

ELECTRONIC BANKING IN
UKRAINE: THE FACTORS IN
DECISION-MAKING

by

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Abstract

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The paper overviews the development investigates the factors that influence the decision of Ukrainian banks to start providing electronic banking by testing the main hypotheses that the decision making over entering electronic banking depends on banks' deposits normalized by assets using logistic regression model. It then examines the results of the modeling draws conclusions and identifies possible policy implications. Application of the model of decision-making confirms the hypotheses that Ukrainian banks' decision on electronic banking is positively statistically significantly influenced by its size and private deposit base.

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GLOSSARY

Automated Clearing House (ACH). An automated clearing and settlement system for recurring payments. *Note: Most ACH systems are operated by the Central Banks.*

Automated teller machine (ATM). A special device that allows customer to make debit transactions for electronic payment and delivers cash.

Direct deposit. An accounting entry that moves money from the an employer's account to that of an employee.

Home Banking. Banking services that allow a customer to interact with a financial institution from a remote location by using a telephone (Telephone banking or Telebanking), television set, terminal, personal computer (PC-banking), or other device to access a telecommunication system which links to the institution's computer center.

Internet banking. Systems that enable bank customers to access accounts and general information on bank products and services through a personal computer (PC) or other intelligent devices.

Stored Value Card. A card that stores prepaid value by magnetic stripe or computer chip (smart card).

INTRODUCTION

Technological innovations are the most important source of economic growth. Rapid advancements in technology, if properly and timely captured and implemented in production, contribute to sustained economic development of a country. Conversely, a country that fails to benefit from new technologies, or even delays their implementation, eventually finds itself persistently lagging behind the others.

One of the most important and the most dynamic spheres of innovations is the new economy, which came into being through the revolutions in electronics, computers, computer networks and eventually the development of the Internet. Some part of the economy has moved into electronic space. The physical market is being gradually replaced or at least supplemented by the virtual one.

But the technological changes affect not only production and trade, or in other words 'real economy', but also financial intermediaries and banks in particular. Thus, virtual production and electronic commerce come hand in hand with electronic banking.

Banks as financial institutions naturally react very quickly to any change in the economic and technological environment. The case of electronic banking is not an exception. Just five years ago, no one ever heard of electronic banking in Ukraine. Today, many Ukrainian banks issue electronic cards; some of them offer Internet and telephone banking.

In transition countries, banks are the most important financial intermediaries and sometimes the only ones. And yet, the general public is quite resilient to keep their savings.

Therefore, banks are trying to attract customers in different ways. The most trivial way is in raising interest rates. It is a rival way and all banks that engage in the price war eventually loose. Additionally, this way did not prove to be efficient because of growing costs and an unstable clientele in search of higher interest rates on deposits.

There are also non-rival ways to attract customers. Nowadays, the most popular way is in making financial innovations and introductions of new products to the market. Electronic banking is becoming the way for development of banking system.

For the purpose of optimal regulation and stimulation of electronic banking it is important to understand which banks are most likely to adopt electronic banking before others.

In this paper, we prove that the relative share of deposits of physical persons positively influences the decision to introduce electronic banking

The paper has the following structure. In Chapter I we review the literature related to electronic banking, its regulation and modelling. Then, in Chapter II, we present a theoretical background of the model and discuss present situation with electronic banking in Ukraine. Chapter III describes the data and methodology of the research. Chapter IV presents empirical findings and gives their interpretation. Finally, the major findings of the paper are summarized in conclusions as well as some policy recommendations are given.

Chapter I

LITERATURE SURVEY

Recent discussion of electronic banking in Western economic and financial literature is quite diverse. The fact of such diversity can be explained by the difficulty of finding a universal approach to this issue that would be absolutely free of drawbacks. Therefore, in this chapter we review the literature, relevant to the questions that are raised in this paper.

1.1. Electronic Banking and Electronic Money

Let us first identify what is understood by “electronic banking”. At the time, definition made by Roger W. Ferguson, Jr. is most commonly used in literature: “Thus, at one end I would include telephone banking, credit cards, ATMs, and direct deposit, all of which are fairly mature and familiar products, but ones that are certainly electronically based. At the other end are stored-value cards and Internet-based stored value products, products that are still mostly in the experimental stage. In the middle are debit cards, a product that has been around for a number of years but which only recently began to achieve wide market penetration, electronic bill payment innovations, and PC banking, a newer product that is becoming increasingly robust and sophisticated.” (Ferguson, 1998)

The role of electronic banking is increasing in many countries. There are several reasons for that. First of all, this is due to increasing role of electronic money as a main instrument of electronic banking. Secondly, transition to electronic money is only possible through a wide implementation of electronic banking in the sense that issuing institutions have been developing simultaneously with institutions accepting e-money.

Electronic money as one of the main instruments of electronic banking has also attracted much attention of financial economics. Good (1998) in her paper comes up with several important conclusions which characterize the development of electronic money. The most relevant of those to the current paper are:

- “1. Electronic money systems will slowly be adopted by U.S. consumers as an additional payments method.
2. Technology acceptance is accelerating and this will speed the adoption of electronic money systems
3. Acceptance by European and Asian countries, as well as the **developing countries**, will push acceptance in the United States.
4. The market for electronic money systems should be allowed to develop on its own **without** government interventions.” (Good, 1998)

Actually, the problems of development of electronic banking and electronic money are closely related. Therefore, further in the paper we will use the terms such as “electronic banking” or “adoption of electronic banking” in a broader sense to include the development of separate products of electronic banking.

1.2. The View of Electronic Banking as a Financial Innovation

Let us consider main factors that cause electronic banking to occur. The mainstream economic theory treats electronic banking as a financial innovation that is effectuated by a vision of bank as a profit-generating facility. It follows then, that “...**A change in the financial environment will stimulate a search by financial institutions for innovations that are likely to be profitable.**” (Mishkin 2000, p. 239)

‘Starting in the 1960s, individuals and financial institutions operating in financial markets were confronted with drastic changes in the economic environment: Inflation and interest rates climbed sharply and became harder to predict, a situation that changed demand conditions in financial markets. The rapid advance in computer technology changed supply conditions. In addition, financial regulations became more burdensome. Financial institutions found that many old ways of doing business were no longer profitable; the financial services and products they had been offering to the public were no longer selling. Many financial intermediaries found that they were no longer able to acquire funds with their traditional financial instruments, and without these funds they would soon be out of business. To survive in the new economic environment, financial institutions had to research and develop new products and services that would meet customer needs and prove profitable, a process referred to as **financial engineering**. In their case, necessity was the mother of innovation.’ (Mishkin 2000, p. 239)

Mishkin gives three basic types of financial innovation:

- responses to changes in the demand conditions;
- responses to changes in the supply conditions;
- avoidance of regulations.

Further, he classifies electronic banking facilities as a response to changes in the supply conditions effectuated by improvement in computer and communications technology (Mishkin 2000, p. 240).

The fact that the provision of electronic banking is a response to changes in supply conditions suggests that this type of financial innovation will be implemented by banks and offered to the public when demand for these services is yet little or non-existent. This means that the demand for such services is being formed only in the process of selling these services. This fact has important implications for the nature of innovation process and its efficiency which will be discussed more in the next chapter.

A slightly different and more detailed view of innovations was expressed by other academic economists:

“[They] have identified several forces driving the innovation process. First, innovations have responded to market demands for risk-sharing, risk-pooling, hedging and intertemporal or spatial transfers of resources that are not currently available. Second, innovations have satisfied continuing needs for lower transactions costs or increased liquidity. Third, innovations have reduced asymmetric information between trading parties and improved the monitoring of the performance of principals by agents. Fourth, innovations have facilitated the avoidance of taxes, regulatory and accounting constraints.” (Santomero 1998, p.21)

Therefore, electronic money and banking, according to this classification, fit into the second category and is obviously there to lower transaction costs and increase liquidity. This suggests that electronic banking will be introduced sooner or later by the majority of banks and it is a question of timing and regulation of electronic banking industry. Some banks choose to introduce electronic banking earlier; some banks will choose it later. Unlike in a planned economy, in a market economy managerial decisions play a key role in the introduction of e-banking. In the next chapter, we speculate that managerial decisions in turn depend on internal economic factors.

1.3. Electronic Money and Banking: Regulatory and Public Policy Issues

Anderson and Kegels (1998) emphasize four goals of financial policy in transition countries:

- Assure stable financial environment;
- Enhancing the quality of enterprise governance,
- Promoting liquidity of real and financial asset markets, and

- Facilitating retreat of the State.

If the first goal is achieved, electronic banking can facilitate achieving of the second and third goals by reduction of physical contacts with bank and increase in liquidity with introduction of electronic money. The fourth goal can be achieved by electronic money developing into laissez-faire banking with gradually diminishing role of the state the regulation of financial sector and the whole economy in transition countries.

Electronic banking is evolving rapidly in developed as well as developing and transition countries. However, to our surprise that in Malaysia, for example, Internet banking is still not available! "It may seem ironical that the country that has undertaken great initiatives in supporting developments on the Internet, still disallows its banks from providing Internet banking services. The government's main concern is the security of these electronic transactions." (Guru et al., 2000)

The speed of adoption may crucially depend of the government role that may be either discouraging or stimulating. The experience of developed countries shows that no simple answer exists to the question of the regulation of e-banking.

The legislation specific to electronic banking does not exist in developed counties. However, in some of them the need for such legislation is recognized. These include Germany, Switzerland, and the United Kingdom. In Canada and Sweden a necessity for such legislation is under discussion. The United States, France, Belgium and the Netherlands do not discuss this question at the time. (Good 1997, p. 28)

The duality of electronic money is also important issue to consider when trying regulating electronic money and banking. "[I]nsreasing number of economists put forward the idea that money ought to be considered as a flow of information."

(Pifaretty, 1998, p.4) "Sifers (1997) raises an issue of convergence between telecommunications and banking in electronic payments and claims that it is becoming harder to tell what type of legislature we should think of. Describing the situation with electronic money regulation in United States he says:

“Rather than establishing a regulatory framework, the federal government has effectively adopted a wait-and-see approach. The lack of any regulations attempting to address the issues raised could unintentionally slow the development and impair consumer acceptance. Regulatory action should be formulated that flexibly adapts itself to market conditions. The regulatory scheme should be flexible enough to permit adjustments in the intermediate term. It is unclear, for instance, how to balance promoting competition and innovation while at the same time ensuring against the failure of an issuing unregulated institution. To what extent should regulators be concerned about risks that are introduced in the payment system, particularly from nonfinancial entities, and can nonfinancial entities be expected to accept the same level of responsibility as banks without regulation?” (Sifers, 1997)

The same can be said about Ukrainian legislature. A draft of the Law of Ukraine “About Money Transfer in Ukraine” has been submitted to Vekhovna Rada for 15 times and was rejected by its profile committee. This draft (available at www.bank.gov.ua) contains: 44 definitions of elements of electronic banking and money and other related terms; interbank electronic transactions; responsibility in transactions; privacy information protection; control over money transactions. NBU officials wait until electronic banking will mature and after that will try to tackle this issue. However, the time will be lost, and a dynamic but unregulated environment will produce a highly distorted market which will be harder to regulate, stimulate or put in order.

The fact that in Ukraine electronic banking is unregulated has important implications for the current research: the absence of regulation of electronic banking implies that there cannot be any influence of regulation on the probability of adoption of electronic banking neither in general nor specifically.

In other words, regulation is **not** a factor in decision-making on the adoption of e-banking.

1.4. Banking Innovation and Efficiency

From general questions of definitions, classification and regulation let us go on to more specific questions of a measurable influence of banking innovation on bank efficiency and vice versa, i.e. the influence of bank efficiency on adopting new technologies.

The first issue is important because if the market is not distorted and if banking innovations increase efficiency all banks should adopt electronic banking simultaneously. But this is not the case in any country. Therefore, there exist some other factors which influence the decision-making.

One of the main factors that characterizes today's financial environment is uncertainty. Uncertainty makes for managers extremely difficult to form the strategy for the future. "The tension we experienced in the banks over forming a strategy for the future reflects the tension between investing in the perfection of the alignment of labor, capital and production processes for today's strategy versus the investment in a portfolio of alternative future strategies." (Frei, Harker and Hunter, 1997a)

Another factor is a problem of a measure of bank efficiency. Frei, Harker and Hunter (1997b) emphasize the role of X-efficiency reflected in management practices of different. This amends the role of traditional measures of efficiency like return on equity etc.

The second is important for implications for the future of the electronic banking industry. If only efficient banks choose to introduce electronic banking, then the whole industry will be efficient and no regulatory intervention is needed.

Conversely, if problem banks engage in electronic banking, then the future of industry may be troublesome. “Inefficient firms cannot be excluded from the market in one moment.” (Frei, Harker and Hunter 1997b, p. 44) This creates a problem of ‘adjustment’ that is harmful for both customers and sound banks because asymmetric information disallows customers to distinguish sound from problem banks. This leads to the underconsumption of banking services and makes the banking system inefficient.

Hunter et al. (2000) report that technology alone does not determine earnings. Their results suggest that earnings are mainly influenced by business strategy, market segmentation, and consumer preferences.

Frei and Harker (1996) focus on separate processes of banking services delivery channel and emphasize that traditional measures of efficiency such as transactions per full-time equivalent employee (FTE), return on assets (ROA) and return on equity (ROE) do not permit to evaluate the drivers of performance. In their research, they use bank specific indicators of performance such as Check Cycle Time, ATM Cycle Time and Customer Time, the outputs that are impossible to get in Ukraine simply because they are not reported by Ukrainian banks. Therefore, we use the return on equity as the indicator of bank efficiency.

1.5. Modeling the Economic Behavior of Banks

Now, let us focus on a group of studies, which investigates the economic behavior of banks over decision-making on implementation of electronic banking. Earlier in this chapter, it was said that the supply side of the market for electronic banking plays a key role for banks in adopting e-banking. Additionally, a persistent necessity to lower transactions costs in order to make economic profits makes the question of adoption significantly dependent on internal economic factors. Fortunately, this dependence can be measured econometrically.

Two studies Hitt, Frei and Harker (1998) and Furst, Lang, Nolle (2000a) are of interest both in terms of comprehensiveness and methodology used.

Hitt, Frei and Harker investigate a question of how financial firms make investment decisions. The research is based on case studies of PC-banking and development of corporate Internet sites for 6 large financial institutions.

The authors emphasize two conflicting goals of financial firm:

- short term goal of maximizing the firm's value (which is mainly reflected by return on equity measure);
- long term goal of retaining high value customers (which is reflected in deposits to asset ratio).

Consequently, two different models are used to reflect these goals. The first goal is consistent with a competitive model of one-period profit maximizing firm. It is based on the notion that bank generates profit in the short term using a vector of physical, technological, managerial inputs, etc. It does not include in profit function as customers' commitment to the bank, implicit and explicit insurance of the both customer and bank as is the case for the second goal.

For the second goal, long term relationship between customer and bank matters. This implies that "...competition ... may be undesirable if it reduces future profits and hence the amount of risk sharing that can occur. It also suggests that when choosing strategies to maximize the benefits of relationships firms should be concerned with offering a range of profitable services, rather than simply expanding the number of services available." (Allen and Gale 1997, p. 22)

Hitt, Frei and Harker found that PC banking main economic function was retaining high-value consumers rather than adding to financial firm's value. (Hitt, Frei and Harker 1998, p.43).

This result may signify that introduction of electronic banking, in general, may be driven primarily by the need to retain the current customer base, which can be expressed numerically in the ratio of deposits relative to all assets of the bank. In the empirical part we are going to test whether this is the case in Ukraine.

Furst, Lang, Nolle, 2000a use econometric model to investigate the factors of decision-making on Internet banking for banks. The main factors explaining which banks have chosen to offer Internet banking (INTNEW) for all as well as for small national banks are: the size of the bank (ASSETS), the age of the bank (YOUNG), physical location of the bank in an urban area (URBAN), membership in a banking-holding company (BHC), deposits to assets ratio (DEPOSITS), relatively higher premises and other fixed expenses to net operating revenue (EXPENCES), and higher non-interest income (NIINCOME), ROE (ROE), and CAMELS-rating (CAMELS) .” (Furst, Lang, Nolle, 2000a, p. 35). The signs of coefficients of these factors as it was viewed by (Furst, Lang, Nolle, 2000a) are presented in the Table 1.

Table 1. Summary of Expected Signs of the Model of Internet Banking

Variable	Sign	Note
ASSETS	positive	
YOUNG	positive	dummy
BHC	positive	dummy
URBAN	positive	dummy
DEPOSITS	negative	
EXPENCES	ambiguous	
NIINCOME	positive	
ROE	ambiguous	
INEFFICIENCY	ambiguous	
CAMELS	ambiguous	

Thus, their model looks like the following:

$$\text{INTNEW} = f(\text{ASSETS}, \text{YOUNG}, \text{BHC}, \text{URBAN}, \text{DEPOSITS}, \text{EXPENCES}, \text{NIINCOME}, \text{ROE}, \text{INEFFICIENCY}, \text{CAMELS})$$

The explanatory variables in the model are lagged one year from dependent variable, which takes into account the fact that there is a time lag between actual decision-making and observable results. Another tool is a sample selection. The sample was limited is to banks that introduced Internet banking to a certain date. The number of Ukrainian banks is limited to around 200 banks and this is very problematic to apply the same technique for Ukraine.

A very important question that may arise here is whether banks that introduced electronic (Internet) banking became more profitable and risky. If yes, then this can negatively influence the results of simulation by making profitability and risk endogenous. However, there is still no clear answer to that. In general, these

banks do not appear more profitable or riskier than others. (Sullivan, R. J. 2000, p.2). Further we will assume for Ukraine that electronic banking does not have a significant influence on the profitability and riskiness of a bank, based on a relatively small share of electronic banking industry of the whole banking system of Ukraine.

Chapter II

THE THEORETICAL PART

2.1. Importance of Research in Electronic Banking

Recent technological innovations in the banking sphere raise various questions about the direct and indirect, short run and long run impact on the behavior of economic agents and economic development in the country in question. These questions are particularly important to answer for developing countries and countries in transition, because along with market failures, these countries still continue to experience government failures. So the regulatory mechanisms have to take into account both aspects.

How can the optimal regulation of an industry be created when no such industry existed before? In case of Ukraine, the National Bank of Ukraine is not yet in favor of any regulation of electronic banking except certification of systems of electronic banking for commercial banks.

The difficulty of development of innovations has economic background and is associated several types of market failures.

Free-riding versus monopolization problem. Consider market before the new product or technology has not been yet introduced. Few firms introduce the new product into the market in its primary form. These firms make improvements in the product as well as in the way it is delivered incurring some fixed costs for this. The new product takes hold; customers know it better and the first-comers begin to raise profits from their initial investment. After that two scenarios are possible.

According to one of them, if the know-how can be easily transferable other firms enter the market starting to undercut the first-movers. Being aware of this, all firms can wait until someone introduces a new product, improves it and then other firms free-ride at the first-mover's expenses. The idea of promotion of innovation leads to a question of regulation which would stimulate innovative activities to increase efficiency of firms. Regulation may also make transfer more difficult (more costly) resolving the problem of free-riding.

If know-how is not easily transferable, the first-mover monopolizes the market and raising the question of regulation again to remove inefficiencies of other sort.

Asymmetric information problem. In connection with electronic banking, this problem arises at both sides: *adverse selection* and *moral hazard*.

The problem of *adverse selection* arises, for example, when the customer does not know which bank is safe and which is not or whether the payment will reach destination. In an open electronic environment like Internet customer's money may be relatively easily stolen through manipulation with electronic accounts. And this belief may scare away potential customers from adoption of e-banking. Also banks are could be subject to risks, especially in the case of transactional Web-sites when at least some part of bank's computer system is open to outside and either some 'customers' can withdraw more money then they actually have on their account or non-customers can steel money due to cheap but unreliable security system.

Moral hazard can be a problem of the development of e-banking. If deposits in a bank are protected by deposit insurance, the bank can take excessive risk knowing it is guaranteed from runs. Excessive risk may quickly eat up all bank's capital and lead to liquidity problems. Ebanking demands from bank high liquidity to make payments immediately. Therefore, moral hazard from one end

and higher liquidity constraints from the other may discourage banks from adoption of e-banking.

“Too big to fail” policy problem. This problem is closely connected with the moral hazard problem and at the same time makes it more severe. The state is not interested in the failure of a big bank because of negative political, social and economic consequences. Therefore, a big bank has may undertake risky projects (economically unjustified innovation policy in our case) knowing that in the state will bail it out anyway. Consequently, such banks can engage in introductions of wide varieties of sophisticated electronic banking products which may not consumed at the time.

Agency problem. Arises when the interests of managers of the bank maximizing their own utility decide on innovations policies (which may not only increase efficiency, but also decrease it) contradicts to bank mission as a revenue-generating facility for the owners. Monitoring of managerial activities when it is done excessively may hamper the development innovations and necessary decisions are not taken in time.

However, all these issues can be neutralized or at least mitigated by the appropriate design of regulation. Such optimal regulation can be achieved only when it has answers to these basic issues:

- Who are the main actors of “the play”?
- Which economic factors explain decision of banks to adopt e-banking?
- Which of those “decisive factors” should be the most carefully monitored?

Thus, the main task of economic research in e-banking is in providing the regulatory institutions with clear answers to these questions. Further in this paper we try to answer these questions.

2.2. Actors

The actors fall in three main categories: consumers, commercial banks, and regulating authorities.

Consumers are main users of electronic banking, i.e. companies, organizations, private persons; by using electronic banking, they primarily want to save time, and their money. Some use it for prestige as long it is a rare service. At the beginning of introduction of ebanking, when customers do not know much about it and demand for these services is low, they do not play a significant role in adoption of electronic banking. When the awareness of the product grows, the role of customers increases and they begin to influence the type of the product directly or indirectly. As a result, suppliers of the services tailor the product to the customer's needs.

The regulating authorities (first NBU, Verkhovna Rada and the government) establish 'rules of the game' and create institutional environment for electronic banking; legislative and other regulatory bodies, influence decisions of all actors.

Commercial banks are the providers of electronic banking services for customers. They are the main players of the game and we focus primarily on them. Ukrainian market for electronic banking services is now at the first stage of its formation. Yet, not only the largest, but also some medium and small size banks are beginning to provide e-banking in different forms. The terms and conditions of their services differ much and this causes some differences in the price of these

services. However, banks try to behave strategically in order to capture positive economic profits.

Besides mentioned, there are other actors that influence the situation but to a smaller extent. International financial organizations, Electronic Funds Transfer (EFT) systems, mass media, Internet Service Providers (ISPs) and others may contribute to the development of e-banking.

2.3. Development of the Model of Electronic Banking for Ukraine

To answer the last two questions we have to develop econometric model that would link some bank-specific economic factors and an observable outcome of decision-making.

There is no doubt that electronic banking will eventually mature, as a banking product and this will lead to a greater efficiency in the banking industry as well as in the entire economy. But developing in Ukraine a system of electronic banking will require a lot of funds at all stages. And as is true for all dynamically developing markets, the initial development may take place in a monopolistic (oligopolistic) environment, which leads to deadweight losses and reduction in economic efficiency. (Pindyck and Rubinfeld, 1997, p.354). In the U.S., customer use of Internet banking is disproportionately concentrated among a few large banks. (Furst, Lang and Nolle, 2000b, p.29)

The government has not yet developed a solid legal base for electronic banking activities in Ukraine. Regulation in this sphere is required to protect customers from inexplicable raise in the prices of these services. In addition, given pragmatic and grounded elaboration of this regulation, it may stimulate the development in other spheres (Internet, retail services, etc.). Inactivity of the government creates

additional obstacles on the way of e-banking or at least does not remove existing ones.

Private benefits from electronic banking are almost obvious. Consumers save time of searching for lower interest rates (for loans and deposits) or better services. The reduction in interest rates due to increased competition caused by implementation of e-banking favors customers as well as bankers get more in profits from using new technologies in banking. On the other hand, the costs may be quite impressive when one imagines the scale of possible fraud or bank runs that may spread over the electronic banking system. Therefore, risk-averse customers may refrain from using electronic banking services in favor of conventional banking.

All in all, consumers along with many banks are only starting to use the e-banking. Banks that adopted e-banking are trying to capture the market and economic profits, as they are afraid that the government may take measures for or against them. As to the government, it has done little to regulate new banking activities. This situation describes the conditions under which the development of electronic banking takes place in Ukraine.

In the assessment of electronic banking we identified three main parties, which are affected by electronic banking: regulators, banks and customers. We mainly concentrate on the second party and investigate the observed results of banks' assessment of consumer demand for electronic banking services.

These contradictions are highlighted in economic literature. "There is much interest in these new forms of payments being shown by technology firms, banking organizations, credit card companies, and Central banks. However, the majority of the general public is blissfully unaware that these new payments

methods could be looming on the personal financial horizon.” (Good, 1997, p. 40)

Up to the moment, there were no serious attempts to verify the potential demand for electronic banking services and its dynamics in Ukraine with appropriate data. This question is still unanswered, first of all, because research on this topic is usually conducted by commercial banks. But the results of this research are usually kept confidential. The same concerns the supply side of the market. Many potential consumers are not aware of the new products and opportunities that exist for e-banking users.

Legislation of electronic banking as a balance between stimulation and regulation to compensate for market imperfections should be based on economic analysis and thoroughly justified. Studying incentives and disincentives should be at the beginning of this analysis. And the first question which arises is whether regulators can use available information and study first of all economic incentives which explain the decision of a bank to adopt electronic banking. Despite adoption or not adoption is a question of managerial decision, this managerial decision should have some economic basis. In the current paper we attempt to prove that along with the size of the bank, such basis is a deposit base normalized by assets of a bank.

2.4. Deposits of Physical Persons and Decision-Making on Technology

There are several reasons why deposits of physical persons have more influence on the process of decision-making about technology in Ukraine than other bank characteristics.

In Ukraine, as in many countries of former Soviet Union, the banks are in fact the only institutions that take deposits, so if people want to save their money with some financial intermediary they turn to a bank.

They are much more important than the deposits of corporate clients because of about 163 Ukrainian banks 141 banks hold deposits of physical persons and only 36 hold deposits of corporate clients. Therefore, the direction of marketing efforts is directly to physical persons. Marginal effect of such efforts may be quite high, especially for new products.

The role of deposits of private persons in the decision-making process can be assessed econometrically.

2.5. The Main Question and the Main Hypothesis

The main question of the thesis is:

How deposits influence the likelihood (probability) of adoption electronic banking?

In order to formulate the conclusions and policy implications we answer the following auxiliary questions:

What are the main factors that influence the likelihood of adoption electronic banking? What is the direction of this influence?

In order to answer the thesis question we formulate the main hypotheses:

H₀: In Ukraine, deposits of physical persons (normalized to assets) ***ceteris paribus*** do not influence or negatively influence the probability of adoption of electronic banking by a bank.

H₁: In Ukraine, deposits of physical persons (normalized to assets) ***ceteris paribus*** positively influence the probability of adoption of electronic banking by a bank.

Chapter III

DATA AND METHODOLOGY OF EMPIRICAL RESEARCH

3.1. Data Description

Electronic banking is a relatively new branch of banking. Consequently, very little information is available for research. Additionally, the problem seems to be in both in the difficulty to follow net banks activities and the general issue of banking secrecy. “Banks are the second least reported source of information, just ahead of electronic media.” (Kennickell and Kwast (1997), p. 21) Therefore, the banks’ publicly reported balance sheet entries and profit-loss statements are the main source of information about their performance and current financial state.

In the present research, we use two datasets. The first dataset provides a monthly data on balance sheet entries as well as profit and loss statements items of Ukrainian banks for the period January 1998 – August 2000, while in the simulation we use only the data for December 1999. The second one contains the same, though much more detailed, reports on the first quarter of 2001. The second dataset is more comprehensive providing more detailed information of banks’ revenues and expenses.

Additionally, we have a list of Ukrainian banks which adopted electronic banking by either developing corporate Internet site, or offering telephone banking on the end of fourth quarter of 2000 and of first quarter of 2001. The data comes from Association of Ukrainian Banks, the Bulletin of NBU and Internet sites www.banker.kiev.ua. We included in our sample all Ukrainian banks because only

few Ukrainian banks were offering e-banking before 1998 and because of this they cannot have significant results of the estimation.

3.2. Methods Used

To answer the thesis question, we use econometric modeling. We test the null hypothesis using multivariate logit regression with the dependent variable Y which reflects whether the bank adopted electronic banking ($Y=1$) or not ($Y=0$); and independent variables internal bank's characteristics (assets, ROE, structure of non-interest expenses and income, and relative share of deposits and fixed assets) serving as main economic factors of decision-making on introduction electronic banking by a bank; and control factor (the age of the bank).

The main testing tool we use logit regression which relates the probability of the outcome (assumed to be distributed with logistic distribution) expressed in log odds ratios on the right hand side and the linear combination of the values of specific bank characteristics on the left hand side.

The independent variables measured at time t_0 whether dependent variable is measured at time t_1 . This was made in order to account for the time lag between economic factors and decision-making which is t_1-t_0 and assumed to be equal 1 year for all banks.

By computing the marginal effects, we determine how strong the influence of each factor is.

Since we have different datasets, we use different specifications derived from the basic one given in the next subsection.

3.3. The Model Description

The main specification of internally based decision-making looks as follows:

$$Y = \mathbf{b}_0 + \mathbf{b}_1 \cdot AGE + \mathbf{b}_2 \cdot A + \mathbf{b}_3 \cdot ROE + \mathbf{b}_4 \cdot DPAR + \\ + \mathbf{b}_5 \cdot DCAR + \mathbf{b}_6 \cdot FEXP + \mathbf{b}_7 \cdot NIINC + \mathbf{b}_8 \cdot INEFF + \mathbf{e}$$

where, Y = decision-making status at time t_i ; 1 – decision has been made, 0 – otherwise;

AGE – age of the bank measured in years, from the day of registration till time t_i ;

A – Assets at time t_i ;

ROE – Return on Equity for given period assigned to time t_i ;

$DPAR$ – Deposits (physical persons) to Assets ratio at time t_i ;

$DCAR$ – Deposits (corporate clients) to Assets ratio at time t_i ;

$FEXP$ – Expenses for fixed assets to Net Operating Revenue ratio at time t_i ;

$NIINC$ – Non-interest income to net operating revenue ratio at time t_i ;

$INEFF$ – Non-interest expense to net operating revenue ratio at time t_i ;

Compared to the model in Furst, Lang and Nolle, 2000a, the CAMELS variable (the NBU began measuring CAMELS-rating of Ukrainian commercial banks only this year and this information is confidential) drops out. Since, we do not have revenues-expenses breakdown for the first dataset and age-location variables for the second one. Therefore, the equations for estimation are built taking into account this data deficiency.

Since the dependent variable takes values either 1 or 0, we do not have to incorporate in it various products of electronic banking. Instead, we chose one

product or mix of typical products that are in the middle of adoption and are well represented on the market electronic banking services. For this purpose we choose the setup in which the dependent variable takes value of 1 if the bank developed corporate Internet site and was either issuing payment cards or was offering telephone banking by January 2001 (end of the fourth quarter 2000) for the first dataset and April 2001 (end of the first quarter of 2001) for the second , and 0 – otherwise.

Let us consider independent variables for the two datasets. Independent variables for the first dataset are used as of December 1999 balance sheet entries. The method of calculation of variables from balance sheet entries will be presented in Appendix A.

Let us then identify the signs of coefficients. Based on previous research (Furst, K., W. Lang, D. Nolle, 2000a), we expect that *ceteris paribus* assets of a bank **A** positively influence the likelihood of adoption of electronic banking. This may be explained by the fact that more assets make possible for a bank to more easily incur start-up and maintenance costs of introduction of e-banking thus reducing average total costs of a single electronic transaction.

AGE controls for “newness” of a bank. We expect this coefficient to be positive as it is likely that some new banks were formed based on a belief that new technology created new business opportunities. (Furst, Lang and Nolle, 2000a, p. 32) Instead of dummy, we use the numeric value of the period from registration of a bank until the exogenous variables measurement time (time t_0).

The direction of ROE, FEXP and INEFF is ambiguous. Because as was previously established by Furst, Lang and Nolle:

for ROE“...it is possible that more profitable banks could choose to incur the costs of offering Internet banking both because they are financially more able to do so, and because they believe doing so will help them maintain their competitive position. However, less profitable banks might be more willing to invest in Internet banking to improve their performance ...” (Furst, Lang and Nolle, 2000a, p. 33)

Additionally, we propose to estimate for the second dataset the model where replace ROE by its score because at the beginning of the year, large number of banks reports negative net profits. To repair this deficiency along with absolute figure we introduce ranks of banks by ROE from the worst (rank equal one) to the best (rank equal maximum - 163).

for FEXP: ” On the one hand, banks with relatively high expenses on premises and fixed assets may view adoption of [electronic banking] as a way to reduce expenditures devoted to maintaining a branch network.³⁹ On the other hand, some analysts have argued that banks without a large branch network will seize on offering [e-banking] as an inexpensive means to expand their customer base...” (Furst, Lang and Nolle, 2000a, p. 32)

for INEFF: “The higher the value of this variable, the more inefficient is the bank. Our sign expectation for this variable, like ROE, is ambiguous. The estimated coefficient for the variable could be positive if inefficient banks viewed [electronic banking] as a means to become more efficient. Alternatively, the coefficient could be negative if relatively efficient banks are more innovative and better able to incorporate new technology and new services.” (Furst, Lang and Nolle, 2000a, p. 32)

“**NIINC** expresses “aggressiveness” of a bank business strategy and tells how much of its income comes from fees. We hypothesize that banks with a greater

reliance on nontraditional revenue are more likely to view [e-banking] as a way to market fee-generating services, and are more likely to be institutions that adopt innovative services as part of an overall aggressive business strategy.” (Furst, Lang and Nolle, 2000a, p. 33)

We decompose depositary base on private and corporate deposits because it makes difference in Ukrainian context to consider banks which have higher share of physical persons’ deposits and those which have more deposits of corporate clients to have different incentives to offer e-banking. Banks with ‘private’ deposits should react more actively, since usually ebanking is associated with small transactions, which more appeals to physical persons.

We expect the sign of coefficient by DPAR and DCAR to be negative as suggested Furst, Lang and Nolle (2000a) for their DEPOSITS variable, because banks that relay less on traditional sources will offer e-banking more readily. We test this in the next section. Therefore, we hypothesize that the influence of the ratio of deposits to total assets to be negative.

If influence of deposits is statistically significant, then we are interested whether some particular type of deposits plays major role or marginal contributions of all types are almost the same.

Chapter IV

ESTIMATION RESULTS AND THEIR INTERPRETATION

4.1. Estimation Results

Table 2. Summary Statistics for Main Regressions

Coeff. (p-value)	Dataset 1		Dataset 2		
	Restricted	Not Restricted	Restricted	Not restricted	ROE- ranked
Constant	-1.613295 (0.000) ^{***1}	-1.394548 (0.054) [*]	-1.758618 (0.000) ^{***}	-1.823146 (0.000) ^{***}	-2.570507 (0.000) ^{***}
AGE		-.1200522 (0.274)	--	--	--
A	.0044258 (0.005) ^{***}	.0040972 (0.008) ^{***}	.0033444 (0.009) ^{**}	.0032006 (0.013) ^{**}	.0034284 (0.018) ^{**}
ROE	-.8155637 (0.042) ^{**}	-.7973813 (0.073) [*]		.7186724 (0.878)	.010604 (0.028) ^{**}
DCAR		1.713382 (0.170)		.6150501 (0.722)	.6126883 (0.715)
DPAR	4.609798 (0.009) ^{***}	5.973582 (0.005) ^{***}	8.351859 (0.001) ^{***}	8.15876 (0.001) ^{***}	8.668767 (0.001) ^{***}
FEXP	--	--		.1196925 (0.030) [*]	.1576505 (0.025) [*]
NIINC	--	--		.0162239 (0.637)	.0132792 (0.739)
INEFF	--	--		-.032161 (0.117)	-.0408793 (0.065) [*]
No. obs.	131	131	163	163	163
Pseudo R ² (p-value) ²	0.1153 (0.0032) ^{***}	0.1336 (0.0085) ^{***}	0.1988 (0.0001) ^{***}	0.2153 (0.0001) ^{***}	0.2411 (0.0002) ^{***}

¹ *) significant at 10 % level, **) significant at 5 % level, ***) significant at 1 % level.

² p-value for the Wald test of joint insignificance of all variables.

In this part, we estimate the basic specification for two datasets. The estimation results for both datasets are given in Table 2. Stata log-file is given in appendix B.

Estimation was done in Stata 6.0 using routine maximum likelihood estimation. To correct for heteroskedasticity of residuals we use robust estimation using Huber/White/sandwich estimator of variance.

We estimated restricted as well as not restricted versions of equations to see the influence of insignificant variables on results.

PseudoR²s are low but usual for this type of regression. They cannot be used as a measure of the goodness-of-fit, and to some extent account for unobserved factors that may explain banks' decision-making over e-banking.

The Wald test suggests that we can reject the hypothesis of joint insignificance of regression coefficients at 1% level of significance (p-values range from 0.0001 to 0.0085).

As it can be seen from Table 2. Summary Statistics for Main Regressions, the variables second dataset better explain the decision of banks on e-banking than the first one for restricted and non-restricted versions. This is perhaps due to less variation of quarterly data as opposed to monthly data.

AGE coefficient has expected sign but is insignificant. Therefore we conclude that the data does not support the argument of more innovativeness of young banks.

We also see that coefficients of A and DPAR variables are significant in all specifications at the level of significance no more than 5 %. At the same time, DCAR is highly insignificant in all specifications which mean that the data does not support the idea that there exists the relationship between the corporate

deposit base and decision-making over e-banking. Moreover, DPAR and DCAR have wrong signs, whereas A has the right sign.

FEXP coefficient is significant and positive, which means that with larger share of expenses for premises and fixed assets, which usually happens when a bank has large branch network, are pushing banks to innovate as an alternative to expansion of branch network.

NIINC and INEFF are insignificant in unrestricted specification. Therefore, we cannot support their influence on the decision-making on e-banking with the data available.

ROE has contradictory effect on the probability of adoption of electronic banking. First dataset shows that ROE has negative absolute statistically significant influence on the probability of adoption. The second shows that only relative efficiency of the bank matters which is shown by significance of ROE coefficient only if it is represented by the rank rather than by absolute value.

Table 3. Marginal effects of the Main Regression on the Second Dataset

Y	Coef.	Std. Err.	x-bar	P>z	[95% Conf. Interval]		Mean contribution
A	0.000563	0.000204	369.313	.006	0.000163	0.000963	0.20796015
ROE	0.126433	0.822169	0.028422	.878	-1.48499	1.737853	0.00359347
DPAR	1.435331	0.368481	0.078461	.000	0.713121	2.157541	0.11261751
DCAR	0.108203	0.305451	0.157718	.723	-0.49047	0.706876	0.01706553
FEXP	0.021057	0.009611	0.573512	.028	0.00222	0.039894	0.01207638
NIINC	0.002854	0.006045	4.92438	.637	-0.00899	0.014703	0.01405517
INEFF	-0.00566	0.003599	7.06993	.116	-0.01271	0.001396	-0.040001
Obs.P=	0.3865	Pred. P=	0.4998				

In Table 3, we see the marginal effects of each variable of the second dataset. We see that the most important mean contribution comes from assets variable A., almost 21 percent out of total 38.7 percent. The coefficient 0.000563 means that each additional 10 mln. Hryvnas increases probability of adoption by 0.5%.

Another important mean contribution comes from DPAR variable which amounts up to 11.3 %. One percent increase in deposits to assets ratio causes 1.44% increase in probability of adoption of e-banking.

The last variable that has statistically significant but rather small contribution to the probability of adoption is FEXP. Its mean contribution is only 1.2% so we can make conclusion that this actor has only marginal influence of the probability of adoption.

We continue our analysis and ask whether there exists a part of deposits of which is mostly responsible for the changes in the probability of adoption. For this purpose, we break down each type of deposits into two subtypes according to their liquidity: sight deposits (S) and time deposits (T). Thus instead of two variables (DPAR and DCAR) we get four (DPSAR, DPTAR, DCSAR, and DCTAR).

Table 4 provides estimation results when we take into account different subtypes of deposits. As we can see, results from two datasets are slightly different. Time deposits coefficient for physical persons is significant at 10 and 5 % for the corresponding datasets. Sight deposits are significant at 20 and 1 % for the first and the second datasets. The rest of results are practically the same.

The result of estimation on the first dataset do not add much to what we already know about influence of deposits on decision-making.

Table 4. Summary Statistics for Auxiliary Regressions

	Dataset 1		Dataset 2	
	Coeff.	(p-value)	Coeff.	(p-value)
Constant	-1.401351	(0.056)*	-2.036135	(0.000)***
AGE	-.1195674	(0.288)**	--	--
A	.0042119	(0.007)***	0.00357879	(0.015)**
ROE	-.8421261	(0.059)*	0.3457879	(0.944)
FEXP	--	--	0.1282914	(0.054)*
NIINC	--	--	0.0178165	(0.638)
INEFF	--	--	-0.0345171	(0.124)
DPSAR	13.26117	(0.178)	33.75113	(0.010)***
DPTAR	4.611701	(0.094)*	5.666594	(0.040)**
DCSAR	1.345784	(0.329)	0.1780643	(0.926)
DCTAR	2.927766	(0.323)	3.923475	(0.301)
No. obs.	131	131	163	163
Pseudo R ²	0.1403	(0.0397)**	0.2390	(0.0006)***

Table 5. Marginal effects of the Auxiliary Regression on the Second Dataset

Y	Coef.	Std. Err.	x-bar	z	P> z	[95% Conf. Interval]		Mean Contrib.
A	0.000532	0.000199	369.313	2.67	0.008	0.000142	0.000923	0.196622
ROE	0.058615	0.83529	0.028422	0.07	0.944	-1.578523	1.695753	0.001666
FEXP	0.021747	0.011119	0.573512	1.956	0.05	-0.000046	0.04354	0.012472
NIINC	0.00302	0.006404	4.92438	0.472	0.637	-0.009531	0.015571	0.014872
INEFF	-0.00585	0.003769	7.06993	-1.553	0.121	-0.013237	0.001535	-0.04137
DPSAR	5.721204	2.10995	0.016212	2.712	0.007	1.585778	9.85663	0.092752
DPTAR	0.960553	0.4428	0.062249	2.169	0.03	0.092682	1.828424	0.059793
DCSAR	0.030184	0.32311	0.116811	0.093	0.926	-0.603101	0.663469	0.003526
DCTAR	0.665074	0.643789	0.040908	1.033	0.302	-0.59673	1.926878	0.027207
obs. P=	0.386503	pred. P=	0.525976					

However, the second dataset shows interesting results, which are especially well seen through the prism of marginal effects in Table 5.

Along with almost 20% influence of assets at the level of significance 1 %, we can observe highly statistically significant results for sight 9% mean contribution to the likelihood at the level 1 % and almost 6% mean contribution of time deposits significant at 5 %. Log-file of regression summary is given in APPENDIX C.

4.2. Discussion

Our analysis shows that in the absence of regulation and in the presence of uncertainty in the market for ebanking services, larger Ukrainian banks and banks oriented on private clients (physical persons) respond more actively to adoption of electronic banking and adopt new products quicker than smaller banks or the ones with small relative private *ceteris paribus*

Using available data, we refute the null hypothesis that in Ukraine deposits of physical persons (normalized to assets) ***ceteris paribus*** do not influence or negatively influence the probability of adoption of electronic banking by a bank. Thus, we have to accept the alternative hypothesis that deposits of physical persons (normalized to assets) ***ceteris paribus*** positively influence the probability of adoption of electronic banking by a bank.

The problem with data, especially with the banking data makes economic research in banking very challenging.

The data does not give us clear evidence that profitability used as a measure of overall efficiency influences the probability of adoption.

CONCLUSIONS AND POLICY IMPLICATIONS

This work was intended to show that bank characteristics serve as economic factors and statistically significantly influence the probability of adoption of electronic banking in Ukraine.

We established that the probability of adoption of electronic banking is positively correlated with the size of the banks expressed in total assets. Therefore, the size of the bank, according to our model is the most important factor of introduction by the bank new products of electronic banking in Ukraine.

Deposits of physical persons relative to assets also play important role in the decision-making process and are positively correlated with the likelihood of adoption of electronic banking. This contradicts to the finding of Furst et al. (2000a) on the US data. The explanation of this phenomenon is that deposits of physical persons are more important source of funds for Ukrainian banks than for their American counterparts. American banks have much more diverse sources getting monetary assets.

It is interesting to verify this result for other transition countries and especially for FSU countries like Russia. Unfortunately, such data was not available for research.

These results suggest that inevitable spread of electronic banking in Ukraine may lead to consolidation of funds of small Ukrainian banks to allow them to innovate more readily and thus compete with larger banks.

However, NBU should monitor carefully the performance of banks, especially those which are adopting electronic banking and sacrifice either too much security or efficiency and prevent undesired misallocation of financial resources.

At the same time, NBU should facilitate adoption of electronic banking and electronic money by adequate design of certification of systems and firms which provide outsourcing in cooperation with other Central Banks. Also it is important to provide information to commercial banks and their customers in order to raise confidence of banking and general public in new payment methods.

This is important since it raises not only efficiency of some commercial banks but also of the financial system and Ukrainian economy as a whole.

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APPENDIX A: CALCULATION OF THE VARIABLES

A (Assets) = Total Assets

AGE = 01 Jan 2000 – Date of Registration (date of entry)

ROE (return on equity) = After Tax Net Profit/ Capital

**Net Operating Revenue = Total Revenue – Total Expenses + Creation of Resources
+ Tax Paid**

FEXP = Expenses for Fixed Assets / Net Operating Revenue

NIINC = Non-Interest Income /Net Operating Revenue

INEFF = Non-Interest Expense / Net Operating Revenue

**DPSAR (sight deposits to assets ratio: physical persons) = Sight Deposits Of Physical
Persons/ /Assets**

**DPTAR (time deposits to assets ratio: physical persons) = Time Deposits Of Physical
Persons/ /Assets**

DPAR (deposits to assets ratio: physical perons) = DPSAR + DPTAR

**DCSAR (sight deposits to assets ratio: corporate clients) = Sight Deposits Of
Corporate Clients /Assets**

**DCTAR (time deposits to assets ratio: corporate clients) = Time Deposits Of
Corporate Clients /Assets**

APPENDIX B: LOG-FILE OF ESTIMATION OF THE MAIN REGRESSIONS

```
. logit y a roe dpar ,robust
```

```
Iteration 0:   log likelihood = -81.411524
```

```
-----
Iteration 5:   log likelihood = -72.027675
```

```
Logit estimates                               Number of obs   =       131
                                              Wald chi2(3)    =       13.83
                                              Prob > chi2     =       0.0032
Log likelihood = -72.027675                 Pseudo R2      =       0.1153
```

```
-----
              y |               Coef.   Robust
                |               Std. Err.      z    P>|z|     [95% Conf. Interval]
-----+-----
              a |   .0044258   .0015652     2.828  0.005     .001358   .0074935
             roe |  -.8155637   .4005313    -2.036  0.042    -1.600591  -.0305368
             dpar |   4.609798   1.771381     2.602  0.009     1.137954   8.081642
            _cons |  -1.613295   .3295526    -4.895  0.000    -2.259206  -.9673835
-----
```

```
Mean of marginal effects,                   Number of obs =       131
observation-by-observation
```

```
-----
              y |               Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-----+-----
              a |   .0008164   .0002628     3.107  0.002     .0003014   .0013314
             roe |  -.1504474   .0707765    -2.126  0.034    -.2891668  -.0117279
             dpar |   .8503713   .2983058     2.851  0.004     .2657027   1.43504
-----
```

. logit y age a roe dpar dcar,robust

Iteration 0: log likelihood = -81.411524

Iteration 5: log likelihood = -70.536955

Logit estimates	Number of obs =	131
	Wald chi2(5) =	15.49
	Prob > chi2 =	0.0085
Log likelihood = -70.536955	Pseudo R2 =	0.1336

y	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
age	-.1200522	.1097559	-1.094	0.274	-.3351699	.0950655
a	.0040972	.0015401	2.660	0.008	.0010787	.0071156
roe	-.7973813	.4455146	-1.790	0.073	-1.670574	.0758113
dpar	5.973582	2.145999	2.784	0.005	1.767502	10.17966
dcar	1.713382	1.248884	1.372	0.170	-.7343856	4.161151
_cons	-1.394548	.7239612	-1.926	0.054	-2.813485	.0243903

Mean of marginal effects, observation-by-observation	Number of obs =	131
---	-----------------	-----

y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
age	-.0216363	.019296	-1.121	0.262	-.0594557	.0161831
a	.0007384	.0002558	2.887	0.004	.0002371	.0012397
roe	-.1437074	.0780263	-1.842	0.066	-.2966362	.0092213
dpar	1.076584	.3374147	3.191	0.001	.4152637	1.737905
dcar	.3087931	.2210267	1.397	0.162	-.1244114	.7419975

. logit y a dpar ,robust

Iteration 0: log likelihood = -108.74678

Iteration 6: log likelihood = -87.12332

Logit estimates	Number of obs =	163
	Wald chi2(2) =	18.71
	Prob > chi2 =	0.0001
Log likelihood = -87.12332	Pseudo R2 =	0.1988

y	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
a	.0033444	.001287	2.599	0.009	.0008221	.0058668
dpar	8.351859	2.423004	3.447	0.001	3.602858	13.10086
_cons	-1.758618	.3134421	-5.611	0.000	-2.372953	-1.144282

Mean of marginal effects,
observation-by-observation

Number of obs = 163

y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
a	.0006019	.0002076	2.900	0.004	.000195	.0010087
dpar	1.503026	.3785857	3.970	0.000	.7610121	2.245041

. logit y a roe dpar dcar fexp niinc ineff,robust

Iteration 0: log likelihood = -108.74678

Iteration 6: log likelihood = -85.338839

Logit estimates

Number of obs = 163
Wald chi2(7) = 26.87
Prob > chi2 = 0.0004
Pseudo R2 = 0.2153

Log likelihood = -85.338839

y	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
a	.0032006	.0012936	2.474	0.013	.0006653	.0057359
roe	.7186724	4.681322	0.154	0.878	-8.45655	9.893895
dpar	8.15876	2.394056	3.408	0.001	3.466496	12.85102
dcar	.6150501	1.729509	0.356	0.722	-2.774726	4.004826
fexp	.1196925	.0551534	2.170	0.030	.0115938	.2277911
niinc	.0162239	.0343426	0.472	0.637	-.0510864	.0835342
ineff	-.032161	.0204896	-1.570	0.117	-.0723198	.0079978
_cons	-1.823146	.3692486	-4.937	0.000	-2.54686	-1.099432

Mean of marginal effects,
observation-by-observation

Number of obs = 163

y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
a	.0005631	.0002043	2.756	0.006	.0001627	.0009634
roe	.1264326	.8221686	0.154	0.878	-1.484988	1.737853
dpar	1.435331	.3684813	3.895	0.000	.7131214	2.157541
dcar	.1082028	.3054509	0.354	0.723	-.49047	.7068757
fexp	.0210569	.0096109	2.191	0.028	.0022199	.0398939
niinc	.0028542	.0060453	0.472	0.637	-.0089944	.0147028
ineff	-.0056579	.0035987	-1.572	0.116	-.0127113	.0013955

. logit y a roer dcar dpar fexp niinc ineff,robust

Iteration 0: log likelihood = -108.74678

Iteration 6: log likelihood = -82.530257

Logit estimates

Number of obs = 163
Wald chi2(7) = 27.83
Prob > chi2 = 0.0002
Pseudo R2 = 0.2411

Log likelihood = -82.530257

y	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
a	.0034284	.0014452	2.372	0.018	.000596	.0062609
roer	.010604	.0048232	2.199	0.028	.0011508	.0200572
dcar	-.6126883	1.680567	-0.365	0.715	-3.906539	2.681162
dpar	8.668767	2.511407	3.452	0.001	3.746501	13.59103
fexp	.1576505	.0703475	2.241	0.025	.019772	.295529
niinc	.0132792	.0399254	0.333	0.739	-.0649731	.0915315
ineff	-.0408793	.0221376	-1.847	0.065	-.0842682	.0025096
_cons	-2.570507	.4985656	-5.156	0.000	-3.547677	-1.593336

Mean of marginal effects,
observation-by-observation

Number of obs = 163

y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
a	.0005817	.0002158	2.696	0.007	.0001589	.0010046
roer	.0017993	.0007711	2.334	0.020	.0002881	.0033105
dcar	-.1039623	.2828386	-0.368	0.713	-.6583158	.4503912
dpar	1.470935	.3843022	3.828	0.000	.7177166	2.224154
fexp	.0267505	.0115738	2.311	0.021	.0040662	.0494347
niinc	.0022532	.0067872	0.332	0.740	-.0110495	.015556
ineff	-.0069365	.0037469	-1.851	0.064	-.0142803	.0004073

. log close

APPENDIX C: LOG-FILE OF ESTIMATION OF THE AUXILIARY REGRESSIONS

```
. logit y age a roe dpsar dptar dcsar dctar,robust
```

```
Iteration 0: log likelihood = -81.411524
```

```
Iteration 5: log likelihood = -69.989369
```

```
Logit estimates                                     Number of obs =      131
                                                    Wald chi2(7) =      14.73
                                                    Prob > chi2 =      0.0397
Log likelihood = -69.989369                       Pseudo R2 =      0.1403
```

y	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
age	-.1195674	.1126101	-1.062	0.288	-.3402791	.1011443
a	.0042119	.0015631	2.695	0.007	.0011483	.0072754
roe	-.8421261	.4466063	-1.886	0.059	-1.717458	.0332062
dpsar	13.26117	9.835325	1.348	0.178	-6.01571	32.53806
dptar	4.611701	2.75771	1.672	0.094	-.7933107	10.01671
dcsar	1.345784	1.379963	0.975	0.329	-1.358895	4.050462
dctar	2.927766	2.961761	0.989	0.323	-2.877179	8.73271
_cons	-1.401351	.7324979	-1.913	0.056	-2.83702	.0343188

```
Mean of marginal effects,                          Number of obs =      131
observation-by-observation
```

y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
age	-.0213894	.0196899	-1.086	0.277	-.059981	.0172021
a	.0007535	.0002584	2.916	0.004	.0002471	.0012599
roe	-.1506482	.0774909	-1.944	0.052	-.3025276	.0012313
dpsar	2.372295	1.729162	1.372	0.170	-1.016801	5.76139
dptar	.8249885	.4654836	1.772	0.076	-.0873427	1.73732
dcsar	.2407476	.245137	0.982	0.326	-.2397122	.7212073
dctar	.5237488	.522531	1.002	0.316	-.5003931	1.547891

```
. logit y a roe fexp niinc ineff dpsar dptar dcsar dctar,robust
```

```
Iteration 0: log likelihood = -108.74678
```

```
Iteration 7: log likelihood = -82.75185
```

```
Logit estimates                                     Number of obs =      163
                                                    Wald chi2(9) =      29.14
                                                    Prob > chi2 =      0.0006
Log likelihood = -82.75185                         Pseudo R2 =      0.2390
```

y	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
a	.0031409	.001292	2.431	0.015	.0006087	.0056731
roe	.3457879	4.932305	0.070	0.944	-9.321353	10.01293
fexp	.1282914	.0664922	1.929	0.054	-.002031	.2586138
niinc	.0178165	.0378681	0.470	0.638	-.0564036	.0920367
ineff	-.0345171	.0224591	-1.537	0.124	-.0785362	.009502
dpsar	33.75113	13.16557	2.564	0.010	7.947092	59.55517
dptar	5.666594	2.757067	2.055	0.040	.262842	11.07035
dcsar	.1780643	1.904748	0.093	0.926	-3.555172	3.911301
dctar	3.923475	3.796917	1.033	0.301	-3.518347	11.3653
_cons	-2.036135	.4063774	-5.010	0.000	-2.83262	-1.23965

```
Mean of marginal effects,                          Number of obs =      163
observation-by-observation
```

y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
a	.0005324	.0001994	2.670	0.008	.0001415	.0009233
roe	.058615	.8352899	0.070	0.944	-1.578523	1.695753
fexp	.0217469	.011119	1.956	0.050	-.000046	.0435397
niinc	.0030201	.0064037	0.472	0.637	-.0095308	.015571
ineff	-.005851	.0037685	-1.553	0.121	-.0132372	.0015351
dpsar	5.721204	2.10995	2.712	0.007	1.585778	9.85663
dptar	.9605526	.4427995	2.169	0.030	.0926815	1.828424
dcsar	.0301839	.3231103	0.093	0.926	-.6031006	.6634685
dctar	.6650739	.6437892	1.033	0.302	-.5967298	1.926878

```
. log close
```