

The Influence of Business Cycle on the Forecast of Household Financial Situation

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Abstract

The paper presents the results of the analysis of relationships between the forecasts of household financial situation and quarterly growth of GDP. The research uses ordered dependent variable models (assuming three values: forecasted worsening, no changes, improvement) related to the GDP growth rate and selected control variables. In our calculations we used the quarterly results of economic sentiment surveys in Lubelskie Voivodship conducted from 2nd quarter of 2006 to 3rd quarter of 2012.

Introduction — economic sentiment surveys as a source of information about the financial situation of Lubelskie Voivodship households

The University of Management and Administration in Zamość has conducted quarterly economic sentiment surveys among Lubelskie Voivodship households since the 2nd quarter of 2001. The surveyed household members are asked, inter alia, about their assessment of their household financial situation in a particular quarter compared to the previous quarter and for their predictions for the next quarter of the year.

Respondents may choose from three answers: financial situation has improved (will improve), has not changed (will not change) or it has worsened (will worsen). We also gathered such characteristics of respondents as: number of household members, monthly income per person in respondent's household, as well as their education, age, job status, sex and residence. So far we have conducted 46 surveys and collected around 18 700 questionnaires.¹ The gathered data is then the basis for calculating quarterly household confidence indexes in Lubelskie Voivodship households as well as conducting specific analyses of the behavior demonstrated by household members.²

1 Methodology of research

A research hypothesis was formed stating that financial situation forecasts made by household members in Lubelskie Voivodship depend on changes in the GDP growth rate in Poland.³ In order to verify the above hypothesis, we adopted an approach consisting in the construction models of ordered dependent variable related to the GDP growth rate and selected control variables.

1. [In the journal (in both Polish and English texts) European practice of number notation is followed—for example, 36 333,33 (European style) = 36 333.33 (Canadian style) = 36,333.33 (US and British style). Furthermore in the International System of Units (SI units), fixed spaces rather than commas are used to mark off groups of three digits, both to the left and to the right of the decimal point.—Ed.]

2. More specific description of conducted surveys and results obtained so far can be found in (Kowerski 2013; Kowerski et al. 2012).

3. It would seem that a more appropriate indicator for describing changes in the assessment of financial situation in Lubelskie Voivodship households would be the GDP growth rate in this region, but such an indicator is not calculated quarterly on the regional level and, what is more important, earlier research based on annual data has proven that the economic sentiment index in Lubelskie Voivodship is more correlated to the Polish GDP growth rate than to the regional rate (Kowerski 2013).

The dependent variable is an orderly variable⁴ which is the answer provided to the following question: “How do you assess the financial situation of your household in the next quarter compared with the situation in current quarter?” with ordered values: 1—it will worsen, 2—it will remain unchanged, 3—it will improve.

It is assumed, that every respondent “creates” his own model of latent variable y_i^* :

$$(1) \quad y_i^* = \mathbf{X}_i^T \beta + \varepsilon_i,$$

where:

- y_i^* —value of latent dependent variable for an i -th respondent,
- \mathbf{X}_i^T —vector of values of independent variables for an i -th respondent,
- β —vector of structural parameters of the model,
- ε_i —random disturbance,

on the basis of which the assessment of household is made (Greene 2012, 787–794).

The value of the ordered dependent value y_i depends then on the value of the latent variable y_i^* , according to the rule⁵

$$(2) \quad y_i = \begin{cases} 1 & \text{for } y_i^* \leq \gamma_1 \\ 2 & \text{for } \gamma_1 < y_i^* \leq \gamma_2 \\ 3 & \text{for } \gamma_2 < y_i^* \end{cases} .$$

It does not matter that the ranks were chosen arbitrarily and may adopt different values in other models. The only requirement for ordered variables is to meet the following rule:

$$(3) \quad \text{if } y_i^* < y_j^* \text{ then } y_i < y_j .$$

A big advantage of this model is that the results may be interpreted as probabilities. The probability of each rank of the Y variable is as follows:

$$(4) \quad \begin{aligned} P(y_i = 1 | x_i, \beta, \gamma) &= F(\gamma_1 - x_i^T \beta) \\ P(y_i = 2 | x_i, \beta, \gamma) &= F(\gamma_2 - x_i^T \beta) - F(\gamma_1 - x_i^T \beta) , \\ P(y_i = 3 | x_i, \beta, \gamma) &= 1 - F(\gamma_2 - x_i^T \beta) \end{aligned}$$

where F is a distribution function of the random variable ε .

The γ values are the boundary points and are estimated together with the β parameters by means of the maximum likelihood method through maximizing the log likelihood. The maximization of the likelihood function may be done using a few methods. The eViews software offers Newton-Raphson and Goldfeld-Quandt (quadratic hill climbing) methods. In most cases it is assumed that the models of ordered dependent variable are logit or probit models.

We assume that the ordered dependent variable adopts a logit model, so the F function is a logistic distribution function, in which values may be calculated using the following formula:

$$(5) \quad F(y) = \frac{e^y}{1 + e^y} .$$

The conducted research brings time-pooled data. Therefore, in modeling the forecasts for household financial situation in $t + 1$ quarter we can use the concept of autoregressive micro-macro modeling, in which, apart from quarterly economic growth rate, other independent variables are autoregressive variable describing assessment of the household’s financial situation in t quarter compared to $t - 1$ quarter and control variables describing individual features of particular respondents (Kowerski and Bielak 2009):

4. Models of ordered dependent variables have been used to analyze discreet phenomena for nearly forty years (McKelvey and Zavoina 1975). A group of University of Management and Administration staff have been working on research applying micro-macro dependent variable models to analyze respondents’ answers given in economic sentiment surveys in Lubelskie Voivodship. The results of these surveys can be found in (Bielak and Kowerski 2008; Kowerski 2008; Kowerski and Bielak 2009).

5. See: EViews 5.1 User’s Guide to Quantitative Micro Software, LLC, Irvine CA, s. 639.

$$(6) \quad Y_{it+1} = \alpha_0 + \alpha_1 t + \alpha_2 Y_{it} + \alpha_3 X_t + \sum_{j=1}^k \beta_j Z_{itj} + \sum_{p=1}^r \lambda_p Q_p + \varepsilon_{it},$$

where:

Y_{it+1} —dependent variable assuming the value of 1 if i -th respondent replied that in $t + 1$ quarter compared to t quarter, his household financial situation will worsen, the value of 2 if i -th respondent replied that in $t + 1$ quarter compared to t quarter, his household financial situation will not change, and the value of 3 if i -th respondent replied that in $t + 1$ quarter compared to t quarter, his household financial situation will improve;

Y_{it} —autoregressive independent variable assuming the value of 1 if i -th respondent replied that in t quarter compared to $t - 1$ quarter, his household financial situation has worsened, the value of 2 if i -th respondent replied that in t quarter compared to $t - 1$ quarter, his household financial situation has not changed, and the value of 3 if i -th respondent replied that in t quarter compared to $t - 1$ quarter, his household financial situation has improved;

X_t —independent variable, describing GDP growth rate in t quarter compared to previous quarter in current prices;⁶

Z_{itj} —independent variable describing j -th individual feature of i -th respondent in t quarter (idiosyncratic variable);

Q_p —vector of seasonal variables, assuming the value of 1 in p quarter and the value of 0 in other quarters;⁷

t —time expressed by consecutive numbers of conducted surveys;

ε_{it} —random disturbance.

Selecting the most appropriate models, we applied a criterion of maximizing the value of McFadden's coefficient of determination (McFadden 1974), observing the principle that the model should consist only of those variables whose coefficients are statistically significant and coincidental (Hellwig 1976).

2 Results of the research

Due to lack of complete data—assumed to be potential independent variables—from previous periods concerning information about respondents, in constructing the model we used questionnaires obtained in the surveys beginning with 2nd quarter of 2006, which gave us around 10 600 single observations. In the estimated model of ordered dependent variable Y_{it+1} , apart from GDP growth rate in t quarter compared to the previous quarter in current prices (X_t) and autoregressive variable Y_{it} as well as zero-one variables describing the influence of seasons on respondents' answers, the following control variables were used:

- Z_{it1} —age of i -th respondent in t quarter (in years)
- $Z_{it2} = Z_{it1}^2$ —age of i -th respondent in t quarter, squared
- Z_{it3} —sex of i -th respondent in t quarter, assuming the values of: 1—male, 2—female
- Z_{it4} —place of living of i -th respondent in t quarter, assuming the values of: 1—city, 2—country
- Z_{it5} —monthly income per 1 person in a household (in PLN)

The quality of the estimated model should be viewed positively. All variables in the presented model are statistically significant on the level of significance below 0,02, a high value of LR statistic indicates that in total, all coefficients of the model significantly differ from zero, therefore the specified variables significantly influence the value of the latent dependent variable. Moreover,

6. It was assumed that business cycle will be described by the growth rate in t quarter compared to the previous quarter in current prices, as respondents were asked about their assessment of their household financial situation in $t + 1$ quarter compared to previous quarter and their answers were not de-seasoned.

7. However both the dependent variable and the independent variable are subject to seasonal deviations, therefore the model needs zero-one variables describing the influence of the seasons on respondents' answers.

Tab. 1. Results of the estimation of the logit model of ordered variable describing the forecast of a household's financial situation (Y_{it+1})

Variable	Coefficient	z statistic	p value
GDP quarterly growth rate (X_t)	0,0808	3,9742	0,0001
Assessment of financial situation in t quarter compared to $t - 1$ quarter	1,3996	35,2249	< 0,0001
Q_1	-1,4323	-4,1372	< 0,0001
Q_2	-1,8690	-6,2509	< 0,0001
Q_3	-2,3930	-4,5254	< 0,0001
Age (Z_1)	-0,0466	-6,0205	< 0,0001
Age squared (Z_2)	0,0003	3,5036	0,0005
Sex (Z_3)	0,0999	2,4735	0,0134
Place of living (Z_4)	-0,1109	-2,7255	0,0064
Monthly income (Z_6)	0,2328	11,3250	< 0,0001
γ_1	-0,8492	-2,4403	0,0147
γ_2	2,6922	7,6810	< 0,0001
Pseudo- R^2		0,1482	
LR statistic		2996,2630	
p value for LR statistic		< 0,0001	

the tests of added variables proved that there are no redundant variables in the model. A relatively low pseudo- $R^2 = 0,148$ is of secondary importance in the case of logit models (Greene and Hensher 2010)⁸ compared to obtaining statistically significant coefficients and their practical interpretation (Gujarati 2003, 595–607).

The estimated model confirmed the formulated hypothesis that the forecast of the household financial situation in Lubelskie Voivodship depends on the business cycle in Poland measured with GDP growth rate. In periods of a good business cycle respondents forecast better financial situation of their households than they would do, assuming all other variables have the same values, in periods of a bad business cycle. The analysis of control variable coefficients allows us to draw further conclusions that, observing the *ceteris paribus* principle, better forecasts for the next quarter are made by respondents who positively assessed current financial situation of their households, and who are younger, male, live in a city and have higher income per household member.

A more detailed interpretation of the estimated values of the logit model of ordered dependent variable is not so simple. It is assumed that the values of limit points (γ) do not have a “classic” econometric interpretation. Admittedly, there are some authors who claim that these values reveal some information on the preferences of the surveyed group of respondents (for example see: Daykin and Moffatt 2002). However in this case we do not take the challenge of interpreting the obtained values of γ coefficient. On the other hand, the estimated coefficient values for particular independent variables can be used to calculate the probability of the answers depending on the assumed values of independent variables (Greene 2012, 787–790).

In our case the estimated coefficients allow us to calculate the probability of the answers that in the next quarter the household's financial situation will worsen (e.g., $P(Y = 1)$), will not change (e.g., $P(Y = 2)$) or will improve (e.g., $P(Y = 3)$) depending on changes to the quarterly GDP growth rate, assuming that other independent variables adopt the determined values.

The distribution of probabilities defined in this way in relation to a selected macroeconomic variable was determined analytically (Kowerski 2008, 52–57). If the specified variable is a stimulant⁹ then the more its value grows there is lower probability of the answer that the situation will worsen. On the other hand, the probability of the answer that the situation will not change initially

8. Even more so as this is not an analogous measure to R^2 coefficient for classic linear regression.

9. A stimulant is a variable whose growth in value causes growth in the value of the dependent variable.

grows in parallel with the decreasing probability of the answer that the situation will worsen. Some respondents who have thought that the situation will worsen have lost their confidence in this scenario and answer that the situation will not change. However, after reaching the maximum value, the probability of the answer that the situation will not change starts to fall while the probability of the answers expecting improvement increases. Some respondents who have not been certain so far begin, along with the increasing value of the macroeconomic variable, to believe that the situation will really improve.

In the case of the estimated model of the forecasts of household financial situation in Lubelskie Voivodship, particular probability functions take the following shape:

$$(7) \quad \begin{aligned} P(Y = 1) &= F(-0,849 - y^*) \\ P(Y = 2) &= F(2,692 - y^*) - F(-0,849 - y^*) \text{ ,} \\ P(Y = 3) &= 1 - F(2,692 - y^*) \end{aligned}$$

where F is a logistic distribution function and the latent variable is described by the equation

$$(8) \quad \begin{aligned} y^* &= 0,081X_t + 1,340Y_{it} - 1,432Q_2 - 1,869Q_3 - 2,393Q_4 - 0,047Z_1 + \\ &+ 0,000276Z_2 + 0,100Z_3 - 0,111Z_4 + 0,233Z_6 \end{aligned}$$

Tab. 2. Probability of answers provided by hypothetical respondents depending on selected values of GDP growth rate

Respondent answer on household's financial situation in next quarter	GDP rate of growth (quarterly, %)					
	unfavorable features respondent			favorable features respondent		
	-15	0	15	-15	0	15
current quarter situation compared to previous quarter worsened (1)						
Situation will improve (3)	0,015	0,048	0,145	0,096	0,263	0,545
Situation will remain unchanged (2)	0,326	0,587	0,709	0,689	0,662	0,432
Situation will worsen (1)	0,659	0,365	0,146	0,215	0,075	0,023
current quarter situation compared to previous quarter remained unchanged (2)						
Situation will improve (3)	0,057	0,170	0,407	0,300	0,590	0,829
Situation will remain unchanged (2)	0,620	0,706	0,553	0,637	0,390	0,165
Situation will worsen (1)	0,323	0,124	0,040	0,063	0,020	0,006
current quarter situation compared to previous quarter improved (3)						
Situation will improve (3)	0,198	0,453	0,736	0,635	0,854	0,952
Situation will remain unchanged (2)	0,697	0,512	0,254	0,349	0,141	0,047
Situation will worsen (1)	0,105	0,035	0,010	0,016	0,005	0,001

After inserting the values of independent variables characterizing particular respondents into the equation above, we can analyze the influence of the changes in GDP growth rate on their forecasts concerning household financial situation.¹⁰ Figures 1 and 2 illustrate changes in the probability of evaluation by a hypothetical respondent with unfavorable and favorable characteristics for the household's financial situation.¹¹

Although greater quarterly GDP growth rate always decreases the probability of the answer that in the next quarter the household's financial situation will worsen and increases the probability of the opposite answer, the values of those probabilities are strongly related to the features of

10. Using a different transcription of the model—not taking into account the probability of obtaining a particular answer, but merely a “classification” of the result on the basis of the obtained value I_Y we can write:
 $Y = 1$ for $y^* \leq -0,849$
 $Y = 2$ for $-0,849 < y^* \leq 2,692$
 $Y = 3$ for $2,692 < y^*$

11. The paper (Kowerski 2008) also contains formulas for calculating inflection points and function maximum

$P(Y = 2)$, as well as points of intersection $P(Y = 1)$ and $P(Y = 2)$ as well as $P(Y = 3)$ and $P(Y = 2)$.

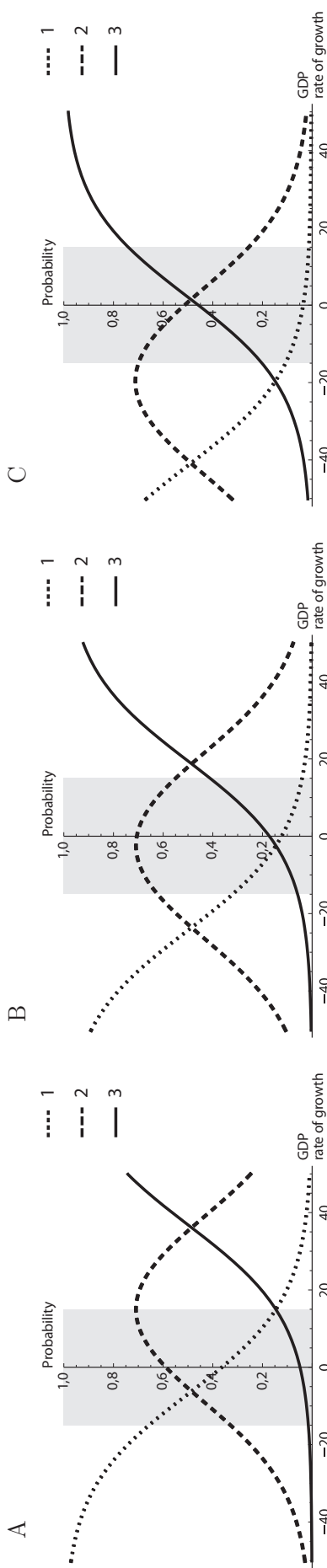


Fig. 1. Changes in probability of answers “1” (will worsen), “2” (will remain unchanged) or “3” (will improve) depending on quarterly GDP growth rate for a respondent with unfavorable features (age: 60, sex: woman, place of living: countryside, monthly income < PLN 100) for the next quarter household’s financial situation (shaded area covers changes of GDP growth rate observed in the analyzed period) and by current quarter financial situation assessment (*A*—worsened, *B*—unchanged, *C*—improved)

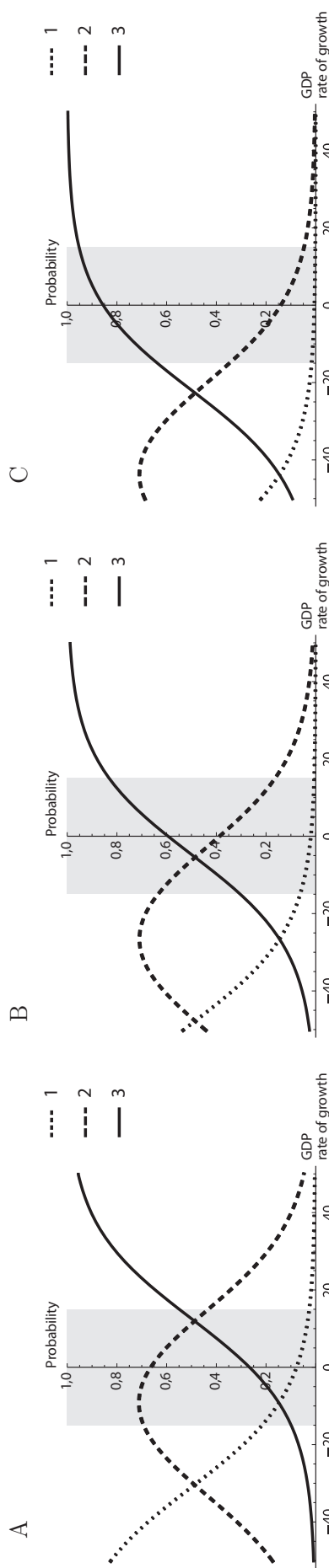


Fig. 2. Changes in probability of answers “1” (will worsen), “2” (will remain unchanged) or “3” (will improve) depending on quarterly GDP growth rate for a respondent with favorable features (age: 25, sex: man, place of living: town, monthly income > PLN 1000) for the next quarter household’s financial situation (shaded area covers changes of GDP growth rate observed in the analyzed period) and by current quarter financial situation assessment (*A*—worsened, *B*—unchanged, *C*—improved)

respondents and their evaluation of their household financial situation in current quarter compared to the previous quarter.

With the lowest quarterly GDP growth rate observed in the analyzed period, equaling -15% , a respondent with favorable features who evaluated that in current quarter, compared to the previous, the financial situation of his household has improved (an optimistic respondent) with 0,635 probability will answer that the financial situation of his household in the next quarter will also improve, with probability of 0,349 that it will remain unchanged and only with probability of 0,016 that it will worsen. On the other hand, a respondent with favorable features who evaluated that in the current quarter the financial situation of his household has worsened (a pessimistic respondent) with probability of merely 0,096 will answer that the financial situation of his household will improve in the next quarter, with probability of 0,689 that it will remain unchanged, and with probability of 0,215 that it will worsen.

With the lowest quarterly GDP growth rate observed in the analyzed period, equaling -15% , a respondent with unfavorable features who evaluated that in the current quarter, compared to the previous, the financial situation of his household has improved (an optimistic respondent) with probability of 0,198 will answer that the financial situation of his household will improve, with probability of 0,697 that it will not change and with probability of 0,105 that it will worsen. With the same growth rate, a respondent with unfavorable features who evaluated that in the current quarter the financial situation of his household has worsened (a pessimistic respondent) with probability of merely 0,015 will answer that the financial situation of his household will improve in the next quarter, with probability of 0,326 that it will remain unchanged, and with probability of 0,659 that it will worsen.

Together with the improvement of quarterly GDP growth rate the probability of the belief that the household's financial situation will be better in the next quarter also grows. With the highest quarterly GDP growth rate observed in the analyzed period, equaling 15% , a respondent with favorable features who evaluated that in the current quarter, compared to the previous, the financial situation of his household has improved (an optimistic respondent) with as much as 0,952 probability will answer that the financial situation of his household in the next quarter will also improve, with probability of 0,047 that it will remain unchanged and only with probability of 0,001 that it will worsen. On the other hand, at the same growth rate, a respondent with favorable features who evaluated that in the current quarter the financial situation of his household has worsened (a pessimistic respondent) with probability of 0,545 will answer that the financial situation of his household will improve in the next quarter, with probability of 0,432 that it will remain unchanged, and with probability of 0,023 that it will worsen.

In the case of a very high growth rate (15%), respondents with unfavorable features also have a much more positive outlook on the future. At this growth rate a respondent who evaluated that in the current quarter the financial situation of his household has improved (an optimistic respondent) with probability of 0,736 will answer that the financial situation of his household in the next quarter will improve, with probability of 0,254 that it will remain unchanged and with probability of merely 0,01 that it will worsen. On the other hand, a respondent with unfavorable features who evaluated that in the current quarter the financial situation of his household has worsened (a pessimistic respondent) with probability of 0,145 will state that the financial situation of his household in the next quarter will improve, with probability of 0,709 that it will not change and with probability of 0,146 that it will worsen.

The estimated model also allows us to graphically present the power of the influence of particular independent variables on the probability of changing responses indicating that the financial situation will improve ($P(Y = 3)$).¹²

The diagrams shown here confirm that the probability of the answer that the financial situation of a household will improve is greatly affected by the evaluation of this situation in current

12. This is a proposal of a slightly different (more accessible) way of analyzing the results of the estimation, as the same conclusions can be drawn on the basis of the analysis of coefficients' significance. In the same way we can also present the diagrams of probabilities for the answer "the situation has not changed" or "the situation has worsened."

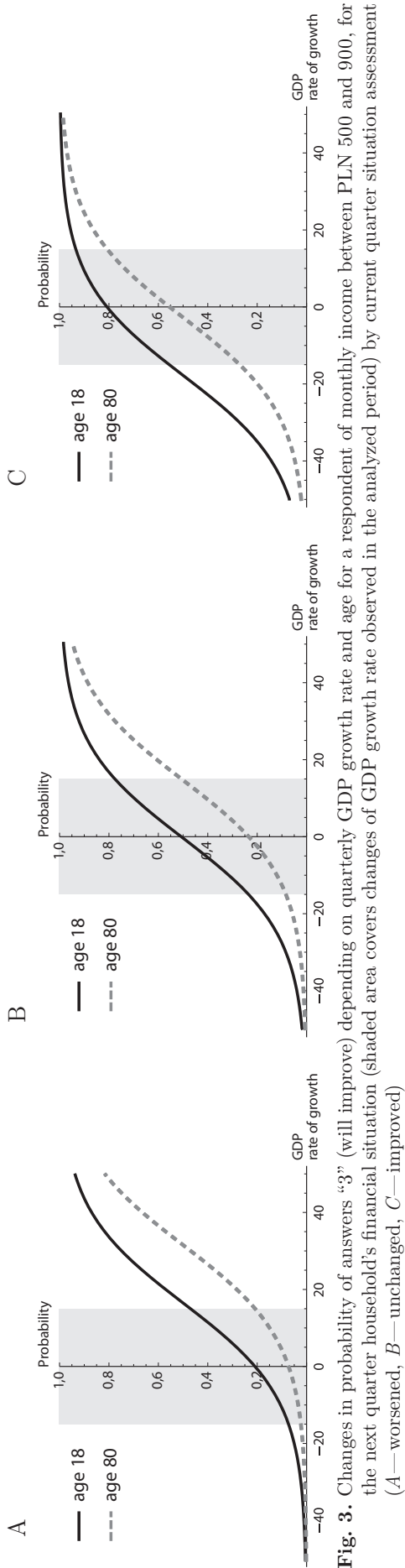


Fig. 3. Changes in probability of answers “3” (will improve) depending on quarterly GDP growth rate and age for a respondent of monthly income between PLN 500 and 900, for the next quarter household’s financial situation (shaded area covers changes of GDP growth rate observed in the analyzed period) by current quarter situation assessment (*A*—worsened, *B*—unchanged, *C*—improved)

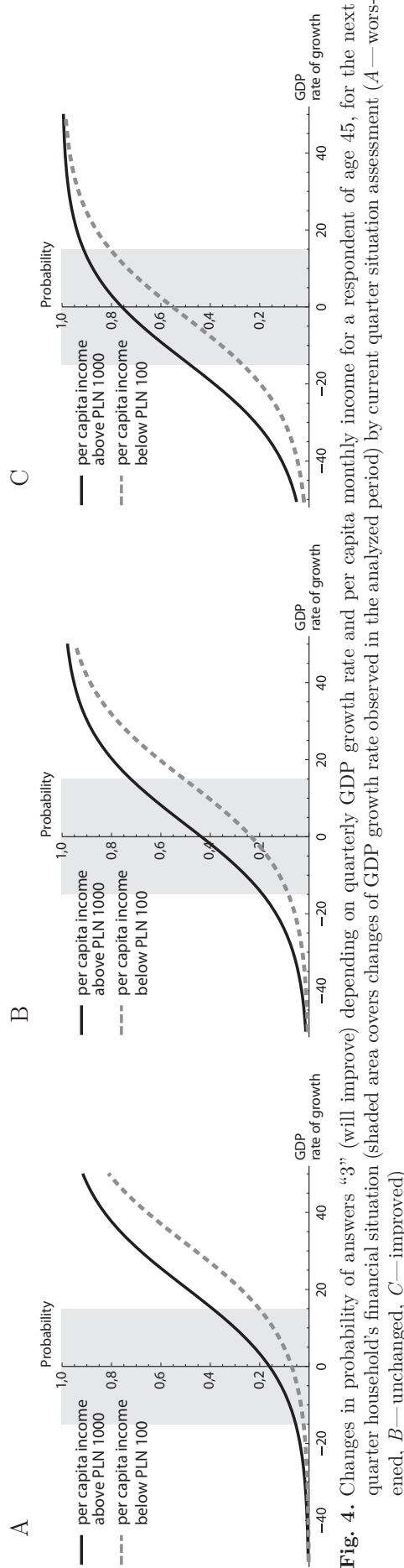


Fig. 4. Changes in probability of answers “3” (will improve) depending on quarterly GDP growth rate and per capita monthly income for a respondent of age 45, for the next quarter household’s financial situation (shaded area covers changes of GDP growth rate observed in the analyzed period) by current quarter situation assessment (*A*—worsened, *B*—unchanged, *C*—improved)

quarter,¹³ but also by monthly income per person and the respondent's age. It must be emphasized, however, that other control variables also remain statistically significant (at the level below 0,02) for impact on the forecast of the financial situation in Lubelskie Voivodship households.

Conclusions

The estimated model shows that the forecast of household financial situation (financial confidence) in Lubelskie Voivodship, apart from idiosyncratic factors typical for each household and the evaluation of the present financial situation of a household, is influenced by the national business cycle. In periods of high economic growth a respondent will see his household's future financial situation more optimistically than in periods of low economic growth. This means that this evaluation is affected not only by "hard" data but also by the respondent's sentiment resulting from their perception of their country's economic situation and possible hopes or fears stemming from the anticipated influence of this situation on the financial situation of their household.

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13. Quite often respondents make a relatively stable evaluation of the situation of their household and "repeat" diagnostic evaluations in their forecasts.