP9

September 2011

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Executive Summary

The crop simulation model shows heterogeneity and discrepancy in the reaction and changes in the output and input price and profit. This discrepancy and fluctuations are determined to the great extent by the price increase of energy inputs (energy and fertilizer). The prescribed increase in crop prices as Oilseeds, Coarse grains, and Wheat (PW120, PW140 and PW180) also is noticed and specified. Altogether, the levels of Output Price and Input Price Profit at regional, subregional and country level as a whole in 2006 compared to their levels in scenario P100 are subject to different movements. Most sensitive to changing scenarios are selected group of Pulses, Oil seed crops and Non-wheat Cereals (a) and Wheat (d) of the Output and Fertilizers (1) and Pesticides (2) Input. Without any modification remains Profit level in 2006. at regional and subregional level and for the country as a whole[1].

[1] The content of this report reflects only the author's views. The European Community is not liable for any use that may be made of the information contained therein.

Contents

Abbreviations and Acronyms

EU	European Union
FACEPA	Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture
FADN	Farm Accountancy Data Network

List of Figures and Tables

Tables:

Figures:

Ex-ante evaluation of Crop Farms

4.1 Data description and statistics

4.1.1 Data preparation

The outputs for the evaluation of crops include Ya (aggregation of Y1= pulses and oil seed crops and Y2= non-wheat cereals, Yb = Y3 (potatoes), Yc = Y4 (sugar beet and other industrial crops), and Yd = Y5 (wheat).

Variable inputs include X1: fertilizers, X2: pesticides, X3: seeds, X4: services, X5: capital inputs and X6: farmland.

Sample specification

Austrian sample of crop farms covers period from 1995 to 2007.

Descriptive statistics

Table 4 1Descriptive statistics of the crop farms in Austria

Variable	Obs	Mean	Std. Dev.	Min	Max
Cost	132099	57683.6	36653.51	11992.47	302587.3
ya	132099	0.91704	0.8978	0	13.1216
yb	132099	0.31491	1.1564	0	19.7084
yc	132099	0.83995	1.05183	0	8.7388
yd	132099	5.84731	5.250942	0	50.995
px1	132099	0.94551	0.072167	0.856	1.1224
px2	132099	1.03513	0.04686	1	1.1749
px3	132099	0.97494	0.02851	0.940	1.0550
px4	132099	0.91755	0.06791	0.756	1.0706
px5	132099	0.91557	0.07021	0.813	1.2151
px6	132099	0.98050	0.04933	0.8418	1.1402

```
         pya |     132099    1.24016       0.29203      0          2.5617
         pyb |     132099    0.29514       0.55452      0          2.6819
         pyc |     132099    0.703967      0.5388       0          1.3752
         pyd |     132099    1.257715      0.4803       0          2.2848
          x1 |     132099    3806.901    3214.77        0        35499.19
          x2 |     132099    2597.102    2644.47        0        30490.57
          x3 |     132099    4468.306    5037.12        0        86599.26
-------------+-----------------------------------------------------
          x4 |     132099    12466.24    10622.79   969.84       170790.0
          x5 |     132099    25254.21    15863.09   2501.50      168488.9
          x6 |     132099     9090.84     7799.12       0         85969.9
```

4.2 Empirical specification of the cost function

The fit of the model is a quadratic specification with fixed-effect and global positive restriction on marginal costs.

4.3 Input demand and marginal cost elasticities

4.3.1 Input demands

Almost all the demand inputs are positive and the percentage of negative input demands except the Capital inputs is close to zero.

4.3.2 Own input demand elasticities

The medians of own input elasticities particularly X2 (pesticides), X1(fertilizers) and X5(capital inputs) are inelastic.

Table 4 2 *Own input demand elasticities for the crop farm sample*

	Min	**Max**	**Median**
Elx1_px1	-68,7743	0	-0,039379
Elx2l_px2l	-8,44697	0	-0,001336

Elx3_px3	-5,72942	0	-0,148561
Elx4_px4	-1,79017	0	-0,176033
Elx5_px5	-0,733999	0	-0,043436
Elx6_px6	-7436,53	0	-0,291641

4.3.3 Own marginal cost elasticites

The own marginal cost elasticities for all aggregated outputs are positive indicating crop farms are on their upwards sloping curve of marginal cost. However, the effects are very low as these elasticities are on average close to zero.

Table 4 3 *Own marginal cost elasticities for the crop farm sample*

	Min	Max	Median
ElMCya_ya	1.6e-10	8.8e-07	2.8e-08
ElMCyb_yb	2.0e-12	5.0e-09	4.3e-10
ElMCyc_yc	1.2e-07	5.8e-06	7.9e-07
ElMCyd_yd	4.2e-06	.005171	.001062

4.4 Marginal costs, average costs and quota rents

4.4.1 Marginal costs

The over all average marginal cost for Ya (pulses, oil seeds and non-wheat cereals), Yb (potatoes), for Yc (sugar beet and other industrial crops) and Yd (wheat) amounts to 41,6; 29.4; 25.9 and 61.2 respectively.

The marginal costs are 30% of the observed farm gate prices for Ya (pulses, oil seeds and non-wheat cereals), 25% for Yb (potatoes) 49% for Yc (sugar beet and other industrial crops) and 52% for Yd (wheat).

4.4.2 Average costs

The average costs are not that much different (less than or equal to +/- 1) from the marginal costs for Ya (pulses, oil seeds and non-wheat cereals), Yb (potatoes), for Yc (sugar beet and other industrial crops). The difference between marginal and average costs is bigger for Yd (wheat). It equals to +5.

The average costs account for more or less similar percentages of the farm gate prices for all crop aggregates except for Yb (potatoes) which accounts 25%.

4.5 Reference years, calibration method and calibration success rate

"HighPricesCrop&EnergyCropFarms"

4.5.1 Selected reference years

The selected reference years are 2004, 2005 and 2006.

4.5.2 Selected calibration method

Selected calibration method is based on the quadratic model in the mathematical programming.

4.5.3 Calibration success rate

Since the values of both criteria (ShareProfitCal and ShareOutputCal) to pass through the Calibration not known, was used as a benchmark indicator FarmProfitDiffC. To limit above which is not considered that the farm has passed Calibration considered ± 0,09. For those farms which FarmProfitDiffC has a value less than or equal to 0.09 and greater than -0.09 is assumed that passed successful Calibration. Obviously, at a higher value as FarmProfitDiffC ± 0,1, the number of farms successfully pass Calibration will be greater. Then share in Table 4.5. will be 11.8% and 98.4% respectively for 2004, 2005. For 2006. remains the same level of 38.6% of Calibration success rate. From the perspective of the value of the requirement FarmProfitDiffC be sufficiently close to zero value is chosen equal to ± 0,09.
From Table 4.4 shows that for 2005. Calibration success rate is high enough.

Table 4 4 Number of farms, number of calibrated crop farms and calibration success rate

Reference year	Number of farms in the sample	Number of farms calibrated in the sample	Calibration success rate (%)
2004	290	22	7.6
2005	305	298	97.7
2006	282	109	38.6

4.6 Simulation results at regional level

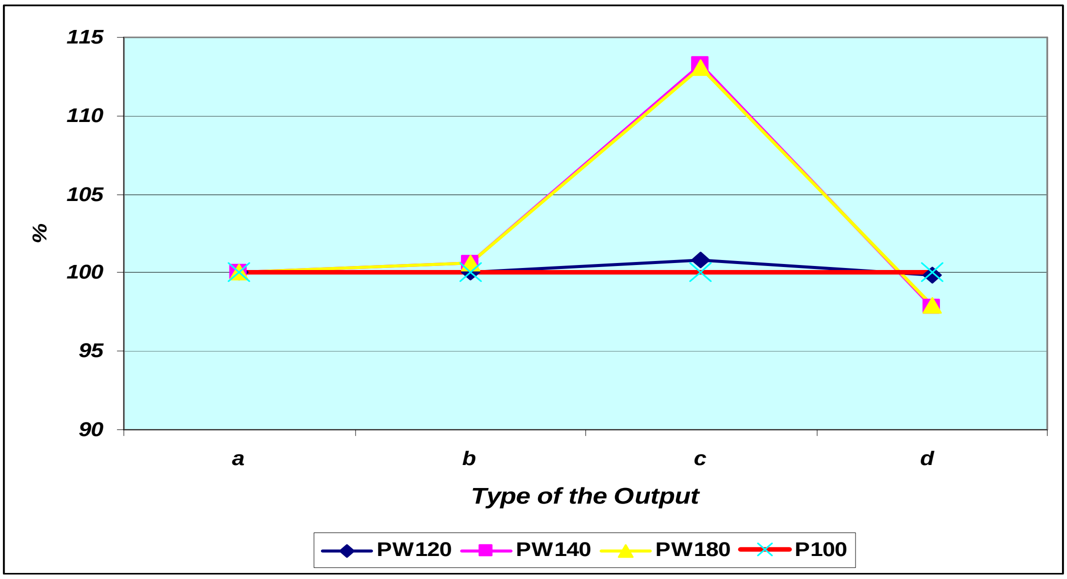
The selected scenarios are as follows: P100, PW120, PW140 and PW180.

The selected scenarios are the following: P100, PW120, PW140 and PW180. The reference scenario against which to measure changes in levels of Output, Input and Profit in the concomitant increase in energy-related input prices (energy and fertilizer) and some crop prices as Oilseeds, Coarse grains, and Wheat is one in which prices do not change (R100). At regional level, the results show that over the years do not change the levels of Output and Profit. Some modifications depending on the chosen scenario (PW120, PW140 and PW180) to R100 scenario is seen in changes in the levels of certain types of Input.

4.6.1 Changes in output levels

The results show that at the regional level (Nuts1), for the whole country and subregional level (Nuts2) in each years almost do not vary in terms of Output values depending on the selected scenarios. This conclusion is valid also for 2005. in any four types of Output they remain constant in different scenarios. In 2006. there are greater differences in the two types of Output between separate scenarios. These are Output: Sugar beet and other industrial crops (c) and Wheat (d) scenario for PW140 and PW180, where the degree of change compared to R100 respectively reached 13.2% and 13.02% for Sugar beet and other industrial crops (c) and -2.2% and -2,, 07% for Wheat (d). In the other two types Output (Potatoes (b) and the group of Pulses, Oil seed crops and Non-wheat Cereals (a) amendments to all scenarios is less than 1%.

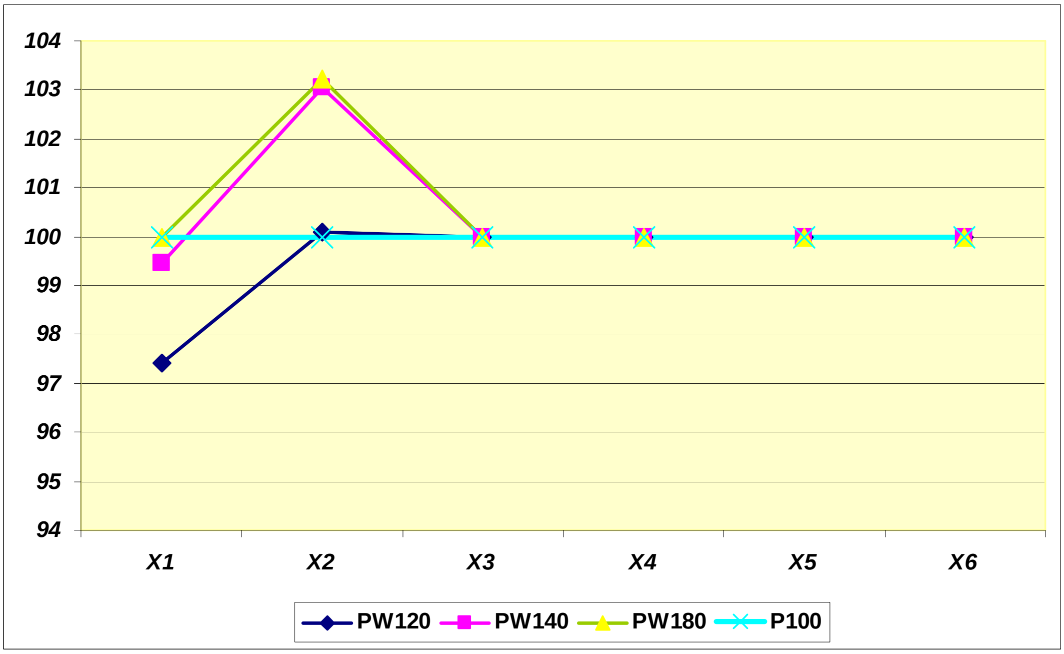
Figure 4.6 1 Changes in output levels by different kind of Scenario" "HighPricesCrop & EnergyCropFarms" , reference scenario - P100, 2006 year (%)



4.6.2 Changes in input levels

The results on changes in Input levels show that at all regional levels (State, Nuts1 and Nuts2) in 2005. changes in the levels of each as far as 6 species Input levels are not influenced by the selected scenarios. In 2004 and 2006. unchanged in various scenarios is the level of Farmland (6). Very slight changes (very close to zero) in 2006. there are levels of Seeds (3), Services (4) and Capital inputs (5) in scenarios PW120, PW140 and PW180. Relatively larger changes are in 2006. levels of Fertilizers (1), Pesticides (2), which increases the level of Pesticides (2) was 3.2% in the scenario to scenario PW180 R100. The level of Fertilizers (1) decreased in all three scenarios PW120, PW140 and PW180, by 2.57 %, to 0.54 % and 0.02 %.

Figure 4.6 2 Changes in Input levels by different kind of Scenario" "HighPricesCrop & EnergyCropFarms" , reference scenario - P100, 2006 year (%)



4.6.3 Changes in Profit levels

Profit levels at all regional levels (State, Nuts1 and Nuts2) remain unchanged under the various scenarios. This conclusion is valid for three years from the reference period.

Table 4 5 Output, input and income responses to dairy reform by dairy price decline, region, member state, reference year-2006 (1000000 nominal euros)

Variable description	Scenario	Average per region1 (1,2 and3)	Average per region2 (101,102,201,202, 301,302,303and304)	Total sample (Austria)
Pulses and oil seed crops and non-wheat cereals (a)	P100	2,44	1,58	7,31
	PW120	2,44	1,58	7,31
	PW140	2,44	1,58	7,31
	PW180	2,44	1,58	7,31
Potatoes (b)	P100	1,73	1,04	5,18
	PW120	1,73	1,04	5,18
	PW140	1,73	1,04	5,18
	PW180	1,73	1,04	5,18

Sugar beet and other industrial crops ©	P100	2,12	1,27	6,36
	PW120	2,12	1,27	6,36
	PW140	2,12	1,27	6,36
	PW180	2,12	1,27	6,36
Wheat (d)	P100	1,85	1,11	5,54
	PW120	1,85	1,11	5,54
	PW140	1,85	1,11	5,54
	PW180	1,85	1,11	5,54
Fertilizers (1)	P100	0,985	0,591	2,96
	PW120	0,959	0,576	2,88
	PW140	0,978	0,588	2,94
	PW180	0,984	0,591	2,95
Pesticides (2)	P100	0,688	0,413	2,06
	PW120	0,666	0,400	2,00
	PW140	0,686	0,411	2,06
	PW180	0,691	0,414	2,07
Seeds (3)	P100	1,149	0,689	3,45
	PW120	1,107	0,644	3,32
	PW140	1,142	0,685	3,43
	PW180	1,164	0,698	3,49
Services (4)	P100	3,34	2,01	10,03
	PW120	3,32	1,99	9,45
	PW140	3,35	2,01	10,06
	PW180	3,36	2,02	10,09
Capital inputs (5)	P100	5,46	3,276	16,38
	PW120	5,48	3,286	16,43
	PW140	5,48	3,286	16,43
	PW180	5,46	3,275	16,38
Farmland (6)	P100	496,82	298,1	1490,4
	PW120	496,82	298,1	1490,4
	PW140	496,82	298,1	1490,4
	PW180	496,82	298,1	1490,4
Regio profit	P100	1000	1000	10000
	PW120	1000	1000	10000
	PW140	1000	1000	10000
	PW180	1000	1000	10000

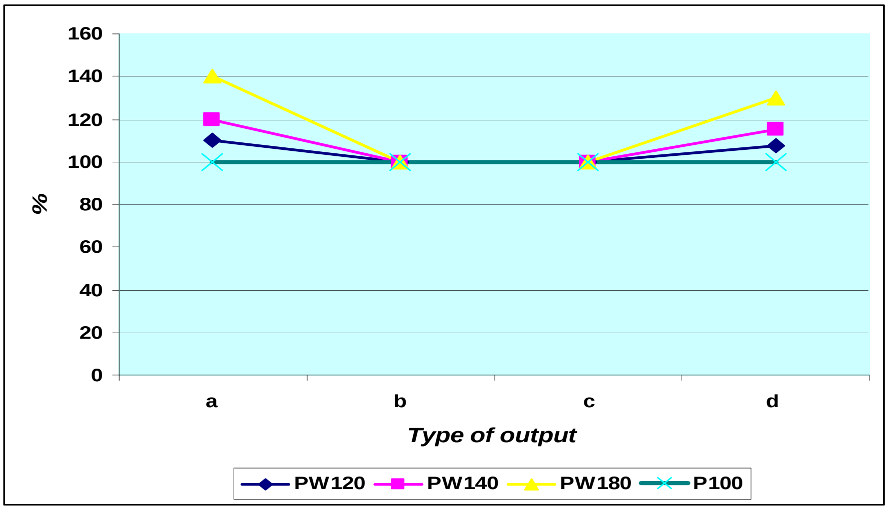
4.7 Simulation results at farm level

At farm level simulation results show that differences between scenarios are seen in changes in the level of Farm Output Price and Farm Input Price, whilst the Farm Profit remains constant in all scenarios considered.

4.7.1 Changes in Farm output price

In 2006 degree of variation in the level of Farm Output Price from scenario to scenario RW120 RW180 to R100 is the most significant in Pulses and Oil seed crops and non-wheat cereals (a), followed by changes in the level of Wheat (d). It increases proportionally with the increase in prices of crop and energy prices in the scenarios RW120, RW140 and RW180. Modifications range from 10% to 40% from 7.5% to 30% in the above mentioned two types of output.

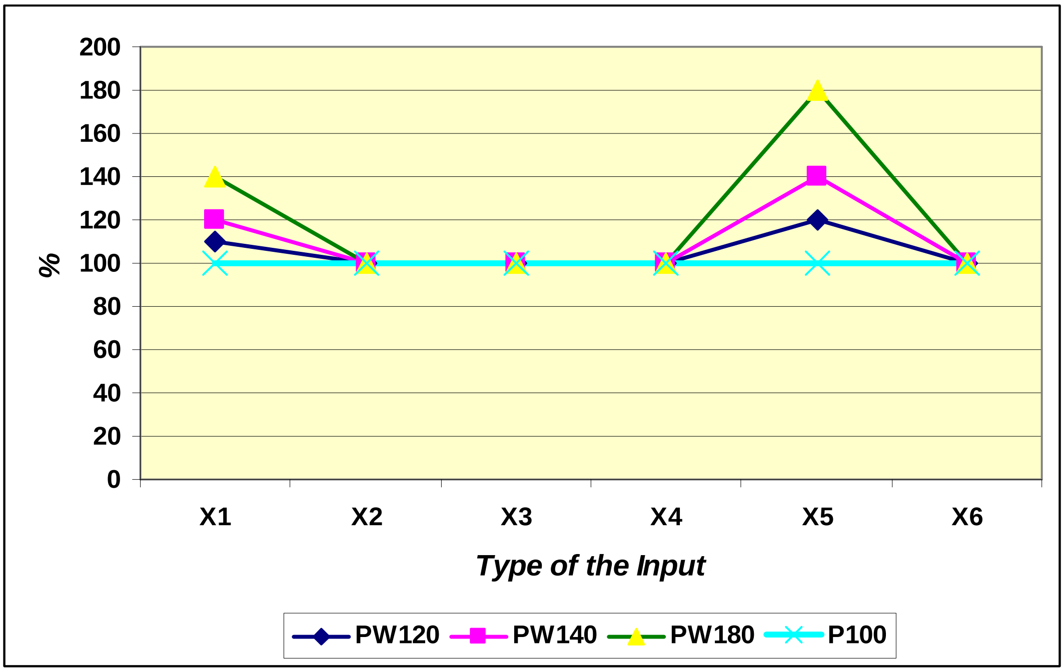
Figure 4.7 3 Changes in Farm output price by different kind of Scenario" "HighPricesCrop & EnergyCropFarms" , reference scenario - P100, 2006 year (%)



4.7.2 Changes in Farm Input Price

Changes in the level of Farm Input Price in 2006. scenario to P100 are different for each Input. Most of these changes are expressed in Fertilizers (1) and Capital inputs (5), where the scenario PW180 they increased by 40% and 80%. In scenarios PW120, PW140 Farm Input Price for these two types of Input also increased but to a much lesser extent: by 10% and 20% for Fertilizers (1) and Capital inputs (5) by 20% and 40% compared with a scenario P100. The level of other types of Input: Pesticides (2), Seeds (3), Services (4) and Farmland (6) is not affected by the scenario. In all scenarios, it remains at the level of the scenario P100.

Figure 4.7 4 Changes in Farm Input price by different kind of Scenario" "HighPricesCrop & EnergyCropFarms" , reference scenario - P100, 2006 year (%)



4.7.3 Changes in Farm Profit

Farm Profit level in 2005 and 2006. remains almost constant for different scenarios (changes are practically zero: the order of E-03 and E-08). Only in 2004. Farm Profit decreased marginally in PW140 and PW120 scenarios respectively 1% and 0.034%, a scenario PW180 increased by only 0.14%.

Conclusions

The simulation results show that the various scenarios of price increase for energy-related input prices (energy and fertilizer) on the one hand, and some increase in crop prices as Oilseeds, Coarse grains, and Wheat on the other hand (PW120, PW140 and PW180), have different impact on changes in levels of Output Price and Input Price Profit at regional, subregional and country level as a whole in 2006 compared to their levels in scenario R100. Most sensitive to changing scenarios are selected group of Pulses, Oil seed crops and Non-wheat Cereals (a) and Wheat (d) of the Output and Fertilizers (1) and Pesticides (2) Input. Without any modification remains Profit level in 2006. at regional and subregional level and for the country as a whole.

At the farm level in 2006. The biggest changes in the level of Pulses Price and Oil seed crops prices, a group of Input are Fertilizers (1) and Capital Inputs (5). In 2006. Farm Profit levels remain constant also compared with the level of P100, and regional level.

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Ex-Ante Evaluations Using Flexible Cost Functions with FADN data for Italy (Piemonte Region)

Working paper for WP9

September 2011

DRAFT

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Executive Summary

Insert your text here…[1]

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Contents

Abbreviations and Acronyms

EU	European Union
FACEPA	Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture
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List of Figures and Tables

Figures

Tables

1. Introduction

[First, introduce the region(s), the member state and the reference years for simulations as well as the period on which is based the estimation of the cost function that you use in the mathematical programming. Introduce the scenarios you simulate and the expected simulation results. Introduce briefly the approach that you use, in particular by referring to Henry de Frahan *et al*. (2011).

Second, if you know previous ex-ante evaluations or simulations performed on similar simulation scenarios, indicate here the methods and the results that have been obtained.

Finally introduce the limits of your ex-ante evaluations both in terms of sample and methodology.]

2. Ex-ante evaluation of dairy reform

2.1. Data description and statistics

2.1.1. Data preparation

Output 2 (non-dairy animal output) and output 3 (crop outputs) are aggregated so that:

Ya = Y1 (milk output),

Yb = Y2 (other animal outputs) + Y3 (crop outputs).

2.1.2. Sample specification

Italian sub sample of dairy farms (TF equal to 4110, 4120 or 4310).

The region analyzed is Piedmont.

2.1.3. Descriptive statistics

Outputs are rescaled.

Table 2.1. Descriptive statistics of the dairy farm sample, Piedmont (Italy) 1993-2007

Variable	Obs	Mean	Std. Dev.	Min	Max
Cost	69801	66738.71	101513	2118.692	3559577
ya	69801	.5983117	1.034167	0	35.14257
yb	69801	1.195063	2.358949	0	113.4457
px1	69801	.8231595	.1273725	.5809872	1.02972
px2	69801	.8916985	.0925711	.7291722	1.13799
px3	69801	1.050749	.069726	.9500433	1.1432
px4	69801	.9679617	.075574	.8319383	1.092504
px5	69801	.9677252	.0606171	.8893614	1.10911
px6	69801	.7340962	.2145038	.5292757	1.314759
px7	69801	.8943109	.1227116	.7680469	1.242034
pya	69801	1.076787	.0548809	1	1.180262
pyb	69801	1.002258	.0461524	.8889725	1.121725
x1	69801	3315.987	9507.737	0	659069

```
          x2 |     69801    4275.291    6413.659           0   173023.5
          x3 |     69801    8046.312    10474.49    463.2933   366250.5
-------------+--------------------------------------------------------
          x4 |     69801    24108.85       33965    984.0337   970873.1
          x5 |     69801    21591.24    45762.75           0    1702619
          x6 |     69801    4259.953    6861.701           0     203710
          x7 |     69801    1141.078    1686.142           0   36452.55
```

2.2. Empirical specification of the cost function

Quadratic specification, no fixed-effect, restrictions on the positiveness of marginal costs imposed, because without restrictions they are not fulfilled .

2.3. Input demand and marginal cost elasticities

2.3.1. Input demands

Percentage of the observations with negative estimated input demand :

- 1.64% for input X11 (Animal-specific inputs).
- 0.05% for input X6 (crop land)
- 19.1% for input X7 (grass land);

2.3.2. Own input demand elasticities

Medians of input demands are inelastic, except for X7 (Grass land).

Table 2.2. Own input demand elasticities for the dairy farm sample, Piedmont (Italy) 1993-2007

	Min	Max	Median
Elx1_px1	-1.37506	-0.00013	-0.00444
Elx2_px2	-0.2618	-1.1E-05	-0.00159
Elx3_px3	-1.27568	-0.00062	-0.11643
Elx4_px4	-0.88611	-0.00016	-0.07187
Elx5_px5	-7.11264	-0.00074	-0.01392
Elx6_px6	1.60E+07	-0.00586	-0.55195

Elx7_px7	-1848.17	-0.00887	-3.06233

2.3.3. Own marginal cost elasticites

Marginal cost elasticities are close to zero.

Table 2.3. Own marginal cost elasticities for the dairy farm sample, Piedmont (Italy) 1993-2007

	Min	Max	Median
ElMCya_ya	2.90E-10	7.70E-07	2.70E-08
ElMCyb_yb	1.10E-07	0.006591	0.0001

2.4. Marginal costs, average costs and quota rents

2.4.1. Marginal costs

Mean observed marginal cost for Ya (milk output): 265,69 € (76% of the observed farmgate price). It rises from 1993 to 2006. That the mean observed marginal cost for Ya is at 76% of the observed farmgate price is realistic given the quota constraint.

2.4.2. Average costs

Average costs are very close to marginal costs. Mean observed average variable cost for Ya (milk output): 264.9 € (75% of the observed farmgate price). It rises from 1993 to 2007.

2.4.1. Quota rents

The quota rent for Ya (milk output) is 86 € per ton (24% of the observed farmgate price). It decreases from 1993 (118€/ton) to 2007 (32€/ton).

Table 2.4. Prices, estimated marginal costs, quota rents and marginal cost elasticities for milk output from the long-run augmented SGM specification, Piedmont (Italy) 2007 (€/1000 litres)

Region	Variable	Mean	Standard deviation	Minimum	Maximum
Piedmont 1201	Milk price	391.0884	11.16895	380.0489	412.1483
	Marginal cost	315.36	2.77431	307.475	324.489
	Quota rent	32.8758	2.77431	23.7466	40.76
	Rent/Milk price (%)	9.4407	0.7967	6.8191	11.7047
	Marginal cost elasticity	6.50E-08	8.30E-08	2.90E-10	7.70E-07

2.5. Reference years, calibration method and calibration success rate

As presented above, the sample considered to analyze the effects of farm behavior in relation to different policy and market scenarios in Italy belongs to the Piemonte region, one of the most specialized agrarian region in Italy. The analysis focuses on the dairy sector considering the farms producing milk inside the Italian FADN.

The first phase of the analysis used to evaluate the impact of policy and market scenarios on the dairy farm decision concerns the calibration that is operated following the approach suggested by Henry De Frahan et al. (2011) and using the model developed within the FACEPA project. The calibration method as discussed inside the Deliverable X.X uses a multi-output multi-input flexible cost function and specific calibration terms inside individual objective functions submitted to a milk quota restriction. The model is able to exactly calibrate the production levels observed in the reference year.

In this specific context, the model calibrates with respect a unique activity, that is the milk production with respect of which the objective function is maximized considering the constraint of milk quota. Furthermore, the model has a long-run perspective and considers three reference years for performing the estimations and the market and policy simulations.

2.5.1. Selected reference years

The entire dataset covers 9 years, from 1999 to 2007. The reference years selected for the calibration and simulation are 2005, 2006 and 2007. 2007 is the most recent year present in the Italian FADN used in this analysis.

2.5.2. Selected calibration method

The method of calibration applied to the Piemonte's sample is widely explained in Henry De Frahan et al. (2011) and inside the Deliverable X.X. In this analysis, the model specified for the calibration and simulation has a long-run perspective, so that each individual (farm) objective function is formulated with a long-run quadratic cost function estimated in a previous phase. The model calibrates using specific linear adding terms inside the objective function. The calibration terms are derived from the optimality conditions of the long run model according to the proposal suggested by Heckelei and Wolff (2003).

2.5.3. Calibration success rate

The model was applied to a sample of 280 farms (101 for 2005, 88 for 2006 and 91 for 2007). The calibration results are illustrated by the Table 2.5, where it is possible to verify that all the farms calibrate with only one with a very small difference in 2005. The results showed in the table below concern the comparison between the observed farm profit in each reference year with the farm profit generated by the model throughout the calibration approach briefly presented in the previous paragraph.

Table 2.5. Number of farms, number of calibrated farms and calibration success rate, Piedmont, Italy, 2005-2007

Reference year	**Number of farms in the sample**	**Number of farms calibrated in the sample**	**Calibration success rate (%)**
2005	101	100	99
2006	88	88	100
2007	91	91	100

In terms of output differences, the calibration presents a rate of success not lower than 98.8%. Calibration on 2007 shows a perfect reproduction of the reference situation.

2.6. Simulation results at regional level

The simulation phase is based on the milk quota removal scenario that will realize after March 2015. In this respect, the model evaluate the reaction in term of production plan of each farm considered in the sample reaching thus a result that can be evaluated also at regional level. The basic scenario characterized by the quota abolition is integrated by a series of milk price hypothesis. These market scenarios consider a set of likely reduction in milk price, starting from a situation with a reduction of 10% up to a stronger reduction of 60% with respect to the reference year. In detail, the scenarios investigated are implemented as follow:

- P100 : no reduction in milk price and milk quota abolished
- P 90 : -10% in price observed in the reference year and milk quota abolished

- P 80 : -20% in price observed in the reference year and milk quota abolished
- P 70 : -30% in price observed in the reference year and milk quota abolished
- P 60 : -40% in price observed in the reference year and milk quota abolished
- P 50 : -50% in price observed in the reference year and milk quota abolished

Since the evaluation is carried out on a single region, the simulation results will be discussed at aggregated level trying to compare the differences in variable dynamics with respect to the each reference year. The outcomes of the model permits to analyze the change in output and input levels, both in economics and in quantity terms, and the level of income. This discussion faces the result comments in economic terms in relation to the main product (milk) and the income achieved. The main results produced by the model are showed by the Table 2.6.

2.6.1. Changes in output levels

The output levels are differentiated in two categories: the milk output for sale and the other animal outputs for sale, that is in particular the meat production. All the output variables included in Table 2.6 are measured as percentage variation compared to the situation observed in the basic situation.

Observing the results for milk production in Table 2.6 is quite clear that the quota abolition has a very low effect. More precisely, comparing the results achieved for the three years, the milk quota removal doesn't produce an important increase in the milk supply, but a very small augmentation of 0.2% with respect the basic situation. This result seems to depend to the low convenience of the milk activity in the region. Breeders cannot expand the production due to economic and physical restrictions, ie a low marginal profit associated to this activity and a rigidity in farm structures (available land).

The previous statement is supported by the results in presence of milk price modification. The price reduction has very different effects in relation to the reference sample. The 2005 sample of farm react to the price reduction and milk quota removal only starting from scenario P80, that seems the threshold reduction for milk. While, in 2006 and 2007 the reduction in milk production starts from the first price scenario reduction. In 2005, the farm production allocation is very relied to the market prices rather than the abolition in milk quota. Milk quota removal is considered by the model simulation as a residual restriction policy component that doesn't affect the decision to increase the production capacity.

In 2007, the most recent year, the quota removal associated to a reduction of 10% reduces the milk output of more than 30% with respect the basic scenario and the scenario P100. This results might be attributed to the decision of small farms to abandon the sector. The progressive reduction in milk price produces a reduction in milk production but with lower marginal effects.

2.6.2. Changes in input levels

The strong reduction in milk production has the effect to save input quantity. All the input components considered in the evaluation reduce the level with respect to the basic situation. Crop specific inputs, cows, other intermediate inputs and other animal specific inputs show a reduction of 30% in all reference years. Also the purchased feeds, grassland and cropland indicates a reduction that corresponds to the scenarios with a strong decrease in milk production.

With respect the results obtained is not possible to evaluate the process of substitution produced by the reduction in milk quota. A reduction in milk production might produce an increase in the arable crops or in industrial crops, but this kind of dynamics cannot be precisely appreciated.

2.6.3. Changes in income levels

Despite the scenario P100, where the farm income increases in all the reference years in relation to the small increase in milk production, the scenarios with reduction in milk price highlight a progressive reduction in the level of income up to -60% for the 2005 reference year. The lower impact on the other reference year can be due to the higher starting milk prices observed in 2006 and 2007.

Table 2.6. Output, input and income responses to dairy reform by dairy price decline, Piedmont, Italy, 2005-2007 (%)

Variable description	**Scenario**	**Piemonte 2005**	**Piemonte 2006**	**Piemonte 2007**
Milk output for sale (a)	P100	100.298	100.261	100.467
	P90	100.123	70.013	69.948
	P80	59.906	56.985	60.904
	P70	59.459	56.283	60.56
	P60	59.384	55.929	60.386
	P50	59.348	55.67	60.333
Other animal outputs for sale (b)	P100	100.298	100.215	100.273
	P90	100.523	98.929	95.651
	P80	94.254	94.589	99.023
	P70	95.041	92.581	99.46
	P60	94.593	91.615	99.566
	P50	94.148	90.989	99.375
Other animal specific inputs (1)	P100	99.895	100.016	99.967
	P90	99.744	72.224	66.009
	P80	57.244	58.512	58.429
	P70	56.882	56.82	58.319

	P60	56.742	55.937	58.224
	P50	56.644	55.339	58.096
Crop specific inputs (2)	P100	99.929	100.013	99.959
	P90	99.852	81.93	78.109
	P80	73.63	72.483	73.765
	P70	73.453	71.1	73.75
	P60	73.344	70.39	73.71
	P50	73.262	69.914	73.612
Cows (3)	P100	99.873	99.972	99.896
	P90	99.777	83.197	79.298
	P80	72.414	74.902	74.676
	P70	72.182	73.855	74.609
	P60	72.092	73.305	74.557
	P50	72.03	72.934	74.486
Other intermediate inputs (4)	P100	99.898	99.97	99.913
	P90	99.761	77.303	73.599
	P80	65.429	66.948	66.655
	P70	65.079	66.004	66.459
	P60	64.996	65.496	66.358
	P50	64.949	65.147	66.302
Purchased feeds (5)	P100	99.916	99.999	99.961
	P90	99.726	68.714	63.654
	P80	52.546	54.477	53.992
	P70	52.069	53.22	53.711
	P60	51.954	52.547	53.566
	P50	51.886	52.083	53.487
Grassland (6)	P100	100	100	100
	P90	99.836	69.623	67.005
	P80	60.391	56.413	57.289
	P70	59.949	55.537	56.935

	P60	59.877	55.061	56.773
	P50	59.844	54.725	56.738
Cropland (7)	P100	100	100	100
	P90	100	91.774	87.79
	P80	78.569	86.29	87.131
	P70	78.628	85.014	87.305
	P60	78.433	84.368	87.33
	P50	78.258	83.943	87.207
Farm incomes	P100	102.343	101.731	101.441
	P90	84.037	87.39	89.482
	P80	72.2	78.699	81.878
	P70	61.322	70.445	74.486
	P60	50.477	62.257	67.123
	P50	39.642	54.116	59.775

2.6.4. Changes in farmland rents

The model outcomes show null dual values for all the scenarios.

Table 2.7. Changes in farmland rents to dairy reform by dairy price decline, region, member state, reference year (%)

Scenario	Name of the region (Nuts code)	Name of the region (Nuts code)	Name of the region (Nuts code)
P100			
P90			
P80			
P70			
P60			
P50			

2.7. Simulation results at farm level

2.7.1. Changes in output levels

Fig. 2.1: Frequency for milk supply (year 2005)

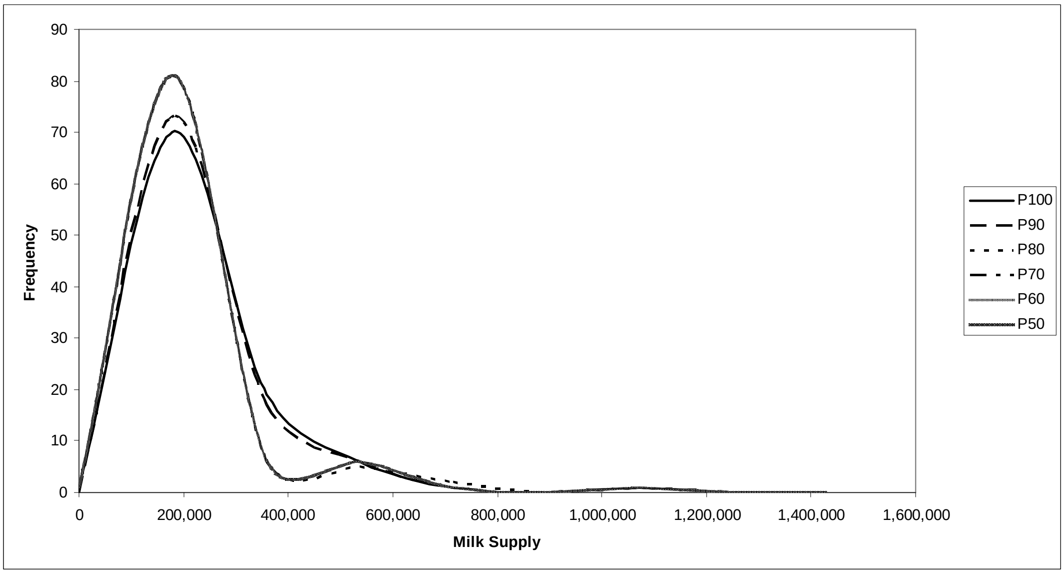


Fig. 2.2: Frequency for milk supply (year 2006)

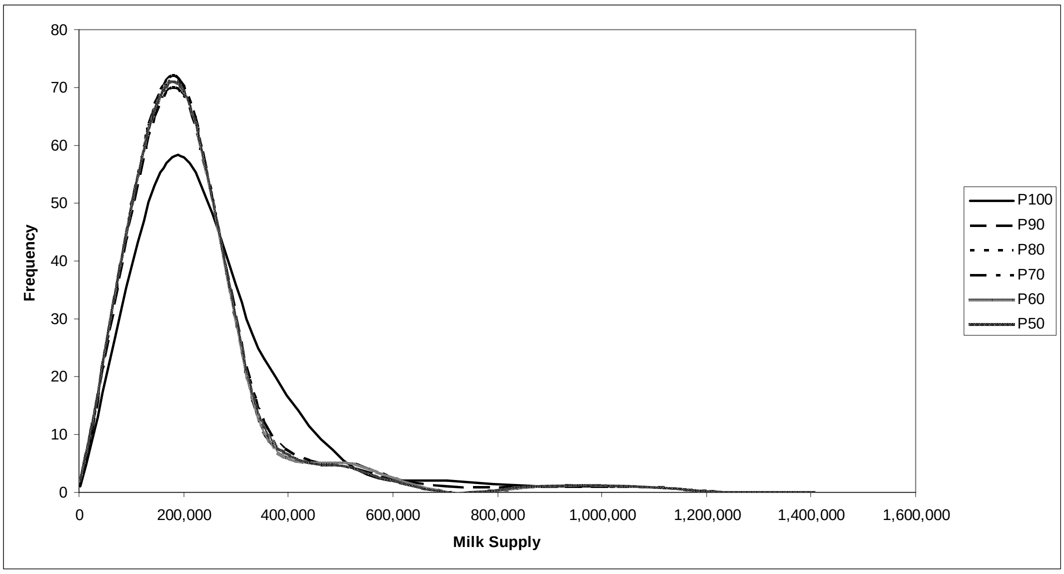


Fig. 2.3: Frequency for milk supply (year 2007)

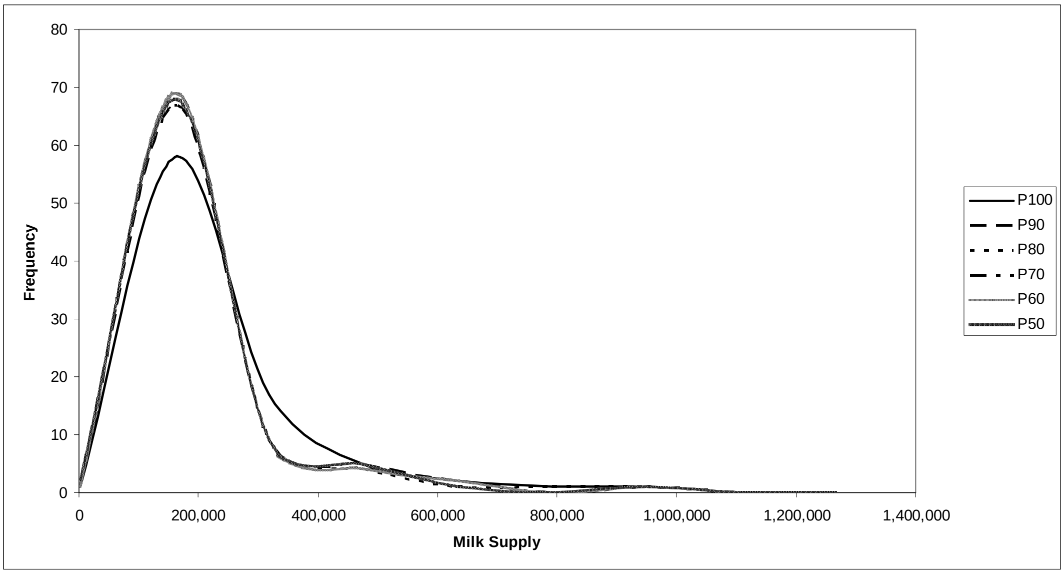
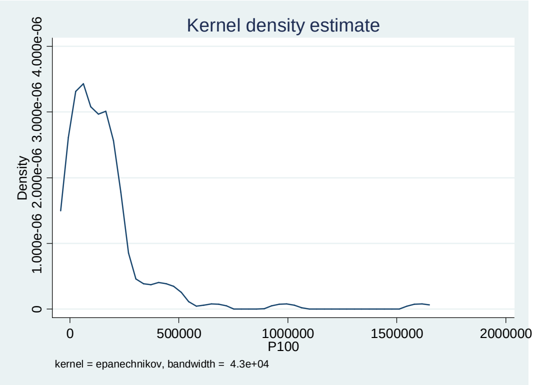
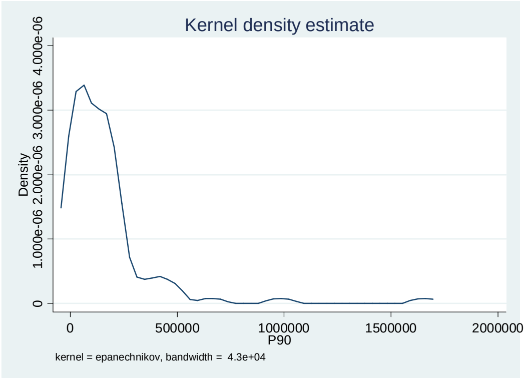


Fig. 2.4: Kernel density for milk supply (year 2005)

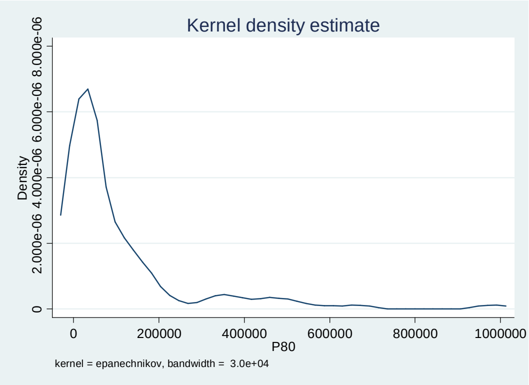
2.4a- Scenario P100



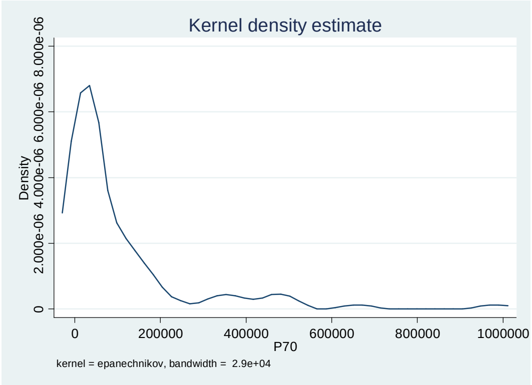
2.4b- Scenario P90



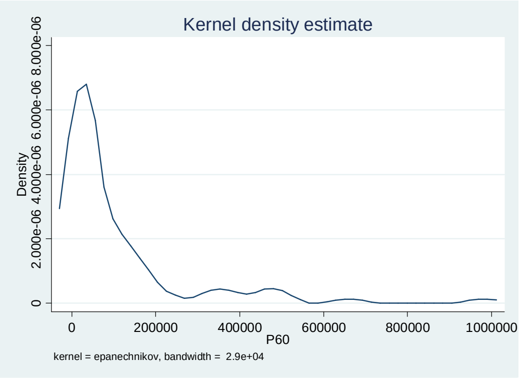
2.4c- Scenario P80



2.4d- Scenario P70



2.4e- Scenario P60



2.4f- Scenario P50

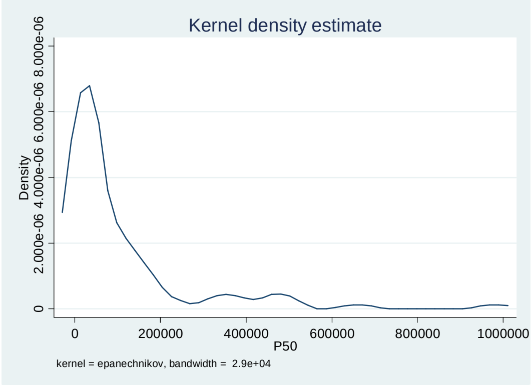
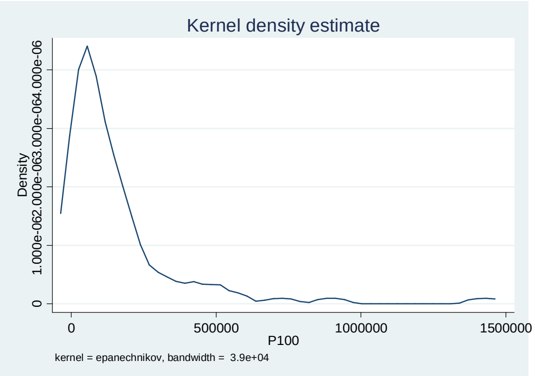
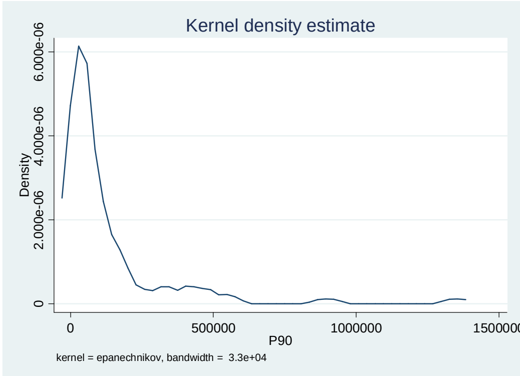


Fig. 2.5: Kernel density for milk supply (year 2006)

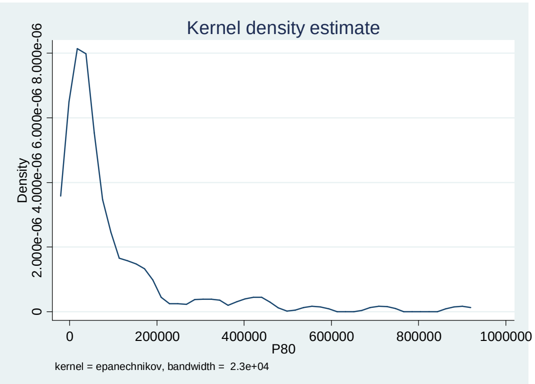
2.5a- Scenario P100



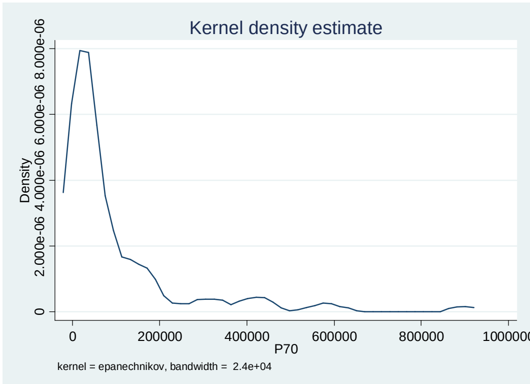
2.5b- Scenario P90



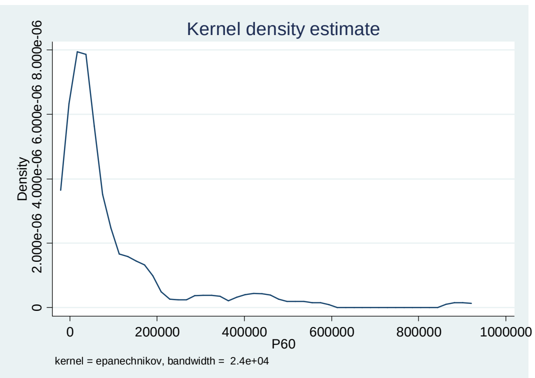
2.5c- Scenario P80



2.5d- Scenario P70



2.5e- Scenario P60



2.5f- Scenario P50

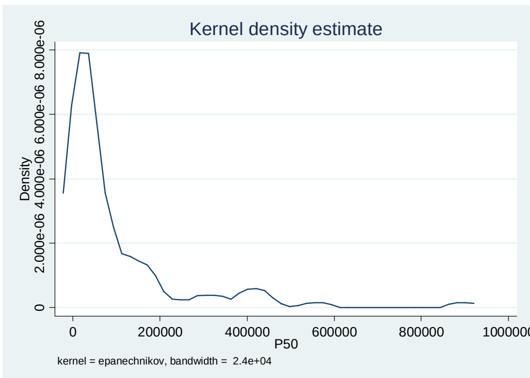
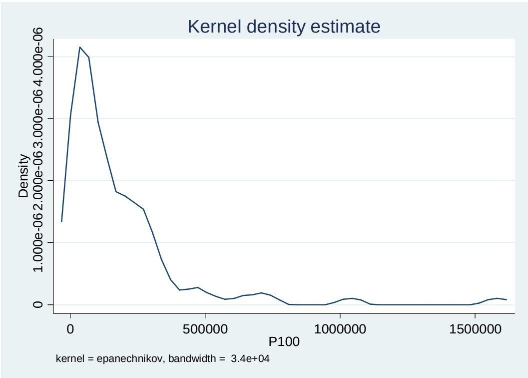
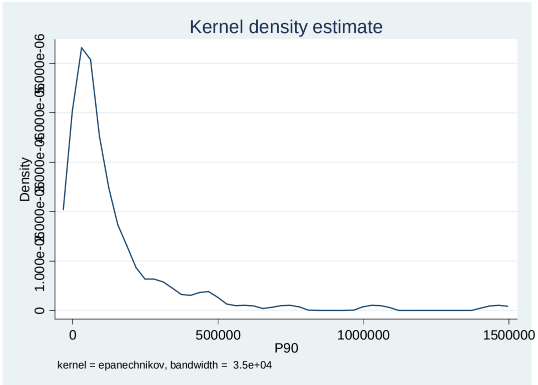


Fig. 2.6: Kernel density for milk supply (year 2007)

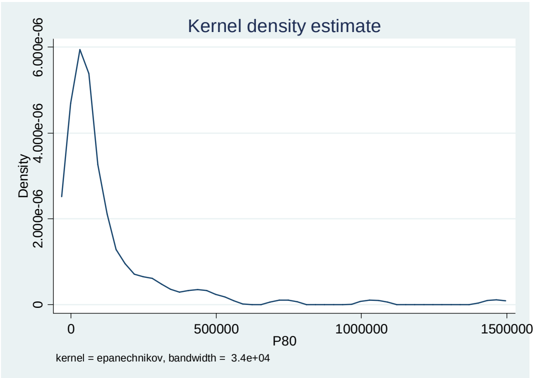
2.6a- Scenario P100



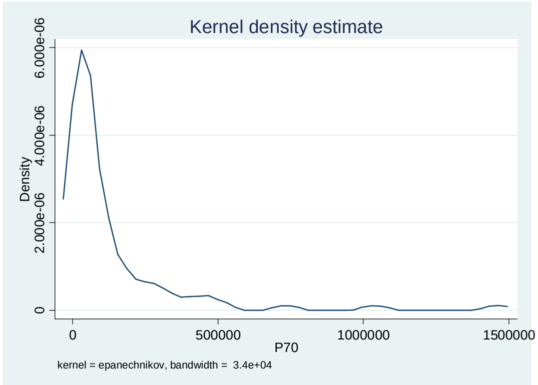
2.6b- Scenario P90



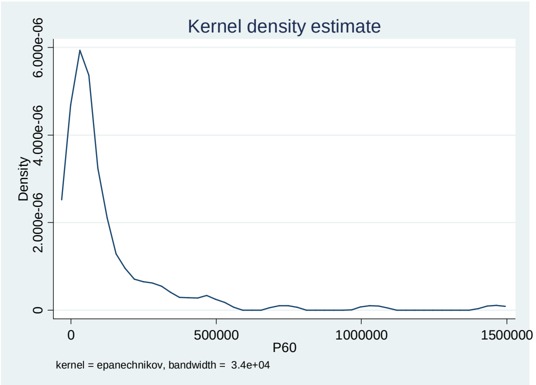
2.6c- Scenario P80



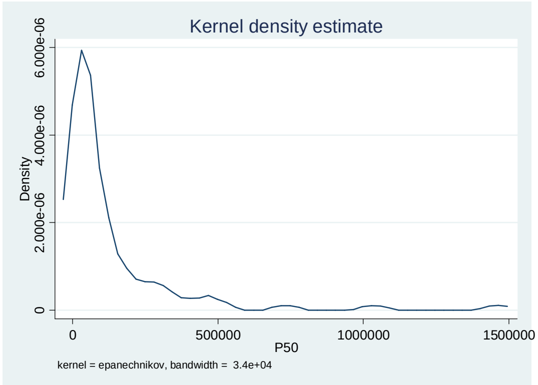
2.6d- Scenario P70



2.6e- Scenario P60



2.6f- Scenario P50



2.7.2. Changes in input levels

Fig. 2.7: Frequency for cows (year 2005)

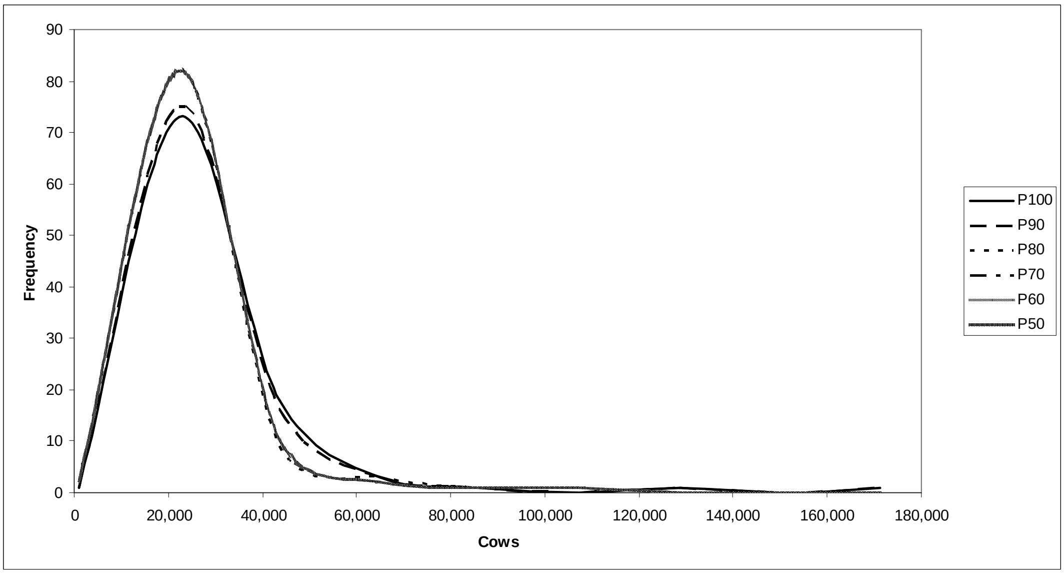


Fig. 2.8: Frequency for cows (year 2006)

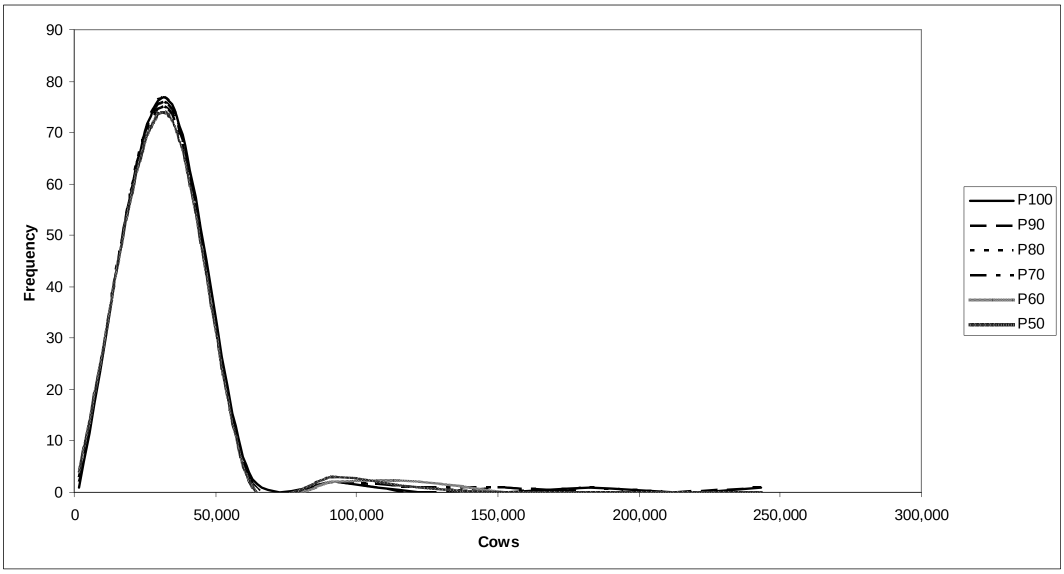


Fig. 2.9: Frequency for cows (year 2007)

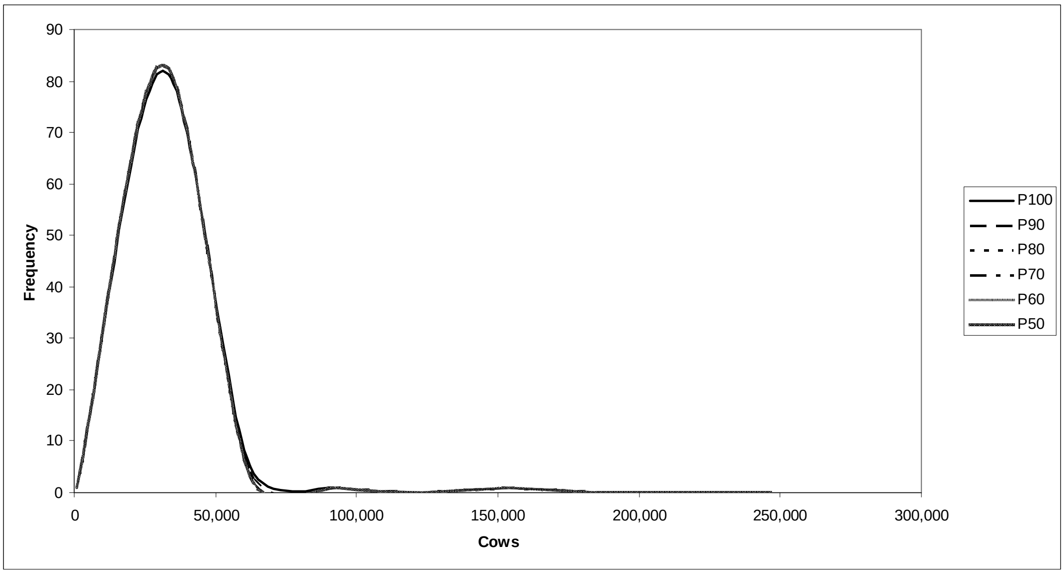


Fig. 2.10: Frequency for purchased feeds (year 2005)

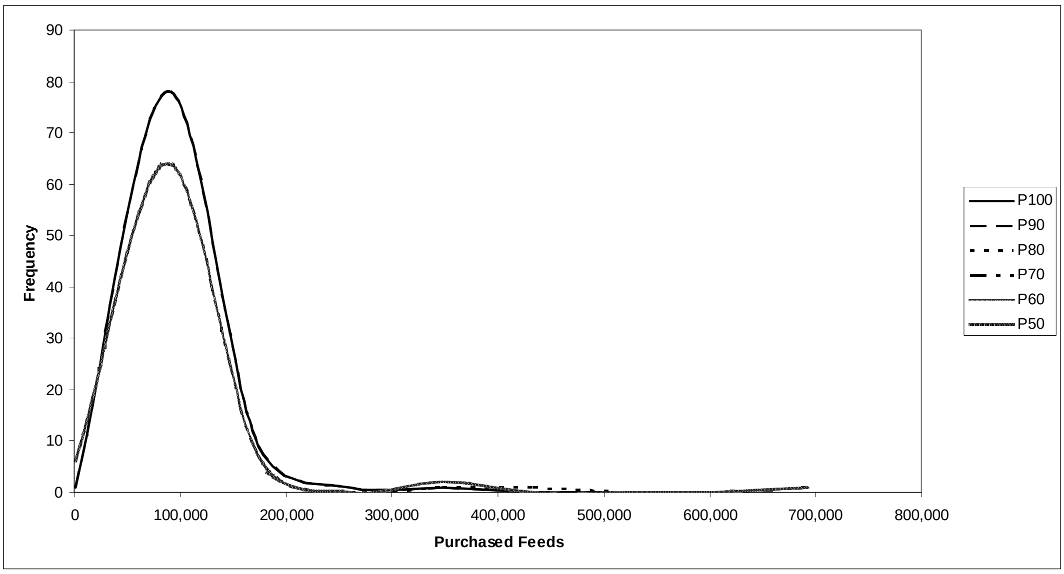


Fig. 2.11: Frequency for purchased feeds (year 2006)

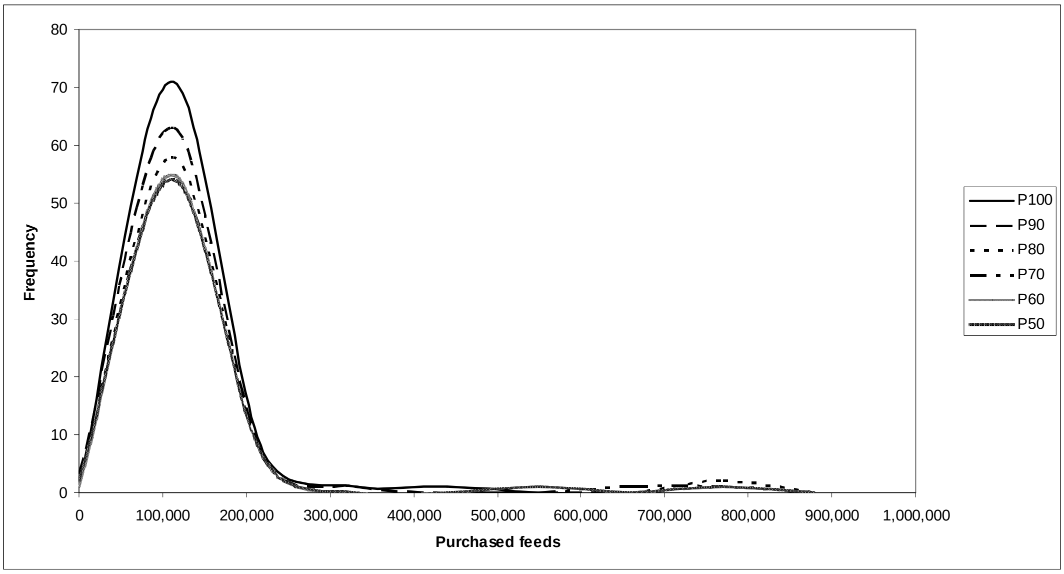
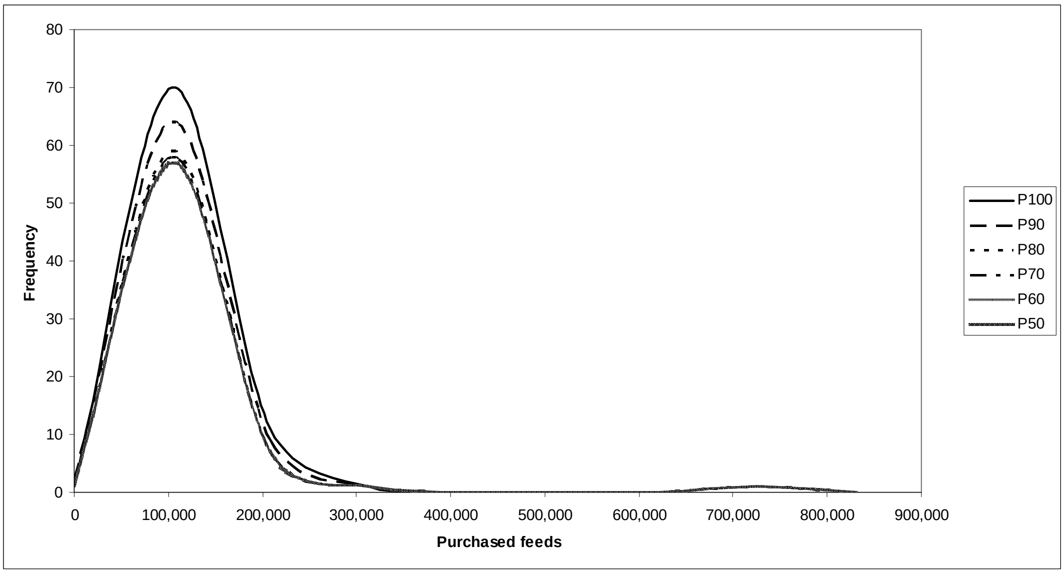


Fig. 2.12: Frequency for purchased feeds (year 2007)



2.7.3. Changes in income levels

Fig. 2.13: Frequency for farm profit (year 2005)

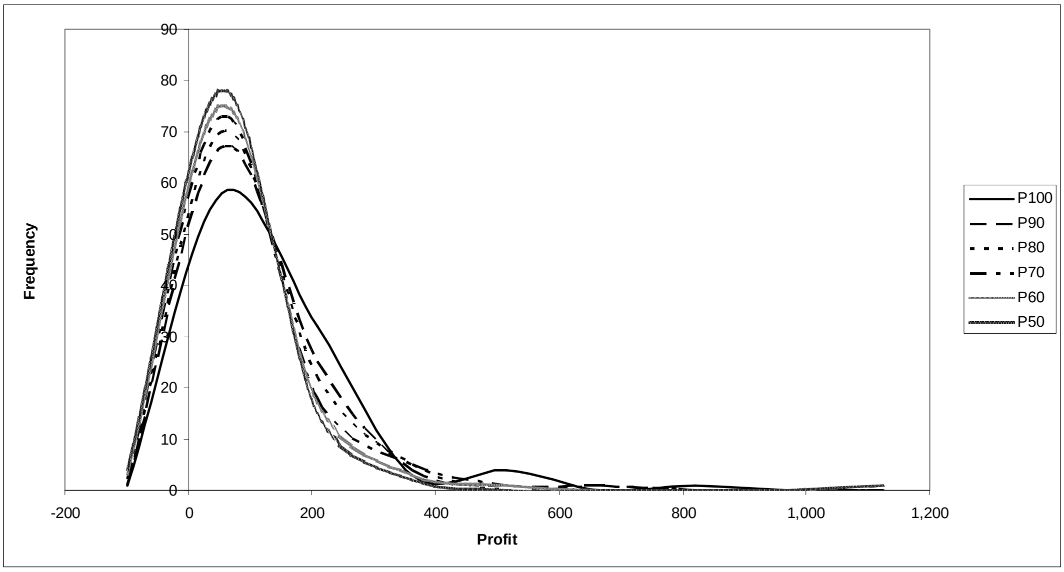


Fig. 2.14: Frequency for farm profit (year 2006)

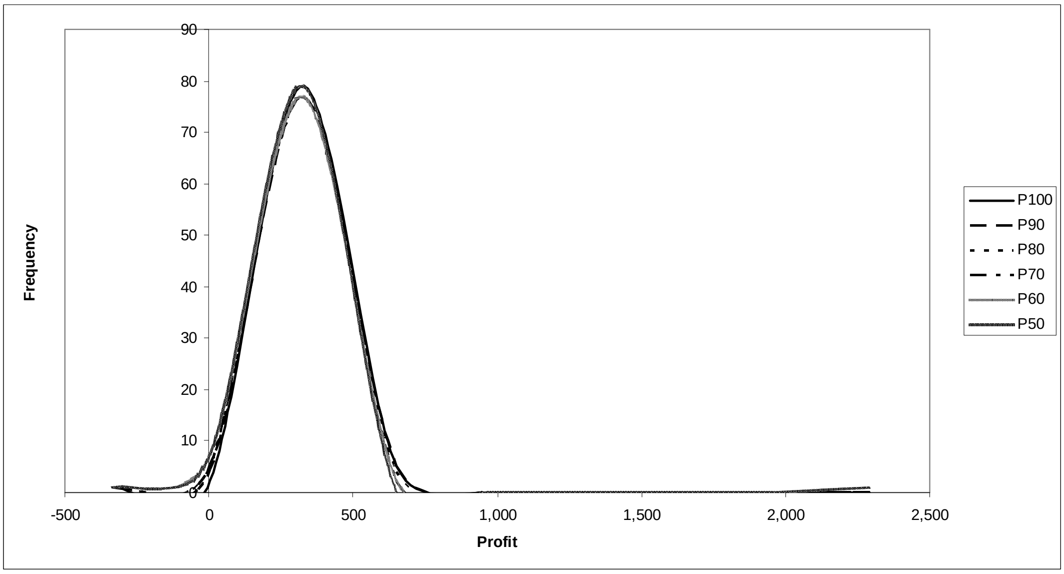


Fig. 2.15: Frequency for farm profit (year 2007)

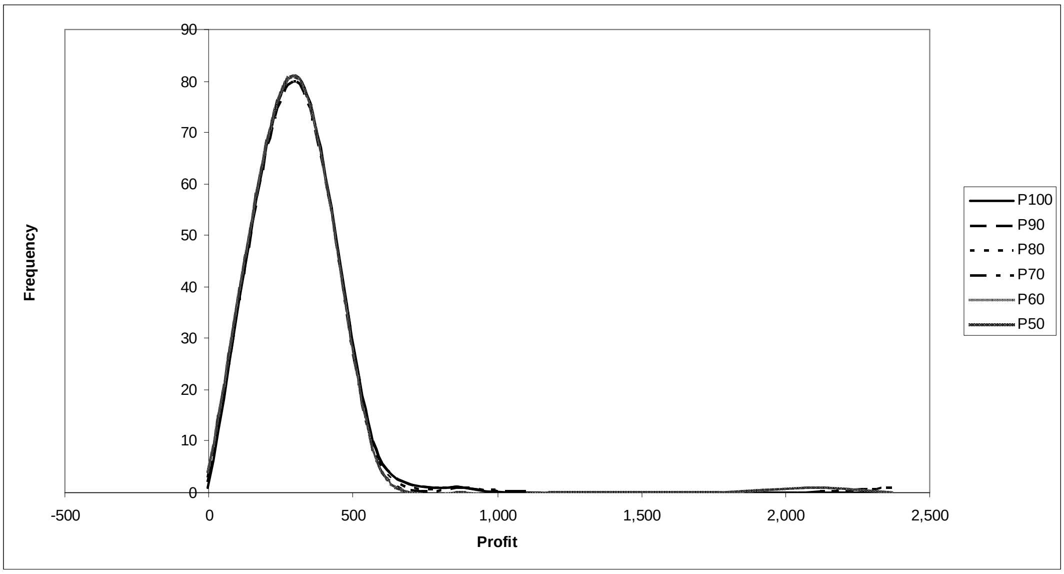
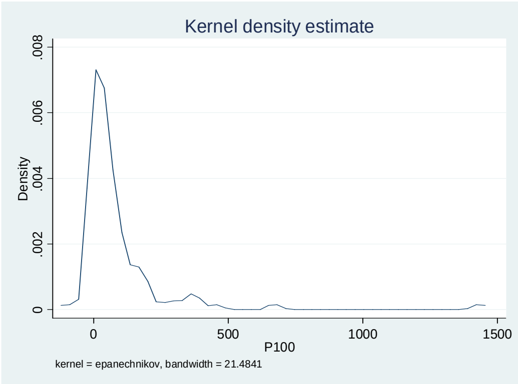
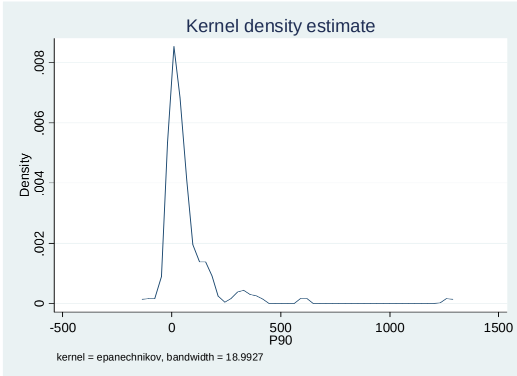


Fig. 2.16: Kernel density for farm profit (year 2005)

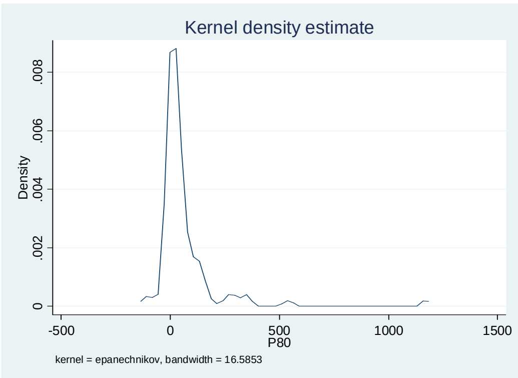
2.16a- Scenario P100



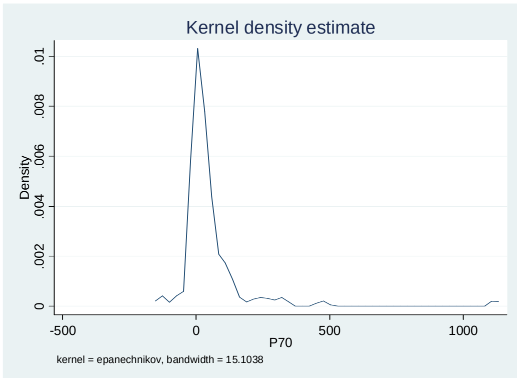
2.16b- Scenario P90



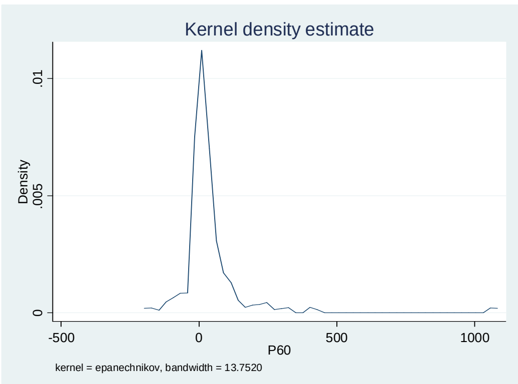
2.16c- Scenario P80



2.16d- Scenario P70



2.16e- Scenario P60



2.16f- Scenario P50

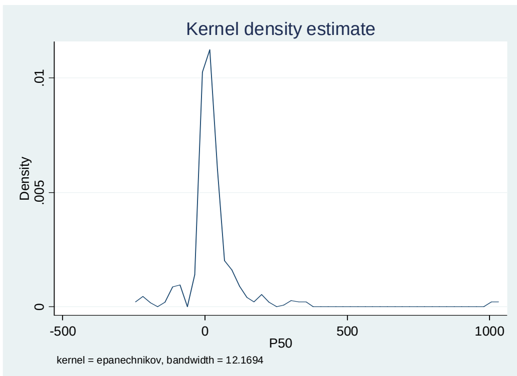
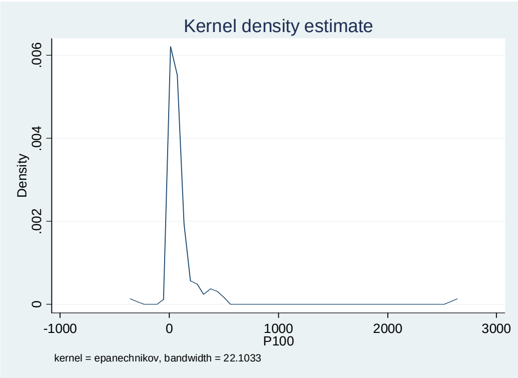
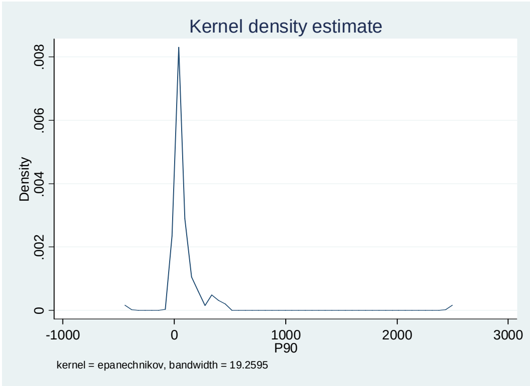


Fig. 2.17: Kernel density for farm profit (year 2006)

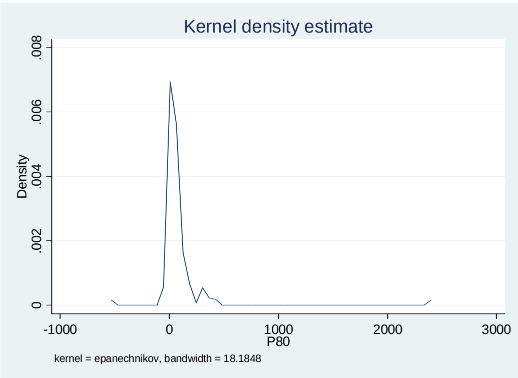
2.17a- Scenario P100



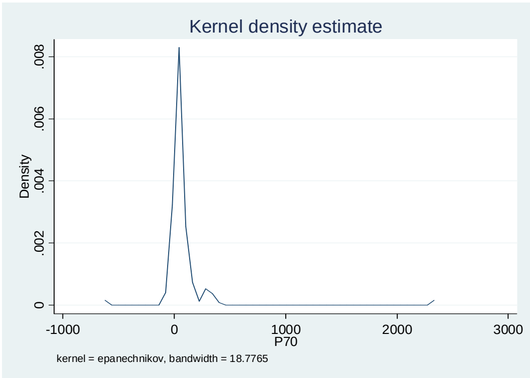
2.17b- Scenario P90



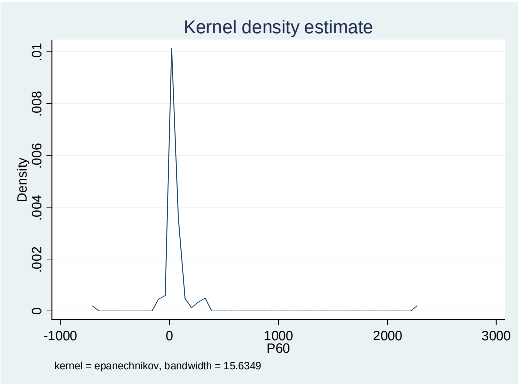
2.17c- Scenario P80



2.17d- Scenario P70



2.17e- Scenario P60



2.17f- Scenario P50

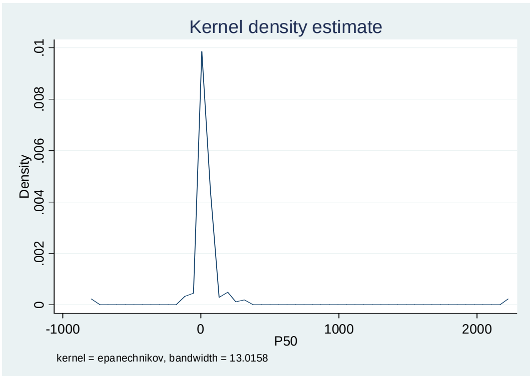
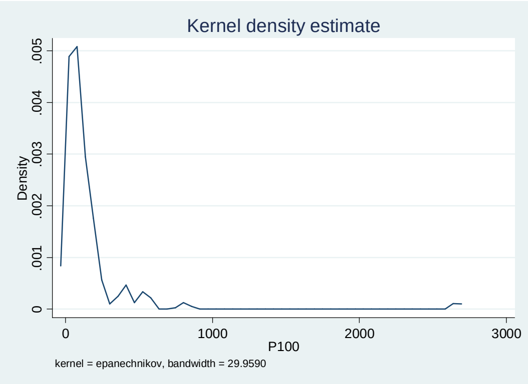
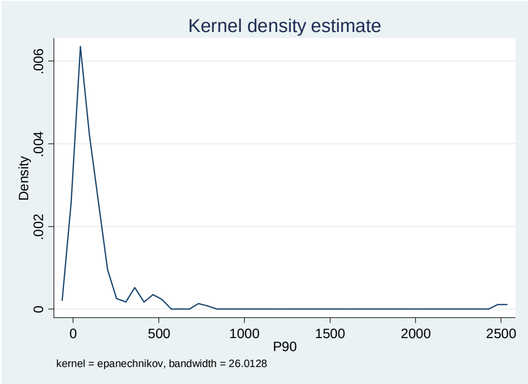


Fig. 2.18: Kernel density for farm profit (year 2007)

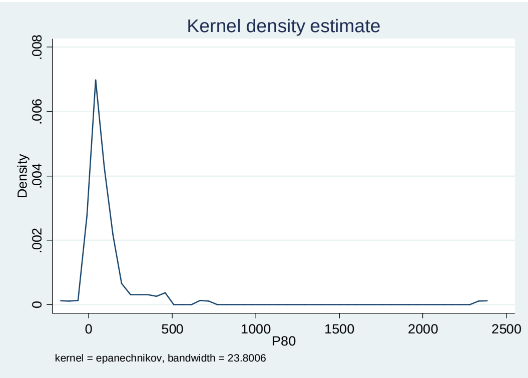
2.18a- Scenario P100



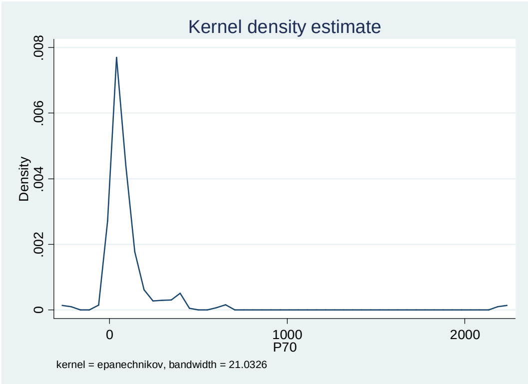
2.18b- Scenario P90



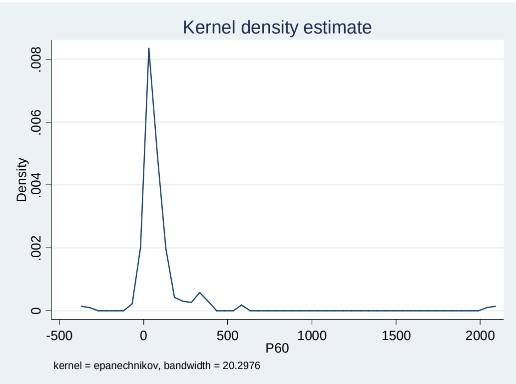
2.18c- Scenario P80



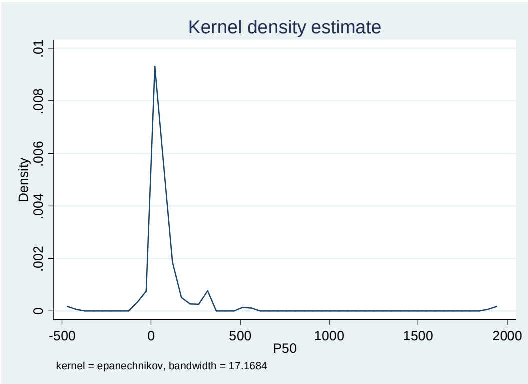
2.18d- Scenario P70



2.18e- Scenario P60



2.18f- Scenario P50



Conclusions

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Annex 1

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