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# FARM SIZE AND EFFICIENCY: THE CASE OF SLOVENIA

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***Abstract***

This paper investigates farm technical, scale, allocative and economic efficiency and its relationship with farm size in Slovenia over the period 1994-2003. Development of farm efficiency during the transition period, the evolution of farm size (small or large) and their contribution to the performance of the agricultural sector are crucial questions for the future of rural areas, in particular in Slovenia where predominantly family farms are of relatively small size. The results suggest that there is a positive relationship between farm efficiency and size in this country, and that labour is more crucial than any other production factor in the country's rural areas.

***Keywords:*** efficiency, size, farm, Data Envelopment Analysis, Slovenia

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## 1. INTRODUCTION

The relationship between farm size and farm efficiency is one of the most researched topic in development economics (e.g. JOHNSON AND RUTTAN, 1994). Many researchers have argued, usually based on empirical studies, that there exists an inverse relationship between farm size and productivity (see for example CORNIA, 1985; VERMA AND BROMLEY, 1987). The small farms' superiority is in particular explained by labour market imperfections: higher effort of family labour (being the residual profit's claimant) versus hired labour; and thus by supervision costs. The inverse relationship has, however, been often challenged (see for example FEDER, 1985), based on imperfections in the other markets, namely land and capital: large farms are for example able to have easier and cheaper access to credit, and benefit from reduced land prices.

Transition from central-planning to a market economy has also attracted some size-efficiency studies for emerging market economies and their agricultural sectors in Central and Eastern European (CEE) countries (e.g. GORTON AND DAVIDOVA, 2004; LATRUFFE ET AL., 2005). But these studies do not agree on the direction of the size-efficiency relationship, and there is no such a research for Slovenia, which developed from the former Yugoslavia. Slovenia has successfully entered into the European Union (EU) in May 2004 and became the first of the new EU member state to be a member of the European Monetary Union (EMU) by introducing the

Euro in 2007. This implies a developed and stable economy. However, there are differences in efficiency among economic sectors where agriculture, as one of the least productive sectors, has plaid a certain social buffer role providing food security for those who lost employment in other economy sectors during transition (BOJNEC AND DRIES, 2005). Slovenia is an interesting case study for at least three reasons. Firstly, there is a considerable gap between the high level of overall economic development and the low productivity in agriculture, that indicates possible agricultural and farm restructuring problems. By the level of economic development measured by gross domestic product (GDP) per capita, Slovenia has exceeded the EU average (EUROSTAT, 2007). Most of the Slovenian territory is classified as rural (EUROPEAN COMMISSION, 1994) with a significant role of agriculture in employment. The significant gap between the proportion of agricultural employment (10 percent) and agricultural contribution to GDP (2 percent) indicates lower productivity in agriculture vis-à-vis the other sectors in the economy. The number of agricultural holdings is declining, indicating processes of farm concentration and restructuring, but the average farm size remains relatively small: in 2005 land used per agricultural holding was around 6.3 hectares. Secondly, Slovenia in 2004 became an EU member and entered into the Single European Market (SEM). Due to the increased competition on the enlarged SEM, rationalisation of input costs to increase farm efficiency might be one of the farm strategies. Finally, one of the reasons of lower agricultural productivity and higher farm input costs might be input market imperfections. For example labour hoarding in agricultural holdings might be due to limited employment opportunities outside farms, resulting in low productivity on the prevailing small family-owned and operated farms. Thus, Slovenian rural areas might have been plagued by factor market imperfections during the period studied in this paper. However, it is not clear whether the outcome has been a higher productivity of small-scale farming.

Therefore, this paper contributes to the farm size-efficiency literature by investigating the issue in Slovenia. Moreover, contrary to previous studies that concentrate on one productivity measure, we calculate not only technical efficiency but also allocative and economic efficiency. We first present Slovenian farm structures in censuses. Then we describe the methodology and the dataset used, followed by the presentation of the empirical results. In final concluding section broader policy implications for Slovenia and for the CEE are derived in terms of strategies to increase farm efficiency and welfare of rural areas.

## 2. SLOVENIAN FARM STRUCTURES

The Slovenian agriculture has traditionally been owned and operated by family farms. Similar as in Poland and in the rest of the former Yugoslavia, the communist collectivization of agriculture in Slovenia failed and most of the land has remained within small scale peasant farm structures (BOJNEC AND SWINNEN, 1997). Such structures are clearly shown by the comparison of the number of agricultural holdings (Table 1) and the number of family farms according to the European Eurostat classification (Table 2). Almost one-third of agricultural holdings in Slovenia during the communist system cultivated land or performed agricultural activities in a size below the minimum considered farm size by the Eurostat standards. Their major sources of incomes were from non-agricultural activities.

**Table 1: Number of agricultural holdings in censuses, by source of income**

| | Number of agricultural holdings by source of income | | | | | Share (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | total | only from agriculture | from mixed sources | from non-agricultural activities | without a source of income | total | Only from agriculture | from mixed sources | from non-agricultural activities | without a source of income |
| 1960 | 194,855 | 95,918 | 84,251 | 11,306 | 3,380 | 100 | 49.2 | 43.2 | 5.8 | 1.7 |
| 1969 | 180,228 | 80,302 | 80,043 | 14,793 | 5,289 | 100 | 44.6 | 44.4 | 8.2 | 2.9 |
| 1981 | 192,090 | 21,675 | 52,060 | 116,533 | 1,822 | 100 | 11.3 | 27.1 | 60.7 | 0.9 |
| 1991 | 156,549 | 18,585 | 57,721 | 79,293 | 950 | 100 | 11.9 | 36.9 | 50.7 | 0.6 |

Source: SORS, Statistical Yearbook of Slovenia 2001-2002.

Slovenian agriculture is based on small-scale family farms. Similar as in some other developed countries, the number of family farms has decreased with some structural shifts by socioeconomic type of family farms that are derived from activities that household members performed (Table 2). Full-time farms are farms on which all active household members (aged 15 to 64) are employed on the farm in an amount of at least 1.2 annual work units (AWU). Part-time farms are farms on which household members are active on and outside the family farm. Supplementary farms are farms on which none of the household members (aged 15 to 64) work only on the farm, but only household members employed elsewhere, retired persons and dependants work on the farm. Aged farms are farms on which only household members over 64 years of age live. As can be seen from Table 2, both the number and the proportion of full-time farms have declined and the majority of family farms are part-time and supplementary farms. The number and the proportion of part-time farms have declined, but the opposite is found for supplementary farms. The number of aged farms is declining.

**Table 2: Number of family farms in censuses, by socioeconomic type**

| | Number of family farms | | | | | Share (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | total | full-time Farms | part-time farms | supplementary Farms | aged farms | total | Full-time farms | Part-time farms | supplementary farms | aged farms |
| 1991 | 111,546 | 23,765 | 55,585 | 21,412 | 10,784 | 100 | 21.3 | 49.8 | 19.2 | 9.7 |
| 1997 | 90,459 | 13,843 | 27,452 | 39,473 | 9,691 | 100 | 15.3 | 30.4 | 43.6 | 10.7 |

Source: SORS, Statistical Yearbook of Slovenia 1998-2000, 2003.

Farm restructuring in Slovenia during the last two decades is an outcome of land restitution (of nationalized agricultural and forest land) to the former owners, and the natural evolution process that has occurred with the introduction of a market economy. The transition process from the previous self-managed socialist system to a market economy has not brought as substantial changes in farm structures as in some other CEE countries. The number of agricultural farms, which are mostly family farms, has declined steadily. Table 3 includes both family farms and a small number of former socially-owned farms, which are now mostly agricultural enterprises. The decline in the number of agricultural farms is confirmed for the farms utilizing less than 10 hectares of land. Since 2003 stabilization in the number of farms can be observed, and even a slight increase in the number of agricultural farms utilizing less than 5 hectares of land.

**Table 3: Number of agricultural farms in censuses, by utilised agricultural area**

| | Number of farms | | | | | Share (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1991 | 1997 | 2000 | 2003 | 2005 | 1991 | 1997 | 2000 | 2003 | 2005 |
| | 111,951 | 90,611 | 86,467 | 77,149 | 77,175 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Without utilized agricultural area | 20 | 34 | 44 | 23 | 34 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| up to 1.00 ha | 15,576 | 8,448 | 7,999 | 5,375 | 5,731 | 13.9 | 9.3 | 9.3 | 7.0 | 7.4 |
| 1.01-3.00 | 41,062 | 31,040 | 27,255 | 22,220 | 23,206 | 36.7 | 34.3 | 31.5 | 28.8 | 30.1 |
| 3.01-5.00 | 22,868 | 20,073 | 18,130 | 16,777 | 16,868 | 20.4 | 22.2 | 21.0 | 21.7 | 21.9 |
| 5.01-10.00 | 24,251 | 22,469 | 22,058 | 20,633 | 19,775 | 21.7 | 24.8 | 25.5 | 26.7 | 25.6 |
| 10.01-20.00 | 7,251 | 7,619 | 9,165 | 9,695 | 8,819 | 6.5 | 8.4 | 10.6 | 12.6 | 11.4 |
| over 20.00 ha | 923 | 928 | 1,816 | 2,427 | 2,743 | 0.8 | 1.0 | 2.1 | 3.1 | 3.6 |

Source: SORS, Statistical Yearbook of Slovenia 2000-2006.

On average Slovenian farms are small by agricultural area per farm and by economic size. Between 2000 and 2005 the average farm size has increased from 5.6 ha to 6.3 ha of utilized agricultural area per farm. As it can be seen from Table 4, the large majority of Slovenian farms are smaller than 8 European Size Units (ESU) or 9,600 Euro.

**Table 4: Agricultural farms by European Size Unit (ESU)* classes**

| | Number of farms | | Share (%) | |
|---|---|---|---|---|
| | 2003 | 2005 | 2003 | 2005 |
| Total | 77,149 | 77,175 | 100.0 | 100.0 |
| Up to 2 ESU | 37,720 | 37,302 | 48.9 | 48.3 |
| 2 – 8 | 29,981 | 30,522 | 38.9 | 39.5 |
| 8 – 16 | 6,124 | 5,946 | 7.9 | 7.7 |
| 16 – 40 | 2,825 | 2,889 | 3.7 | 3.7 |
| 40 – 100 | 386 | 414 | 0.5 | 0.5 |
| 100 – 250 | 59 | 43 | 0.1 | 0.1 |
| 250 and over | 54 | 48 | 0.1 | 0.1 |

* 1 ESU = 1,200 Euro. Source: SORS, Statistical Yearbook of Slovenia 2006.

## 3. METHODOLOGY AND DATA USED

The selected Slovenian farms that are included in the Farm Accountancy Data Network (FADN) for the period 1994-2003 are used as the database (for more information on the sample, see BOJNEC AND LATRUFFE, 2007a, 2007b). Summary statistics on data set used are presented in Table 5. The average farm size in the FADN sample is three times as large as the average size in Slovenia in terms of utilized agricultural area (UAA), as well as likely in terms of output and input uses. The sample farms might additionally be more efficient than the average Slovenian farm. However, they represent a more viable part of the Slovenian farming sector that is likely to be the outcome of farm restructuring, and thus the future of Slovenia's rural areas.

The non-parametric method Data Envelopment Analysis (DEA) is used to calculate technical, allocative and economic efficiency (see Coelli et al., 2005). The model used has an output-orientation and is multi-output (crop revenue, livestock revenue, and other revenue, all in values) and multi-input (UAA in ha; labour in Annual Working Units AWU; capital in value; variable inputs in value). All values are expressed in current Slovenia tolars (SIT), the Slovenian currency between October 1991 and 31 December 2006, when the Euro is introduced. In a second stage, the relation between efficiency and size is measured with Spearman correlation coefficients on several farm size measures (total output in value, UAA in ha, labour in AWU; assets in value; livestock units).

**Table 5: Summary statistics by individual years in current prices**

| | Total revenue (mio SIT) | Crop revenue (mio SIT) | Livestock revenue (mio SIT) | Other revenue (mio SIT) | Land (UAA ha) | Labour (AWU) | Capital (mio SIT) | Variable inputs (mio SIT) | Livestock units |
|---|---|---|---|---|---|---|---|---|---|
| 1994 | 2.50 | 0.71 | 1.30 | 0.49 | 12.39 | 2.02 | 12.9 | 1.43 | 16.08 |
| 1995 | 2.98 | 0.94 | 1.60 | 0.44 | 12.59 | 2.05 | 15.2 | 1.65 | 13.00 |
| 1996 | 3.16 | 1.09 | 1.64 | 0.43 | 12.14 | 2.29 | 12.4 | 1.78 | 12.11 |
| 1997 | 3.32 | 1.12 | 1.69 | 0.51 | 11.14 | 2.08 | 12.6 | 1.92 | 11.09 |
| 1998 | 3.99 | 1.68 | 1.93 | 0.38 | 10.98 | 2.26 | 12.3 | 2.35 | 12.90 |
| 1999 | 4.36 | 1.30 | 2.59 | 0.47 | 12.15 | 2.01 | 14.7 | 2.70 | 13.83 |
| 2000 | 7.39 | 3.49 | 3.21 | 0.69 | 15.89 | 2.31 | 21.1 | 4.35 | 16.82 |
| 2001 | 7.72 | 2.75 | 3.86 | 1.11 | 16.40 | 2.09 | 22.4 | 5.29 | 15.72 |
| 2002 | 7.51 | 3.39 | 3.43 | 0.69 | 21.50 | 5.57 | 30.4 | 3.64 | 17.30 |
| 2003 | 7.27 | 3.28 | 3.33 | 0.66 | 18.49 | 5.39 | 29.4 | 3.52 | 16.74 |

## 4. EMPIRICAL RESULTS

Table 6 displays the average efficiency measures for the whole sample by each year. Over the whole period (1994-2003), the average efficiencies (technical, scale, allocative and cost; both under constant returns to scale CRS and variable returns to scale VRS) are very high (e.g. 0.936 for technical efficiency under CRS). This indicates that farms in the sample are

relatively homogenous in terms of management practices. However, the measures seem to deteriorate over the last years of the period (2002, 2003) for allocative and cost efficiency. This suggests that in the sample a large share of farms were getting further to the efficient frontier in this period, due to a not rational mix of inputs in terms of their respective prices.

The relationship between these efficiency measures and farm size is shown in Table 7, presenting the Spearman correlation coefficients and their significance, between efficiency measures and various size variables. At first sight, no clear picture emerges from the results. Several coefficients are significant, but some have a positive sign while other suggests a negative relationship. It seems however that the most significant coefficients (significance level at 1 percent) are those associated with labour and with total output. Farms producing a large output are highly efficient regarding their decision of input quantities used (technical and scale efficiencies), while farms using a large labour force are highly efficient also regarding the input quantities, but particularly regarding their choice of input mix in terms of their respective prices (allocative and cost efficiencies).

**Table 6: Sample's average efficiency by year**

| | TE under CRS | TE under VRS | SE | AE under CRS | AE under VRS | CE under CRS | CE under CRS |
|---|---|---|---|---|---|---|---|
| 1994-2003 | 0.936 | 0.964 | 0.968 | 0.922 | 0.944 | 0.863 | 0.925 |
| 1994 | 0.939 | 0.984 | 0.955 | 0.941 | 0.951 | 0.892 | 0.935 |
| 1995 | 0.970 | 0.983 | 0.987 | 0.962 | 0.995 | 0.933 | 0.986 |
| 1996 | 0.991 | 1.000 | 0.991 | 0.923 | 0.944 | 0.916 | 0.944 |
| 1997 | 0.942 | 0.975 | 0.967 | 0.956 | 0.959 | 0.900 | 0.952 |
| 1998 | 0.961 | 0.970 | 0.991 | 0.849 | 0.930 | 0.819 | 0.905 |
| 1999 | 0.896 | 0.921 | 0.970 | 0.967 | 0.990 | 0.867 | 0.919 |
| 2000 | 0.961 | 0.995 | 0.966 | 0.919 | 0.915 | 0.884 | 0.912 |
| 2001 | 0.891 | 0.971 | 0.918 | 0.966 | 0.937 | 0.865 | 0.918 |
| 2002 | 0.903 | 0.921 | 0.968 | 0.871 | 0.909 | 0.777 | 0.889 |
| 2003 | 0.904 | 0.921 | 0.968 | 0.869 | 0.909 | 0.776 | 0.888 |

Note: technical efficiency (TE), scale efficiency (SE), allocative efficiency (AE), cost efficiency (CE), constant returns to scale (CRS), and variable returns to scale (VRS).

**Table 7: Spearman correlation coefficients**

| | TE under CRS | TE under VRS | SE | AE under CRS | AE under VRS | CE under CRS | CE under CRS |
|---|---|---|---|---|---|---|---|
| Total output | 0.25*** | 0.17** | 0.24*** | 0.01 | 0.09 | 0.12 | 0.08 |
| Land | -0.18** | -0.13 | -0.13 | -0.04 | -0.04 | -0.19** | -0.07 |
| Labour | 0.17** | 0.06 | 0.16* | 0.28*** | 0.33*** | 0.36*** | 0.31*** |
| Assets | -0.15* | -0.13 | -0.14 | -0.13 | -0.12 | -0.16* | -0.14 |
| Livestock units | -0.04 | -0.17* | 0.02 | -0.19** | -0.08 | -0.17** | -0.11 |

Note: technical efficiency (TE), scale efficiency (SE), allocative efficiency (AE), cost efficiency (CE), constant returns to scale (CRS), and variable returns to scale (VRS).

* significant at 10%, ** significant at 5% and *** significant at 1%

## 5. CONCLUSION

Findings indicate that there is a positive relationship between 'quantity efficiency' and farm size proxied by total output produced, and a positive relationship between 'price efficiency' and farm size proxied by on-farm labour force. Although the direction of relationship is clearly positive, the sense of the relationship is not shown by Spearman correlation coefficients. It might be that (i) size is a positive determinant of efficiency, as well as it might be that (ii) efficiency enables farms to increase their size. However, whatever the sense of relationship, the Spearman analysis highlighted that labour is more crucial than any other production factor in Slovenia's rural areas.

Either (in case (i)) using the abundant labour force in the rural areas enable farms to reach the efficient frontier in particular because (low skilled, unemployed or retired) labour is cheaper than other factors (and thus allocative efficiency is maximised); or (in case (ii)) high efficiency enables farms to employ more labour, which can help reduce unemployment in such areas. These findings are relevant not only for Slovenia, but also for countries with prevailing small scale, labour intensive family farms where agriculture plays a considerable welfare role in rural areas in transformation of society from agrarian into manufacturing and particularly into the service based economy.

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