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ANALYZING MONETARY POLICY OF CENTRAL BANKS THROUGH LIMITED DEPENDENT VARIABLE MODEL

One of the main monetary tools that Central banks use, especially in countries, which set an inflation target, is a key policy rate. A lot of discussions and researches are held on this topic. While implementing monetary policy Central banks take into consideration a transmission mechanism concept that is about interdependence and interaction of macroeconomic indicators.

However, decisions whether to change a key rate or not are made based on complex analysis, using lots of variables, formulas, calibration coefficients and so on. Such models are difficult to prepare because of unreliable or not full due to some security reasons data, also Central banks make lots of adjustments through years of their work.

I suggest that key macroeconomic trends might be observed through Limited Dependent Variable Model that is much easier in preparation than quarterly projection model or etc. This model allows to test the hypotheses whether there is a statistically significant influence of economic indicators on the main monetary tool – key policy rate (KPR). These hypotheses might be useful for market participants other than National Bank, because it doesn't require lots of resources and is easy in explanation.

Main hypotheses I want to test are that consumer price index (CPI), nominal gross domestic product (nGDP) and exchange rate (ER) have a statistically significant impact on policy rate change. In this work I suggest using Ordered Probit Model, where dependent variable is ranged from 1 to 5 regarding the volume of change of the KPR.

Table 1. **Dependent variable change and its respective strategy**

Y	Volume of change	KPR change
5	large increase	≥1
4	small increase	from 0 to 1
3	no change	0
2	small decrease	from -1 to 0
1	large decrease	≥-1

Source: created by the author

Theoretical model is based on the utility from change of policy rate.

$$U_i = a * X_i + b + e_i$$

Empirical model is Ordered Probit Model.

$P(Y_i = 1) = P(U_i \leq y_1) = P(a * X_i + b + e_i \leq y_1) = P(e_i \leq y_1 - a * X_i - b) = F(y_1 - a * X_i - b)$

$P(Y_i = 2) = P(U_i > y_1 \text{ and } U_i \leq y_2) = P(U_i \leq y_2) - P(U_i \leq y_1) = F(y_2 - a * X_i - b) - F(y_1 - a * X_i - b)$

$P(Y_i = 3) = P(U_i > y_2 \text{ and } U_i \leq y_3) = P(U_i \leq y_3) - P(U_i \leq y_2) = F(y_3 - a * X_i - b) - F(y_2 - a * X_i - b)$

$P(Y_i = 4) = P(U_i > y_3 \text{ and } U_i \leq y_4) = P(U_i \leq y_4) - P(U_i \leq y_3) = F(y_4 - a * X_i - b) - F(y_3 - a * X_i - b)$

$P(Y_i = 5) = P(U_i > y_4) = P(a * X_i + b + e_i > y_4) = P(e_i > y_4 - a * X_i - b) = 1 - P(e_i \leq y_4 - a * X_i - b) = 1 - F(y_4 - a * X_i - b)$

Based on p-values, coefficients for CPI, exchange rate and nominal GDP are statistically significant as p-value<0.1. Variables $\gamma 1$ "1|2", $\gamma 2$ "2|3", $\gamma 3$ "3|4", $\gamma 4$ "4|5" are also statistically significant.

	value	Std..Error	t.value	p.value
CPI	0.03574042	0.01468745	2.433399	0.014957826
ER	-0.05907981	0.02427202	-2.434070	0.014930104
nGDP	1.17836807	0.54585008	2.158776	0.030867549
1|2	5.12269609	2.70676252	1.892555	0.058417115
2|3	5.55559520	2.71689007	2.044836	0.040871008
3|4	6.99139192	2.72833006	2.562517	0.010391653
4|5	7.23199358	2.72943914	2.649626	0.008058086

Figure 1. **Estimating coefficients**

Source: created by the author in RStudio

Estimation of marginal effects depicts how CPI, ER and nGDP change influence the decision of NBU on changing the key rate.

	effect.1	effect.2	effect.3	effect.4	effect.5
CPI	-0.010	-0.003	0.005	0.002	0.006
ER	0.017	0.005	-0.009	-0.003	-0.010
nGDP	-0.344	-0.097	0.178	0.066	0.197

Figure 2. **Estimating marginal effects**

Source: created by the author in RStudio

Let consider the effect of CPI: if CPI increases by 1 then the probability of selecting Strategy 1 (decreasing discount rate more than by 1%) decreases by 0.010, of Strategy 2 decreases by 0.003, of Strategy 3 increases by 0.005, of Strategy 4 increases by 0.002 and of selecting Strategy 5 increases by 0.006.

These effects prove the point that an increase in CPI will drive NBU board to choose a strategy, which represents the discount rate rise. NBU rises the discount rate in order to slow down the economy and move inflation to its target that is lower than the actual value. For exchange rate the trend is the opposite. If the exchange rate of UAH rises (UAH becomes weaker) NBU board is most likely to choose strategy 1, and low the discount rate more than 1%.

The model has a very low McFadden value – 5,3%, which is lower than excellent model fit (20-40%). This value is quite low, because the model explains only 51% of choices. I would suggest including some investment indicators in order to make model more accurate and useful for business or academic research.

After predicting a choice of the strategy main conclusion is that the model suggests only two strategies – Strategy 1 (that NBU will largely decrease KPR) and Strategy 3 (that NBU will remain the KPR at the same level). Such results may be a consequence of too high KPR among the years and a successful inflation targeting policy. Low inflation during recent years provides NBU with an opportunity to heat Ukrainian economy and provide GDP growth without a risk of high inflation. From this point conclusion is that NBU is pursuing expansionary monetary policy.

Estimated model fits into hypotheses provided at the beginning. Moreover, all coefficients are statistically significant at the 90% confidence. Marginal effect also fits into underlying theoretical assumptions.

Previously for estimating discount rates mostly autocorrelation or semi-structural models were used, so this research may be a starting point for exploring transmission mechanism through limited dependent variable models. Although this model explains decisions that had already been made, it is possible to make some predictions based on expected values of nominal GDP, exchange rate and inflation that are quarterly published in inflation report by NBU.

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