Patterns of credit ownership in Poland – A multi-group latent class approach

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1.   Introduction

Although there are country-specific differences, the scale of households' participation in the financial market in the EU27 countries amounts to an average of 60% of the total GDP (Pyykko 2011). From this perspective, Polish credit market for households is still at an early stage of development. Polish households incurred 526 billion zloty of debt (ca. 125 billion euro) at the end of March 2012, which amounted to 34% of Polish GDP. It is not only lower than the EU average, but also lower than the average for the New Member States (equal to 42%). The gap between Poland and other EU member states with respect to the households' credit ownership differs between the areas of credit for current consumption and mortgages. The penetration rate of credit for consumption purposes amounts to ca. 9% of Polish GDP being close to the average for New Member States and slightly above the average for all other Member States. Mortgages in relation to GDP account for 21%, which is however still much below the average both for the New and the Old MS. However, contrary to Old Member States, changes in the value of debt of Polish households were considerable with almost twofold increase in the penetration rates of the consumer credit and over fivefold increase in the penetration rate of mortgages (2003 – 2011).

The rapid changes were a consequence on the one hand of the credit market transition processes associated with the changes in the attitudes of Polish citizens and changes in the product offer but on the other hand changes in incomes and other socio-economic characteristics of Polish households. The arguments provided by Paas et al. (2006) indicate that acquisition of financial products is strictly connected to the socio-economic characteristics like age and income level, as these factors direct the needs of households into different groups of products. Nevertheless, accessibility of financial products plays also a vital role over time, especially when it changes, as a consequence of the evolution of the supply side of the credit market. The changes on the supply-side might be even more vital in the case of markets in transition like Poland, where a large group of households "misses" their life-cycle needs associated with credit products as the accessibility of products is limited due to a low-level of credit market development at the certain point of their life-cycle stage.

A distinction between factors associated with the transition process of the Polish credit market (including those connected with supply-side changes during the crisis[2]) and the socio-economic determinants of households' credit demand comprises the main objective of the paper. The starting point of the analysis is the period specific segmentation of households with respect to their credit ownership patterns. Establishing the number of segments enables tracking the determinants of their evolution including the socio-economic characteristics of households.

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[2]   The change observed in the period 2009 – 2011, when most of the effects of the financial crisis started to be visible in the households sector, was driven by two factors: (1) change in households' attitudes with respect to credit products, but also (2) a significant change in the policy of banks and financial intermediaries with respect to their core activity (see Białowolski et al. 2009). It was observed in the increase of strictness in providing credit and also by financial regulation introduced by the Polish Financial Supervision Authority.

Usually, the analyses of credit market are oriented on evaluation of the supply-side, while little attention is given to the households' characteristics potentially driving the change from the micro-perspective. Nevertheless, factors determining micro-level behavior might be also considered highly relevant to the market (Bijmolt et al. 2004). Moreover, a note provided by Bijmolt et al. (2004) suggests that "product ownership represents highly relevant information to support decisions regarding product development, product introduction, cross-selling and segmentation" (p. 324).

The paper is organized as follows. In section 2, Social Diagnosis Survey is presented and basic statistics concerning ownership of credit products are presented with emphasis on their evolution in time. In section 3 multi-group latent class models are described. Section 4 provides details on the results of estimation of multi-group latent class models, which are a tool for segmentation of Polish credit market for households. In this part it is evaluated whether the change in the structure of segments of households having occurred on the credit market should be considered significant. The remainder of the section is devoted to selection of determinants of household's participation in the credit market and segment latent membership. It is checked whether there is an influence of age of head of household, household's income or place of household's location on membership in latent classes.

2. Changes in patterns of credit ownership among Polish households in 2003 – 2011

The most visible changes in the Polish credit market for households are associated with growth in the penetration rates of credit in all areas – consumer, housing and other. The rapid growth in Poland was observed in line with apparent stabilization in other European countries (Figure 1).

Figure 1

Relation to GDP of housing, consumer and other credit for households in Poland and Old Member States (excluding Portugal, Italy, Greece and Spain).
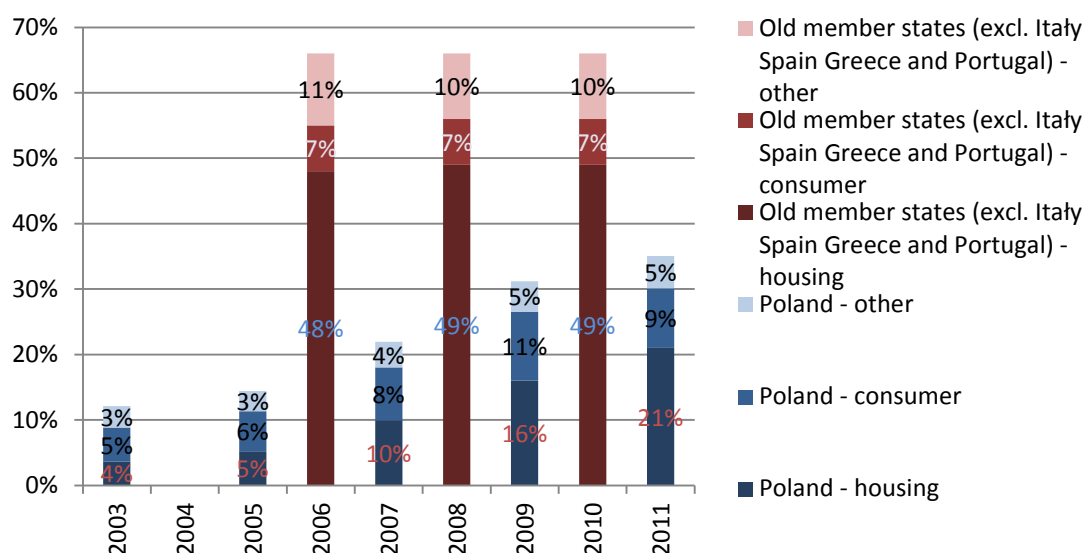
Source: National Bank of Poland, Polish Central Statistical Office, Pyykko (2011).

The source of these changes is subject to examination in this paper. Social Diagnosis study serves as the source of data for analysis (Social Diagnosis 2011). It covers the state of households' credit portfolios for the period 2003 – 2011 and is a panel-type study in which the panel attrition is accounted for by inclusion of new households from a representative

sample. The Social Diagnosis Survey was also evolving during the past decade which resulted in increase of the sample size (Table 1).

Table 1

Number of households participating in the Social Diagnosis Survey by wave

	20003	2005	2007	2009	2011
No. of households	3961	3851	5532	12381	12386

Source: Social Diagnosis 2011.

The development of the Polish credit market for households was not linear from the perspective of the total credit value. The surveys conducted in 2003, 2005 and 2007 covered the period of its rapid growth. The study conducted in March 2009 evaluated the situation on the Polish households credit market shortly after the outburst of the financial crisis. Due to inertia in the patterns of credit possession, at that time changes in households' credit portfolios were probably very limited. The restrictions introduced by Polish financial institutions and Polish Supervisory Authority were either in the preparation stage or present at most for a very short period of time. The study performed in 2011 allowed to evaluate the consequences of the financial crisis on households' credit portfolios.

In the Social Diagnosis Survey credit decisions of households are depicted with respect to dimensions of credit source, objectives for taking credit and the value of credit. The evolution of the share of households with respect to different loan/credit sources is presented in Table 2.

Table 2

The percentage of households with respect to the source of a loan/credit (among borrowers) in the years 2003 - 2011

Source of a loan/credit	2003	2005	2007	2009	2011	P-value for the difference 2011 – 2003
banks	78,4	80,8*	87,9***	90,6***	90,9	0.000
other financial institution	29,7	23,9***	18,1***	12,4***	11,9	0.000
family/friends	10,8	11,8	5,7***	4,3***	5,1*	0.000
average total no. of sources	**1,19**	**1,16**	**1,12**	**1,07**	**1,08**	

Difference with respect to the previous survey: *** significant at 0.01 level; ** significant at 0.05 level; * significant at 0.1 level.
Source: Own calculations based on the Social Diagnosis Survey.

In the last decade Polish credit market became much more institutionalized with a rapid increase in the share of households indebted in the banking sector and significant decrease in the role of other financial institutions and/or private persons. In year 2003 most of indebted households owned a loan/credit granted by a bank (78.4%) but credit from other financial institutions (mostly financial intermediaries) was also very wide spread – 29.7% of all indebted households. In the following years the growth of banks was mainly at the expense of other sources of borrowing. Major changes occurred between 2005 and 2009, when the accessibility of credit from the banking sector increased. It translated into a growth from 80.8% to 90.6% of the share of households indebted in banks. There was a parallel considerable reduction in the share of households with a loan from other financial institution. In 2009 the share of such households declined to only 12.4% of all indebted households. The role of private persons was also significantly reduced in that time. In the period of the most rapid opening of the banking sector (2005 – 2007) the share of households with a loan from private persons slumped from 11.8% to merely 5.7%.

An additional consequence of rapid institutionalization of the credit market for households in Poland was a reduction in the scale of borrowing from diversified sources.[3] In 2003 the average indebted household obtained its debts from 1.19 sources on average. This average had been decreasing till 2009 and then stabilized in 2011. Currently average indebted household uses 1.08 sources of credit, which indicates that mostly households do not mix loans obtained from the banking sector, financial intermediaries and private persons.

The situation with respect to the objectives of taking credit was also subject to considerable changes during the last decade (Table 3).

Table 3

The percentage of households with respect to the objectives of taking a loan/credit (among borrowers) in the years 2003 - 2011

Objectives of a loan/credit	2003	2005	2007	2009	2011	P-value for the difference 2011 – 2003
current consumption expenditures (e.g. food, clothing)	22.7	23.1	17.5***	17.7	17.5	0.000
fixed charges (e.g. house maintenance)	15.3	14.4	12.1**	8.7***	8.0	0.000
purchase of durable goods	38.6	39.9	37.0*	38.5	37.0	0.255
purchase of a house/flat	13.7	11.1**	14.6***	16.6**	18.0*	0.000
renovation of a house/flat	33.9	33.2	36.0*	34.9	31.2***	0.051
medical treatment	10.8	10.9	9.7	8.4*	6.4***	0.000
purchase/rent of working equipment	3.3	3.1	3.3	3.4	2.5***	0.095
vacations	4.2	3.2	3.2	3.2	2.5**	0.000
purchase of stocks	0.4	0.0**	0.3**	0.2	0.1	0.049
repayment of previous debts	10.2	10.7	11.5	7.5***	7.9	0.005
development of own business	8.3	7.0	6.5	6.0	5.6	0.000
education/training	8.8	9.6	6.5***	4.7***	3.4***	0.000
other purposes	14.0	13.9	12.0*	12.9	10.5***	0.000
average total no. of objectives	**1.84**	**1.80**	**1.70**	**1.63**	**1.51**	

Difference with respect to the previous survey: *** significant at 0.01 level; ** significant at 0.05 level; * significant at 0.1 level.

Source: Own calculations based on the Social Diagnosis Survey.

Polish households became more goal-oriented in their behavior on the credit market. In 2003 the average household with credit was financing on average 1.84 objectives. In the subsequent surveys this number declined reaching finally 1.51 in 2011. This change is probably a consequence of increasing affluence of Polish households which reduces the role of credit as a source of money for current needs. Share of respondents indicating the following goals: current consumption expenditures, fixed charges, had decreased very significantly between 2003 and 2011. Better affluence was also reflected in a decline in the share of households that need to finance repayment of their previous debts with a new credit/loan. Share of these households dropped the most between 2007 and 2009, when the growth of per capita income amounted to 20% in real terms. The improvement in the financial situation of Polish households was also visible in lower number of households that applied for credit in order to finance their vacations and/or medical treatment.

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[3] It does not imply that the number of credit agreements per indebted household decreased. It only shows that there was no longer a need to search for a loan from different sources.

The areas in which stabilization of the share of households was observed comprise credit associated with the purchase of durables and credit/loan to finance renovation of an apartment. These two goals are the most widespread motives for taking a credit. Only in the area of house/flat purchase credit had become increasingly popular throughout the period of analysis – especially between 2005 and 2009. The share of households financing this expenditure rose from 13.7% in 2003 to 18.0% in 2011.

Although there were changes in the objectives and sources of taking credit in the past years, the most visible were the changes in the value of debt with respect to average monthly incomes.

Table 4

**The percentage of households with respect to the value of a loan/credit
(among borrowers) in the years 2003 - 2011**

Value of a loan/credit (relative to household's monthly incomes)	2003	2005	2007	2009	2011
up to monthly incomes	23.6	24.4	23.8	24.3	22.1
above monthly incomes - up to quarterly incomes	32.6	31.1	28.7	24.0	22.6
above quarterly incomes – up to semi-annual incomes	20.4	18.7	19.4	18.4	16.7
above semi-annual incomes – up to annual incomes	12.7	14.1	12.5	14.3	14.8
above annual incomes	10.7	11.7	15.7	18.9	23.8
P-value of the chi-square test for differences in consecutive waves	---	0.482	0.009	0.000	0.000

Difference with respect to the previous survey: *** significant at 0.01 level; ** significant at 0.05 level; * significant at 0.1 level.

Source: Own calculations based on the Social Diagnosis Survey.

Only between 2003 and 2005 there was observed insignificant difference in the value of debt among households with credit/loan. In the following years there was an abrupt increase in the value of debt, which is especially visible in the share of households with debt exceeding their average annual incomes. In 2003 they accounted for merely 10.7% of all indebted households, while in 2011 the percentage reached 23.8%. There was a very little change in the share of households possessing debt of a value not exceeding monthly incomes, which might suggest that low value loans preserved their position on the market. On the other hand, there was a decline in the share of medium-value loans. Share of households indebted at the level ranging from their monthly to their semi-annually incomes declined from 53.0% in 2003 to 39.3% in 2011.

3. Multi-group latent class model in accounting for credit product ownership patterns

Latent-class models can be applied as a segmentation technique in order to define the optimal number of homogeneous segments on the market. In this application, it is assumed that the correlations between indicators (questions) are explained only by the latent class membership, which is a latent explanatory variable for the answering pattern. Thus, it is assumed that within the latent class, answers to different indicators (questions) are independent of each other.

The main advantages of latent-class based clustering over other clustering methods were summarized by Vermunt and Magidson (2002):

1. It is a modeling based approach, which provides results that can be subject to formal (or semi-formal[4]) testing. It is assumed that data are generated by a mixture of probability distributions;

2. Restrictions on parameters can be made and tested in order to obtain more parsimonious model;

3. No scaling decisions are necessary and the scaling of variables does not affect the result.

A characteristic feature of the latent class analysis is that the latent variable is also discrete. Classes are designed to identify groups of individuals that possess a certain pattern of behavior and to test whether this pattern can be explained by the class membership.

Multi-group latent class modeling is an extension of latent class modeling. It was originally developed for the analysis of latent structures of categorical latent variables across different number of groups (Kankaras et al. 2011). It serves as a useful tool for segmentation, which additionally, through a series of constraints, enables testing of the homogeneity of segments' pattern among groups. In this paper different groups correspond to different time points of analysis, which enables testing equivalence of the meaning of segments in time.

Multi-group latent class model can be defined with N manifest variables A_1 A_2 .... A_N (answers to questions) each having M_i $(m_1=1..M_1;$ $m_2=1..M_2;$ $...;m_N=1..M_N)$ answer categories, one latent variable X with $k=1,...,K$ classes and one grouping variable T with $t=1,...,L$ groups. In this setting, it is possible to define L cross-tables each with N-dimensions that represent interrelations between manifest variables in each group (in our case at each time-point). Including latent variable X leads to the following form of the model:

$$\pi_{m_1 m_2 ... m_N kt}^{A_1 A_2 ... A_N X|T} = \pi_{kt}^{X|T} \pi_{m_1 kt}^{A_1|XT} \pi_{m_2 kt}^{A_2|XT} ... \pi_{m_N kt}^{A_N|XT}$$

(1), where

$\pi_{m_1 m_2 ... m_N kt}^{A_1 A_2 ... A_N X|T}$ defines conditional probability that respondent with the set of answers $(m_1, m_2, ..., m_N)$ given in period t belongs to the latent class k, while $\pi_{kt}^{X|T}$ defines conditional probability of belonging to class k given period t, and $\pi_{m_i kt}^{A_i|XT}$ defines probability of providing answer m_i to item A_i given class membership (k) and given the period of analysis (t). Latent class models in such specification are based on an assumption of local independence, which implies that answers to manifest questions ($A_1, A_2, ..., A_N$) are independent of each other, given the latent class k.

In this paper conditional probabilities $\pi_{m_i kt}^{A_i|XT}$ in a latent class model are specified with l logistic type parameterization. In such a case, probability of providing a given answer can be defined as follows:

$$\pi_{m_i kt}^{A_i|XT} = \frac{e^{thresh_{m_i,k,t}}}{1+e^{thresh_{m_i,k,t}}} - \frac{e^{thresh_{m_i-1,k,t}}}{1+e^{thresh_{m_i-1,k,t}}}$$

(2), where

for each question there are $M_i-1*K*L$ estimated thresholds with constraints $\forall_{k \in K \wedge t \in L} thresh_{0,k,t} = -\infty$ and $\forall_{k \in K \wedge t \in L} thresh_{M_i,k,t} = +\infty$. Latent class membership depends also on the unconditional class

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membership ($\pi_{kt}^{X|T}$), which is estimated with the multinomial logistic regression of the form

$$\pi_{kt}^{X|T} = \frac{e^{thresh_{k,t}}}{1 + \sum_{i=1}^{K-1} e^{thresh_{i,t}}} \,. \tag{3}$$

Measurement invariance, associated with homogeneity of the segmentation pattern between groups, can be defined at two levels. The most basic multi-group latent class model with measurement invariance assumes equality of thresholds for the probabilities of question answers, which can be formally stated as: $\forall_{i \in N; m_i \in M_i; k_1, k_2 \in K; t_1, t_2 \in L} thresh_{m_i, k_1, t_1} = thresh_{m_i, k_2, t_2}$. This level of measurement invariance is sufficient to ensure structural equivalence of the model (McCutcheon 2002), which takes the form:

$$\pi_{m_1 m_2 \ldots m_N kt}^{A_1 A_2 \ldots A_N X|T} = \pi_{kt}^{X|T} \pi_{m_1 k}^{A_1|X} \pi_{m_2 k}^{A_2|X} \ldots \pi_{m_N k}^{A_N|X} \tag{4}$$

In this specification indicator variables – question answers – are not directly dependent on the grouping variable (time). The understanding of latent classes (segments), as expressed by its indicators (questions), is invariant of the grouping variable. At this level of measurement invariance, change in the probability of answering to given question depends only on the latent class membership, which however can be different between time points. Such model can be described as partially homogeneous (Kankaras et al. 2011).

Higher level of measurement invariance is obtained in a completely homogenous model. It requires that the probabilities of class membership are constrained to be equal between groups. At this level formal definition of measurement invariance requires also: $\forall_{k \in K; t_1, t_2 \in L} thresh_{k,t_1} = thresh_{k,t_2}$. The model can be formally presented as follows:

$$\pi_{m_1 m_2 \ldots m_N kt}^{A_1 A_2 \ldots A_N X|T} = \pi_{m_1 m_2 \ldots m_N k}^{A_1 A_2 \ldots A_N X} = \pi_k^X \pi_{m_1 k}^{A_1|X} \pi_{m_2 k}^{A_2|X} \ldots \pi_{m_N k}^{A_N|X} \tag{5,}$$

which implies that the probability of a given answer set does not depend on the grouping variable (time). In applied research this level of measurement invariance is less interesting as, if established, does not allow to account for differences in group shares between periods of analysis. However, if established for some groups only, might provide interesting insights concerning the characteristics of groups.

The multi-group latent class analysis can be extended by including descriptive variables that serve as predictors of latent class membership and are included in an equation for

$$\pi_{kt}^{X|T} = \frac{e^{thresh_{k,t} + \sum_{j=1}^{J} \alpha_{j,k} \cdot x_j}}{1 + \sum_{i=1}^{K-1} e^{thresh_{i,t} + \sum_{j=1}^{J} \alpha_{j,k} \cdot x_j}} \tag{6,}$$ where $\{x_1, \ldots, x_J\}$ is a set of explanatory variables while $\alpha_{j,k}$

represent estimated parameters which are set equal to zero for a selected, reference class.

In the multi-group approach the comparison between models and the selection of the proper one can be either completely formal, based on the absolute fit defined by tests of likelihood-ratio chi-square (L^2) and Pearson's chi-square (χ^2) or based on the information criteria. With respect to the L^2 and χ^2 tests of absolute model fit, there is a controversy concerning their ability to deal with sparse tables, which are very common in latent class models. These tests reject models too often, while the possible flaws might be associated with lack of the chi-square distribution of the p-value due to low number of individuals in a given cell of a sparse table (Kankaras et al. 2011). Additionally, with large number of observations absolute fit tests tend to be too rigorous and reject plausible models. A commonly adopted approach is thus to conduct a model comparison with information criteria (AIC, BIC, CAIC), which enables comparisons of different kinds of models leading to the selection of the best one.

In this paper, in order to check for the measurement invariance an approach based on the BIC is adopted and the following procedure is applied: (1) the optimal number of groups is established in model for each period separately; (2) the partially homogeneous model is tested for specification with number of latent classes the same as in the heterogeneous model (period-specific) but also for specifications with equal number of classes in all periods – ranging from minimum to maximum number of latent classes obtained for a single period model; (3) for completely homogeneous specification models with number of classes ranging from minimum to maximum are tested,[5] (4) the preliminary solution is selected based on the information criteria, (5) the solution is subject to testing for different constraints associated with time evolution of latent classes.[6] With such an approach it is checked whether heterogeneous, partially homogeneous or completely homogeneous models should be adopted to explain the evolution of the structure of Polish credit market.

For the analysis of factors influencing the latent class membership the adopted procedure comprised: (1) inclusion of all possible explanatory variables in the model (age of household's head, income level, labor market status, number of people in the household, type of community) (2) indicators with largest p-value are eliminated until only indicators with p-value lower than 0.05 are left.

4.   Results

In order to detect the number of homogeneous segments in all time points, latent class models were initially estimated separately for years 2003, 2005, 2007, 2009 and 2011. During the estimation process (see Appendix 1) it was established that in 2003 and 2005 the best fitting models are those with 7 classes, in 2007 the best-fitting model is the 8 class one and in 2009 and 2011 the best fitting models are those with 10 classes. Following the procedure for the assessment of measurement invariance presented in section 3, three types of models were estimated. At first model with unconstrained class probabilities and unconstrained conditional response probabilities (in a logistic specification – threshold structure) was estimated. In the second step a model with constrained conditional response probabilities was estimated, however the possibility of varying class probabilities between time points was left. In this specification, it was allowed to compare the probabilities of class membership in different groups (time points) as the meaning of latent classes was preserved in all periods of the analysis. Finally, a model with not only constrained thresholds, but also with constrained class probabilities was estimated. In such a specification, it was possible to compare the meaning of classes and to state that the response pattern did not depend on the group membership (time point). In this specification it was however required to set equal number of latent classes for all periods of analysis. The values of BIC for the three specifications of the model are presented in Table 5.

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[5]   In this specification model with period-specific number of classes cannot be obtained as latent class probabilities are constrained to be equal.

[6]   The constraints are associated with pattern of time evolution of class membership probabilities. It is checked whether models with sequential elimination of time-specific parameters are better than models with assumed linear trend in evolution of period specific parameters.

Table 5

BIC for heterogeneous, partially homogeneous and completely homogeneous models

BIC	heterogeneous	partially homogeneous	completely homogeneous
different no. of classes	352815.833	346527.263	---
10 classes	---	344405.594	344592.348
9 classes	---	345485.717	345719.600
8 classes	---	346610.769	346885.934
7 classes	---	348659.039	349862.964
Source: Own calculations in Mplus.			

Based on the results the best fitting model is 10 class partially homogeneous one with varying probabilities of class membership between periods. Further estimations proved that some period-specific parameters in the 10-classes partially homogeneous solution are not significantly different from zero. Moreover, in some cases a trend in values of parameters associated with time was noticed, which implies that there was a similar difference between estimated thresholds for the consecutive periods in equation (2). As multi-group latent class models might be tested for the presence of period specific effects, two alternative sets of constraints were imposed in the partially homogeneous specification with 10 classes. In the first specification, it was checked whether the information criterion improves for a model with period-specific parameters constrained to zero for parameters with p-value above 0.05. Second specification was based on parameters obtained in 10-class partially homogeneous model but when a visible trend was observed, the parameters were constrained accordingly to the hypothesized pattern either to follow a linear trend, trend with a break in 2009 (associated with the outburst of the crisis) or to be equal for some periods. In the first specification an improvement in the model fit was observed (BIC = 344231.707). However, in the second specification the fit improved even more considerably and BIC amounted to 344147.389. This result advocates for adopting a partially homogeneous model with period specific thresholds allowed to follow a trend in some classes.

In the following step all explanatory variables were included in order to account for class membership. Afterwards, the number of variables was sequentially reduced in order to reduce these insignificantly different from zero. A model with reduced number of explanatory variables (BIC = 337123.134), where all of them were characterized by the p-value lower than 0.05, was adopted as the final solution. Item response probabilities in each latent class for the final model were presented in Table 6.

Table 6

Response probabilities in latent classes

		Results in probability scale									
		c.1	c.2	c.3	c.4	c.5	c.6	c.7	c.8	c.9	c.10
	credit ownership	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000
credit value (in the value of monthly incomes)	Zero	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
	< 1	0.199	0.055	0.099	0.240	0.379	0.337	0.304	0.048	0.397	0.000
	1 – 3	0.263	0.168	0.191	0.290	0.294	0.359	0.362	0.064	0.322	0.000
	3 – 6	0.229	0.230	0.232	0.201	0.160	0.166	0.196	0.087	0.155	0.000
	6 – 12	0.175	0.244	0.252	0.143	0.099	0.086	0.079	0.146	0.077	0.000
	above 12	0.134	0.303	0.226	0.126	0.067	0.053	0.059	0.655	0.049	0.000
credit source	Banks	1.000	0.968	0.996	1.000	1.000	1.000	0.180	1.000	0.162	0.000
	other financial institution	0.049	0.271	0.023	0.038	0.015	0.006	1.000	0.040	0.100	0.000
	family/friends	0.015	0.257	0.040	0.011	0.005	0.010	0.015	0.023	1.000	0.000
credit target	current consumption expenditures (e.g. food, clothing)	0.048	0.574	0.021	0.029	0.042	0.613	0.193	0.017	0.578	0.000
	fixed charges (e.g. house maintenance)	0.006	0.478	0.008	0.009	0.005	0.305	0.091	0.004	0.386	0.000
	purchase of durable goods	0.284	0.431	0.263	0.145	1.000	0.063	0.381	0.120	0.155	0.000
	purchase of a house/flat	0.020	0.087	0.043	0.004	0.005	0.021	0.096	1.000	0.045	0.000
	renovation of a house/flat	1.000	0.454	0.145	0.000	0.000	0.143	0.441	0.126	0.145	0.000
	medical treatment	0.040	0.341	0.014	0.029	0.021	0.217	0.083	0.002	0.179	0.000
	purchase/rent of working equipment	0.000	0.048	0.347	0.002	0.001	0.002	0.005	0.002	0.003	0.000
	Vacations	0.022	0.103	0.011	0.009	0.016	0.026	0.079	0.011	0.006	0.000
	repayment of previous debts	0.036	0.558	0.054	0.032	0.015	0.116	0.059	0.010	0.178	0.000
	development of own business	0.003	0.075	0.715	0.000	0.000	0.003	0.013	0.012	0.017	0.000
	education/training	0.026	0.239	0.042	0.027	0.012	0.095	0.081	0.010	0.034	0.000
	other purposes	0.060	0.259	0.068	1.000	0.000	0.052	0.139	0.023	0.099	0.000
No. of credit purposes		1.545	3.647	1.731	1.286	1.117	1.656	1.661	1.337	1.825	0.000

Source: Own calculations in MPlus based on data from The Social Diagnosis.

The final model comprises an implicit description of the latent classes of households in Poland on the credit market. There are nine distinct groups of households active on the credit market (classes 1 – 9) and a group of households not participating in the market. With respect to groups (classes) the following description can be provided:

Class 1 – Households with rather low value of debt, which was always acquired in a bank (rarely supported by a loan from other financial institution). The debt was always devoted to renovation of a house/flat (100%) and sometimes to purchase of durables (28.4%).

Class 2 – Households indebted for many purposes (average 3.647) and very often with high value of debt (54.7% with debt exceeding their semi-annual incomes). Their sources of credit are mainly banks (96.8%), but they also often search for credit in other financial institutions (27.1%) and among their friends and family (25.8%). In this group there is a very high probability of credit for current consumption (57.4%) and repayment of previous debts

(55.8%), with fixed charges, purchase of durables and renovation of a flat (each of the last three exceeding 40%). Due to very high value of debt and goals associated with current consumption (or repayment of debts) this group of households can be classified as overindebted.

Class 3 – Households with above average value of debt ; almost always in banks (99.6%) and extremely rarely elsewhere. Their objective of taking credit is to develop their business (71.5%) or, which is a very close counterpart, purchase working equipment (34.7%). However, these households are only slightly less active than average in acquiring very popular credit products – for purchase of durables (26.3%) and renovation of a flat (14.5%).

Class 4 – Households that have a debt of a below-average value. They acquire it always in banks (100%) and very rarely support it by a loan from other sources. They use it always to finance other purposes (100%) and rarely purchase of durables (14.5%).

Class 5 – Households with relatively small value of debt (67.3% with debt below their quarterly incomes). Similarly to households in latent class 4 they always acquire credits in banks (100%) and extremely rarely elsewhere. Debt is devoted almost solely to purchases of durables (100%).

Class 6 – Households with low value of debt (69.6% with debt below their quarterly incomes) acquired in the banking sector (100%) and extremely rarely elsewhere – similarly to households from the latent classes 4 and 5. Their debt is devoted to current consumption (61.3%) and, also current, fixed charges (30.5%). In this group there is a significant share of households taking credit for medical treatment (21.7%). They are also sometimes financing renovation of a flat (14.3%) and repayment of previous debts (11.6%). Due to the latter feature and mainly current consumption being the objective of taking credit in this group, these households can be perceived as being in a pre-overindebted state.

Class 7 – Households with low value of debt but always acquiring it in other financial institution (100%) and only sometimes in the banking sector (18.0%). They devote their loans to renovation of a flat (44.1%) and purchase of durables (38.1%). They also use credit/loan to finance other objectives including: current consumption (19.3%), fixed charges (9.1%), medical treatment (8.3%), education & training (8.1%) and vacations (7.9%).

Class 8 – Extremely highly indebted households (65.5% possess debt exceeding their yearly incomes). Their source of credit are banks (100%) and rarely some other institutions. The main objective (100%) is to finance purchase of house or flat. Rarely they finance also renovation of house or flat (12.6%) or a purchase of durables (12.0%).

Class 9 – The group of households that acquire loans from friends and family (100%) sometimes supporting it by a loan from bank (16.2%) or other institution (10.0%). The value of debt is the lowest among all the groups (71.9% with debt below their quarterly incomes). Similarly to households in class 6, they finance their current consumption (57.8%) and/or fixed charges (38.6%). In this group there is also an above average exposure to credit for medical treatment (17.9%) or previous debt repayment (17.8%). The most popular credit objectives (renovation of a flat and purchase of durables) are less likely to occur in this group (14.5% and 15.5% respectively). Similarly to the households in latent class 6, these can also be considered as pre-overindebted.

The segmentation of the Polish credit market from the perspective of households' behavior provides an insight into the key groups of households present on the market. With latent-class based segmentation one can additionally trace an evolution of the composition of the market in the past decade (Figure 2).

Figure 2

Households' activity on the credit market in Poland between 2003 and 2011

Percentage of households active on the credit market	Evolution of latent structure of the credit market in Poland
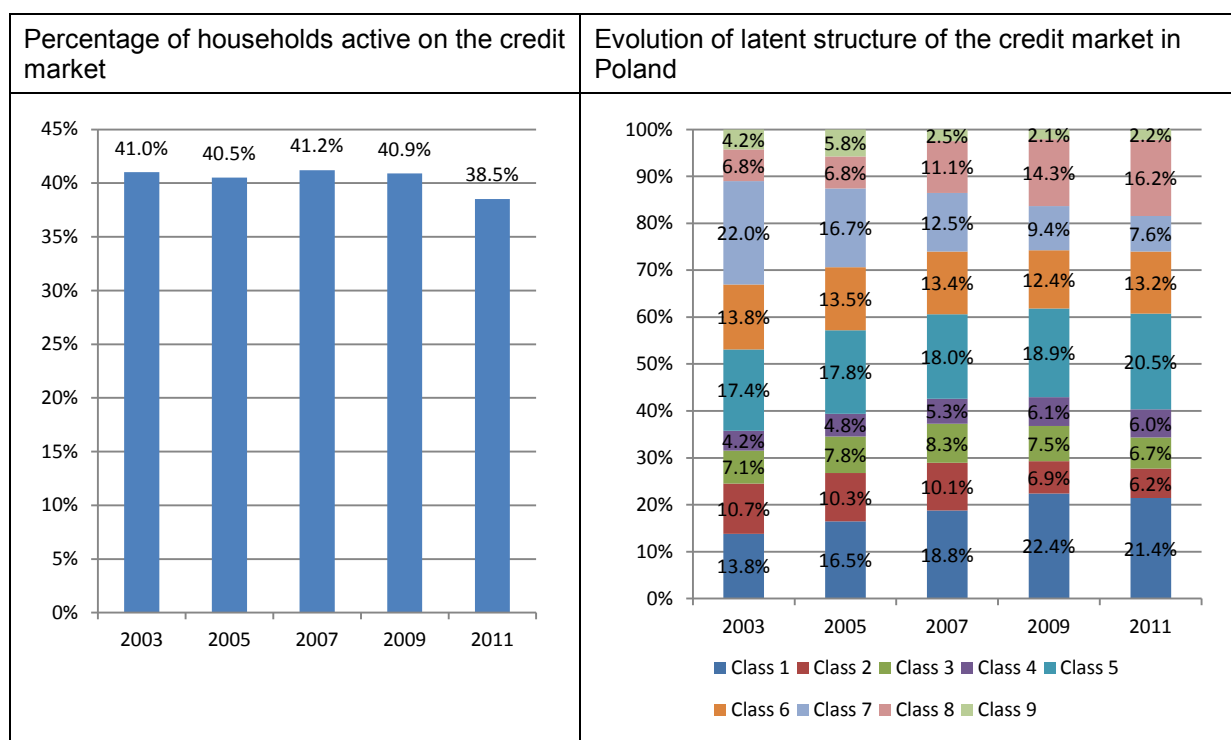
Source: Own calculations.

In Poland the share of households participating in the credit market had dropped between 2009 and 2011 – after the period of stability between 2003 and 2009. However, more fundamental changes were visible with respect to the evolution of the composition of the market. In 2003 class 7 was the most represented one. It indicates that a very important role played by other financial institutions at that time had diminished in the following years. The declining role of non-banking forms of borrowing was confirmed by gradual vanishing of the group of households that borrow from private persons (class 9). At the same time, the more goal-oriented approach to credit taking adopted by Polish households resulted in a decline in the share of households classified as overindebted (class 2).

An inverse situation was observed with respect to class 8, comprising households indebted for purchase of an apartment/house. Share of these households increased from merely 6.8% to 16.2% in the period of analysis. A significant upswing was also reported for class 1 (households with credit for renovation of their apartment), which in 2011 accounted for 21.4% credit market share and eight years earlier constituted only 13.8%.

In the multi-group latent class approach without covariates the total change in the market structure is attributed to the time evolution of the market, which however does not allow to account for the socio-economic factors influencing the participation in credit market. These factors usually comprise incomes and life-cycle stage of the household. In order to evaluate the influence of both transition of the credit market and socio-economic characteristics, the final model with final set of covariates is presented in Table 7.

Table 7

Parameter estimates for latent class model with covariates

		c.1	c.2	c.3	c.4	c.5	c.6	c.7	c.8	c.9	c.10
Time evolution	2003	-.242	.438	.414	-.223	.000^f	.000^f	1.221	-.303	.512	ref.
	2005	-.121	.438	.414	-.112	.000^f	.000^f	.916	-.303	.897	ref.
	2007	.000^f	.438	.414	.000^f	.000^f	.000^f	.611	.000^f	.000^f	ref.
	2009	.121	.146	.207	.112	.000^f	.000^f	.305	.000^f	.000^f	ref.
	2011	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
No. of people in household	1	-.900	-1.321	-1.507	-.405	-.902	.000^f	-.425	-1.095	.000^f	ref.
	2	-.368	-.363	-.564	.000^f	-.396	.000^f	-.227	-.530	.000^f	ref.
	3	.000^f	.000^f	-.310	.000^f	-.227	.000^f	.000^f	.000^f	.000^f	ref.
	4	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
	5 or more	.198	.000^f	.499	.000^f	.000^f	.338	.000^f	.000^f	.000^f	ref.
real income per equivalent unit	up to 500 PLN	-1.130	.564	-.463	.000^f	-.760	.277	-.201	-1.410	2.119	ref.
	above 500 PLN up to 1000 PLN	-.221	.447	-.262	.000^f	-.184	.277	-.201	-.535	.891	ref.
	above 1000 PLN up to 1500 PLN	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
	above 1500 PLN up to 2000 PLN	.000^f	-.450	.000^f	.000^f	.000^f	-.402	.000^f	.385	.000^f	ref.
	above 2000 PLN up to 3000 PLN	.000^f	-.559	.401	.000^f	.000^f	-.725	-.201	.937	.000^f	ref.
	above 3000 PLN	-.374	-.626	.849	.000^f	.000^f	-1.103	-.876	1.727	.000^f	ref.
labour market status	Employed	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
	Unemployed	-.502	.000^f	-1.746	-.873	.000^f	.000^f	-.966	-1.085	.000^f	ref.
	not active	.000^f	.000^f	-1.929	.000^f	.000^f	.000^f	-.812	-.353	.000^f	ref.
age of the household's head	up to 24 years	.000^f	.000^f	.000^f	-1.614	.000^f	.000^f	-1.081	.000^f	1.129	ref.
	25 – 34 years	.255	.000^f	.000^f	.000^f	.355	.000^f	-.396	1.593	.376	ref.
	35 – 44 years	.309	.000^f	.000^f	.000^f	.310	.000^f	.000^f	1.321	.000^f	ref.
	45 – 54 years	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
	55 – 64 years	.000^f	-.297	.000^f	.000^f	.000^f	.000^f	-.333	.000^f	-.376	ref.
	65 and more years	-.666	-1.527	-.618	-.788	-.484	-.526	-.770	-.932	-1.129	ref.
Place	cities with 100.000 inhabitants or more	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
	cities with 20.000 – 100.000 inhabitants	.000^f	-.441	.000^f	.000^f	.000^f	.000^f	.000^f	.000^f	.000^f	ref.
	towns up to 20.000 inhabitants	.208	-.787	.524	.000^f	-.151	.000^f	-.200	-.497	.000^f	ref.
	rural areas	.231	-.984	1.069	.000^f	-.268	-.615	-.499	-.709	-.426	ref.

Source: Own calculations in MPlus based on data from The Social Diagnosis. f –fixed parameters.

The results presented in Table 7 served as the prerequisite for calculating an expected evolution of the share of each of the credit market segment after accounting for the influence of the socio-economic characteristics of households (state what in Appendix 3 is). The most visible change was observed with respect to the class 7, which consists of households

indebted at other financial institutions. Households with the same socio-economic characteristics tended to move to banks (always perceived as more transparent and reliable) when the product offer was widened (richer/enriched). From the theoretical evolution of class 7 (see Appendix 3) it can be noticed that over 99% of change in the relative importance of the group on the credit market was due to the transition process of the credit market and less than 1% was due to the evolution of the socio-economic characteristics of households present in that group.

Till 2007 extremely large momentum of the market for mortgages (Figure 1) was mostly driven by the transition process of the Polish market associated with better accessibility of credit for housing purposes. From 2007, although there was an over twofold increase in the value of mortgages, it was mostly driven by growth of incomes and new waves of young adults (with their families) entering the market. In the case of this group (class 8), the relation between incomes and class membership is the strongest one. In terms of the odds for being in the latent class 8, households with incomes above 3000 PLN are 23 times more likely to be in that class than those with incomes below 500 PLN. In the case of households indebted for purchase of an apartment, also the influence of age is the strongest in all groups. For the whole period 2003 – 2011 almost 65% of the change in the share of households in the class 8 can be explained by the change in the socio-economic characteristics of households and only 35% resulted from the transition of the credit market in Poland.

In the case of class 5 and class 6 the transition component was not significant and fixed to zero in the estimation process. It implies that it was a change in relative importance of class 10 and change in the households' characteristics that were influencing acquisition of credit for durables and credit for current expenditures.[7] In the case of credit for durables, mainly households with low incomes suffered from reduced access to the market. It was also visible that households with head in the age 25 – 44 years turned to this source of credit the most often, while those with head aged over 65 used this kind of credit rarely. Additionally, households from rural areas and small towns used such a credit rarely, which was probably a consequence of reduced access to it there. In the case of households taking credit mainly for current expenditures (class 6), the level of incomes acted strongly against acquisition of such products, while the number of people in the household exceeding 5 was a stimulus for acquiring loan for current expenditures. Like in all other classes, also in class 6, households with head aged 65 or more used credit for current consumption much more rarely. Nevertheless, in the case of credit for durables and credit for current consumption the influence of the age (being 65+) was the lowest among groups. An interesting observation is that the credit for current consumption is much less often used in rural areas, which is probably caused by lower accessibility of banks there and also higher self-sustainability of households.

With respect to class 1 and class 4, the transition of the Polish credit market, associated with higher accessibility of credit for the purposes of durable goods purchases and financing of other purposes, was stopped in 2009. Afterwards, the conditions for granting a credit were significantly strengthened due to both the financial crisis and the regulations of the Polish Financial Supervisory Committee. Households started to reduce their demand for house/flat renovation but also tended to less likely finance their additional objectives accordingly. Renovation of a flat/house was the most often objective among households with middle incomes. Demand for this type of credit significantly dropped for households with average per capita income exceeding 3000 PLN. Nevertheless, in both of these groups the major role in the change of overall share of households was attributed to the transition process

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[7] It should be remembered that the transition component is set relatively to class 10 (reference class), which makes the expected share of households in class 5 and 6 dependent on the relative change in the share of respondents in class 10.

(69% and 88% respectively) and not to the change in the socio-economic characteristics of households.

One of the most specific segments of households on the credit market is the group oriented towards financing their entrepreneurial activity with credit (class 3). Evolution of accessibility of such credit was negative and for households with given characteristics better accessibility was observed in 2003 – 2007, while later it has gradually declined. On the other hand, membership in this group is very strongly related to incomes and (obviously) to the labour market status. Age of the household's head becomes an important factor influencing negatively this type of credit demand only for households with head above the age of 64. Contrary to other classes, only in this group of households rural location is the stimulus for credit demand. The odds for being a member of this group are almost three times higher in rural areas than in major cities. It is also important to notice (see Appendix 3) that in this group the transition of credit market acted in the direction of reduction of credit accessibility, which probably corresponds to harsher conditions for credit applicants. However, changes in the characteristics of households strongly pushed it upwards.

One of the most interesting groups comprises households that borrow a lot, finance a lot of goals and very often do not manage to cope with their obligations – the over-indebted ones (class 2). In the past years this group has been gradually vanishing, which was partially a consequence of the transition of Polish credit market – banks were less willing to provide credit products to the group of over-indebted (around 65% of the change is due to the transition process). On the other hand, gradually increasing income level, which strongly affected membership in the latent classes of over-indebted, stimulated even more rapid decrease in the share of such households in Poland. The problem of over-indebtedness is less visible in a group of households with head in an older age but also for households with only one or two members. The problem of over-indebtedness is to a large extent a problem of urban areas. In small towns the odds for being a member of the group are two times lower than in the group of inhabitants of large cities and in rural areas the odds for membership in the class are almost three times lower.

5.   Conclusions

This paper provides an analysis of Polish credit market from the perspective of credit product acquisition by households. In the scope of analysis, at least nine distinct approaches to credit product acquisition in Poland were identified. It was also shown that models in which the understanding of groups (in terms of the indicators) remains constant in all periods of analysis, are superior to the models in which the rules of segmentation of the market are allowed to change over time.

The most fundamental development of the paper is the delimitation between the changes observed on the Polish credit market for households that were the consequence of the transition process of the credit market and those that can be attributed to changes in the socio-economic characteristics of Polish households. It was observed that around 85% of all changes that occurred in the structure of Polish credit market for households between 2003 and 2011 were due to the factors associated with transition of the Polish credit market. Households started to use differently the products accessible on the credit market, which was also to a large extent driven by changes in the product offer accessible to them. The most striking example is the market for loans from other financial institutions. A very significant decline in the share of households with such a loan can be in 99% explained by the transition process of the credit market in Poland. On the other hand in the group of households taking mortgages the transition process is able to explain merely 35% of the huge gain in importance of the group. The transition process of the Polish credit market was

also able to only partially explain the changes in the share of over-indebted. With respect to the share of households with credit for development of their own businesses, the transition of the market acted in the opposite direction than attitudes associated with households characteristics.

Appendix 1:
Latent class model BIC's for the periods of analysis

No. of latent classes	BIC for unrestricted model				
	2003	2005	2007	2009	2011
2 classes	29349.776	28316.920	39128.532	81579.451	76549.666
3 classes	28760.524	27563.485	38152.615	79706.263	74588.002
4 classes	28191.615	27122.462	37599.420	78290.421	73199.089
5 classes	28120.525	27021.176	37111.750	77354.982	72343.302
6 classes	28109.434	26926.512	37010.231	76785.171	71686.767
7 classes	28107.718	26918.971	36938.402	76263.461	71205.349
8 classes	28132.096	26939.353	36855.417	75914.120	70948.634
9 classes	---	---	36872.248	75557.279	70692.260
10 classes	---	---	---	75331.111	70471.353
11 classes	---	---	---	75366.834	70474.126

Source: Own calculations in MPlus based on data from The Social Diagnosis.
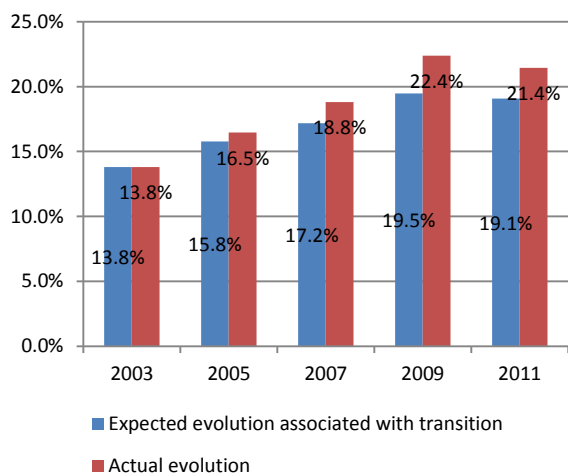
Różne czcionki w tabelce.

Appendix 2:
Latent classes – item answer probabilities
for a model without covariates

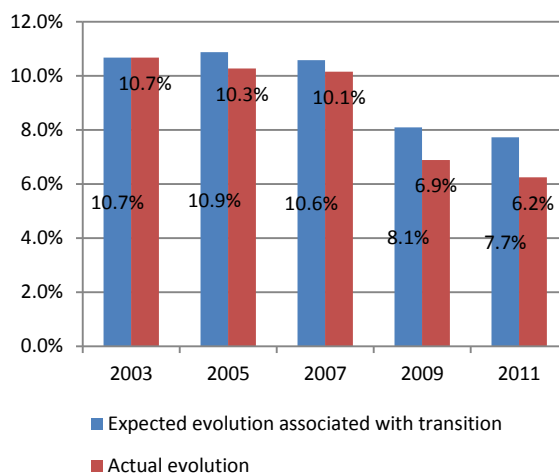|		Results in probability scale									
		c.1	c.2	c.3	c.4	c.5	c.6	c.7	c.8	c.9	c.10
	credit ownership	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000
credit value (in the value of monthly incomes)	Zero	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
	< 1	0.198	0.059	0.101	0.240	0.376	0.342	0.309	0.050	0.428	0.000
	1 – 3	0.266	0.183	0.184	0.290	0.294	0.359	0.364	0.069	0.308	0.000
	3 – 6	0.230	0.237	0.225	0.202	0.162	0.166	0.191	0.087	0.142	0.000
	6 – 12	0.174	0.242	0.253	0.143	0.101	0.080	0.077	0.147	0.070	0.000
	above 12	0.132	0.279	0.237	0.125	0.068	0.053	0.059	0.647	0.052	0.000
credit source	Banks	1.000	0.970	0.996	1.000	1.000	1.000	0.146	1.000	0.076	0.000
	other financial institution	0.056	0.265	0.025	0.042	0.018	0.010	1.000	0.042	0.102	0.000
	family/friends	0.015	0.257	0.043	0.012	0.006	0.019	0.015	0.023	1.000	0.000
credit target	current consumption expenditures (e.g. food, clothing)	0.056	0.572	0.016	0.041	0.046	0.625	0.193	0.019	0.555	0.000
	fixed charges (e.g. house maintenance)	0.008	0.477	0.009	0.012	0.008	0.306	0.092	0.007	0.370	0.000
	purchase of durable goods	0.283	0.431	0.248	0.146	1.000	0.039	0.374	0.116	0.151	0.000
	purchase of a house/flat	0.016	0.088	0.049	0.003	0.007	0.012	0.093	1.000	0.049	0.000
	renovation of a house/flat	1.000	0.458	0.141	0.000	0.000	0.107	0.438	0.131	0.140	0.000
	medical treatment	0.043	0.351	0.014	0.031	0.022	0.207	0.082	0.004	0.169	0.000
	purchase/rent of working equipment	0.004	0.047	0.329	0.004	0.006	0.007	0.005	0.002	0.003	0.000
	Vacations	0.022	0.103	0.012	0.007	0.016	0.026	0.078	0.010	0.006	0.000
	repayment of previous debts	0.036	0.540	0.050	0.032	0.015	0.119	0.061	0.010	0.158	0.000
	development of own business	0.000	0.070	0.772	0.002	0.000	0.003	0.013	0.009	0.019	0.000
	education/training	0.026	0.228	0.033	0.027	0.012	0.108	0.080	0.010	0.029	0.000
	other purposes	0.061	0.260	0.062	1.000	0.000	0.035	0.137	0.022	0.098	0.000
No. of credit purposes		1.555	3.625	1.735	1.305	1.132	1.594	1.646	1.340	1.747	0.000

Source: Own calculations in MPlus based on data from The Social Diagnosis.

Appendix 3:
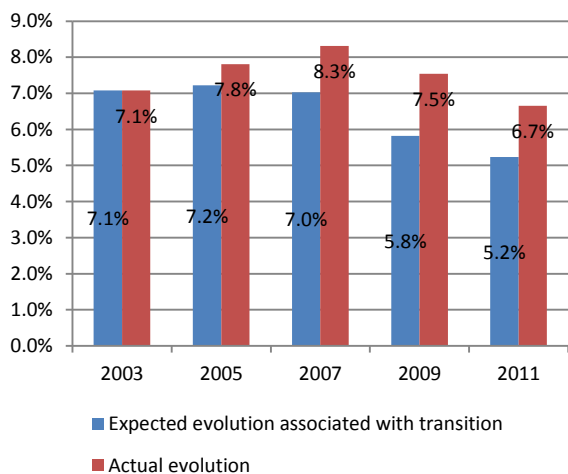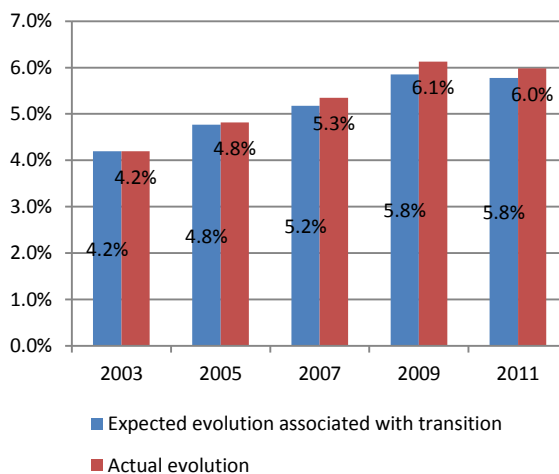# Decomposition of changes associated with transition of the Polish credit market for households
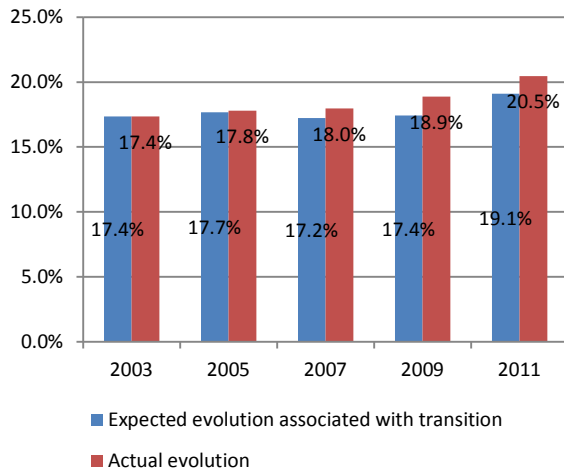
Class 1

	2003	2005	2007	2009	2011
Expected evolution associated with transition	13.8%	15.8%	17.2%	19.5%	19.1%
Actual evolution	13.8%	16.5%	18.8%	22.4%	21.4%

Class 2

	2003	2005	2007	2009	2011
Expected evolution associated with transition	10.7%	10.9%	10.6%	8.1%	7.7%
Actual evolution	10.7%	10.3%	10.1%	6.9%	6.2%

Class 3

	2003	2005	2007	2009	2011
Expected evolution associated with transition	7.1%	7.2%	7.0%	5.8%	5.2%
Actual evolution	7.1%	7.8%	8.3%	7.5%	6.7%

Class 4

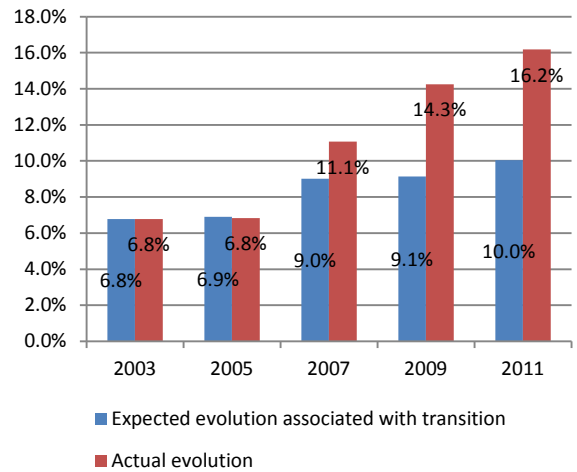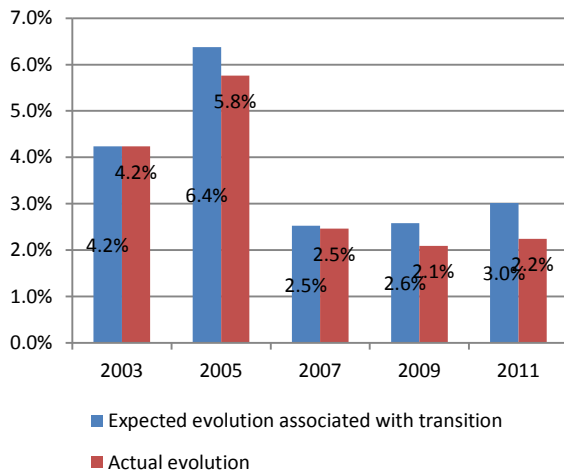|	2003	2005	2007	2009	2011
Expected evolution associated with transition	4.2%	4.8%	5.2%	5.8%	5.8%
Actual evolution	4.2%	4.8%	5.3%	6.1%	6.0%

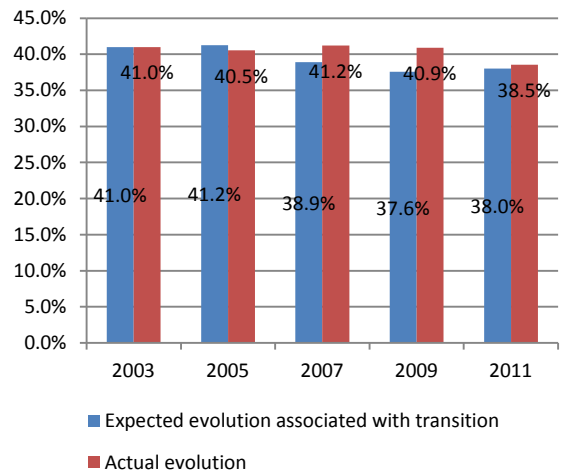## Class 5

Class 6

Class 7

Class 8

Class 9

Class 10 (inverse of class 10)

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