DEMAND ESTIMATION IN THE BANKING SECTOR OF MOLDOVA

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Abstract
Following the idea of some experts that concentration indexes (Herfindahl-Hirschman Index, concentration ratio, etc.) could be misleading indicators of market power, we used a structural demand model for deposits to measure the market power within the Moldovan banking sector.
The goal of the paper was to estimate the demand function for deposit market within the banking industry. Based on discrete-choice demand estimation, we have calculated the-price elasticities for deposit market provided by the commercial banks in Moldova.
In this paper, we would like to analyze how consumers respond to prices and bank characteristics, market power and impact of changes on consumer welfare.

1. Introduction

Function of competition in the market is to ensure better quality of goods, lower prices and promote innovation. Competition in banking sector allows the private sector, households and entire economic system to benefit of cheap financial resources and higher returns for money deposited in the financial institutions. In this article, we have the goal to estimate the demand function for deposit market and calculate the price elasticities. The obtained results could be useful to measure the unilateral effects of mergers between banks and formulate some conclusions about possible price increase and effects on consumer's welfare. Demand estimation is the first step in assessing competition, market power and consumer behavior in the market.

The estimation is applied to deposit market of the banking industry. Our goal is to answer the questions about what and to what extend influence the consumer behavior. The model is constructed based on individual banking characteristics and we would like to assess in particularly how price, availability and quality of banking services influence the consumer decision on choosing the deposit services of a specific bank. We paid a specific attention to elasticities of interest rates and service fees established by financial institution and have seen to what extend they determine the behavior of a consumer. In other words, using the estimation of a logit-based model,

we evaluated the consumer response to deposit interest rates and account fees in choosing a bank and how they react with respect to bank characteristics, density of branches, staff professionalism.

One of the main disadvantage of the structural demand model for assessing competition in a market is necessity of large accounting data. We used the monthly dataset provided by National Bank of Moldova for 2014-2016. The method used is discrete-choice approach, because it gives the possibility to estimate a large number of substitution parameters due to several banks in the market. The discrete-choice model could be used for industries where there are a large number of competing products, products are differentiated, and consumers make „discrete choices", meaning that they typically use only one of the competing products. The demand for deposit market could be calculated based on individual utility maximization and characteristics-based discrete choice model with product differentiation. First, we performed demand estimations in order to calculate the elasticities. Second, we analyzed the results and gave some comments on price elasticities in banking industry.

The paper is composed of three sections. Section one, except introduction, provides an overview of the banking industry in Moldova, some remarks about competition and methods to measure it, and estimation results of demand functions obtained by other researchers. In section two, we described data and estimation model. Results are presented in section three, including price elasticities. We ended with some conclusions on the results, and explanations on the way the bank characteristics influence the consumer behavior.

2. The degree of investigation of the problem currently, and purpose of research

Moldovan banking sector is composed of 11 banks, which employs 7808 people and has 796 branches. At the end of July 2017, return on equity (ROE) for the whole sector was equal to 14.7% and return on assets was 2.5%. As a whole, banking sector is considered concentrated, because five largest banks hold 83.5% of total assets of the banking system. In 2016, banking sector accounts for 89.8% of total assets of the financial system, share of banking assets to GDP was equal to 54.2%, while the share of financial system assets was – 60.3% to GDP. Financial system of Moldova is dominated by banks and its stability has a direct impact on economic growth [5].

In the last three years, the banking system could be characterized as unstable and vulnerable, due to fail of three banks in the system. One of them is state-owned bank "Banca de Economii", which put pressure on the entire system stability. At the same time, the trust between private sector and financial institutions was affected to a large extent because of banking crises in 2014-2015. So, in 2017 it was registered a low demand for loans, liquidity surplus in the industry, while the interest rates for deposits continued to reduce with a higher pace comparing to loans. One of reasons of low demand on loans is high interest rates due to high level of non-performed loans (16.2% - quarter I, 2017), which creates obstacles to lowering the interest rates and increases the amount of lending activity. We elaborated a graph on trends of deposits and interest rates in the banking system during 2013 - quarter II 2017 [5].

After the crises, deposit market showed revival tendencies and interest rates decreased. Anyway, the amount of deposits, nor in national currency, neither in foreign currency reached the level of

2014. Comparing to 2015, the amount of deposits in national currency increased by 30.6% at the end of semester I 2017, while the amount of deposits in foreign currency decrease by 5.0% in the same period. Among the factors that influenced the decrease of deposits is lack of trust between client and bank and reduction of interest rate on foreign deposits with 0.86 pp.
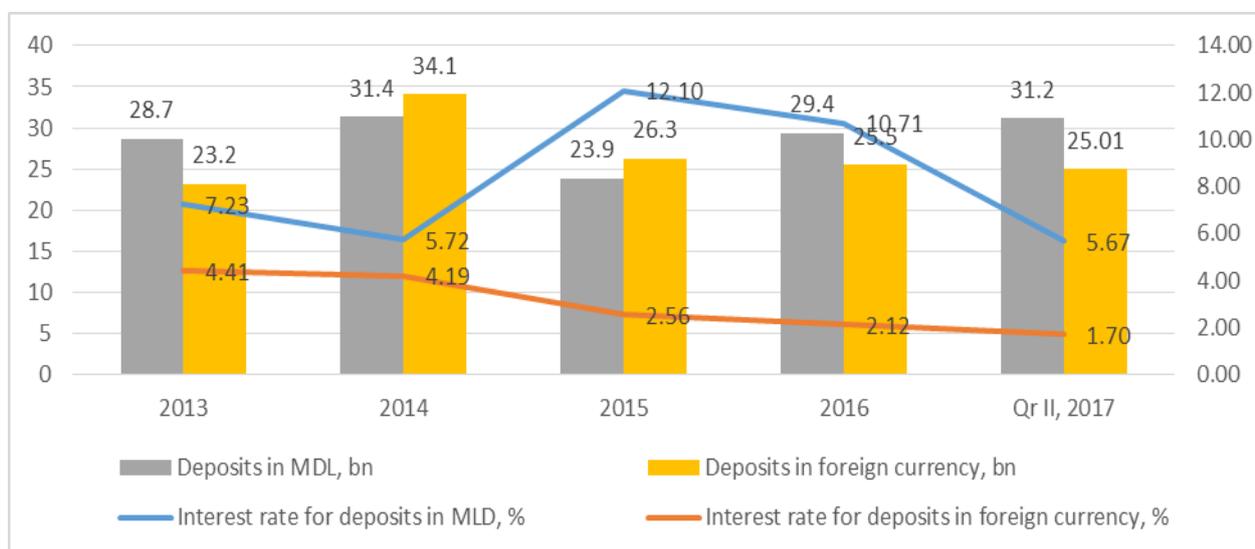

Chart 1. The dynamics of deposit and interest rates during 2013 and quarter II 2017

Source: Elaborated by authors based on data provided by National Bank of Moldova [5]

We used the statistical information about deposits to estimate demand function for deposit market. In the calculations, we excluded data for three banks that are in process of liquidation (Banca de Economii, Unibank, Banca Sociala) because lack of statistical information for 2016 and half of 2015 put pressure on calculations and could generate wrong results.

There are different methods to assess competition in the banking industry. Each of them has their own limitations and advantages. Among the main approaches to analyze competition in the banking sector is the Structure-Conduct-Performance paradigm, explored a lot by the researchers. One of the disadvantage of this paradigm is its reliance on accounting data and endogeneity issues pervading the relationship between the variables. The new method developed is called "New Empirical Industrial Organization", which focuses on a single industry and introduce theoretical methods to analyze the firm behavior and market power could be estimated.

One of the most popular approaches to test the market power were Panzar-Rosse, developed in 1987 and Bresnahan's conjectural variation model. Panzar-Rosse approach exploits the fact that changes in input prices should affect revenues differently, depending on the degree of competition. The model relies on the relationship between input prices (marginal costs) and equilibrium gross revenue, derived from the theory of the firm under alternate assumption about competitive conditions [1, p. 410]. Conjectural variation (CV) approach, proposed by Bresnahan and Lau in 1982 focuses on market structure parameters. A potential shortcoming of CV approach is it requires knowing the nature of demand relationship and accurate determination of the geographic scope of the market would seem to be of a particular importance [1, p. 412]. The Panzar-Rosse

test's data requirement is low and available, but it is very sensitive to the specification of the reduced-form revenue function.

Researchers have developed new methodologies and among the most significant is structural demand estimation. This approach is more realistic and measures market power based on assumptions of differentiated products. Given that once demand parameters are known, estimates of own-price elasticity and cross-price elasticity can be used to determine markups and the effects of changes in policy or market environment [1, p. 413]. In antitrust practice, estimation of demand is central to the determination of the relevant market, which is required in the evaluation of mergers among firms operating in the same market.

As part of new methodologies used to study competition in banking sector is discrete choice models, which define consumer preferences over characteristics of the products. The research done by Berry, Levinson and Pakes (1995), known as BLP, provides the framework to structurally estimate demand and supply using aggregate price and quantity data [2, p. 841]. The approach is to map firms observed pricing decisions into their unobserved costs by estimating a demand function and assuming a particular strategic model of competition.

For the banking industry, Dick (2002) was the first to structurally estimated demand for deposits as a way to determine the impact on consumer welfare from significant changes in banking markets followed by deregulation of branching networks [3, p. 38]. In her work, she did not test market power. Molnar (2008) in his paper wrote about results of other researchers, as Nakane et al. (2006), Ho (2007) and Molnar et al. (2007), who applied similar technics to estimate demand elasticities to study market power on supply side in the Brazilian, Chinese and Hungarian retail banking sector. Nakane et al. (2006) used outside estimates of marginal costs, while Molnar et al. (2007) used accounting data to calculate marginal costs. Ho (2007) estimated a system of differentiated product demand and pricing equation jointly under alternative market structure [4, p. 8].

In this paper, we used structural demand estimation to obtain all the parameters of demand function and calculate price elasticities.

3. Methods and materials applied

We estimated the demand function for deposit market following the methodology described by researcher Dick (2002) and Molnar (2008). The idea of the modeling is to aggregate heterogeneous consumer's discrete choice for deposit services of commercial banks. It is based on nature of consumer decision in choosing a financial institution to deposit money. Model is built on utility function, which reflects consumer preferences over product characteristics.

Demand is estimated following the discrete choice approach. The methodology allows for product differentiation and solves the dimensionality problem present when many firms are in the market. The simplest specification of the discrete-choice model is the logit demand specification. The basic assumption is that an individual consumes a unit of brand that yields the highest utility. In our model, consumers $i = 1,..., I_t,$ maximize their utility by purchasing deposit services from a

bank $j= 0, 1, ..., J_t$ in time $t = 1,..., T$ time period. j=0 choice present the outside option of not choosing a commercial bank, which represents all the households savings in the financial institutions minus deposits in the commercial banks. The utility function takes a linear form. The conditional indirect utility of consumer i from choosing bank j's deposit service at time t includes a mean utility δ_{jt}^d and individual specific, iid, mean zero random disturbance ε_{ijt} [4, p. 9].

$$v_{ijt}^d = \delta_{jt}^d + \varepsilon_{ijt} = r_{jt}^d \alpha^d - r_{jt}^{sd} \alpha^s + x_{jt} \beta^d + \xi_{jt}^d + \varepsilon_{ijt} \quad (1)$$

Where r_{jt}^d is interest rates paid by banks on deposits and r_{jt}^{sd} is fees on deposits, x_{jt} is a K dimensional vector of observed bank characteristics other than interest rate, ξ_{jt}^d represents bank characteristics unobserved by an econometrician (depicted as mean across consumers and independent across banks), and $\theta_D = (\alpha^d; \alpha^s; \beta^d)$ is a $K + 2$ dimensional vector of the mean level of taste parameters to be estimated. Parameters of utility function do not depend on individual i's characteristics. We assumed that variation in consumers taste enters only through the additive term ε_{ijt}. Consumers maximize their utility and choose bank j whenever it gives them highest utility. For example $U\left(r_{jt}^d, r_{jt}^{sd}, x_{jt}, \xi_{jt}, \varepsilon_{ijt}; \theta_D\right) \geq U\left(r_{lt}^d, r_{lt}^{sd}, x_{lt}, \xi_{lt}, \varepsilon_{ijt}; \theta_D\right)$ for all $l \neq j$ and t, where ε_{ijt} reflects consumer specific terms that are not observed by econometricians. The closed form solution of the multinomial logit model, assuming that the unobservable' distribution is a type-I extreme value, yields banks j's market share in market d at time t as following.

$$s_{jt}^d\left(\delta_t^d\right) = \frac{\exp(\delta_{jt}^d)}{\sum_{r=0}^J \exp(\delta_{rt}^d)}, \qquad j = 1,...J \quad (2)$$

The limitations of logit model is that it restricts consumers to substitute towards other brands in proportion to market share despite the characteristics. Anyway, this problem is not serious because the share of outside good is almost inexistent, the number of banks is limited and there are no huge quality differences among them. It seems reasonable that the market share drives the substitution patterns.

One of the problems of estimating demand function could be that prices are correlated with unobserved demand factors, such as style or service quality. Endogeneity issues could produce biased parameter estimates. It was emphasized by researchers that ignoring correlation could lead to upward sloping demand curves. In order to fix the endogeneity problem, the literature suggests using instrumental variables. Instrumental variables are called BLP instruments, because Berry, Levinsohn and Pakes (1995) developed them [2, p. 841].

The main idea of instrumental variables in discrete choice model is to use characteristics of other products in the market as instruments for price. It is assumed that product characteristics other than price are exogenous and therefore orthogonal to unobserved demand. In the same time, price and unobserved product characteristics enter the demand equation in a nonlinear way, and the application of instrumented variables become heavy. In order to avoid this problem, Berry

proposed to transform the equation such that the parameters enter the objective function linearly. The logit demand function will take the following form for deposit supply.

$$\ln\left(s_{jt}^d\right) - \ln\left(s_{0t}^d\right) = \delta_{jt}^d = r_{jt}^d \alpha^d - r_{jt}^{sd} \alpha^{sd} + x_{jt}\beta^d + \xi_{jt}^d \quad (3)$$

We can estimate this equation by a simple ordinary least square regression, but interest rate and fees are potentially endogenous. Equation was estimated using General Method of Moments (GMM) estimator, standard IV as special case of GMM estimator.

Based on estimated parameters of the demand equation, we calculated the elasticities. The price elasticities of bank j in period t are derived from equations (1) and (2). The formula for interest rate elasticity is formula (4), while fee elasticity can be calculated using formula (5).

$$\eta_{jkt}^d = \frac{\partial s_{jt}^d}{\partial r_{kt}^d}\frac{r_{kt}^d}{s_{jt}^d} = \begin{cases} \alpha^d r_{jt}^d \left(1 - s_{jt}^d\right) & if\ j = k \\ -\alpha^d r_{kt}^d s_{kt}^d & if\ j \neq k \end{cases} \quad (4)$$

$$\eta_{jkt}^{ds} = \frac{\partial s_{jt}^d}{\partial r_{kt}^{sd}}\frac{r_{kt}^{sd}}{s_{jt}^d} = \begin{cases} \alpha^{sd} r_{jt}^{sd} \left(1 - s_{jt}^d\right) & if\ j = k \\ -\alpha^{sd} r_{kt}^{sd} s_{kt}^{sd} & if\ j \neq k \end{cases} \quad (5)$$

In order to estimate the equation (3), summary statistics of the variables, which contains a description of the variables, is reflected in the table below.

Table 1. Descriptive statistics of the demand estimation model

Variables	Description	Min	Max	Mean	St. dev.
1	2	3	4	5	6
Deposit market share (MS)	Share of deposit of each bank to total deposit in the market, %	0.15	28.193	7.497	7.865
Interest rate (INT)	Interest expenses to total deposits, %	0.042	10.839	2.712	1.886
Fees (FEE)	Fee revenue to total deposits, %	0.102	12.366	1.561	1.317
Branch density (BD)	Number of branches per 1 square km	0.0001	0.0064	0.0019	0.0016
Banking Efficiency Index (IEB)	Change in Banking Efficiency Index calculated by EVM Group,	-13.885	2.586	-0.084	1.276
Employees per branch (EMP)	Number of employees to number of branches	6.13	47.50	13.90	7.25
Instrumented Variables					
Fixed capital costs (AMR)	Fixed capital costs to total assets	0.016	0.717	0.202	0.134
Personnel Expenses (CAT)	Personnel expenses to total assets, %	0.069	6.679	1.139	1.008

1	2	3	4	5	6
Operational costs (COAT)	Operational costs to total deposits	0.038	4.282	0.970	0.721
Euribor	1 month Euribor	-0.374	0.258	-0.083	0.209
Wages (PERS)	Wage per employee	5487.8	44547.0	11955.2	5242.7

Source: developed by authors based on statistical information provided by National Bank of Moldova for 2014-2016

We used a monthly dataset provided by National Bank of Moldova for 2014-2016 and Banking Efficiency Index calculated by "EVM" Rating and Evaluation Agency. During the estimations, we excluded the data for three banks that are in liquidation process, to ensure consistent estimation. The bank characteristics are chosen from available data and we believe that they are important and recognizable to the consumer.

In the demand estimation, the two prices are observed, which are interest rate and service charges (fees) for deposit services. They are imputed as share of interest expenses and fee revenues to total deposits. In addition, we included several bank characteristics, number of employees per branch and branch density, which was calculated as number of branches of individual bank to total area of the country, which is 33846 square km.

Unobserved bank characteristics are variables such as bank's service quality, reputation and prestige, reputation aspects related to its soundness as a financial institution. In order to avoid endogeneity between variables, unobserved characteristics and price of the deposit services, instrumental variables are used.

An important issue is choosing the instruments. For estimating the demand function, the interest rates and fees are instrumented with administrative costs per total assets, lagged values of fees and interbank interest rate (Euribor) and characteristics of other banks. So, we used as instruments: 1 month Euribor, lagged fees, wage per employee and cost shifters (operational expenses, fixed capital expenses, personnel expenses). Cost shifters were derived from profit and loss report provided by the National Bank of Moldova.

4. Results obtained and discussions

Based on equation (3), we estimated the demand of deposit services using logit specification and IV estimation with cost shifters and BLP instruments. The dependent variable are the logarithms of deposit market shares of each bank. We excluded the logarithms of share outside goods provided by other monetary institutions, because the share of other institution, which accept savings, is very low and insignificant. The explanatory variables are the interest rate, service fee, bank characteristics (employees per bank and bank density) and change in banking efficiency index. Table below reports the GMM estimates of demand function for deposit services in a logit specification using Eviews program.

Table 2 reports the results of estimations. All the variables are significant, and interest rate and fee have the expected sign. Increase of service fee and decrease of interest rate will reduce the market share and demand for deposit services of a bank. The density of branches and number of

employees per branch are significant and have the expected sign. Even if internet banking is developing, presence of banks in territory, as well as number of people who provide deposit services are very important. Market share of deposits and branch density and number of employees per branch have a direct proportional link.

Table 2. Results of demand estimation with logit specification and BLP instrument

Dependent Variable: MS
Method: Generalized Method of Moments
Sample (adjusted): 2 372
Included observations: 121 after adjustments
Estimation weighting matrix: HAC (Bartlett kernel, Newey-West fixed
Standard errors & covariance computed using estimation weighting matrix
Instrument specification: AMR CAT COAT EURIBOR LAGFEE PERS BD IEB EMP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.482140	0.567785	-9.655315	0.0000
INT	14.57557	5.048769	2.886955	0.0046
FEE	-28.54023	6.135895	-4.651356	0.0000
BD	963.5805	104.0198	9.263432	0.0000
IEB	-0.229564	0.113965	-2.014339	0.0463
EMP	0.038009	0.016431	2.313210	0.0225

R-squared	0.808292	Mean dependent var	-3.453497
Adjusted R-squared	0.799957	S.D. dependent var	1.347150
S.E. of regression	0.602528	Sum squared resid	41.74960
Durbin-Watson stat	0.163465	J-statistic	5.657812
Instrument rank	10	Prob(J-statistic)	0.226202

The change in banking efficiency index is significant and has a negative sign, which means that an increase in banking efficiency index, cause a decrease in deposit market share. The banking efficiency index is calculated based on three indicators: return on sales (net income to total income); return on equity (net income on average equity capital); and asset rotation (total income to average total assets). This index takes into account all the activity of a bank and a huge contribution to its value should be the lending activity.

We tested the model using the tests provided by Eviews on endogeneity of regressors and diagnosis of weakness of instruments. Results for weak instruments diagnosis show that selected instruments are not weak, because Cragg-Donald F-statistic equal to 37.3927 is higher than Stock-Yugo critical values. Regressor endogeneity test rejected the null hypothesis and we can reject the assumption that variables can be treated as exogenous.

The estimated demand function will take the following form:

$$Deposit\ market\ share = -5.49 + 14.58 * interest\ rate - 28.54 * fee + 963.58 *$$
$$branch\ density - 0.23 * banking\ efficiency\ index + 0.04 * employees\ per\ branch$$

(6)

We used the estimated parameters of the demand function to calculate the price elasticity. Under the logit function, the median elasticity of service fees is -0.35, while the median deposit rate elasticity is 0.32. If we have to interpret the results, we could say that 1% increase in fees would lead to 0.35% decrease in market share, while 1% increase in interest rate, would lead to 0.32% increase in deposit market share. Table 3 shows the percentiles of distribution of price elasticities across banks, based on estimation of equation 6.

Table 3. Price elasticity percentiles

Price	Median	10%	25%	75%	90%
Service fee	-0.35	-0.76	-0.52	-0.19	-0.09
Interest rate	0.32	0.07	0.16	0.51	0.70

Source: developed by authors based on estimated parameters of demand function

According to the table, in case of service fee elasticity, in 90% of cases the elasticity will be lower or equal to -0.09. In the same time, in 25% of all the results, the elasticity of interest rate will be lower or equal to 0.16.

5. Conclusions

In the last years, researchers have developed new methodologies on assessing the market power of the firms, called structural demand estimation. The approach measures competition based on product differentiation, consumer reaction to bank characteristics, density of branches, staff professionalism. The goal of out paper was to estimate the demand function and calculate the prices elasticities for deposit market in the banking industry of Moldova. The elasticities can be used to determine the effects of changing policies and market environment. The obtained results are the first step and a useful tool in measuring competition in the banking sector and analyses the effects of a merger in the market.

Based on discrete-choice approach and logit specification, we estimated the demand function for deposit market. According to results, deposit market share of banks depends on interest rate, fees charged as well as bank density and employees per branch. Even if internet banking has developed in the recent years, banks will increase their share on deposit market by direct contact with the population. Therefore, we can conclude that consumers respond not only to price, but also to other bank characteristics.

We used the parameters of the estimated demand for deposit market in the banking sector to calculate the price elasticities for interest rate and service fees. According to results, an increase of 1% in fees would lead to 0.35% decrease in market share, while an increase of 1% in interest rate would lead to 0.32% increase in market share.

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Rezumat

Urmare a părerii unor experţi, conform căreia indicii de concentrare (ex. indicele Herfindahl-Hirschman, rata de concentrare, etc.) ar putea fi înşelători în vederea evaluării puterii de piaţă, am folosit modelul cererii structurale pentru a măsura puterea de piaţă în sectorul bancar moldovenesc.

Scopul lucrării este de a estima funcţia cererii pentru depozite din cadrul sectorului bancar. În baza estimării cererii discreţionare am calculat elasticitatea preţurilor pentru serviciile de depozit oferite de băncile comerciale din Moldova.

În această lucrare am analizat modul în care consumatorii răspund preţurilor şi caracteristicilor băncilor comerciale din ţară, puterii de piaţă şi impactului reformelor asupra bunăstării consumatorilor.

Cuvinte-cheie: estimarea cererii, depozite, alegerea discretă, puterea de piaţă, sector bancar

Аннотация

Следуя мнению экспертов, согласно которым индексы концентрации (например, индекс Херфиндаля-Хиршмана, уровень концентрации и др.) могут вводить в заблуждение при оценке рыночной способности, мы использовали модель структурного спроса для измерения рыночной власти в банковском секторе Молдовы.

Цель данной статьи состоит в оценке функции спроса на депозиты в банковском секторе. На основе оценки дискреционного спроса мы рассчитали ценовую эластичность депозитных услуг, предлагаемых молдавскими коммерческими банками.

В этой статье мы проанализировали, как потребители реагируют на цены и характеристики коммерческих банков, рыночную способность (власть) и влияние реформ на благосостояние потребителей.

Ключевые слова: оценка спроса, депозиты, дискреционный выбор, рыночная способность (власть), банковский сектор