

ANALYSIS OF TEMPORARY ASPECTS OF POVERTY IN POLAND BETWEEN 1997–2000 BY HAZARD MODELS

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ABSTRACT

This paper examines the extent and characteristics of poverty in Poland analyzed on the basis of panel data from CHER (Consortium of Household Panels for European Socio-Economic Research) for the years 1997–2000. The analysis presented shows a low households' dynamic of income in this period. The total number of years spent in poverty as well as different sequences of entry to and exit from poverty suggest the tendency to a persistent form of this phenomenon in the population. During the period studied, the basis for the calculation of the number of years spent in poverty was the rate of exit from and entry to poverty. The calculations have been made according to the method of analyzing poverty dynamics by hazard models, considering observed and unobserved heterogeneity of individuals to "explain" a chance of exit and return to the sphere of poverty.

Key words: Permanent and transient poverty, Hazard models, Multi-spell poverty episodes, Unobserved heterogeneity

Introduction

Poverty has affected society since the beginning of mankind. It still is experienced not only by citizens of undeveloped countries but also by those living in highly developed economies. The existence of poverty on a large scale leads to a wide interest in this topic, although research on poverty is primarily conducted by countries in which the scope of this phenomenon is marginal. A different situation persisted in centrally-planned economies, where poverty was not officially recognized as the aim of socialist regimes was to eliminate poverty.

In recent years, income dynamics and duration of poverty have been more often discussed during public and academic discussions as socially important

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factors completing information on income distribution. It has been agreed that the best way to measure and understand the problem is to supplement traditional studies based on cross-series data with long-term analysis based on panel data.

When a household's gross income declines below a minimum level and there are not enough financial resources to satisfy basic human needs, its members are considered to be poor. When this situation persists for an extended period of their lives then an entire society is affected by effects of poverty. A long-term poverty of the same group of people is difficult to accept not only because of social fairness but also due to high external costs of permanent marginalization and social exclusion. Political stability is also an important reason why the topic of poverty arouses so much interest both in highly developed and developing countries.

The aim of this paper is to analyze duration of poverty in Poland over the period of 1997–2000, using panel data from the CHER¹ database. An exact specification of the population permanently living in poverty and its differentiation from the category of people who experience this state temporarily may aid in preparing programs of social assistance targeted at these groups that are not able to exit poverty by themselves. Studies of this type are necessary due to a large scale of this phenomenon as well as limited amount of resources which, for the sake of a permanent budget deficit problem in Poland, may be of use to overcome the problem. If I succeed in defining the category of those chronically living in poverty, this analysis may prove helpful in targeting the financial assistance for the poor more effectively while cutting the budgetary resources earmarked for this purpose at the same time.

The main questions put forth in this paper are as follows:

- When does a household find itself in poverty and how long does the poverty last?
- Does “recurrence of poverty” exist i.e. whether repeated spells of poverty could be considered an adequate indicator of permanent poverty?
- What socio-economic characteristics of households allows for the best identification of poverty in Poland between 1997–2000?

This article uses econometric methods of poverty analysis by model hazard taking into account observable and unobservable heterogeneity of individuals. It carries out estimation of two complimentary log-log type models in discrete time. They differ in method by which they describe duration of so-called base hazard function. In the first model, it has a non-parameter shape while in the second it is a polynomial time function.

The article consists of five parts. The first part includes the methodology used in constructing the econometric model. The second part describes the data used in the analysis, definition of poverty as well as independent variables of the model. The third part provides a short description of poverty dynamics and its duration in Poland. To introduce a distribution of time spent in poverty an exit rate from and

¹ Consortium of Household Panels for European Socio-Economic Research.

a return rate to poverty have been used. The parametric method of analyzing poverty is presented in the fourth part. The last part is a summary of the results and conclusions.

1. Duration theory

To study the exit from and return to poverty rates of households, this article applies the Jenkins (1995, 2004) and Devicienti (2000, 2002) methodology. The hazard function, $h(t)$ ¹ is used for calculating exit and return probabilities.

Let $\langle \tau_1, \tau_n \rangle$ be an observation period of the sample, while $\langle t_1, t_k \rangle$ - period of poverty. In the study, one can have censored observations - that is, those that contain information how long the person "was affected" by poverty, but the exact moment of exit from and entry to poverty are unknown.

Let T_i be the length of the poverty episode of i -the individual. Let the length of this time be a realization of the continuous random variable T_i with the distribution function $F(\tau)$ and the density function $f(\tau)$, then the probability that a state of poverty will last shorter than τ years under a condition that it occurred is:

$$F(\tau) = \Pr(T_i < \tau) \quad (1)$$

However, the probability that occurrence of poverty will last a minimum of τ years under condition that it occurred is²:

$$S(\tau) = 1 - F(\tau) = \Pr(T_i \geq \tau) \quad (2)$$

where: $S(\tau)$ – survival function.

The continuous time hazard rate is:

$$\theta(\tau) = \lim_{\Delta\tau \rightarrow 0} \frac{\Pr(\tau \leq T_i < \tau + \Delta\tau | T_i \geq \tau)}{\Delta\tau} = \lim_{\Delta\tau \rightarrow 0} \frac{F(\tau + \Delta\tau) - F(\tau)}{\Delta S(\tau)} = \frac{f(\tau)}{1 - F(\tau)} = \frac{f(\tau)}{S(\tau)} \quad (3)$$

This rate can be interpreted as a probability of ending the episode of poverty in the range $[\tau, \tau + \Delta\tau]$ for small $\Delta\tau$ under condition of "survival" to time τ .

It is important to notice that hazard rate in continuous time does not satisfy all properties of probability and especially the hazard rate may be greater than 1.

The survival function as well as hazard rate are connected by simple direct relation, that is:

$$\theta(\tau) = -\frac{S'(\tau)}{S(\tau)} = -\frac{d}{d\tau} \ln S(\tau) \quad (4)$$

¹ $h(t)$ – hazard rate in discrete time, $\theta(\tau)$ – hazard rate in continuous time.

² The survival function provides a probability that the person will live longer than some given time τ or in other words – that they live until time τ (Stanisz, 2003).

and

$$S(\tau) = \exp \left[- \int_0^{\tau} \theta(z) dz \right] \quad (5)$$

This research had begun from non-parametric¹ estimation of survival and hazard functions utilizing the Kaplan-Meier estimator.

1.1.Kaplan-Meier Estimator

The Kaplan-Meier estimator is calculated in accordance with the following formula²:

$$\hat{S}(\tau_j) = \prod_{j|\tau_j < \tau_n} \frac{n_j - h_j}{n_j} = \prod_{j|\tau_j < \tau_n} (1 - \hat{\lambda}(\tau_j)) \quad (6)$$

where:

$\{\tau_j : j = 1, 2, \dots, k\}$ - is a set of all moments of the events which occurred;

$\tau_1 < \tau_2 < \dots < \tau_k < \infty$ - in the order of duration of the episodes;

n - a number of observations, $k < n$, because a part of the observations is censored;

h_j - a number of completed cases with a duration of τ_j ;

n_j - a count of the risk set, that is a number of episodes exposed to completion in a time τ_j , $n_j = (m_j + h_j) + (m_{j+1} + h_{j+1}) + \dots + (m_k + h_k)$;
where: m_j - a number of censored observations with a censored duration in the interval $[\tau_j, \tau_{j+1})$;

$\lambda(\tau_j)$ - a probability of ending the occurrence in the near (right-sided) τ_j point, under a condition that the episode has lasted until point τ_j . $\lambda(\tau_j)$ is a

¹ A non-parametric analysis allows us to analyze data without making assumptions regarding distribution. This has certain benefits as well as pitfalls. On one hand, a possibility to analyze data without making assumptions about the real distribution of "life" lets one overcome potentially great errors. On the other hand, confidence levels related to non-parametric analysis are generally much wider than those based on parametric calculations; moreover in the latter case forecasts beyond the sample are possible,
http://www.weibull.com/LifeDataWeb/nonparametric_analysis.htm.

² Kiefer (1988).

theoretical hazard function, and $\hat{\lambda}(\tau_j) = \frac{h_j}{n_j}$ is an empirical “estimator” of hazard function at point τ_j .

The Kaplan-Meier estimator can also be set using the life duration table methodology¹. In this case, the estimator has a form of:

$$\hat{S}(j) = \prod_{k \leq j} \left(1 - \frac{d_k}{r_k} \right) \quad (7)$$

where:

d_k – a number of occurrences which has finished in k range;

$$r_k = r_{k-1} - \frac{1}{2} m_k;$$

where:

m_k – a number of censored occurrences in a range (a_{k-1}, a_k) ;

r_{k-1} – a risk set - a set of units that lived to the uppermost part of the range (a_{k-2}, a_{k-1}) and so have a chance to enter (a_{k-1}, a_k) range.

Therefore, one can see that here a survival function is estimated and its only argument is time. Based on survival function, one can easily transform to hazard function of the following form:

$$\theta(\tau) = -\frac{d}{d\tau} \ln \hat{S}(\tau) \quad (8)$$

1.2. The parametric method: discrete time model, including observed and unobserved heterogeneity of individuals

When estimating the hazard rate with the use of the Kaplan-Meier method, one does not consider the heterogeneity of individuals, which depends on observed and unobserved variables. This problem is resolved by the parametric method.

Although exit from poverty can occur at any moment of time (stochastic process for continuous time), usually the duration of poverty episodes is observed in discrete, not continuous time². The models with a discrete time, however, have some advantages. One of these comes from the fact that discrete time models

¹ This method is the oldest technique of estimating survival and hazard functions.

² Jenkins (2004).

combine variability in time with elastic specification of duration interdependencies¹.

For the needs of this analysis, discrete models presented by Jenkins (1995) have been used:

- 1) Prentice-Gloeckler model (1978);
- 2) an extended model by Meyer (1990), the Prentice-Gloeckler model (1978) which contains the gamma distribution that includes unobserved individual heterogeneity.

An exit hazard rate from a given state (poverty or wealth) in a discrete time for i -th individual in period t is specified by Prentice and Gloeckler (1978) as:

$$h_i(t) = 1 - \exp[-\exp(\theta_0(t) + \beta' X_i(t))] \quad (9)$$

where:

$X_i(t)$ – independent variables (variable with time or fixed);

β – a vector of unknown parameters;

$\theta_0(t)$ – a base hazard rate, that is a hazard for a given individual when all independent variables' values are equal to zero.

The model also known as the „complementary log-log” can be interpreted as a model with discrete time which is directly related to hazard in continuous time². The assumption of a base hazard form $\theta_0(t)$ may unnecessarily limit the scope of hazard and bring potential bias of the β estimator. That is why, it is especially important to include general nonparametric specifications.

2. Data and variable description and definition of poverty margin

The data used in this empirical research come from the CHER database. It is a harmonized and standardized microeconomic database created from already existing panels pertaining to living conditions of individuals and households in the European Union before its expansion in 2004, as well as for Poland and Hungary. The database contains detailed data on income and professional activities of individuals, their education, employment, employment history, and others. Variables describing social relations and the sentiments of the members of the households are also included there. In the CHER database two Polish panels are available: the first one referring to years 1994–1996, the second to 1997–2000. Okrasa (1999) analyzes household welfare trajectories during the period 1993–1996 to identify long-term poverty and determine the relevance of household asset endowments as determinants of household poverty and vulnerability over time. Overall income mobility in Poland, at that period, was high. In other words,

¹ Duration data analyses benefit from the use of discrete-time models. However, available econometric software is usually unable to account for the sampling method used, thereby raising the probability of sample selection bias (Jenkins, 1995).

² Jenkins (1995).

the percentage of households that had changed their original position was substantial. The trends in repeated poverty during the growth period were similar so that during the pre-transition era: the fraction of households experiencing two year poverty oscillated around 10 percent after it had worsened significantly during the recession itself (Okrasa, 1999).

This paper is based on the second panel referring to 1997–2000. In this panel 12208 households are incorporated.

Defining the category of poverty is a key element in assessing its range and depth¹. The kind of definition accepted will determine which groups of society may be acknowledged as the most vulnerable to poverty risk. The choice of a method setting the poverty margin depends on whether poverty is treated as a relative or absolute category. In the first case, poverty is understood as a relative deprivation, the level of which is depicted in a relation to wealth of other, better situated members of the society. In the second case, poverty is understood as a lack of fixed sources of income independent of the level of resources available to an overwhelming part of society which the impoverished individual is a member of².

¹ Kot (2000, p. 182).

² Panek, Podgórski, Szulc (1999).

Table 1. A trend of real average equivalent income as well as characteristics of impoverished households

Characteristics of impoverished households			1997	1998	1999	2000
Real average equivalent income (for all households)		(in PLN)	9360	9130	8940	9200
		(in %)	100	97,52	95,54	98,30
Poverty margin	50% median income	Impoverished households (%)	7,16	7,85	7,59	7,55
		Real average equivalent income of poor families (in PLN)	2850	2600	2780	2860
		Real average equivalent income of wealthy families (in PLN)	10520	10370	10160	10390
		Average poverty gap ¹ (in PLN)	1050	1215	1055	1015
		Income gap index ²	0,27	0,31	0,27	0,26
	75% median income	Impoverished households (%)	23,05	22,82	21,97	21,54
		Real average equivalent income of poor families (in PLN)	4333	4132	4132	4130
		Real average equivalent income of wealthy families (in PLN)	11650	11420	11130	11370
		Average poverty gap (in PLN)	1610	1706	1630	1685
		Income gap index	0,27	0,29	0,28	0,29

Source: CHER database: Poland (1997–2000); own calculations.

Literature on the subject discusses the following lines of poverty: absolute, relative, subjective and official³. Nevertheless, most of the research⁴ shows the poverty's boundary as a proportion of central tendency measures (average or median) of a distribution of a given population. In the poverty analysis it is reasonable to use various poverty boundaries⁵. In this article I consider a household (and thus all its members) as impoverished⁶ if its real equivalent

¹ A poverty gap shows how far poor persons are from the poverty margin, that is, how much on average each family, living in the poverty zone, should receive in order to find itself exactly on the poverty margin.

² An index used to synthetically assess a depth of poverty is an income gap index defined as:

$$I = \frac{1}{N \cdot z} \sum_{i=1}^N \left(z - \frac{y_i}{m_i} \right), \text{ where: } N - \text{a number of households, } z - \text{a poverty margin, } y_i - \text{an}$$

income of household i , m_i – equivalence scale of i -th household (Panek, Podgórski, Szulc, 1999).

³ Golinowska (1997, p. 20-24]. The lines of absolute poverty were used in research by Denisczuk, Sajkiewicz (1995), Kurowski (2008), relative lines were used by GUS in Poland (Kordos, Ochocki, 1993), subjective lines of poverty in the following studies (Kot, 1995, 1998, Kasprzyk, 2000).

⁴ The relative lines of poverty were used in studies by Eurostat and by GUS in Poland. In the European Union countries as an official boundary of poverty - half of an average income - is used.

⁵ Steward, Swaffie (1999), Cappellari (2000).

⁶ It is important to notice that the level of poverty boundary and its proportion to delineating the equivalent income are a result of statistical agreement.

income¹ is lower than the poverty boundary line of 50% or 75% of real equivalent median income measured according to the OECD relative scale (100/70/50)². However, it is important to notice that according to Hagenaars et al. (1994) the OECD scale is too much focused on large families and therefore, the so-called OECD modified scale³ has been proposed. The choice of using the OECD original scale in research is justified for at least two reasons. Firstly, the original scale is used by Eurostat, and secondly – in the 1990s – it showed a relatively high conformity with scales estimated on the basis of real expenses of households taking part in family's budget research (Szulc, 1995).

Table 1 presents the primary characteristics of poverty in the analyzed sample for Poland between 1997–2000. Over this period the average income declined by approximately 2%. The average real income of the population – after a dramatic decrease at the beginning of the transformation period – was continuously increasing until 1998. From this moment, there was a vivid decline in high, over the last few years, economic dynamic followed by a later reduction of the rate of growth in the real income of the population. The number of individuals having income below a relative boundary of poverty of 50% median income, after an increase in 1998 began to drop. Yet, at the relative boundary of poverty of 75% median income, the number of impoverished households shows a declining trend since the beginning of the studied period. The amount needed to combat poverty with the use of the poverty boundary of 50% median income is on average 1100 PLN (about 1700 PLN when a poverty boundary of 75% median income is used). The average wealth of an impoverished household group is lower by about 27% than the poverty line (in 1999 even by 31%) with the use of a poverty boundary of 50% median income (on average 28% when a poverty boundary of 75% median income is applied).

2.1.Characteristics of independent variables used in the study

The choice of independent variables in the panel model was based on previous studies which pertained to poverty analysis. Variables that have been used in the two types of the models are as follows: poverty exit rates and poverty return rates are presented below. They include:

¹ In the study a net real equivalent income was considered, expressed in year 2000 currency (indices for the following years: 1 [2000], 1·1,073 [1999], 1·1,073·1,118 [1998], 1·1,073·1,118·1,149 [1997]) (Inflation in the years 1997–1999 equalled: 14,9%, 11,8%, 7,3%, „Indices for prices of consumer goods and services for 1950–2002” can be found at, <http://www.stat.gov.pl>).

² Net equivalent income was set using a equivalent scale utilized by GUS, which gives a weight of 1 per head of the household and 0,7 for every other adult person (age>15 years) as well as 0,5 for every child in the household (age ≤15 years).

³ Net equivalent income was set using a modified equivalent scale, which gives a weight of 1 per head of the household and 0,5 for every other adult person (age>15 years) as well as 0,3 for every child in the household (age ≤15 years).

- Duration of poverty (in years) - a variable used in exit from poverty model: **duration_poverty_{it}** (composed of three levels: 1 – exit from poverty after 1 year, 2 – exit from poverty after 2 years, 3 – exit from poverty after 3 years). A variable used in return to poverty model: duration of wealth (in years) – **duration_wealth_{it}** (composed of three levels: 1 – return to poverty after 1 year, 2 – return to poverty after 2 years, 3 – return to poverty after 3 years).
- Gender of the head of the household: **gender_{it}** (composed of two types: 1 – male, 2 – female).
- Professional status of the head of the household: **status_{it}** (composed of four levels: 1 – employed and self-employed, 2 – retired, 3 – unemployed, 4 – not active professionally for other reasons).
- Education status of the head of the household: **education_{it}** (composed of three levels: 1 – incomplete primary and primary, 2 – secondary and vocational, 3 – higher).
- Place of living: city, **countryside_{it}** (composed of two types: 1 – city, 2 – countryside).
- Geographical region¹: **region_{it}** (composed of four types: 1 – Eastern Poland and Warmia and Mazury, 2 – Southern Poland, 3 – Western Poland and Pomeranian, 4 – Centre).

¹ The following regions form the voivodships: Eastern Poland and Warmia and Mazury: lubelskie, podkarpackie, podlaskie, warmińsko-mazurskie; Southern Poland: małopolskie, opolskie, śląskie, świętokrzyskie; Western Poland and Pomeranian: dolnośląskie, lubuskie, pomorskie, zachodnio-pomorskie; Centre: kujawsko-pomorskie, łódzkie, mazowieckie, wielkopolskie. This classification is different from the division of the country into regions by GUS (GUS, 2008), however, for the purpose of this paper such an assumption was the most convenient.

Table 2. Characteristics of independent variables are used in the model

Independent variables	The rate of exit from poverty		The rate of return to poverty	
	Impoverished families	Wealthy families	Impoverished families	Wealthy families
Variables pertaining to the head of the family				
Gender (%):				
– male	62	66	58	65
– female	38	34	42	35
Age (average in years)	45	45	46	45
Education (%):				
– incomplete primary and primary	38	32	32	32
– secondary and vocational	61	65	67	64
– higher	0,8	3	1	3
Professional status (%):				
– employed and self-employed	60	70	63	69
– retired	10	10	9	12
– unemployed	5	2	5	0,2
– not active for other reasons	25	18	23	18
Extent of the balance in the family budget (%):				
– surplus	4	24	77	97
– deficit	96	76	23	3
Variables pertaining to the household				
Number of children below six years of age (average)	1,4	0,4	–	–
Number of children of the age between of 6 and 16 (average)	1,3	0,4	–	–
Place of employment (%):				
– city	–	–	36	42
– countryside	–	–	64	58
Region (%):				
– Eastern Poland and Warmia and Mazury	28	28	32	28
– Southern Poland	21	21	19	21
– Western Poland and Pomeranian	20	17	15	18
– Centre	31	33	33	33
Macroeconomic variables				
Unemployment rate (average in %)	14	13	–	–
Year of entry into poverty (%):				
– 1997	26	–	–	–
– 1998	26	33	–	–
– 1999	25	38	–	–
– 2000	24	29	–	–
Number of households	2722	775	192	1238

Source: CHER database: Poland (1997–2000); own calculations.

- Extent of the balance in the family's budget: **budget_{it}** (composed of two types: 1 – surplus, 2 – deficit).
- Year of entry into poverty: **year_{it}** (composed of four levels: 1 – 1997, 2 – 1998, 3 – 1999, 4 – 2000).
- Age of the head of the household: **age_{it}** and age squared: **age_2_{it}** (literature on the subject emphasizes a nonlinear relation between age and exit from and return to poverty).
- Number of children below 6 years of age: **number_children6_{it}**.
- Number of children between the ages of 6 and 16: **number_children16_{it}**.
- Unemployment rate according to voivodship: **rate_unemployment_{it}**.

For the correctness of conducted analysis, some variables have been transformed into 0–1 variables¹. Table 2 includes characteristics of these independent variables used in the model².

3. Nonparametric method

This part presents the results of the study using the nonparametric method³ on the topic of duration of poverty. It also provides distributions of the years spent in poverty in one-spell or multi-times episodes.

3.1. Statistics describing the dynamic of poverty

Table 3 shows that when using a poverty margin of 50% median income, 17% of the population studied was affected by poverty (40% at a poverty margin of 75% median income), in this case, 1,2% (8,6%) of the population was included in a prolonged poverty. The expected amount of time spent in poverty at a poverty margin of 50% median income, for those entering the panel and studied during

¹ Some variables were transformed into 0–1 variables: **duration_poverty_02_{it}**, **duration_poverty_03_{it}** (1 if a family exits the poverty after 2 years, 3 years, respectively), **duration_wealth_02_{it}**, **duration_wealth_03_{it}** (1 if a household returns to poverty after 2 years in wealth, after 1 year in wealth, respectively), **gender_02_{it}** (1 if the head of the household is a female), **status_02_{it}**, **status_03_{it}**, **status_04_{it}** (1 if the head of the household is: retired, not employed, non active for other reasons), **education_02_{it}**, **education_03_{it}** (1 if the head of the household has one of the following education types: vocational and secondary, higher), **city_countryside_02_{it}** (1 if the household is located in the countryside), **region_02_{it}**, **region_03_{it}**, **region_04_{it}** (1 if the household is located as follows: Southern Poland, Western Poland, the Centre, respectively), **budget_02_{it}** (1 if the family had a negative balance of the family budget), **year_02_{it}**, **year_03_{it}**, **year_04_{it}** (1 if the household entered poverty in one of the following years 1998, 1999, 2000, respectively).

² In the parametric method property margin of 75% median income has been used (100/70/50 scale).

³ The nonparametric method provides information about a change in individual's behavior dependent on time under assumption of nonexistence of a particular form of an event distribution (Frątczak, Babiker, Gach-Ciepiela, 2005).

the 4 year period, equals to 0,3 part of the year; for the poverty margin of 75% median income, it equals to 0,89 part of the year.

Table 3. Household distribution by the number of years spent in poverty

Number of years in poverty	Percentage share of impoverished households with the use of a relative margins of poverty	
	50% median	75% median
0	82,89	60,56
1	8,90	13,79
2	4,56	9,98
3	2,46	7,03
4	1,18	8,64

Source: CHER database: Poland (1997–2000); own calculations.

Table 4 presents sequences of income in years 1997–2000 for the studied sample. If a household was in poverty in a given year, it is marked as “U”, if not, then as “N”. The first column shows how long the poverty lasted, whether the studied individual exited poverty and whether they returned to it.

A long-term perspective presented in Table 3 and Table 4 might be compared to a short-term cross-section view proposed in Table 1. A rate of poverty at a given point of time equals, on average, approximately 23% at a poverty margin of 75% median income and about 8% at a poverty margin of 50% (Table 1). Table 3 shows though that 40% of the studied population at the poverty margin of 75% median income (17% at a poverty margin of 50%) had been affected by poverty at least once. However, the data in Table 4 demonstrates that in many cases, individuals experienced poverty in the subsequent years (multi-time episodes). One can thus reason that households entering (or exiting) poverty might be beginning a long period of remaining in that state and, what is more important, they are non-differentiable from those that are located below the poverty margin in only one or two observed years. As a result, the extent of the phenomenon of poverty is underestimated. In each of these four years, one can note that this applies to about 8% of impoverished households at a poverty margin of 50% of the median income (23% at a poverty margin of 75%), while in the entire four-year period, shorter or longer episode of poverty was overcome by as much as 17% of households at the poverty margin of 50% median income (40% at the poverty margin of 75%).

Table 4. Household distribution in a 4-year sequence of states (U – poverty, N – not in poverty)

State sequences	Percentage share of impoverished households using a relative margins of poverty	
	50% median	75% median
NNNN	82,89	60,56
NNNU	2,43	3,15
NNUN	1,81	2,66
NNUU	1,18	2,36
NUNN	2,36	3,28
NUNU	0,56	1,18
NUUN	0,66	1,58
NUUU	0,95	2,17
UNNN	2,30	4,70
UNNU	0,53	1,25
UNUN	0,69	1,08
UNUU	0,33	1,41
UUNN	0,95	2,53
UUNU	0,39	1,38
UUUN	0,79	2,07
UUUU	1,18	8,64
Total	100,00	100,00

Source: CHER database: Poland (1997–2000); own calculations.

3.2. Rates of exit from and re-entry to poverty (Kaplan-Meier estimator)

In this study of exit from and return to poverty rates a nonparametric method has been used. According to the Devicienti's ¹ definition(2002), the exit rates that are relevant in this context are the ones that refer to a cohort of individuals just falling into poverty, hence at risk of remaining in poverty thereafter. The re-entry rates refer instead to a cohort of individuals just starting a spell out of poverty, and so at risk of re-entering. Exit rates are calculated by dividing the number of individuals ending a spell after d years in poverty by the total number with low income for at least d years. The re-entry rates were calculated analogously. To estimate the exit rate, the author used the following sequences: $NUxx$ and $xNUx$, where $x = N, U$ (NNUN, NUNN, NUNU, UNUN, NNUU, NUUN, UNUU, NUUU), however the return rate: $UNxx$ and $xUNx$, where $x = N, U$ (UNUU, UNUN, UUNU, NUNU, UUNN, NUNN, UNNU, UNNN). Unlike the simple calculation of the number of years in poverty, such a periodical approach can include the right-side censored observations. For the purposes of this analysis, the

¹ Devicienti (2002, p. 8–9).

left-side censored observations have been excluded, on account of which the research study starts from 1998 or later.

Table 5. Survival function and rates of exit from poverty (Kaplan-Meier estimator)

Years	Relative poverty margin			
	50% median income		75% median income	
	Survival function	Return rate	Survival function	Return rate
1	1 (-)	0,6346 (0,0494)	1 (-)	0,5219 (0,0330)
2	0,3654 (0,0299)	0,4082 (0,0913)	0,4781 (0,0228)	0,4211 (0,0608)
3	0,2162 (0,0312)	-	0,2768 (0,0258)	-

**) in brackets standard errors are provided.*

Source: CHER database: Poland (1997–2000); own calculations.

Table 5 shows exit rates from poverty using a relative poverty margin. An estimated hazard rate confirms negative effects of poverty duration: the longer the individual lives in poverty, the lesser probability that this state will change in the next period. For the cohort of individuals that begin a period of poverty, the probability of exit after the first year is equal to about 64%, and after two years to approximately 41% (a relative poverty margin of 50% median income), however, for the same cohort the probability of exit from poverty after the first year is equal to about 52%, and after two years to approximately 42% (a relative poverty margin of 75% median income).

Table 6. Survival function and rates of re-entry to poverty (Kaplan-Meier estimator)

Years	Relative poverty margin			
	50% median income		75% median income	
	Survival function	Return rate	Survival function	Return rate
1	1 (-)	0,2429 (0,0314)	1 (-)	0,2008 (0,0203)
2	0,7571 (0,0273)	0,1860 (0,0465)	0,6992 (0,0203)	0,2099 (0,0341)
3	0,6162 (0,0388)	-	0,5524 (0,0265)	-

**) in brackets standard errors are provided.*

Source: CHER database: Poland (1997–2000); own calculations.

Generalizing results from Table 5 and Table 6 implies the thesis that low income includes a wide spectrum of households. Yet, it is not a fixed group. Although there are individuals present in it who are permanently poor, many families exit from and enter poverty.

3.3. Poverty duration in one-spell and multi-time episodes

The estimation of exit from and re-entry to poverty allows us to introduce “distribution of time spent in poverty”. Such distribution is a basic measure of duration of poverty.

The distribution of years spent in one-spell episodes of poverty has been calculated using only exit rates presented in Table 5 (e.g. two years spent in poverty depicted as $(NUUN)$, where N - a period of wealth and U - a period of poverty). It was assumed that $e(d)$ and $r(d)$ are respectively exit rate from and re-entry to poverty after d years. With exception of the left-side censored periods, the probability of this sequence is calculated as: $(1-e(1))*e(2)$.

The distribution of years spent in poverty in the case of multi-time episodes was calculated using the exit and re-entry rates presented in Table 5 and Table 6 (e.g. two years in poverty depicted as $(NUNU)$). With exception of the left-side censored periods, the probability of this sequence is calculated as: $(UNU)=e(1)*r(1)$.

To calculate the probability of observing two years of living in poverty within these four years, one must calculate the probability of occurrence of all possible combinations which generate a sum of two years in poverty and adding them up. In comparison to the forecasts for one-spell and multi-time periods, also a distribution of “time spent in poverty” was calculated using the following sequence: $(NUxx)$, where $x = N, U$.

Comparing Columns 2 and 3 in Table 7 one can notice that in one-spell episodes the distribution of “time spent in poverty” was overestimated for one year spent in poverty. For two-year duration of poverty the use of “one-spell episode” approach in each case results in underestimation of distribution of the time spent in poverty.

Table 7. Distribution of years spent in poverty for the cohort of individuals beginning a period in poverty in 1998

Years in poverty	Distribution in one-spell episodes		Distribution of years spent in poverty in the following three years			
			expected ¹		actual ²	
	50% median income	75% median income	50% median income	75% median income	50% median income	75% median income
1	0,6346	0,5219	0,4805	0,3649	0,5217	0,4000
2	0,1492	0,2013	0,3033	0,3583	0,2681	0,3360
3	0,2162	0,2768	0,2162	0,2768	0,2101	0,2640

Source: CHER database: Poland (1997–2000); own calculations.

¹ Expected distribution of years spent in poverty was delineated using exit and entry rates from/to poverty taken from the Kaplan-Maier model (Table 5 and Table 6).

² Actual distribution of years spent in poverty was delineated using the following sequence $(NUxx)$, where $x=N, U$.

It is important to emphasize that the above mentioned analysis assumes that all observed episodes pertain to a homogeneous population. However, it is more probable that different families having special characteristics (observed and unobserved) meet various rates of exit and re-entry to poverty, which explains why permanently poor households exist. As a result one must change from unilateral to multilateral approach which allows for dependence of an exit rates and re-entry rates on important socio-economic correlations. In the parametric method the poverty margin of 75% median income is used because it gives more possibilities to study the processes of exit from and re-entry to poverty in a short-run.

4. Parametric method: model with discrete time taking into consideration observed and unobserved heterogeneity of individuals

This part presents the results of studies on duration of poverty obtained by the use of parametric method¹. The estimated model contains variables pertaining to characteristics of the head of a household as well as the household itself and also conditions on the labor market, which have impact on the probability of exit and re-entry into poverty later on.. The estimation of the two complementary log-log models with discrete time has been conducted. The first one (Model I) includes elastic non-parametric specification for the base hazard function. The second one (Model II) describes the base hazard, using the multi-dimensional duration function, that is: $\theta_0(t) = at + bt^2 + ct^3$. The use of these two models was justified by the observations made by Meyer (1990) that: “parameters of the base hazard function depict an important characteristic of the data, which would be omitted, if the model would have been estimated by a simple parametric base hazard function”. Models Ia and IIa that include an unobserved heterogeneity have been also estimated.

4.1. Who exits from poverty?

Table 8 presents the analysis of duration of episodes of poverty that end by the household gaining a wealth status. Model 1 confirms a negative relation between duration of poverty and the probability of leaving these conditions, which was earlier observed on the basis of the results from Table 5: the longer a family remains in poverty, the harder it is for them to re-enter the state of wealth. The probability of exit rate from poverty also depends on the characteristics of the head of a family (e.g. gender, education) and a household (e.g. number of children, family's annual budget). Basing on collected evidence, households

¹ About parametric models it is said that the analytical form of probability distribution of density is known.

headed by women remain in poverty longer, which is shown by Model II. The probability of exit from poverty decreases along with the increase in the number of children in a household (aged up to 6 years) as bearing children makes full-time employment more difficult (especially in the case of women).

Moreover, the results of the estimation show that the higher educational level of the head of a family, the lower the chance of experiencing a relatively long period of poverty by their family and the easier fight with poverty. Having a higher education gives a many-times greater chance of exit from poverty than in the case where the head of a family has a secondary or vocational education. An important aspect of the possibility to exit poverty is also the status of the head of a family on the labor market. Households where the family is headed by an unemployed person are in a decisively worse situation. Furthermore, 1% increase in an unemployment rate in a voivodship, decreases the probability of exit from poverty by approximately 2,5 % according to Model I. A family budget deficit has also a negative impact on exit from poverty, another factor in delineating duration of poverty being a macroeconomic situation of a country as well as a period on which the beginning of impoverishment fell (for household which became poor in 1998, 1999 and 2000, a chance to exit poverty was much higher than for those in the base group which entered poverty in 1997). This phenomenon could have taken place due to economic growth in Poland¹.

¹ Results of international research (Barro, 1999) and interdependencies between unequal general income and economic growth in Poland during the transformation period confirm that one cannot expect, in the conditions of Polish economy, a significant limitation of income disproportions. An observations of annual fluctuation of GDP increase rates and Gini factor over the years 1989–1999 confirm that in Poland a higher speed of economic growth was accompanied by a lower build up of inequalities in terms of social division of income (Jabłoński, 2002).

Table 8. Analysis of poverty duration in Poland – exit from poverty

Independent variables	Without unobserved heterogeneity		With unobserved heterogeneity	
	Model I	Model II	Model Ia	Model IIa
	Parametr [standard error]			
Duration of poverty:				
– two years	- 0,910* [0,095]	-	- 0,815* [0,121]	-
– three years	- 1,989* [0,097]	-	- 2,528* [0,161]	-
Year of entry into poverty:				
1998	2,586* [0,215]	-	2,191* [0,293]	-
1999	2,793* [0,223]	-	2,564* [0,326]	-
2000	2,679* [0,232]	-	3,177* [0,370]	-
Variables pertaining to the head of the family				
Gender (female)	-	- 0,2445* [0,0817]	-	- 0,422* [0,153]
Age	- 0,106* [0,010]	-	- 0,113* [0,012]	-
Age_2/100	0,091* [0,011]	-	0,098* [0,013]	-
Professional status:				
– retired	- 0,140 [0,169]	- 0,379* [0,131]	- 0,018 [0,203]	- 0,572** [0,249]
– unemployed	- 0,856* [0,336]	- 1,370* [0,338]	- 0,983** [0,456]	- 2,005* [0,542]
– not active professionally	- 0,269* [0,109]	- 0,557* [0,104]	- 0,383* [0,135]	- 1,192* [0,227]
Education:				
– vocational or secondary	-	0,032 [0,083]	-	0,121 [0,149]
– higher	-	1,165* [0,272]	-	2,098* [0,460]
Variables pertaining to the household				
Number of children up to 6 years	- 0,363* [0,060]	- 0,395* [0,055]	- 0,317* [0,075]	- 0,627* [0,133]
Number of children between 6 and 16 years of age	- 0,120* [0,040]	- 0,305* [0,039]	- 0,152* [0,050]	- 0,594* [0,107]
Budget deficit of the family	- 0,797* [0,084]	- 0,712* [0,078]	- 0,670* [0,101]	- 0,857* [0,129]
Unemployment rate	- 0,029** [0,011]	- 0,049* [0,010]	-0,0844* [0,028]	- 0,175 [0,029]
<i>t</i>	-	- 2,601* [0,295]	-	- 1,153* [0,427]
<i>t</i> ²	-	1,947* [0,155]	-	1,191* [0,231]
<i>t</i> ³	-	- 0,334* [0,024]	-	- 0,200* [0,036]
Number of families	3497			
Logarithm likelihood	- 1294,438	- 1557,785	- 1056,284	- 1269,667

Stars signify a significant of parameters of the following levels: * 1%, ** 5%, *** 10%.

Source: CHER database: Poland (1997–2000); own calculations.

The results of the estimations of Models Ia and IIa, taking into consideration unobserved heterogeneity of the studied individuals are included in Table 8. These differ from the results obtained on the basis of Models I and II. In some cases, an absolute value of coefficients is greater, which strengthens the impact of regressors on a chance of exit from poverty. Models Ia and IIa are also characterized by a greater value of the logarithm likelihood.

4.2. Who returns to poverty?

The results of the estimated models of the chances of the families to return to poverty are included in Table 9. It is important to notice that estimated coefficients are characterized by a greater variability than in the case of exit rates. Model I shows a positive interdependence between duration in wealth after exit from poverty and re-entry to it, which weakens with an increase in years spent in wealth. However, on the basis of the model including heterogeneity of the studied individuals, one can discern that even after two years spent in wealth there is a negative relationship between wealth and re-entering poverty. Therefore, the longer a person stays unaffected by poverty, the lower the chance of re-entering it. Moreover, the probability of returning to poverty decreases if: families live in the city, the head of a family is a man (an interesting fact is that this variable, in Model I for estimating the rate of exit from poverty, was insignificant) and when the education level of the head of a family increases.

Model II also includes variables describing a geographical region where the household is situated. The results of estimations do not show significant differences between voivodships (in each case there was a negative relation). Households in voivodships of Western Poland are, however, in a better situation in comparison to households in voivodships of the Eastern Poland as well as Warmia and Mazury.

Table 9. Analysis of poverty duration in Poland – return to poverty

Independent variables	Without unobserved heterogeneity		With unobserved heterogeneity	
	Model I	Model II	Model Ia	
	Parametr [standard error]			
Duration of wealth:				
– two years	0,456**	[0,192]	-	- 0,131 [0,540]
– one year	1,461*	[0,187]	-	1,625* [0,219]
Variables pertaining to the head of the family				
Gender (male)	- 0,496*	[0,146]	- 0,687* [0,140]	- 0,553** [0,278]
Age_2/100	-0,041*	[0,005]	- 0,035* [0,006]	- 0,042* [0,007]
Professional status: unemployed	1,191*	[0,411]	1,297* [0,364]	0,803*** [0,463]
Education:				
– vocational or secondary	-0,672*	[0,145]	- 0,545* [0,154]	- 0,776** [0,333]
– higher	-1,719**	[0,717]	- 2,002* [0,720]	- 1,527** [0,725]
Variables pertaining to the household				
Budget deficit of the family	1,101*	[0,089]	-	1,118* [0,098]
Region:				
– South	-		- 0,593* [0,201]	-
– Eastern	-		- 0,770* [0,221]	-
– Centre	-		- 0,552* [0,166]	-
Place of living: countryside				
	- 0,287**	[0,146]	-	- 0,343** [0,155]
t				
	-		- 0,545** [0,255]	
$\hat{r}^2$				
	-		0,286* [0,072]	
Number of families	1430			
Logarithm likelihood	- 487,939		- 552,704	- 412,127

Stars signify a significant of parameters of the following levels: * 1%, ** 5%, *** 10%.

Source: CHER database: Poland (1997–2000); own calculations.

Conclusions

Poverty has always been one of the most important problems of the contemporary Poland. The research based on panel data representative of the whole country has shown a low income dynamic of families living in Poland between 1997–2000. The total number of years spent in poverty and various sequences of entry to and exit from poverty have indicated the permanence of this phenomenon in the population.

As follows from the conducted analysis, a small number of families (less than 1,5% of the population at a poverty margin of 50% of median income and less than 9% at a poverty margin equal to 75%) was impoverished for the entire period of the study, yet a much higher percentage of the entire population experienced

poverty at least once (17% at the poverty margin of 50% of median income and 40% at the poverty margin equal to 75%). A relatively wide array of households live on low income. However, it is not a fixed group. Even though there are some individuals who are permanently impoverished poverty transitions occur. Approximately 65% of the studied families at a poverty margin of 50% (52% at the poverty margin equal to 75%) come out of poverty after the first year of being impoverished. Nevertheless, only 25% at a poverty margin of 50% (20% at the poverty margin of 75%) become poor once again. After two years of living in poverty, 40% of families exit it, but 18% at a poverty margin equal to 50% (20% at a poverty margin equal to 75%) re-enter a group of impoverished families. Because of a short time period of the sample the study could not have incorporated a wider analysis of this type. One can assume, however, that the longer the family lives in poverty, the more difficult it is for them to change their situation, and even if their income increases above the poverty margin, the probability of these households becoming poor once again is still quite high.

Another important issue to analyze is the distribution of the number of years spent in poverty, considering exits and re-entries of families to this situation. Taking into account the sequences of episodes of being impoverished and wealthy, where the families found themselves in particular years, one can forecast that as much as 50% of the studied families at a poverty margin equal to 50% (65% at a poverty margin equal 75%) will spent at least 2 following years in poverty. However, when including only one-spell episodes of becoming impoverished, these prognoses come to a level of ca.35% of the studied families at a poverty margin equal to 50% (48% at a poverty margin equal to 75%). The actual values amount to 48% at a poverty margin of 50% (60% at a poverty margin equal to 75%) therefore, including the sequences of the episodes improves the results. The observed results also show that the length of time of poverty may depend on a type of the definition of exit from and re-entry to poverty rates that is accepted. The analysis using the parametric method illustrates that there are groups of population more vulnerable to dropping below the poverty margin with higher probability of remaining impoverished over a longer period of time. These are households composed of a larger number of not only children but also adults, where the head of a family is an older person (mainly a woman) with a low education level. The life in voivodships with a high rate of unemployment is a factor increasing poverty, and especially endangered are households where the head of a family is unemployed.

Okrasa (1999) used four-year panel data (1993–1999) from Poland's Household Budget Survey to explore the distinction between transitory and long-term poverty and examine poverty mobility. The section of population that could minimize or avoid chronic poverty in Poland included those living in urban areas, headed by older and better educated, with few children and unemployed members and possessing financial or physical assets. Households with a larger kinship network faced significantly less danger of falling into chronic poverty or vulnerability.

The results of the estimation of models including unobserved heterogeneity of studied individuals confirm a negative interdependence between the exit from poverty rate and its duration. For parents staying a relatively long periods of time in poverty it is much more difficult to exit it on their own. Though, the longer the household that exited poverty remains outside that situation, the lower the chance that they will return (a negative relation exists after two years of being above the poverty margin).

The above conclusions may be useful for preparing plans to deal with long-term poverty in Poland. They will allow for a better understanding of the poverty phenomenon in Poland and factors that cause it. The results obtained might be helpful for an effective policy formulation: adding to an income of employed household members, early identification of families often entering the sphere of poverty and permanently impoverished, modeling of conditions on the labor market so as to lower the incidence of poverty in Poland.

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