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Longitudinal examination as a possible method of observing agriculture

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Keywords: longitudinal (development successive) examination, method, applicability.

Summary findings, conclusions, recommendations

On the basis of our examinations we have come to the conclusion that longitudinal examinations are the simplest and most up-to-date methods as well as the most cost-efficient ones for following the decision-making, preparatory data collection, processing and analysis opportunities, which better and better serve the sustainability of agriculture, together with subsequently tracking feedback about the decisions to see if the given measure has really resulted in reaching the objectives.

The method was proved capable of supplying both micro- and macro-level information in the desired breakdown, groupings and systems of connections.

The development successive (panel) examination that we applied can serve as the basis of decision-making affecting huge areas by means of total listings and breakdowns. Moreover, it can also control their effects and aftermaths.

We suggest implementing the introduction this data-collecting and information-supplying method, declared desirable by the European Union. Implementation would be eased to a great extent by the fact that the relevant organisations stand available.

Introduction

Due to the favourable natural endowments and historical traditions, agriculture plays a decisive role in the social, political and, last but not least, economic life of our country. It is not a negligible fact either that during the EU integration this branch caused most of the problems as the analysis of the agricultural sector is a more complex task than that of any other sector at all levels. Here totally different procedures must be examined at the same time (e.g. biological, technological, demographic, climatic, market and income ... etc.). According to *Simai (2002)*, the complex analysis of the processes happening in the sector is a complex task even regarding the decentralisation of the production sy-

stem". To achieve this, a lot of precise information is necessary about the endowments and situation of the homesteads to make well-established decisions as well as to measure the aftermath of certain decisions. The information outlined cannot be supplied perfectly and the future cannot be forecast by any of the systems. At the same time, the so-called longitudinal (development successive) examination as a method of procedure can be of approximate accuracy as it describes changes in their process and correlations in dynamism, development in contrast with the traditional static examinations.

The method was tested by means of the changes in private farms for a period of 15 years.

The main objective of the examination was to find out if the longitudinal method was really useful and suitable to examine the development of the actors in agriculture, i.e. to make a model of its application to trace down the changes in the single private farms of Heves county.

The database of the examinations

The thorough listings of 1994 and 2000 carried out by the *National Statistical Office* (NSO) serve as the basis of macro-level comparison and the listings of 2005, between which the connection was established by the individual identification of homesteads in the representative sample.

The results of the examination were assessed for 15 years (1991-2006) in 31 private farms of Heves county- mainly based on own data collection and the data of the NSO by thoroughly processing such data as the personal particulars of the farmers, the formation of land size, vegetable production, plant production, fruit-and grape production together with animal husbandry.

The unique identification of the homesteads was also ensured here. The problem was how to manage the homesteads ceased to operate in the meantime but this was solved by indicating them in a separate line of the table (in 1991 there were 31, in 2006 only 17 homesteads).

By making use of the results, the shifts in the volume and structure can be presented based on the changes in the model homesteads, which can perfectly show the shifts and trends typical of the private homesteads.

The definition, role and significance of longitudinal (development successive) examinations

Juhász aroused the problems of lack of information in 1999 in the European in-

tegration process when he saw the reasons for coordination problems in the Hungarian vegetable-fruit branch in the following:

- „The precise knowledge of production and market quantities – *lack of information*.
- Lack of reliable price estimates, forecasts, short-and long-term market reports – *lack of information*.
- Market information supporting long-term producers' decisions – *lack of information*.”

None of the systems can perfectly supersede the lack of information as the forecast of the future can only be stochastic. Determinism can only be expected in the case of the events already happened or when there is an extremely tight correlation (dependence). However, the so-called longitudinal (development successive) examination as a method of procedure can be of approximate accuracy. As a terminus technicus, I will use this term as a development successive examination in my own research. What do we mean under this term?

Development successive examination: describes changes in their process and correlations in dynamism, development in contrast with the traditional static examinations.

The term *change* usually denotes a change in quantity but also in quality in a positive or negative direction. However, *development* means a change in quality due to the change in quantity. We think the longitudinal method we applied and from which we carried out panel examination can best be termed as *development successive examination* in the national terminology.

Of course, to support this, first of all the term of longitudinal examination must be clarified:

According to the collection of concepts of methodology „*longitudinal examination* is a research project including data recording at different times, in contrast with the examination of cross-sections. *Panel*

examination: such a *longitudinal examination* during which data are collected from the same sample (panel) at different times” (Szabó, 2006).

The „concise dictionary” of PR gives the following examination: „*longitudinal examination* is such research that relies on data collection at different times. *Panel examination*: one of the types of *longitudinal examination* in which the same individuals are asked many times in a certain period to examine the process of changing the responds, usually in connection with the same questions or problems”.

According to *Babbie (2003)* unlike cross-section examinations, *longitudinal examinations* are planned to inspect the same phenomenon for a longer period of time.

In case of quantitative research like surveying a huge population (pattern) it is more difficult to carry out longitudinal examinations. However, it is often the best way to study changes in time. The Reader must get acquainted with three types of longitudinal examinations: trend, cohorts and *panel examinations*.

Trend examinations study the changes in a special sub-population in time.

Cohors examinations study special sub-populations (cohors) and check how they are changed in time.

Panel examinations are like trend and cohorts examinations but here the same people are examined every time (*Domán – Tamusné, 2002*).

The advantage of longitudinal examinations over the cross-section ones is obvious: we can get detailed information about the processes in time. However, this has a high price both in terms of time and money mainly in case of the examinations of high volume. Observations must be made at the same time with the events and this may need a lot of cooperates.

Panel examinations give the most thorough, precise data of the temporal chan-

ges but *we have to face a unique problem here: that is dropping out*. One part of those asked during the first wave of the survey may not take part in further records due to their own decisions or special circumstances. The danger is that dropping out of the examination cannot be regarded incidental so results can be distorted. So, for instance, when *Carol S. Aneshensel* and his colleagues compared the sexual behaviour of Latin and non-Latin teenagers by using panel examination, a difference was found between the characteristics of Latin teenagers born in America and in Mexico. We have to take these differences, deviations into consideration so that misleading conclusions should not be drawn concerning the differences between Latin and non-Latin teenagers (*Aneshensel et al., 1989*). Figure 1 presents cross-section examinations and the three types of longitudinal examinations where trend, cohorts and panel examinations are well interpreted. It is worth reading the work of Joseph J. Leon entitled “Ageing and time dimension”. *Szabó (2006)* defines the types of longitudinal examinations in his book called “Introduction to the methodology of longitudinal examinations 1” the same way as *Babbie (2003)* but he goes further and asks: Why are longitudinal examinations necessary? He also answer the question saying the following:

- result-cause effects can also be presented not only correlation;
- the levels of development and temporal succession of events can also be examined.

But the examinations of cross-sections can also be suitable with appropriate questions.

- I ask for a date to the events.
- I can exclude certain logical trends.

„When only longitudinal examination can be applied

- a clear picture can be obtained about the levels of development (rate of development);
- the condition can be separated and also can be checked;
- such input can be included that could be out of the scope of examination in any other way;
- the effects of environmental trends can be separated (lapsed cohorts examination).
- As in the cross-sectional examination the researcher tries to predict the directi-

on of the effect, there is no real possibility to set up and test interaction or transactional models (panel examination)."

According to *Collins, 2000* „for the ideal longitudinal examination

- the proper theoretical model of change;
- such temporal design that is able to examine the clear and detailed picture of the change; and
- a suitable statistical model that tests the theoretical model is necessary”.

Figure 1

Ageing and time dimension			
cross-section examinations		trend examinations	
	1990		1990-2000
↑	41-50	41-50	↔
↓	51-60	51-60	↔
↕	61-70	61-70	↔
↕	71-80	71-80	↔
panel examinations		panel examinations	
	1990-2000		1990-2000
41-50	↔	41-50*	↔
51-60	↔	51-60*	↔
61-70	↔	61-70*	↔
71-80	↔	71-80*	↔
			* the same persons are examined
			+81*

Source: Joseph J. Leon in: Babbie, 2003

The longitudinal examination as a method

Based on our secondary research, we experienced that longitudinal examination as a method is primarily used in surveying education, medical research and all other kinds involving the population (out of 477 bibliographical items only 1 mentions its agricultural respect) (*Ficzeréné, 2007*).

The agricultural application of this method was first mentioned in 1993 in Geneva at the working group session of the Meeting of European Statisticians from the Dutch and Swedish delegation. Both papers were dealing with this topic. The

Swedish delegation handed in their paper under the title of „The long temporal linear examination of the structural changes of the Swedish agriculture” (*Gundel – Laczka, 1995*). One of the conditions of the analysis was the presence of homogeneous time series and another was the identification of homesteads with which the data of the homesteads could reliably be identified at different consecutive times (statistical identification code). The main point of the method is that the size categories of land will be created on the total data set of the index to be analysed (e.g. plot of land). These plot size categories of land will be written into the headings and lateral columns of the table in the same way du-

ring the examination (Ficzereⁿe – Vanó, 2004).

After careful identification the homesteads will be put into the cells of the table according to the area of land possessed during the examined t period of time (side column) as well as during t+1 period of time (heading). This way the homesteads which had the same area of land during the examined t and t+1 period are in the diago-

nal of the table so they kept the same size. Above the diagonal of the table are the ones that increased their area and below the diagonal are those that decreased their area from period t to period t+1. In the two latter cases the size and the extent of the area change can be traced. Of course, the examination can go on consecutively year by year but even the changes of a longer period can easily be analysed (Gundel – Laczka, 1995).

Table 1

The spread of components on the basis of the size categories of the criterion I

t+1 time		classification of criterion				for time t		
		X _{1ah} -X _{1fh}	X _{2ah} -X _{2fh}	X _{3ah} -X _{3fh}	X _{nah} -X _{n^o}			
t time		occurrence of components				Z _t	Y _t	(y/z)
classification of criteria	Y _{1ah} -Y _{1fh}	Z _{x1y1}	Z _{x2y1}	Z _{x3y1}	Z _{xny1}	Σ z _{y1xi}	Σ y ₁	y ₁ ⁻
	Y _{2ah} -Y _{2fh}	Z _{x1y2}	Z _{x2y2}	Z _{x3y2}	Z _{xny2}	Σ z _{y2xi}	Σ y ₂	y ₂ ⁻
	Y _{3ah} -Y _{3fh}	Z _{x1y3}	Z _{x2y3}	Z _{x3y3}	Z _{xny3}	Σ z _{y3xi}	Σ y ₃	y ₃ ⁻
	Y _{nah} -Y _{n^o}	Z _{x1yn}	Z _{x2yn}	Z _{x3yn}	Z _{xnyⁿ}	Σ z _{yⁿxi}	Σ y _n	y _n ⁻
for time	Z _{t+1}	Σ z _{x1yi}	Σ z _{x2yi}	Σ z _{x3yi}	Σ z _{xnyi}	Σ z _{xnyi}	Σ y _i	y _i ⁻
	X _{t+1}	Σ x ₁	Σ x ₂	Σ x ₃	Σ x _n	Σ x _i		
	(x/z)	x ₁ ⁻	x ₂ ⁻	x ₃ ⁻	x _n ⁻	x _i ⁻		

Source: own compilation

Where:

- t and t+1 are successive dates and criterion x is identical with y;

- x_{1ah}-x_{1fh} the upper-lower first class marginal value of the criterion of the component at date t+1 which is the same time t in the longitudinal examination with y_{1ah}-y_{1fh};

- z is the number of the occurrence of components (units) in the size categories of x and y;

- Y_t and X_{t+1} is the total amount of criteria reflected to the given time.

The frequencies inserted in the contingency table can clearly indicate non-random spread without the application of more serious mathematical-statistical methods.

The spread of occurrences of Table 1 in percentage reflected to principal ΣZ_{x_iy_i} in the diagonal of the error range (downwards from left to right) shows the proportion of the units (components) whose examined feature or size did not change between the two dates. The extent of criterion decreased in the case of the components below the diagonal from the previous (t) time to t+1 time while the extent of those above the diagonal increased. By contracting the columns the assessment of the result can be simplified according to Table 2 by highlighting the extent of decrease, increase and invariability (similarity) per category and in total.

Table 2

The spread of components on the basis of the size categories of the criterion 2

t+1 time t time		The change of components from time t to time t+1 according to the criterion			Σ Z _t
		less (a)	similar (b)	more (c)	
Y _{1ah} -Y _{1fh}	or occurrence components	-	$Z_{x1y1}/\Sigma Z_{xiyi}$	$Z_{x2,3,n y1}/\Sigma Z_{xiyi}$	$\Sigma z_{y1xi}/\Sigma z_{xiyi}$
Y _{2ah} -Y _{2fh}		$Z_{x1 y2}/\Sigma Z_{xiyi}$	$Z_{x2y2}/\Sigma Z_{xiyi}$	$Z_{x3,n y2}/\Sigma Z_{xiyi}$	$\Sigma z_{y2xi}/\Sigma Z_{xiyi}$
Y _{3ah} -Y _{3fh}		$Z_{x1,2 y3}/\Sigma Z_{xiyi}$	$Z_{x3y3}/\Sigma Z_{xiyi}$	$Z_{xn y3}/\Sigma Z_{xiyi}$	$\Sigma z_{y3xi}/\Sigma Z_{xiyi}$
Y _{nah} -Y _{n^o}		$Z_{x1,2,3 yn}/\Sigma Z_{xiyi}$	$Z_{xny n}/\Sigma Z_{xiyi}$	-	$\Sigma z_{ynxi}/\Sigma Z_{xiyi}$
Z _{t+1}		$\Sigma z_a/\Sigma Z_{xiyi}$	$\Sigma z_b/\Sigma Z_{xiyi}$	$\Sigma z_c/\Sigma Z_{xiyi}$	1

Source: own compilation

Table 3

The directions of the change of criterion

time	the proportion of the change of components from date to date according to the criterion			the proportion of missing components between t _{n-1} - t _n	Total
	less	similar	more		
t+1	$\Sigma z_a/\Sigma Z_{xiyi}$	$\Sigma z_b/\Sigma Z_{xiyi}$	$\Sigma z_c/\Sigma Z_{xiyi}$	$\Delta Z/\Sigma Z_{xiyi}$	1
t+2	$\Sigma z_a/\Sigma Z_{xiyi}$	$\Sigma z_b/\Sigma Z_{xiyi}$	$\Sigma z_c/\Sigma Z_{xiyi}$	$\Delta Z/\Sigma Z_{xiyi}$	1
t+3	$\Sigma z_a/\Sigma Z_{xiyi}$	$\Sigma z_b/\Sigma Z_{xiyi}$	$\Sigma z_c/\Sigma Z_{xiyi}$	$\Delta Z/\Sigma Z_{xiyi}$	1
t+4	$\Sigma z_a/\Sigma Z_{xiyi}$	$\Sigma z_b/\Sigma Z_{xiyi}$	$\Sigma z_c/\Sigma Z_{xiyi}$	$\Delta Z/\Sigma Z_{xiyi}$	1
t+n	$\Sigma z_a/\Sigma Z_{xiyi}$	$\Sigma z_b/\Sigma Z_{xiyi}$	$\Sigma z_c/\Sigma Z_{xiyi}$	$\Delta Z/\Sigma Z_{xiyi}$	1

Source: own compilation

With the arrangement of the data summarising the changes of the features of the farms between the two dates in the chronological order of the series of survey into a table (Table 3), the changes from time to time can be reviewed much easier and the

partial results can be made more understandable with graphical designs. (The decrease of components resulting from the method of examination can be presented in a separate column in the summarising tables).

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