Productivity growth, technology progress and efficiency change in the French pig sector from 1996 to 2001

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Introduction

Developments in production, breeding and management techniques have resulted in scale economies and have enabled considerable increases in productivity, particularly for larger operations. The objective of this contribution is to measure farms' productivity growth over time and to estimate the level of impact that individual components such as changes in technical efficiency, scale efficiency and technical change (technical progress or regress) have on the productivity growth.

The emergence of environmental regulation during recent decades has added another parameter, which involves a revised measure of productivity growth that captures the costs associated with environmental externalities. Thus, this work moves beyond the traditional studies on productivity growth analysis by considering impacts on both the bad outputs (manure surplus) and good outputs (marketable outputs). This issue can be considered within the framework of the Malmquist-Luenberger (ML) productivity index (Chung et al, 1997). The ML index credits producers for simultaneously, increasing good outputs and reducing the production of bad outputs. The hypothesis of weak disposability on the undesirable outputs is introduced to capture the fact that costs are incurred or increased when regulation on bad outputs is applied to the farm.

Material and Methods

Data for conducting the research are drawn from the Farm Accountancy Data Network (FADN) data set. The sample consists of farms with a pig farming activity from 1996 to 2001. There are between 393 and 406 farms each year.

To implement the Malmquist-Luenberger index, we use a Data Envelopment Analysis based on frontier modelling approach. This methodology has several nice features. It requires only information on input and output quantities, which makes it suitable in the presence of non-marketable goods like pollution. The frontier approach represents the production technology based on the best-performing farms of the sample. Using one good output (gross output), one bad output (manure surplus) and four inputs (land, livestock, labour and variable inputs), indexes were calculated via linear programming methods for efficiency, technical and productivity change across the time periods.

The ML index can be decomposed into two components, one accounting for efficiency change and one measuring technical change where the former, is understood as, how far an observation is from the technology frontier and the latter, is understood as, to be shifts in the technology frontier (Grosskopf, 1993). Following Färe et al. (1994), the ML index efficiency component can be further decomposed into a technical and a scale efficiency change component. We extend this work by allowing an additional component: the environmental efficiency change, which measures the impact of a reduction in the environmental regulation, applied to the farm on the efficiency component of the productivity index.

Results

The cumulative change of ML indexes and its components for the whole data set is depicted in Figure 1 while the cumulative change of efficiency component and its decomposition is shown in Figure 2. The results indicate that over the 1996 to 2001 time period, there has been a productivity growth of approximately 9.3 % per year, which was mostly attributed to technical change (8.9 %), i.e., shifts in the technological frontier. Changes in efficiency had a

smaller effect (1.3 %) on ML productivity growth. However, ML productivity changes and its components vary significantly from year to year. There was sharp growth in ML productivity of near 19 % in 2000, moderate growth of 5.4 and 6.2 % in 1999 and 1997, respectively, and declines of 2 and 7 % in 2001 and 1998, respectively. From Figure 1, it follows that the results of such variation is attributed to both technical change and efficiency change contributions to productivity growth. Both factors exhibited volatile changes while moving in the same direction in all other years. The absence of an apparent trend in the ML productivity index might be explained by the fact that farms in the sample produce different output mixes using different inputs as well as facing dissimilar agro-climatic conditions.
In terms of efficiency change, farm movements towards and away from the technological frontier were attributed to technical and scale efficiency changes. Changes in environmental efficiency did not exceed 1.5 % per year.

Discussion

Results indicated that productivity has not suffered from the implementation of the environmental regulation. Technical progress was found to be a major factor for productivity growth. Efficiency improvement's contribution played a minor, but positive role. The decomposition of efficiency change suggests two comments. First, there still have potentials for improvement of productivity by reducing technical inefficiency and by capturing economies of scale in farm production processes. Second, the implementation of environmental regulation has been an opportunity to develop new production processes that both reduce emissions and increase production.

Conclusion

In terms of structural change in the pig sector, this study suggests that there still have possibility of change in farm size since there subsists economies of scale that can be captured. The effect of environmental regulation on productivity growth has resulted in an increase in technical progress from 1996 to 2000, which highlights the productivity benefits of a cleaner environment support by innovation (Jaffe et al., 1995).

References

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Fig. 1: Cumulative change of ML Indexes

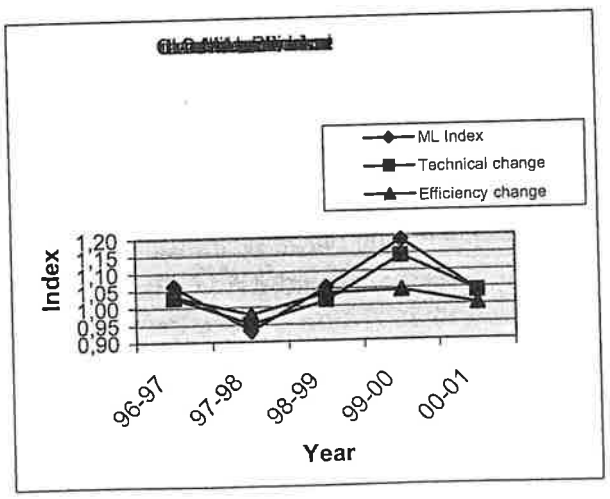

Fig 2: Cumulative change of efficiency components and its decomposition