Efficiency and productivity of the Slovak agricultural investment support beneficiaries

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Abstract
In this paper we estimate the effects of the farm investment support provided under the Rural Development Program (RDP) on efficiency and productivity of the Slovak farms. We used panel data of 631 Slovak farms over 2007-2013 RDP SR programming period. The overall effects of investment support on farm efficiency and productivity we estimated by non-parametric method Data Envelopment Analysis (DEA), using output-oriented CCR and BCC models. Total factor productivity changes were estimated by Malmquist indices and their decomposition. We found, that productivity of both beneficiaries and non-beneficiaries of the investment support slightly decreased over time. This decline could be mostly attributed to technological regression. On average, the farms, non-beneficiaries of investment support, were more technically efficient than beneficiaries. Investment support however, enabled beneficiaries specialised on crop production significantly improve their performance towards the best farms. The investment support provided under the RDP should be more targeted towards smaller farms with low capital endowment.

Keywords: farm investment support, productivity, efficiency, DEA, TFP

JEL Classification: C61, O32, Q12

1. Introduction

Farm investment support is one of the EU Rural Development Programme policy instruments provided to enhance farm productivity, agricultural production efficiency and thus farm competitiveness. Investment to new technologies could lead to efficiency growth and improvement of farm position on the market.

There are growing number of empirical studies on farm investment support impact and farm productivity and efficiency. The most methods used for impact assessment, including the Data Envelopment Analysis (DEA) methodology compare before and post treatment effects or effects with and without treatment (beneficiaries, non-beneficiaries of the support). The shortcoming of such an approach is in the assessment of a total, instead of a net effect of the treatment.

Difficulties of estimation of farm investment support effects on farm efficiency and productivity in EU Member States discussed **Bergschmidt et al. (2006), Coelli et al. (2006) Bergschmidt (2009); Forstner et al. (2009); Bernini a Pellegrini, 2011; Michalek (2012)** and other more descriptive evaluation reports. **Beck and Dogot (2006)** assessed investment support impact on farm income of dairy farms in Valonia and proposed the investment support impact indicators. They found that in the short run there were no connections between investment and farm income growth. Investments however, had positive long run effect on the farm competitiveness and sustainability. **Garbarino and Holland (2009)** applied the qualitative and quantitative methods for assessing the impacts of investment support at farm level. **Gallerani et al. (2008), Viaggi et al. (2011)** analysed farm investment behaviour. They applied mixed methods, using case studies of selected countries, complemented by the

positive programming modelling. Qualitative aspects, socio-economic factors and incentives of farm investment behaviour were examined by **Olsen and Lund (2011). Buysse et al. (2011)** evaluated the impact of farm investment support in Flanders. They found that the investment support of agricultural diversification increased overall production and income. Analysis of technical efficiency and overall TFP productivity in the Czech agriculture conducted **Cechura (2012)** with the Fixed Management Model. The most important factors that determined the Czech farm technical efficiency and TFP were those associated with institutional and economic changes, in particular a growth of subsidies and dramatic increase of meat imports. **Spicka and Machek (2015)** analysed investment activity and investment subsidies allocation in specialized milk farm efficiency change in 100 EU regions over the period 2007 to 2011. They found that investment subsidies per livestock unit are slightly higher in the regions with a negative change in the production efficiency and continuously helped them to mitigate the drop in technical efficiency.

In recent studies the net effects of a policy are estimated using counterfactual approach. **Pufahl and Weiss (2009)** estimated agro-environmental and LFA measures impact on farms in Germany. **Ortner (2012)** assessed the net effects of farm investment support in Austria and found that due to its positive effect on Gross Value Added, investment support rendered private investments profitable. **Wigier et al. (2014)** analysed the investment support impact on Hungarian and Polish farm economic performance. **Kirchweger and Kantelhardt (2014), Kirchweger et al. (2015)** analysed the effects of farm investment policy on structural changes of the Austrian farms. Investing farms significantly enlarge and intensify their production. **Ciaian et al. (2015)** estimated the extent to which farm investment is substituted by investment support policies granted under the EU Rural Development Programme (RDP). They found crowding-out effect of the RDP close to 100%, implying that farms use public support to substitute for private investments.

Investment support effects on farm performance in the Central European region of the EU investigated several authors. According to **Ferto et al. (2012)** subsidized producers can invest in farm development and achieve higher technical progress since they are less credit constrained. **Ratinger et al. (2014)** analysed factors of the Czech farm participation in investment support scheme. They found significant positive effects of the investment support on gross value added and improvement of labour productivity. **Pechrova (2015)** assessed the impact of subsidies from the 2007–2013 RDP of the Czech Republic on efficiency of Czech agricultural holdings and found statistically significant differences between beneficiaries and non-beneficiaries. **Henning and Michalek (2008)** applied econometric approach and PSM approach for assessment of the SAPARD impact on the Slovak farm performance. Similar study was performed by **Božik et al. (2013).** They concluded that investment in farms with strong capital endowment would be realized even without investment support.

Taking into account deficiencies of applied methods and availability of data, the main objective of this paper is to investigate productivity and efficiency of the Slovak farms beneficiaries of the CAP farm investment support provided under 2007-2013 Rural Development Program (RDP). We expect farm productivity and efficiency growth in the period 2007-2013, despite of a negative effect of global crisis. Significant positive change of efficiency and productivity is anticipated in farms, beneficiaries of investment support and those beneficiaries specialised on crop production.

2. Data and Methods

We estimated the overall effects of investment support on productivity and efficiency change. Farm productive efficiency was estimated using Data envelopment analysis (DEA) a

nonparametric method, the output-oriented models, under assumption of constant return to scale (CRS) CCR model (**Charnes, Cooper, and Rhodes, 1978**) and variable return to scale (VRS) BCC model (**Banker, Charnes, and Cooper, 1984).**

Performance of the farms we expressed by total factor productivity (TFP) approach. As an estimator for the TFP change we applied output oriented Malmquist index, which employs **Shephard's (1970)** output oriented distance functions. We follow **Färe et al. (1994)** procedure Eq. 1 and Eq.2.

$$M_0(x^t, y^t, x^{t+1}, y^{t+1}) = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \cdot \left[\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})} \cdot \frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)} \right]$$

$$= TECH(x^t, y^t, x^{t+1}, y^{t+1}) \cdot TCH(x^t, y^t, x^{t+1}, y^{t+1})$$

$$TECH(x^t, y^t, x^{t+1}, y^{t+1}) = \left[\frac{D_o^t(x^t, y^t|VRS)}{D_o^t(x^t, y^t|CRS)} \cdot \frac{D_o^{t++}(x^{t+1}, y^{t+1}|CRS)}{D_o^{t+1}(x^{t+1}, y^{t+1}|VRS)} \right] \cdot \left[\frac{D_o^{t+1}(x^{t+1}, y^{t+1}|VRS)}{D_o^t(x^t, y^t|VRS)} \right]$$

$$= SECH(x^t, y^t, x^{t+1}, y^{t+1}) \cdot PECH(x^t, y^t, x^{t+1}, y^{t+1}) \quad (2)$$

where: M_0 Malmquist TFP index is defined as the geometric mean of two Malmquist indexes for two adjacent periods, which can be decomposed to technical efficiency change (TECH) and technological change (TCH). Malmquist index is based on the assumption that technology exhibits constant returns to scale (CRS).

If the assumption on returns to scale is relaxed to allow variable returns to scale (VRS), then component of TECH, following **Färe et al. (1994)**, can be further decomposed to scale efficiency change (SECH) and pure efficiency change (PECH). To examine differences between average productivity change of the beneficiaries and non-beneficiary farms, we employ Mann-Whitney U-Test. Software DEAP **(CEPA, 2011)** was used to estimate the measures of technical efficiency and productivity.

We constructed fully balanced panel of farm yearly data **(IL MoARD SR, 2014)** from 2007 to 2013 of 631 farms; with average utilised agricultural area (UAA) 1375 ha; 42 annual work units (AWU) and 592 livestock units (LU). Five input variables were used in our study: costs of material and energy inputs and other costs in EUR; the annual work units (AWU), assets in EUR, utilized agricultural area. Two outputs variables were selected: revenues from the sale of own products and services and other revenues.

3. Results and Discussion

Productivity growth may be achieved through technical change and efficiency improvement. Technical change refers to the change in technology which results in an upward shift of the production frontier. Efficiency improvement refers to more efficient use of various resources under current technology. In the period 2007-2013, the highest average technical efficiency (TE CRS) reached farms with mixed production, non-beneficiaries of investment support (Tab.1). Generally, non-beneficiary farms attained higher average technical efficiency compare to beneficiaries. The results indicate technical efficiency gain of livestock farms, both beneficiaries and non-beneficiaries of investment support (Tab. 1).

To examine differences between average productivity change of the beneficiaries and non-beneficiary farms in 2007-2013, we employ Mann-Whitney U-Test with the null hypotheses that the performances of beneficiaries and non-beneficiaries are the same.

Over 2007-2013, the highest enhancement of average productivity exhibited farms with mixed production, non-beneficiaries (Tab. 2). The average productivity fall down in both crop

and livestock production specialised farms, regardless of investment support presence. A drop of average productivity was smaller however in farms specialised on crop production.

In the 2007 to 2013 period we observed moderate productivity decline by approximately 0.7% per year (Tab. 3). Decomposition of productivity change allowed us to identify weakness of farm productivity development. Technical efficiency of all but crop production specialised farms, went up (TECH). This improvement however, had on average very small effect on productivity change. The highest technical efficiency improvement (TECH) was observed in livestock farms, non-beneficiaries of the investment support, followed by farms with mixed production, non-beneficiaries (Tab. 3). It seems that the farm investment support in that period was mainly used to cope with strong competition in a short time.

Tab. 1 Average technical efficiency (TE CRS) of farms, 2007-2013

Farm investment support	Specialisation	Number of farms	2007	2008	2009	2010	2011	2012	2013
Beneficiaries	CP	122	0.684	0.620	0.588	0.638	0.638	0.744	0.675
	LP	127	0.645	0.624	0.540	0.600	0.645	0.697	*0.664
	MP	71	0.681	0.661	0.569	0.619	**0.637	*0.728	0.682
	Average	320	0.668	0.631	0.565	0.619	**0.641	0.722	0.672
Non-beneficiaries	CP	162	0.705	0.652	0.623	0.689	0.675	0.769	0.692
	LP	97	0.648	0.665	0.535	0.614	0.660	0.710	*0.719
	MP	52	0.710	0.708	0.640	0.711	**0.732	*0.787	0.746
	Average	311	0.688	0.665	0.598	0.669	**0.680	0.753	0.709
Average in panel		631	0.678	0.648	0.581	0.644	0.660	0.738	0.690

Notes: CP - crop production; LP- livestock production; MP - mixed production; CRS - constant returns to scale; *0.1 significance level, **0.05 significance level, 0.01 significance level between beneficiaries and non-beneficiaries.
Source: own estimation

Over 2007-2013 period, we observed on average significant technological regress, significant increase of managerial efficiency and decrease of scale efficiency. Managerial efficiency (PECH) one component of a technical efficiency change (TECH) of all farm groups increased over time and shows increasing ability of decision-making units to convert farm inputs into outputs. Managerial efficiency change captures changes in efficiency regarding the variable returns-to-scale (VRS) technology.

The second component of technical efficiency change (TECH) is a technological change (TCH) which refers to shift of the best practice frontier capturing innovations. This shift is affected by adoption of new agricultural technologies or innovations, like high yielding varieties and by a change in the economic policies or environmental and other regulations. Livestock farm adjustment to the EU common market conditions required increased investments for restructuring, introduction of new production technologies, adjustment to the EU production standards and hygiene conditions. Over the seven-year time period, the highest technological progress was gained by crop farms, regardless of investment support. Farms specialised on livestock exhibited significant technological regress. More detail investigation of investment behaviour and prevailing investment activities could discover prevailing regulatory investment by these farms. Farm technological regress significantly affected development of their productivity.

The third component of technical efficiency change, the scale efficiency change (SECH), reached on average values close to 1 and suggests that in general most of the farms are operating close to the right scales. Especially the farms specialised on livestock production,

both beneficiaries and non-beneficiaries could significant improve their technical efficiency by changing their operational scale.

Tab. 2 Yearly and cumulative change of TFP (2007-2013)

Farm investment support	Specialization	2008/ 2007	2009/ 2008	2010/ 2009	2011/ 2010	2012/ 2011	2013 /2012	Cumulative change 2013
Beneficiaries	CP	**0.983	0.898	1.071	1.109	0.965	0.980	0.992
	LP	0.988	0.948	1.020	1.009	0.961	0.976	0.904
	MP	1.023	0.891	1.040	1.048	0.964	0.988	0.946
Non-beneficiaries	CP	**0.965	0.915	1.092	1.109	0.971	0.956	0.993
	LP	1.018	0.901	1.027	1.032	0.953	0.993	0.919
	MP	0.987	0.995	1.058	0.935	1.024	1.013	1.007
GEOMEAN		0.989	0.917	1.055	1.060	0.967	0.977	0.957

Notes: TFP - total factor productivity change (Malmquist index), CP - crop production, LP - livestock production, MP - mixed production; *0.1 significance level, **0.05 significance level, 0.01 significance level between beneficiaries and non-beneficiaries.
Source: own estimation

Tab. 3 Average values of total factor productivity components (2007-2013)

Farm investment support	Specialisation	TFP	TECH	TCH	PECH	SECH
Beneficiaries	CP	0.999	0.997	1.002	1.002	0.996
	LP	0.983	**1.005	***0.979	**1.013	*0.992
	MP	0.991	1.000	0.991	1.005	0.995
	Average	0.991	1.001	0.990	1.007	0.994
Non-beneficiaries	CP	0.999	0.997	1.002	1.000	0.997
	LP	0.987	**1.018	***0.970	**1.024	*0.994
	MP	0.995	1.008	0.987	1.011	0.997
	Average	0.995	1.005	0.990	1.009	0.996
Geom. Mean		0.993	1.003	0.990	1.008	0.995

Notes: TFP - total factor productivity, TECH – technical efficiency change, TCH-technological change, PECH – pure technical efficiency change, SECH – scale efficiency, CP – crop production, LP – livestock production, MP – mixed production; *0.1 significance level, **0.05 significance level, 0.01 significance level between beneficiaries and non-beneficiaries.
Source: own estimation

There was no significant effect of the investment support on farm productivity improvement. On average, the overall productivity of beneficiaries of investment support fall down mainly due to technological regress. The only exemption was a group of farms specialised on crop production, achieving technological progress. Higher technological improvement exhibited on average, beneficiaries of the investment support.

4. Conclusion

We analysed productivity and efficiency of the Slovak farms, beneficiaries and non-beneficiaries of the investment support provided under the 2007-2013 RDP SR. The average productivity fall down in both crop and livestock production specialised farms, regardless of investment support presence. Similarly **Nowak et al. (2015)** found low technical efficiency of the Slovak agriculture in 2010 compare to other EU MS. A drop of average productivity was smaller however in farms specialised on crop production. Technical efficiency of all but crop production specialised farms, went up (TECH). Farms in observed period preferred catch-up strategy. The highest enhancement of average productivity exhibited farms with mixed

production, non-beneficiaries. A decline of average farm productivity of all but crop farms was mainly caused technological regress, regardless of investment support presence. Better targeting of the investment support is therefore very important. The least efficient farms were those specialised on crop production, on the other side they achieved technological progress. Similar results are also found in study of Austrian farms (**Kirchweger et al. 2015**) where farms participating in the Austrian farm investment program increase their production significantly more than the non-beneficiary farms.

The average operational scale of the farms also affected farm productivity development. Its change is the most desirable in farms specialised in livestock production. Managerial efficiency of all farm groups increased over time and shows increasing ability of decision-making units to convert farm inputs into outputs. The results and conclusions of empirical studies estimating the effects of the investment support on farm productivity and efficiency differ. We found that investment support contributed to technological improvement only in crop specialised farms. Farms beneficiaries of investment support were able to moderate decline of their technical efficiency and they shift closer towards the best farms. Similar development was observed in the Czech Republic by **Spicka and Machek (2015).** Capital investment did not have effect on the productivity growth of Dutch arable farms **(Zhengfei and Oude Lansink, 2006)**. The investment support did not show any significant influence on the TE for example of the Swedish farms **(Manevska-Tasevska et al., 2013)**, due to its poor targeting. This study also pointed out, that investment support of regulatory investment generates positive externalities which could be underestimated and have no direct effects on farm output. Regulatory investment carried out by the Slovak farms beneficiaries of the investment support can explain a part of their productivity and efficiency development in 2007-2013.

References

[1] Banker, R.D., A. Charnes, and W.W. Cooper. (1984). Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. Management Science 30(9): 1078-1092.

[2] Beck, M. – Dogot, T. (2006). The Use of Impact Indicators for the Evaluation of Farm Investment Support – A Case Study Based on the Rural Development Programme for Wallonia 2000 – 2006. In Working Papers in Agricultural Economicss, no. 3, pp. 69-77.

[3] Bergschmidt, A. (2009). Powerless evaluation. *EuroChoices, 8*, 37-42.

[4] Bergschmidt, A., Dirksmeyer, W., Efken, J., Forstner, B. and Uetrecht, I. (2006). Proceedings of the European Workshop on the Evaluation of Farm Investment Support. Investment Support for Improvement of Processing and Marketing of Agricultural Products. Arbeitsberichte des Bereichs Agrarökonomie, Working Paper. No. 03/2006. http://hdl.handle.net/10419/39419

[5] Bernini C. – Pellegrini G. (2011). How are growth and productivity in private firms affected by public subsidy? Evidence from a regional policy, *Regional Science and Urban Economics 41,* 253– 265.

[6] Božik, M., Uhrinčaťová, E., Brodová, M. and Štulrajter, Z. (2013). Predikcia dosahov agrárnych politík v odvetví poľnohospodárstva a na jeho regionálnej úrovni. VÚEPP: Bratislava.

[7] Buysse, J., A. Verspecht, A., Huylenbroeck, G. (2011). Assessing the impact of the EU Common Agricultural Policy Pillar II support using micro-economic data. 122nd EAAE Seminar, Ancona, February 17-18, 2011, pp. 10.

[8] Charnes, A., W.W. Cooper, and E. Rhodes. (1978). Measuring the Efficiency of Decision Making Units. *European Journal of Operational Research* 2(6): 429-444.

[9]   Cechura, L. (2012). Technical efficiency and total factor productivity in Czech agriculture. *Agriculture Economics – Czech, 58 (4),* 147-156.

[10]   CEPA - Centre for Efficiency and Productivity Analysis. (2011). A Data Envelopment Analysis (Computer) Program, DEAP V2.1. The University of Queensland. http://www.uq.edu.au/economics/cepa/deap.php

[11]   Ciaian, P., Kancs, d'A., Michalek, J. (2015). Investment Crowding-Out: Firm-Level Evidence from Germany (July 2015). LICOS Discussion Paper 370/2015. http://dx.doi.org/10.2139/ssrn.2634922

[12]   Coelli, T. J., Perelman, S., Lierde, D. V. (2006). CAP Reforms and Total Factor Productivity Growth in Belgian Agriculture: A Malmquist Index Approach. In International Association of Agricultural Economists, Australia, no. 25472, pp. 20.

[13]   Färe, R., Grosskopf, S., Lindgren, B. and Roos, P. (1994). Productivity growth, technical progress and efficiency changes in industrialized countries. *American Economic Review, 84,* 66-83.

[14]   Ferto, I., Bakucz, Z., Bojnec, S. and Latruffe, L. (2012). Investment and Financial Constraints in European Agriculture: Evidence from France, Hungary and Slovenia. IEHAS Discussion Papers 1213. https://ideas.repec.org/p/ags/eaae11/114357.html

[15]   Forstner, B., Bergschmidt A., Dirksmeyer W., Ebers H., Fitschen-Lischewski A., Margarian A. and Heuer J. (2009). Ex-post evaluation of the German farm-investment support programme from 2000–2006. Länderübergreifender Bericht 98, Thünen Institut, Braunschweig.

[16]   Gallerani, V., Gomez y Paloma, S., Raggi, M. and Viaggi, D. (2008). Investment behaviour in conventional and emerging farming systems under different policy scenarios. European Commission. Joint Research Centre. Institute for Prospective Technological Studies. ISBN 978-92-79-08348-8

[17]   Garbarino, S. – Holland, J. (2009). Quantitative and Qualitative Methods in Impact Evaluation and Measuring Results. Discussion Paper. University of Birmingham, Birmingham, UK.

[18]   Kirchweger, S., Kantelhardt, J. (2014). Structural Change and Farm Investment Support in Austria. Contributed Paper prepared for presentation at the 88th Annual Conference of the Agricultural Economics Society, AgroParisTech, Paris, France. http://ageconsearch.umn.edu/handle/170545

[19]   Kirchweger, S., Kantelhardt, J. and Leisch, F. (2015). Impacts of the government-supported investments on the economic farm performance in Austria. *Agricultural Economics – Czech, 61(8),* 343-355. doi: 10.17221/250/2014-AGRICECON

[20]   Manevska-Tasevska, G., Rabinowicz, E. Surry, Y. (2013). Policy impact on farm level efficiency in Sweden 1998-2008. AgriFood Economics Centre Working Paper 2013:6.

[21]   Michalek J. (2012). Counterfactual impact evaluation of EU rural development programmes – Propensity Score Matching methodology applied to selected EU Member States. Vol. 1: A micro-level approach. Joint Research Centre, Institute for Prospective Technological Studies (IPTS), European Commission, Luxembourg. 25419 EN. http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=5360

[22]   Michalek, J., Ciaian, P., Kancas, D'A. (2013). Firm-Level Evidence of Deadweight Loss of Investment Support Polices: A Case Study of Dairy Farms in Schleswig-Holstein. Mimeo. 2013, pp. 31. https://ideas.repec.org/p/ags/iatr13/152258.html

[23]   IL MoARD SR (2014). Information Letters. Database. Ministry of Agriculture and Rural Development of the Slovak Republic.

[24]   Nowak, A., Kijek, T., Domanska, K. (2015). Technical efficiency and its determinants in the European Union agriculture. *Agricultre Economics – Czech, 61(6),* 275-283. doi: 10.17221/200/2014-AGRICECON

[25]   Olsen, J.V., Lund, M. (2011). The impact of socio-economic factors and incentives on farmers' investment behaviour. Food Economics. Acta Agriculturae Scandinavica. 8(3), 173-185.

[26]   Pechrova, M. (2015). Impact of the Rural Development Programme Subsidies on the Farms inefficiency and efficiency. *Agricultural Economics – Czech, 61(5),* 197-204. doi: 10.17221/110/2014-AGRICECON

[27]   Pufahl, A., Weiss, Ch. R. (2009). Evaluating the Effects of Farm Programmes: Results from Propensity Score Matching. *European Review of Agricultural Economics, 36*, 79-101.

[28] Ratinger, T., Medonos, T. and Hruska, M. (2014). The Assessment of the effects of the investment support scheme in the Czech Republic. Poster paper prepared for presentation at the EAAE 2014 Congress Agri-Food and Rural Innovations for Healthier Societies.

[29] Shephard, R. W. (1970). The Theory of Cost and Production Functions, Princeton, NJ: Princeton University Press.

[30] Spicka, J., Machek, O. (2015). Change in the production efficiency of European specialized milk farming. *Agricultural Economics – Czech, 61 (1),* 1-13. doi: 10.17221/112/2014-AGRICECON

[31] Viaggi, D., Raggi, M. and Paloma, S. G. (2011). Farm-household investment behaviour and the CAP decoupling: Methodological issues in assessing policy impacts. *Journal of Policy Modeling, 33*, 127-145. doi:10.1016/j.jpolmod.2010.10.004

[32] Wigier, M., Wieliczko, B. and Forgarasi, J. (2014). Impact of Investment Support on Hungarian and Polish Agriculture. Paper prepared for presentation for the 142nd EAAE Seminar Growing Success? Agriculture and rural development in an enlarged EU. May 29-30, 2014 Corvinus University of Budapest Budapest, Hungary. http://econpapers.repec.org/paper/agseaa142/172973.htm

[33] Zhengfei, G., Oude Lansink, A. (2006). The Source of Productivity Growth in Dutch Agriculture: A Perspective from Finance. *American Journal of Agricultural Economics, 88(3),* 644-656. doi:10.1111/j.1467-8276.2006.00885.x

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