

Evaluation and Management of Land Productivity Using Parametric Malmquest Index (Case Study of Kerman Province in Iran)

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Abstract

Wheat and barley are the main crops in Iran and has multiple uses. Research suggests that subsistence food crops such as wheat and barley has a special place in low-income countries. However, to achieve maximum efficiency for a sustainable agriculture must be able to obtain agricultural inputs such as land. Kerman province is one of the provinces with high production of these products. According to this study the effectiveness and efficiency of these products were in the cities of the province. Results indicate that productivity growth for the city RAVAR, Zarand, Sir Jan and Shahrabak during the 5 -year average is less than one and a numerical approach for other cities has more of a positive productivity growth.

Key world: Sustainable agriculture, Malmquest index, Productivity

Introduction

Productivity simple form is defined Performance plus Effectiveness. Performance is with respect to an input or output to total inputs and effectiveness is defined predetermined targets. But it should be noted that the sum mentioned in the definition of productivity is not really a Sum Arithmetic, but it is a logical add. The simplest definition of productivity as the ratio of amount of product in a certain amount of one or more factors of production. In fact, the change productivity as changes in input use per unit of output or product obtained during a specific time period reveals.

Identifying and explaining agricultural growth

The Malmquist index has gained considerable popularity in recent years due to its appealing feature of allowing a further decomposition of productivity variation. Therefore, to examine the sources of agricultural growth for the this province, we calculate the Malmquist productivity-change indexes as well as the technical-change and efficiency-change components using the mathematical programming procedure outlined in Fa" re, Grosskopf, Norris, and Zhang (1994).

Malmquist index

Following Fa`re et al. (1994), the Malmquist productivity-change index defined as the geometric mean of two distance function-based Malmquist productivity indexes is of the following form,

$$M_0(y_s, x_s, y_t, x_t) = \left[\frac{d_0^s(y_t, x_t)}{d_0^s(y_s, x_s)} \cdot \frac{d_0^t(y_t, x_t)}{d_0^t(y_s, x_s)} \right]^{1/2} \tag{1}$$

In the above equation, the first term in the brackets is the Malmquist productivity index with technology in period t as the reference technology .Here $d_0^s(y_t, x_t)$ Denote the distance function is obtained based on the amount of input **t** with the use of **S** technology. If $M_0 \geq 1$ then it indicates positive TFP growth over time t time to s time, when its value is smaller than one indicates TFP decline, function can be found below:

$$M_0(y_s, x_s, y_t, x_t) = \frac{d_0^t(y_t, x_t)}{d_0^s(y_s, x_s)} \left[\frac{d_0^s(y_t, x_t)}{d_0^t(y_t, x_t)} \cdot \frac{d_0^s(y_s, x_s)}{d_0^t(y_s, x_s)} \right]^{1/2} \tag{2}$$

Fraction outside the brackets in this equation is measured, changes in technical efficiency at **t, s** times. The efficiency is ratio at **t** time to s time. And in the brackets, technological changes can measure the geometric mean measure technological change in **s** and **t** times. The first fraction brackets below indicates the quantity of technological change in terms of input and output at **t** time, Second Fraction of technological change in terms of input and output values of the **s** time . The efficiency-change component, therefore, captures the performance relative to the best practice in the sample and can be interpreted as the catching up effect. The geometric mean of the two ratios inside the brackets in Eq. (2) can be interpreted as the technical-change component, which measures the shift in the frontier over time. Therefore, in our empirical analysis, how much the world frontier shifts at each city's observed input mix is measured by this component.

Results

Required data obtained from Agricultural Organization of Kerman province and Malmquest index were estimated using the software package DEAP. Estimation results are given in the following tables. In 2005 (Table 1) Positive Productivity Been seen for Counties Baft, Bard sir, RAVAR, zarand, Rafsanjan and Kerman. These efficiencies are more than Number one for these Counties.

Table 1- Decomposition of the Malmquist productivity-change index at 2005

Counties	Pure Efficiency	Scale Efficiency	technical-change	efficiency-change	productivity
BAFT	1.00	1.00	1.80	1.00	1.80
BARDSIR	1.00	1.06	1.11	1.06	1.17
BAM	1.00	0.69	1.06	0.69	0.73
RAVAR	1.19	1.02	0.99	1.21	1.20
RAFSANJAN	1.00	1.00	1.14	1.00	1.13
ZARAND	1.03	1.03	1.09	1.06	1.15
SIRJAN	1.00	1.00	0.98	1.00	0.98
SHAHRBABA	0.96	0.98	0.69	0.94	0.65
K					
KERMAN	1.00	1.08	1.50	1.08	1.62
MEAN	1.02	0.98	1.11	0.99	1.11

SOURCE: DATA OF RESEARCH

In 2006 (Table 2) productivity index have been decline this year. In this year productivity growth have been positive for the Counties of Bam, zarand, ShahrBabak and Kerman.

Table 2- Decomposition of the Malmquist productivity-change index at 2006

Counties	Pure Efficiency	Scale Efficiency	technical-change	efficiency-change	productivity
BAFT	1.00	0.90	1.10	0.90	0.99
BARDSIR	1.00	0.40	1.11	0.40	0.44
BAM	0.80	1.16	1.08	0.93	1.00
RAVAR	0.76	1.01	1.06	0.76	0.81
RAFSANJAN	0.73	1.00	1.09	0.72	0.79
ZARAND	1.00	1.00	1.58	1.00	1.58
SIRJAN	1.00	0.93	1.05	0.93	0.98
SHAHRBABA					
K	1.05	1.02	1.89	1.07	2.01
KERMAN	1.00	0.85	1.22	0.85	1.03
MEAN	0.92	0.89	1.22	0.81	0.99

SOURCE: DATA OF RESEARCH

In 2007, Productivity growth has returned to upward trend (Table3). In this year productivity growth is positive for Bardsir, BAM, Rafsanjan and RAVAR Counties.

Table3- Decomposition of the Malmquist productivity-change index at 2007

Counties	Pure Efficiency	Scale Efficiency	technical-change	efficiency-change	productivity
BAFT	1.00	1.04	0.94	1.04	0.98
BARDSIR	1.00	2.57	1.16	2.57	2.99
BAM	1.26	1.26	1.08	1.58	1.71
RAVAR	1.42	1.01	1.21	1.43	1.73
RAFSANJAN	1.38	0.96	0.95	1.31	1.25
ZARAND	0.58	0.98	0.55	0.57	0.31
SIRJAN	0.83	1.02	0.95	0.85	0.81
SHAHRBABA					
K	0.84	0.96	0.88	0.81	0.71
KERMAN	0.86	1.14	0.94	0.98	0.92
MEAN	0.98	1.15	0.94	1.13	1.07

SOURCE: DATA OF RESEARCH

In 2008, Productivity growth has upward trend, too (Table4). The increase in productivity is more than the before year. Bam, RAVAR, zarand, Sirjan and Kerman Counties had high productivity growth.

Table4- Decomposition of the Malmquist productivity-change index at 2008

Counties	Pure Efficiency	Scale Efficiency	technical-change	efficiency-change	productivity
BAFT	1.00	0.97	0.90	0.97	0.87
BARDSIR	0.95	0.98	0.89	0.93	0.83
BAM	1.00	1.00	1.07	1.00	1.07
RAVAR	1.00	0.99	1.36	0.99	1.35
RAFSANJAN	1.00	0.39	0.91	0.39	0.36
ZARAND	1.72	1.02	1.15	1.76	2.03
SIRJAN	1.11	0.99	1.46	1.10	1.61
SHAHRBABA					
K	1.19	0.80	0.91	0.95	0.86
KERMAN	1.16	1.03	2.88	1.20	3.46
MEAN	1.11	0.88	1.19	0.97	1.15

SOURCE: DATA OF RESEARCH

In 2009 Average productivity in the Counties has fallen and some Counties had negative productivity growth in this year (Table5). In this year productivity growth is positive for Bardsir, Rafsanjan and Shahrabak Counties.

Table5- Decomposition of the Malmquist productivity-change index at 2009

Counties	Pure Efficiency	Scale Efficiency	technical-change	efficiency-change	productivity
BAFT	0.70	1.08	0.97	0.75	0.73
BARDSIR	1.05	1.02	1.12	1.07	1.20
BAM	0.90	0.98	0.48	0.88	0.43
RAVAR	0.89	0.94	1.03	0.83	0.86
RAFSANJAN	1.00	2.68	0.96	2.68	2.57
ZARAND	0.84	0.98	0.91	0.82	0.74
SIRJAN	0.69	1.05	0.87	0.72	0.63
SHAHRBABA					
K	1.00	1.31	0.95	1.31	1.23
KERMAN	0.80	0.99	0.51	0.79	0.40
MEAN	0.87	1.15	0.83	1.00	0.83

SOURCE: DATA OF RESEARCE

In 2010, we observed a positive productivity growth (table 6); this growth has been higher than in other years, so, the overall trend in increased productivity seen over the years. In the Counties, Rafsanjan, Zarand, Sirjan and Kerman have been positive productivity growth in this year.

Table6- Decomposition of the Malmquist productivity-change index at 2010

Counties	Pure Efficiency	Scale Efficiency	technical-change	efficiency-change	productivity
BAFT	1.43	0.82	0.94	1.18	1.10
BARDSIR	0.96	0.84	0.65	0.80	0.52
BAM	1.05	0.81	0.92	0.84	0.78
RAVAR	0.94	0.97	0.98	0.91	0.89
RAFSANJAN	1.00	1.00	4.75	1.00	4.75
ZARAND	1.19	1.03	1.01	1.23	1.24
SIRJAN	1.56	1.03	0.98	1.60	1.57
SHAHRBABAK	0.87	0.82	0.57	0.71	0.40
KERMAN	1.26	1.01	9.55	1.27	12.08
MEAN	1.12	0.92	1.34	1.03	1.38

SOURCE: DATA OF RESEARCE

Table 7 indicates the average productivity, efficiency and technical changes during the 6 years. As can be seen, except for years 2005 and 2008 in the remaining years, there has been a positive productivity growth. In addition, according to the results in the table shows that changes in productivity changes and technical efficiency changes can impact on productivity, realized. In all the years that productivity growth has been positive changes in efficiency or technical change more than one, or both of these changes have been more than one.

Table7- average productivity, efficiency and technical changes

YEARS	Pure Efficiency	Scale Efficiency	technical-change	efficiency-change	productivity
2005	1.02	0.98	1.11	0.99	1.11
2006	0.92	0.89	1.22	0.81	0.99
2007	0.98	1.15	0.94	1.13	1.07
2008	1.11	0.88	1.19	0.97	1.15
2009	0.87	1.15	0.83	1.00	0.83
2010	1.12	0.92	1.34	1.03	1.38

SOURCE: DATA OF RESEARCH

Productivity growth can be seen in Figure 1. This trend has decreased since 2009, but in later years, this trend is increasing.

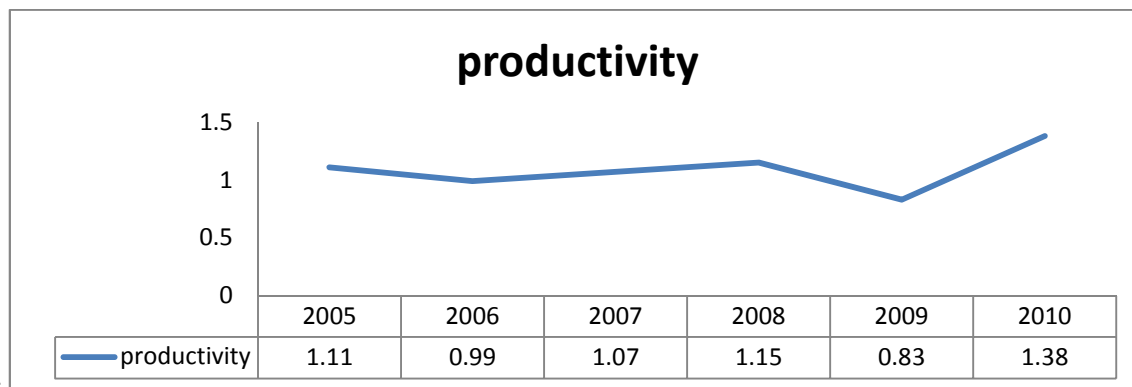


Figure 1 -Average productivity

Table 8 represents a summary of productivity changes in Kerman province. As can be seen in all the cities had over 6 years of positive average productivity growth. Productivity growth is less than one in RAVAR , zarand , Sirjan and ShahrBabak, But this number is very close to one . So we can conclude that technical change has a greater effect on productivity than other variables. The changes in technology after years of war and increasing advances in recent decades have improved performance in most situations.

Table 8 - summary of productivity changes in Kerman province

Counties	Pure Efficiency	Scale Efficiency	technical-change	efficiency-change	productivity
BAFT	1.00	1.03	0.99	1.03	1.02
BARDSIR	1.01	1.01	1.02	1.03	1.05
BAM	1.00	1.01	0.99	1.01	1.00
RAVAR	0.99	1.00	0.99	0.99	0.98
RAFSANJAN	1.00	1.00	1.11	1.00	1.11
ZARAND	1.00	1.00	0.99	1.00	0.99
SIRJAN	1.00	1.00	0.99	1.00	0.99
SHAHRBABA					
K	0.99	0.99	0.96	0.98	0.94
KERMAN	1.00	1.00	1.10	1.00	1.10
MEAN	1.00	1.00	1.01	1.00	1.02

SOURCE: DATA OF RESEARCH

REFERENCES

- Chang, C. C., & Luh, Y.-H. (2000). Efficiency change and the growth in productivity: the Asian growth experience. *Journal of Asian Economics*, 10(4), 551–570.
- Coelli, T. J. 1996. A guide to DEAP Version 2.1: A data envelopment analysis (computer) program, CEPA Working paper 8/96, University of New England, Armidale, Australia
- Färe, R., Grosskopf, S., & Lovell, C. A. K. (1992). Productivity change in Swedish pharmacies 1980–1989: A nonparametric Malmquist approach. *Journal of Productivity Analysis*, 3, 85–101.
- Färe, R., Grosskopf, S., & Norris, M. (1997a). Productivity growth, technical progress, and efficiency change in industrialized countries: Replies. *American Economic Review*, 87, 1040–1043.
- Heydari, KH, 2008, Total factor productivity in wheat production in Central Province, *Journal of Agricultural and Development Economics*, NO.28.
- Mojaverian, M. 2003. Malmquist productivity index estimation strategy for the period 1378-1369. *Journal of Agricultural and Development Economics* 43, pp. 162-143.
- Salami, H and Shahnoshi, N, 2010, Comparison of productivity in agriculture and industry and its influencing factors. *Proceedings of the Third Conference of Iranian Agricultural Economics*, Volume I, Ferdowsi University of Mashhad.
- Shokohi, M and Bakhshode, M, 2009, Regional inequalities and convergence of productivity in different provinces of Iran. *Journal of Agricultural Economics and Development (Science, Industry and Agriculture)*. Volume 23, Issue 2, pp. 117-104.

Chang, C. C., & Luh, Y.-H. (2000). Efficiency change and the growth in productivity: the Asian growth experience. *Journal of Asian Economics*, 10(4), 551–570.

Coelli, T. J. 1996. A guide to DEAP Version 2.1:A data envelopment analysis (computer) program, CEPA Working paper 8/96, University of New England, Armidale, Australia

Färe, R., Grosskopf, S., & Lovell, C. A. K. (1992). Productivity change in Swedish pharmacies 1980–1989: A nonparametric Malmquist approach. *Journal of Productivity Analysis*, 3, 85–101.

Färe, R., Grosskopf, S., & Norris, M. (1997a). Productivity growth, technical progress, and efficiency change in industrialized countries: Replies. *American Economic Review*, 87, 1040–1043.

Heydari, KH, 2008, Total factor productivity in wheat production in Central Province, *Journal of Agricultural and Development Economics*, NO.28.

Mojaverian, M. 2003. Malmquist productivity index estimation strategy for the period 1378-1369. *Journal of Agricultural and Development Economics* 43, pp. 162-143.

Salami, H and Shahnoshi, N, 2010, Comparison of productivity in agriculture and industry and its influencing factors. *Proceedings of the Third Conference of Iranian Agricultural Economics*, Volume I, Ferdowsi University of Mashhad.

Shokohi, M and Bakhshode, M, 2009, Regional inequalities and convergence of productivity in different provinces of Iran. *Journal of Agricultural Economics and Development (Science, Industry and Agriculture)*. Volume 23, Issue 2, pp. 117-104.