FINANCIAL INNOVATIONS AND THE DEMAND FOR MONEY IN UKRAINE

by

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Abstract

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by Valentyna Bilyk

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The thesis is devoted to investigation of the relationship between financial innovations and the money demand in Ukraine, over January 1997 - December 2005. In the study, financial innovations are presented by the index of financial innovations which represents the experts' view on the past and current situation in the development of the certain financial products and instruments widely used in retail and wholesale banking activity (e.g., automated teller machines, collateralized mortgages, credit cards, debit cards, corporate bonds, automated clearing houses, electronic banking, forward contracts, treasury bills, and wire transfers).

Vector error-correction model is applied in order to study the relationship between financial innovations, real volume of industrial production, nominal interest rate, expected depreciation of Ukrainian hryvnia, the level of dollarization in the economy, expected inflation, and real money balances in accordance with the theoretical concepts, as well as to investigate the response of money demand to financial innovations shock by means of the impulse response function. Robustness check indicates an existence and significance of the financial innovations' impact on the demand for money in Ukraine. While financial innovations have positive relationship with the demand for real money balances in the long run in Ukraine, in the short run their impact is negative.

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ABBREVIATIONS

ACH – Automated Clearing House

ATM – Automated Teller Machine

CPI – Consumer Price Index

GDP – Gross Domestic Product

IRF – Impulse-Response Function

PPI – Producer Price Index

UAH – National Currency of Ukraine

USD – National Currency of the United States of America

VECM – Vector Error-Correction Model

GLOSSARY

Automated clearing house – computer-based clearing and settlement facility for interchange of electronic debits and credits among financial institutions.

Automated teller machine – computer terminal activated by a magnetically encoded bank card, allowing consumers to make deposits, obtain cash from checking or saving accounts, pay bills, transfer money between accounts, and do other routine transactions as they would at a bank teller window.

Collateralized mortgage – debt instrument giving conditional ownership of an asset and secured by the asset being financed.

Corporate bond – debt security issued by private and public corporations with the aim to raise money for a variety of purposes such as building new plant purchasing equipment or growing the business.

Credit card – plastic card authorizing the account holder to charge purchases against a preapproved credit line; issued by banks, thrift institutions, retailers, and other credit grantors.

Debit card – plastic card giving consumers access to their funds electronically. Debit cards act like checks when paying for goods and services or withdrawing cash at automated teller machines.

Demand for money – demand for real money balances (quantity of money in real terms); desire of households and businesses to hold assets in a form that can be easily exchanged for goods and services.

Dollarization – situation when the country inhabitants use foreign currency in parallel to or instead of the domestic currency.

Electronic banking – form of banking where funds are transferred through an exchange of electronic signals between financial institutions, rather than an exchange of cash, checks, or other negotiable instruments.

Financial innovations – payment system advances altering or modifying the role of banks, and financial institutions in general, as intermediaries between suppliers and users of funds.

Financial product innovations[1] – innovations that include the introduction of new credit, deposit, insurance, leasing, hire purchase, and other financial products. Product innovations are introduced to respond better to changes in market demand or to improve the efficiency.

Forward contract – agreement between two parties to exchange one currency for another at a forward or future date.

M0 – Cash in Circulation.

M1 – M0 plus demand deposits.

M2 – M1 plus time deposits.

Money – is any good or token used by a society as a medium of exchange, store of value and unit of account. In our particular case under "Money" we consider Ukrainian coins and fiat money.

Money supply – the quantity of money available within the economy to purchase goods, services, and securities; (here, in the thesis, under money supply we consider national currency outside banks plus demand deposits in national currency is considered).

Treasury bill – government promissory note, which should be drawn at sight, and their maturity term shall not exceed one year.

Wire transfer – order to pay funds electronically by wire or telephone instruction, usually involving a large dollar payment.

[1] Heidhues et al. (1997)

C h a p t e r 1

INTRODUCTION

Nothing is so powerful as an idea whose time has come.
V. Hugo

The function of the money demand is justifiably considered to be among the central behavioral relationships in macroeconomic theory. However, changes in the structure of the financial sector can objectively change the reliability of monetary aggregates measures, and thus the efficiency of the monetary policy. The explicit reason for this is the presence of financial innovations that introduce an additional element of uncertainty to the economic environment in which central bank operates (Solans, 2003).

Financial innovations are necessary and useful element in forecasting of the short-run money demand; however the issue of financial innovations in the connection with the demand for money has never been analyzed in Ukraine. Notably, in the world, especially during the last decade, the issue of financial innovations has been profoundly investigated (Ireland, 1995; Koğar, 1995; Frame et al., 2002; Belnye et al., 2004; etc.).

The financial sector of Ukraine is relatively small in comparison with the whole size of the economy. At the same time, almost 90% of the Ukrainian financial sector is represented by the banking sector (Mounier, 2005; Segura, 2006). That is why our study covers mostly the recent financial developments in the banking sector of Ukraine.

The thesis is devoted to the investigation of the short-run dynamics with projection to the long-run relationship of financial innovations and the money demand in Ukraine. The immediate problem of this goal is

associated with the absence of the quantitative representation of financial innovations in Ukrainian data sources. Among the possible solutions, the most reasonable one was to construct the index of financial innovations. The index of financial innovations has been developed according to the idea explicitly explained by Holmes et al. (2001).

In order to have finite and clear structure of what we are going understand under financial innovations, since there is not any strictly defined list in the mainstream of the economic literature, we want our research to concentrate on financial product innovations. Particularly, under financial innovations we understand the following wholesale and retail financial products and instruments: credit cards, debit cards, automated teller machines, collateralized mortgages, corporate bonds, treasury bills, automated clearing houses, wire transfers, electronic banking, and forward contracts. Some of these variables were introduced prior to 1997 (e.g. treasury bills (end of 1995), while other are extremely recent (e.g. collateralized mortgages (were introduced in Ukraine at 2000, but formally started at 2002)).

The study period covers nine years: from January 1997 till December 2005. The data used in the paper has been taken from the National Bank of Ukraine internet site, the State Statistics Committee internet site, International Financial Statistics database CD-ROM, and own efforts devoted to interviewing experts of Ukrainian banking sector with the consequent construction of the index of financial innovations.

The empirical part of the thesis has been conducted by means of the vector error-correction model (VECM). This model has a clear advantage over the other econometric techniques in terms of functionality and use (Sriram, 1999). In particular, it gives a possibility for researchers to analyze a short-run dynamics for variables of our interest rather than only to explore long-run relationship between money demand and explanatory

variables predicted by theory. Besides, this model has been applied to some of the recent study of money demand in Ukraine (Piontkivsky, 2002; Bilan et al., 2003; Zinovyev, 2003, etc.). Therefore, we consider the vector error-correction model (VECM) as an optimal empirical technique to be applied to our empirical study.A priori, we expect the impact of financial innovations on Ukrainian money demand to be significant in the long run. Moreover, we believe that in the short run there is a negative effect of innovations' shock in the financial sector on the money demand in Ukraine.

Current situation in the Ukrainian financial sector proved a tremendous necessity for reforming of the banking sector. This will be difficult to do without referring to the empirical studies. Therefore, we believe our research to contribute to the mainstream of Ukrainian economic literature investigating issue of the money demand, and will be of great interest, as well as, of huge importance in Ukraine.

The remaining part of the thesis has the following structure. Chapter II contains theoretical background on the issue of financial innovations and money demand. In Chapter III we make a short overview on Ukrainian banking sector during 1997-2005. Chapter IV is devoted to the description of the main components and principles of construction of the index of financial innovations, which represents the measure of financial innovations within our empirical study. Then, Chapter V describes the data and its main characteristics, as well, as a short description of the research methodology. Chapter VI highlights on the main empirical results and findings. Finally, Chapter VII presents the main conclusions of the work.

Chapter 2

THEORETICAL BACKGROUND

The relationship between the demand for money and its determinants is considered as a fundamental issue in most theories of macroeconomic behavior. However, in most cases, theoretical and econometric macroeconomic models ignore the institutional aspect of the financial sector and capture financial factors through the supply and demand for money.

The demand for money and its stability is extremely important in the formulation of monetary policy. Moreover, stable function for money demand has long been seen as a critical component for the rational use of monetary aggregates in the monetary policy implementation (Goldfeld et al., 1990). Stable relationship between money, real economy side variable, and the set of variables representing opportunity costs of holding money, is preconditional in answering the extremely important questions about the average growth rate of the money consistent with the price stability (Teles et al., 2005).

Traditionally, most empirical works starts with the conventional formulation of the money demand relationship (Sriram, 1999):

$$Md = L(SV, OC) \tag{2.1}$$

Expression (2.1) represents a relationship between demand for real money balances (Md) and scale or transactions variable (real economy side), and the set of variables representing opportunity cost of holding money (nominal interest rate; in transition economies, in addition to nominal interest rate, the expected inflation, expected exchange rate and

level of dollarization of an economy are used (Bondarenko, 2000; Piontkivsky, 2002; Bilan et al., 2003; Duchene et al., 2005)). Generally, (2.1) presumes a positive relationship of real money balances between the scale variable, and negative one between the opportunity costs.

The estimation of money demand function in its contemporary representations (2.1) has been started initially in the mid-1970s in the USA, when economists and policymakers have noticed that the early standard specification of the money demand model, where money demand was a positive function of the scale variable (Gross National Product or Gross Domestic Product), and a negative one of the opportunity costs (interest rate on government bonds), was not able anymore to explain accurately the changes in the money demand and produced controversial results by overpredicting the level of money in the economy. This finding was called in the literature as the "missing money episode" (Pierce, 1984).

Analyzing the issue it is worthwhile to say that this time period has been distinguished by the unusual economic conditions in many countries such as supply shocks, considerably high and variable inflation, high interest rates, and deep recessions. Moreover, the period coincided with an adoption of the floating exchange rate regimes. As consequence, in a number of major industrial countries there were substantial institutional changes that were brought about by the financial innovations and financial deregulation (Goldfeld et al., 1990).

Therefore, in the period starting from the mid-1970s much attention in the USA was paid to the test of empirical money demand relationships, which led to the reconsideration of the existing previously specifications of the demand for money functions.

Although Ireland (1995) observed that not much theoretical works underline the impact of the financial innovations on the demand for

money, recent decades were especially bountiful in the sense that money demand issue was a subject to a great reconsideration throughout the world. However, Attanasio et al. (1998) argue that it took a lot of time before the issue of financial innovations and the demand for money has become at the centre of attention.

As a matter of fact, there are still researchers in the world who continue investigation of the money demand behavior basing on the traditional specifications (Bação, 1998; Aubry et al., 1999; Ball, 2002).

Aubry et al. (1999) modeling demand for real money balances use natural logarithm of M1 divided by the consumer price index (CPI) as a dependent variable, and as explanatory variables they use natural logarithm of real GDP and 90-day commercial paper rate. Whereas Bação (1998) instead of CPI uses GDP deflator, and the set of explanatory variables includes lagged values of: the natural logarithm of real money balances; natural logarithm of real GDP; natural logarithm of GDP deflator; long-term bank's lending rate; the seasonal variables; natural logarithm of adjusted velocity of narrow money circulation.

The survey of the mainstream of the economic literature devoted to the issue of money demand indicated that it is tremendously important to distinguish between the developed and developing and/or transition countries. It is very important to see the distinctions in the specification of the functional relationship of the money demand in these economies (e.g., needless to say that periods of high inflation in most transition countries resulted in a certain element of dollarization in their economies (Duffy et al., 2004)).

The demand for money in Ukraine has been investigated profoundly, especially within last years. Despite these investigations did not account for financial innovations in Ukraine, they form a sufficient ground for our following study.

There are several economic studies investigating demand for money in Ukraine (e.g., Volkov, 2000; Piontkivsky, 2002; Bilan et al., 2003; Sigayov, 2003; Zinovyev, 2003).

The fact that Ukraine is a dollarized economy makes some of the Ukrainian researchers be more cautious with choosing and specifying variables. Most concern is devoted to the specification of the variables representing opportunity costs of holding money in the economy.

In his work, Volkov (2000), examines demand for real money balances (M1 divided by CPI (1990=100) as a function of real income (GDP), nominal deposit rate on domestic currency deposits (nominal average deposit rate on domestic currency deposits), nominal deposit rate on foreign currency deposits (as a proxy he chooses London Interbank Offered Rate (LIBOR)), and expected exchange rate (as a proxy he chooses lagged value of official exchange-rate). All variables are in logarithmic form.

Investigating demand for money in Ukraine and its determinants, Piontkivsky (2002), for the specification of the real money balances applies money-as-an-asset framework, chooses broad money (M2 less foreign currency component) deflated by the consumer price index. His set of explanatory variables consists of scale variable presented by the index of real GDP, and opportunity costs' vector presented by official UAH/USD exchange rate and consumer price index.

Bilan et al. (2003) estimate demand for national currency only. They, similar to Piontkivsky (2002), use money-as-an-asset framework and choose M2 less foreign currency; however, transformation into the real terms is done by means of composite price index (average of producer and consumer price indices). They construct the index in order to avoid the reported consumer and producer price indices separately to reflect the changes of the price level in the "whole" economy. As a scale variable

they choose volume of industrial production which is collected more accurately than GDP, and thus, is more trustworthy scale variable for Ukraine. Opportunity costs are presented by expected inflation and expected depreciation (several proxies are considered: weighted average depreciation of Ukrainian hryvnia to US dollar over past three months with weighted diminishing backward; moving-sample standard deviation of UAH/USD official exchange rate over past three months; volumes of net purchase of foreign cash by population).

However, checking for stability of the money demand equation in Ukraine, Zinovyev (2003), as a real money balances, takes nominal Money Base (currency in circulation plus commercial banks reserves and cash in vaults) deflated by GDP deflator. GDP deflator, in his particular case, is a weighted average of CPI and deflator of industrial production. Scale variable is real GDP, and opportunity cost is presented by NBU refinancing rate.

Sigayov (2003), in his specification of the demand for money in Ukraine, chooses ratio of M2 to CPI as a real money balances, and explanatory variables are real GDP and long-term interest rate.

Lukyanenko (2003) caveat the possible problems while using monetary models, and built the block of the monetary regressions, where she highlighted the main functional relationships between the aggregate monetary variables.

The functional relationship of money demand in a dollarized economy (Russia) is as well investigated by Ohnsorge et al. (2005). As the real money balances they explore five different aggregates (ruble currency in circulation, ruble narrow money, ruble broad money, broad money, and effective broad money); set of explanatory variables is constituted from industrial production as a proxy for GDP and opportunity costs are presented by nominal ruble deposit rate (weighted average of interest

rates on deposits with different maturities) and nominal ruble-dollar depreciation rate (the rate of return on holdings in U.S. dollars). Inflation rate would be considered as an opportunity cost for Russian economy, however due to the high level of correlation between the depreciation and inflation, the authors decided not to include the level of inflation into the set of explanatory variables.

Nassar (2005) investigating the money demand in Madagascar for defining real money balances uses broad monetary aggregate, M3 divided by composite CPI index; explanatory variables in his money demand function are presented by real GDP and foreign interest rates (due to the lack of alternative financial asset in the economy, the yields on 10-year government bonds in France).

At the same time, there are several arguments against the functional forms of money demand without financial innovations (Arrau et al, 1995), such that the models for money demand which do not include impact of financial innovations result in the persistent models overprediction, implausible results, and high autocorrelation of errors.

Milbourne (1986) states that innovations in the banking and financial sector have caused great difficulties for the monetary policy implementation. For example, in the presence of the financial innovations the shifts in monetary aggregates could not have been explained anymore by the interest rate behavior. He stresses that even if monetary authorities know the specific innovations currently present in the country economy, they cannot be absolutely sure how these innovations can affect particular economic or monetary aggregates (Milbourne, 1986). This knowledge is crucial for the monetary authorities, in the sense that this will give the possibility to interpret growth rates of the monetary aggregates more accurately. This, in turn, implies that the awareness will lead to the more realistic predictions, and thus to the reduction in the policy mistakes.

In addition, Dean (n.d.) highlights on a due caution associated with financial innovations, since they may smooth the difference between the monetary aggregates. Koğar (1995) provides us with a general intuition to this problem. He states that by its nature, financial innovations affect the composition and structure of the monetary aggregates, which might imply unpredictability of the monetary policy outcomes.

Lewis et al. (2000) make rather important suggestion by stating that financial innovations make money supply more exogenous and less endogenous, and have not any impact on the stability of the money demand in the long-run.

Defining financial innovations and their main sources, we should first address to general issue of innovations. Innovations can be considered as the introduction of new products, technologies, etc. to a market or the improvement and modernization of the existing ones (Akhavein et al., 2001). In general, innovations play significant if not a crucial role in improvement of an economic efficiency and productivity. Consequently, under financial innovations we can consider the creation of the new financial markets, instruments, and institutions in the financial services industry (Maureen, 2003), e.g. ATM, debit, credit, smart cards, futures, derivatives etc.

The main reason for financial innovations to occur is the desire of market participants to increase their profits, and who are, therefore, looking for the new efficient ways for this achievement (Koğar, 1995). Lewis et al. (2000) associated the appearance of financial innovations with the changing requirements of customers (e.g., accounting benefits), conditions of suppliers (e.g., transactions costs), environmental conditions (i.e. interest rates, prices, and exchange rates), policy conditions (i.e. regulatory, legislative, and supervisory changes), technology, etc.

There is a natural desire of the economists throughout the world to estimate the level of the impact of financial innovations on the monetary variables, particularly, on the demand for money (e.g., Lewis et al., 2000). However, immediately, they face the problem: what variable can serve as a quantitative measure for financial innovations in the economy? Should it be proxy or direct measure, etc.?

Milbourne (1986) suggests that despite the financial innovations being significant factor to be taken into account while estimating the demand for money, there is not any clear rule for their quantitative measurement. Consequently, it is quite usual to see among the works related to the issue of the financial innovations and the demand for money a significant variety of different proxies for financial innovations used in the studies.

Arrau et al. (1995, Attanasio et al. (Revised, 2001), and Boichanka (2001) model financial innovations as a technological change by inclusion of the time-trend (as a proxy for the financial innovations) into the money demand equation.

Arrau et al. (1993) model financial innovation as an unobservable shock that has a permanent impact on the demand for money. Later, Arrau et al. (1995) study the impact of the financial innovation process on the demand for real cash balances in the developing countries. As a proxy for financial innovations they chose the stochastic trend in the form of a random walk.

Attanasio et al. (Revised, 2001), using cash-in advance approach, model demand for currency as a function of interest rate, consumption, time, and time squared (they model the ATM adoption and effects of technological progress on money demand).

Boichanka (2001), using partial adjustment model, defines demand for money as a function of real wage times level of employment (scale

variable), expected inflation, lagged function of the demand for real money balances, and time (included to capture the effect of financial innovations on the demand for money.

Mannah-Blankson et al. (2004), applying error-correction modeling, use two particular proxies for financial innovations: volume of cash cards transactions in the economy and M2/M1 ratio. They define demand for real money balances (either M1 or M2 in real terms) in Ghana as a function of real income, exchange and inflation rates, and financial innovations.

Among theoretical contributors to the issue of financial innovations, Koulpinskiy (2003), in his work, describes explicitly the ways of the possible development of financial innovations in Ukraine.

Summarizing, we may draw the following conclusions about financial innovations and the demand for money in the existing theoretical context.

First of all, while conducting research we must take into account the fact that money demand function is not stable particularly due to financial innovations. There were applied several approaches to defining demand for real money balances in Ukraine.

In particular, there were applied partial adjustment (Volkov, 2000; Boichanka, 2001; Sigayov, 2003 (two-stage least squares)), and money-as-an-asset (Piontkivsky, 2002; Bilan et al., 2003 (error-correction model)) approaches. We choose error-correction modeling also since Sriram (1999) suggests that the instability of money demand within previously applied partial adjustment framework has disappeared under the error-correction approach.

Second, there is no specific clearly defined measure for financial innovations, but there is a possibility to find an appropriate proxy in

order to measure the general effect of financial innovations on money demand.

Third, Ukraine is a case of dollarized economy. Therefore, in addition to the generally used real income, interest rate, and financial innovations variables, the measure of dollarization of the economy should be (e.g. expected depreciation of domestic currency) and expected inflation should be introduced to the study of the money demand in Ukraine.

Chapter 3

OVERVIEW OF UKRAINIAN BANKING SECTOR

In order to make a profound investigation on the banking sector in Ukraine we need to analyze the situation in the financial system. The explicit reason for this is that future of banking sector depends primarily on the recent trends in the development of the financial sector in general (Vensel, n.d.). At the same time, the tremendous concern for the investigation of the recent developments exactly in the banking sector is closely connected with the notion of immediate reaction of banking institutions to any change in the economic and technological environment (Chornyy, 2001).

Banking system of Ukraine is considered to be the one of the most dynamically developing sector of economy (Rudenko, 2005), however it needs a certain changes in its regulations be undertaken by the central bank.

Let us discuss a little a history of Ukrainian banking sector, back in 1991. The Ukrainian banking sector began with five state-owned banks (Prominvestbank, Bank Ukraina, Ukreximbank, Ukrsotsbank and Savings Bank (Semerenko, 2006)). All of these banks except for Bank Ukraina managed to continue their activity. In March, 1991, the Law of Ukraine "On Banks and Banking" was adopted. This was a starting point for the establishment of new privately-owned commercial banks. Nowadays, the Ukrainian banking system is a two-tier structure consisting of the National Bank of Ukraine (NBU) and commercial banks of various types and forms of ownership including two state-owned banks (Export-Import Bank and specialized commercial Savings Bank).

The National Bank of Ukraine was established by the decree of the Ukrainian Parliament in March, 1999. NBU serves as the Ukrainian central bank pursuing a uniform state monetary policy to ensure the stability of national currency.

Commercial banks are formed as joint-stock companies or as limited-liability companies. The range of commercial bank activities includes: receiving deposits of enterprises, institutions and households; facilitating of the loans to economic entities and households; investments in securities; cash and settlement services; foreign exchange operations etc.

In September, 1998, following Russian default on government bonds, Ukrainian government was forced to restructure its own obligations. The government was not able to pay 80% interest on bonds, and therefore temporarily stopped coupon payments and restructured obligations for ten years with much lower interest rate (11%). This caused massive sale of bonds and withdrawal of foreign investments and foreign currency from Ukraine leading to rapid depreciation of Ukrainian hryvnia from UAH/USD 2.5 to UAH/USD 4.4 in August 1998-August 1999; the banks liquidity deteriorated significantly (Semerenko, 2006).

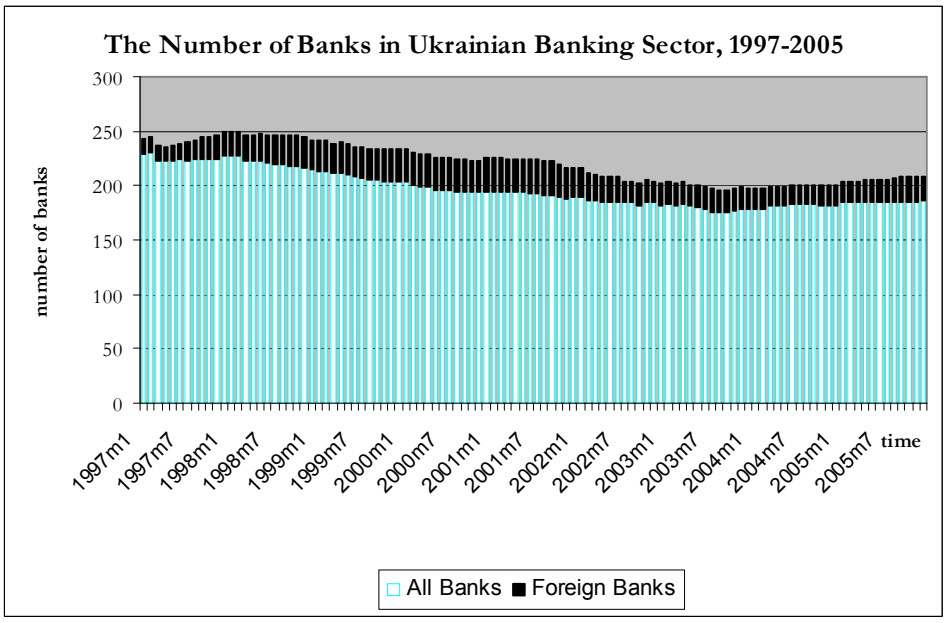
The development of the banking sector started in 2000 and was associated with the positive dynamics in the Gross Domestic Product growth, low inflation, relatively stable exchange rate, and strengthened budgetary system.

In general, the Ukrainian banking system has grown very rapidly within past few years, reflecting an improving operating environment and a strong increase in public confidence in commercial banks (Rudenko, 2005). Moreover, the huge desire of foreign banks to operate in Ukraine is a major indicator of the economic attractiveness.

Nowadays, Ukrainian banking sector is considered as a good investment strategy (e.g., consumer banking sector in Ukraine is underdeveloped in comparison with foreign countries. So that, foreign banks by coming (i.e. new foreign banks) or changing the orientation of their activity (i.e. currently present foreign banks) in Ukrainian banking sector will make a huge profits (as an innovators), and Ukrainian financial sector will experience a new phase of the financial innovations).

This perspective is very soon and might imply various implications for Ukrainian financial sector. The optimistic one is considered as decrease of the number of Ukrainian banks (Figure 3.1) which at the end of 2005 was equal to 186[2] to more reasonable amount. As a consequence Ukrainian banking system would get rid off the significant number of "pocket banks" which makes the operation of the banking, and thus, of the whole economic system less transparent, and therefore, inefficient.

Figure 3.1



[2] Source: the National Bank of Ukraine.

C h a p t e r 4

INDEX OF FINANCIAL INNOVATIONS

Innovation is a historically irrevocable change in the way things are accomplished
J. Schumpeter

The financial innovations can be considered as a process with the significant impact on the financial and real sector of economy. The peculiarity of the innovations, in general, is that nobody can predict the timing of their appearance. However, by its nature, they cannot appear too frequently over the same period (except for, e.g., period of a significant penetration of new informational technologies (early 1990s)).

This index of financial innovations has been constructed similar to the one developed by Holmes et al. (2001). First, we chose ten major and the most frequently used financial innovations of the banking sector in Ukraine (e.g. automated teller machines, cash management accounts, wire transfers, automated clearing houses, credit and debit cards, collateralized mortgages etc.). Second, we developed a questionnaire on the financial products and instruments (Appendix A). Third, this questionnaire has been distributed among the most highly capitalized Ukrainian and some foreign banks, which are basically market makers (e.g. Calyon, Citibank, Raiffeisenbank Ukraine, Ukrgazbank, etc). In order to determine the overall development of financial innovations of Ukraine, the factors constituting the index have been treated equally. The index has not been designed to measure the proportional contribution of the set of statistically independent variables to development of Ukrainian banking sector during 1997-2005.

By its nature it is a qualitative index which is aimed to get the answers on the financial products' development level among the foreign and Ukrainian banks according to the following principle:

- 0 means that the certain financial product or instrument is absent;
- 1 means that the certain financial product or instrument has extremely poor development;
- 2 means that the certain financial product or instrument has poor development;
- 3 means that the certain financial product or instrument has average development;
- 4 means that the certain financial product or instrument has good development;
- 5 means that the certain financial product or instrument is highly developed.

The index of financial innovations has been calculated as follows:

$$FI_t = \frac{1}{\alpha\beta}\sum_{t=1997}^{2005}(CC_t + DC_t + ATM_t + CM_t + CB_t + TB_t + ACH_t + WT_t + EB_t + FC_t) \quad (4.1)$$

$\forall t$, where:

α-number of received questionnaires on Ukrainian Banking sector for the period of 1997-2005;

β-number of financial products/instruments constituting the questionnaire;

CC - level of the development of credit cards in Ukraine in period t;

DC - level of the development of debit cards in Ukraine in period t;

ATM_t - level of the development of automated teller machines in Ukraine in period t;

CM_t - level of the development of collateralized mortgages in Ukraine in period t;

CB_t - level of the development of corporate bonds in Ukraine in period t;

TB_t - level of the development of treasury bills in Ukraine in period t;

ACH_t - level of the development of automated clearing houses in Ukraine in period t;

WT_t - level of the development of wire transfers in Ukraine in period t;

EB_t-level of the development of electronic banking in Ukraine in period t;

FC_t- level of the development of forward contracts in Ukraine in period t;

Results on the index of financial innovations are presented in the Table 4.1. and Figure 4.1.

In the Table 4.1 each financial product or instrument under consideration separately indicates values on parameter with the subsequent computed index on financial innovations, whereas Figure 4.1. gives a graphical representation on the obtained values of the index. Figure 4.1 the upward sloping dynamics of the financial innovations in Ukraine during the last nine years. Moreover, it shows the new phase in the development of financial innovations after 1998, when Ukrainian economy experienced

financial crises. Table 4.1. contains twenty questionnaires' results on foreign and domestic banks as well as international financial institutions (the National Bank of Ukraine, IMF, Calyon, Citibank, Raiffeisenbank Ukraine, Ukrgazbank, Nadra, etc.).

Table 4.1. **Index of Financial Innovations, 1997-2005**

Type of financial product/instrument	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Credit Cards	0.10	0.10	0.30	0.50	0.80	1.05	1.35	1.90	2.15
Debit Cards	0.25	0.40	0.65	1.05	1.45	1.70	2.30	2.40	3.00
Automated Teller Machines	0.55	1.00	1.55	1.90	2.30	2.55	3.00	3.40	3.55
Collateralized Mortgages	0.50	0.70	0.55	0.75	1.05	1.65	1.70	2.25	2.45
Corporate Bonds	0.15	0.20	0.55	0.75	1.00	1.35	1.75	1.90	2.15
Treasury Bills	1.60	1.45	1.05	1.20	1.40	1.65	1.80	2.00	2.40
Automated Clearing Houses	1.95	2.00	2.05	2.50	2.60	2.80	3.25	3.50	3.55
Wire Transfers	1.65	1.90	2.20	2.50	2.95	3.25	3.50	3.95	3.95
Electronic Banking	0.80	0.85	1.15	1.35	1.55	1.80	2.25	2.65	3.05
Forward Contracts	0.70	0.75	0.05	0.05	0.10	0.15	0.35	1.05	1.25
Index of Financial Innovations	0.83	0.94	1.01	1.26	1.52	1.80	2.13	2.50	2.75

Table 4.1. shows that at the end of 2005 the level of development of financial innovations in Ukrainian banking sector, according to the experts' opinion, was equal to 2.75. The minimum value was equal to 0.83 (1997), and maximum value – to 2.75, the mean value was 1.64, and standard deviation was equal to 0.70.

Figure 4.1. **Index of Financial Innovations, 1997-2005**

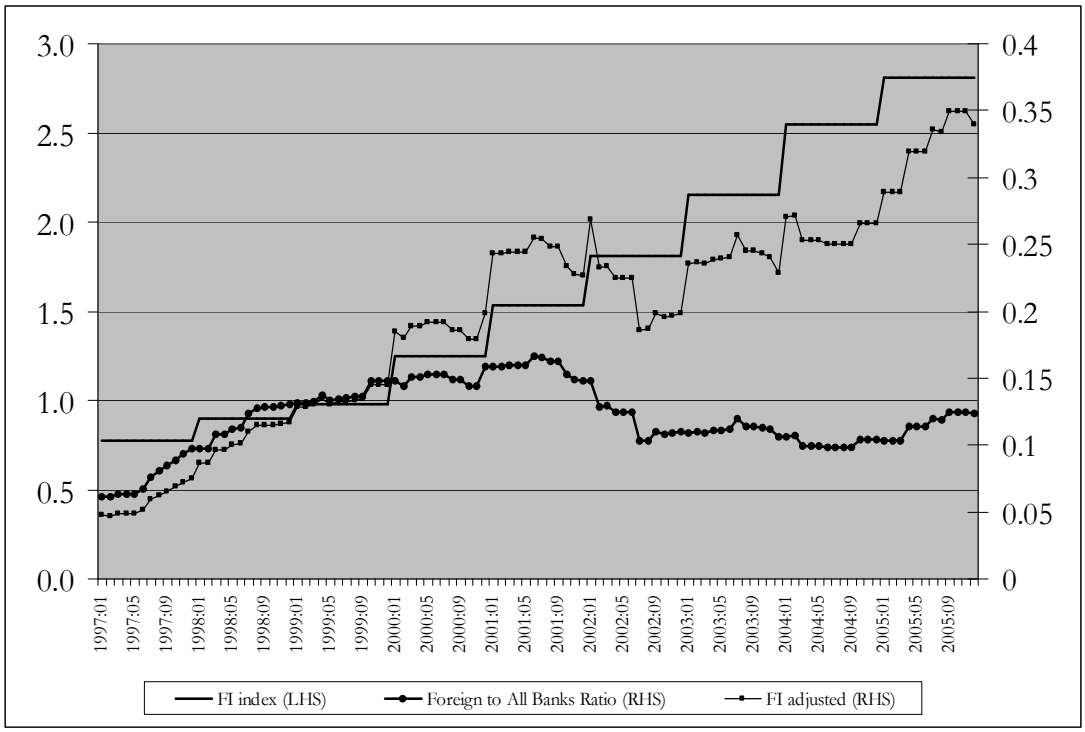
The index of financial innovations is aimed to represent the general level of development of financial innovations in Ukraine during 1997-2005 on annual basis. However, the study is aimed to investigate the financial innovations subject to the monthly development. To protect ourselves against any possible statistical problems connected to the different types of aggregation of variables of interest (monthly frequency) versus index of financial innovations (yearly frequency); we had to adjust our index. Figure 4.2. describes the "nature" of the problem, i.e. "FI index" line (left hand side). There are several solutions to the problem.

First solution is to make an extrapolation. Although this method is sometimes reasonable, it is not so in our case. Extrapolated index of financial innovations is integrated of order two (Dickey-Fuller unit root test statistics for levels is equal to 12.472 (p-value = 1)) while other time series are integrated of order one (Appendix B). In this case, the investigation of the impact of financial innovations on the money demand would have no sense.

Second solution is to assume that foreign banks are the major driving force of financial innovations in the banking sector, and multiply the

value of the index of financial innovations by "the foreign to total number of banks" ratio in order to introduce the effect of monthly variation changes to each observation. As a result, we have got the adjusted index of financial innovations in Ukraine – FI adjusted (Figure 4.2) which is nonstationary and cointegrated of order one (Appendix B).

Figure 4.2. **Adjusted Index of Financial Innovations, 1997-2005**



C h a p t e r 5

DATA DESCRIPTION AND METHODOLOGY

If you torture data sufficiently, it will confess to almost anything.
F. Menger

The main goal of our research is to find out the level of financial innovations' impact on the Ukrainian demand for money. The choice of the data and methodology has been based on the general practices applied in the field of money demand analysis (e.g., Sriram, 1999; Bilan et. al, 2003; Sigayov, 2003 and others).

5.1. DATA DESCRIPTION

In order to make an inference on financial innovations and the demand for money in Ukraine we use 1997-2005 monthly data on macroeconomic and monetary indicators according to the idea presented in the Tables 5.1. and 5.2.

Money is measured by either by narrow (M1) or broad (M2) money less foreign currency component (Piontkivsky, 2002; Bilan et al., 2003) deflated by the price level (P), which allows us to capture how economic agents adjust their highly liquid short-term and medium-term monetary assets in response to the financial innovations, policy and other (e.g. interest-rate, etc.) shocks.

The price level (P) is measured by the composite price index (average between CPI and PPI (Bilan et al., 2003)). The price level value at January 1997 is chosen to be equal to one.

The scale variable for the money demand study is measured by the volume of industrial production (Y) deflated by the Producer Price Index (PPI). This choice has two reasons. First reason is associated with the quality of Ukrainian data on GDP (Bilan et al., 2003), and second one is connected with the fact that time-series data on Ukrainian real GDP for the period of investigation has been stationary (Dickey-Fuller unit root test statistic equals to -6.630 with a p-value being equal to 0.000).

The opportunity costs of holding money are represented by the interest rate on deposits in national currency (R), the expected depreciation measured by UAH/USD official exchange rate (E), expected inflation (π^e), and the level of dollarization in the economy (\$).

The rationale for choosing rate on deposits in national currency is that the demand for M1 less foreign currency component should depend most strongly on the returns to its close substitutes, since demand deposits can be considered (and Figure 5.1 indicates that for the case of Ukraine this statement holds) as a close substitute for M1 due to their relative liquidity (Ball, 2002). The interest rate is aimed to measure the opportunity cost of holding money than an alternative asset in the economy represented by demand (for narrow money) and demand plus time (for broad money) deposits in the national currency.

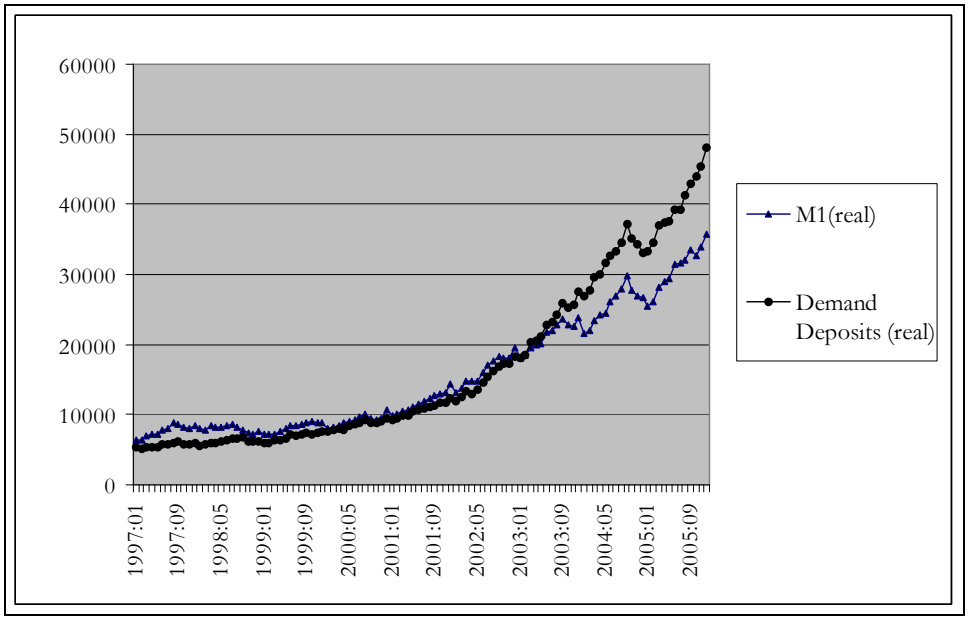
The expected depreciation presented in the economy by the official UAH/USD exchange rate is aimed to capture the effect the substitution between currencies in case of weakening (depreciation) or strengthening (appreciation) of Ukrainian hryvnia with respect to US dollar.

The expected price level (π^e) is aimed to capture the effect of switching from holding money to holding real assets in period characterized by persistent inflationary pressure in the economy. Expected inflation is measured by adaptive mechanism, where the expectations about inflation

current value are based on its previous (lagged) value of the composite price index. The expected price level value at January 1997 is chosen to be equal to one.

The level of dollarization of Ukrainian economy is very important for study, since it measures how dollarization component as such affects the demand for real money balances in Ukraine.

Figure 5.1. **Relationship between the M1 and Demand Deposits in Ukraine, January 1997-December 2005**



Finally, financial innovations (FI) in the economy aimed to measure the effect of developments in the Ukrainian financial sector on the demand for money in Ukraine. They are represented by the adjusted index of financial innovations, fully described in Chapter IV.

The descriptive statistics on the variables used in research and their sources are presented in Table 5.1 and Table 5.2.

Table 5.1. **Description of the Data**

Variable	Units of measurement	Description	Source
$M1^{adj}$	UAH, mln.	$M1^{adj}$ = currency outside banks + demand deposits in national currency	http://www.bank.gov.ua, IFS database, own calculations
$M2^{adj}$	UAH, mln.	$M2^{adj}$ = currency outside banks + demand deposits + time deposits in national currency	http://www.bank.gov.ua, IFS database, own calculations
VIP	UAH, mln	Volume of Industrial Production	http://www.ukrstat.gov.ua
CPI	-	Consumer Price Index, January 1997=100%	http://www.bank.gov.ua
PPI	-	Producer Price Index, January 1997=100%	http://www.bank.gov.ua
P	-	Consumer Price Index, January 1997=100%	http://www.bank.gov.ua
R	%, monthly rate	Interest rate on deposits in national currency	http://www.bank.gov.ua
π^e	-	Expected inflation, Lagged values of P, December 1996=100%	http://www.bank.gov.ua
FI	-	Adjusted Index of Financial Innovations	http://www.bank.gov.ua and own calculations, see Chapter IV, Appendix A for more details
$	-	Level of dollarization in the economy[3]	http://www.bank.gov.ua and own calculations
E	-	UAH/USD official exchange rate, measures value of 1 UAH in terms of 1 US dollar	http://www.bank.gov.ua

[3] Is calculate according to the idea describes in Mongardini et al. 1999).

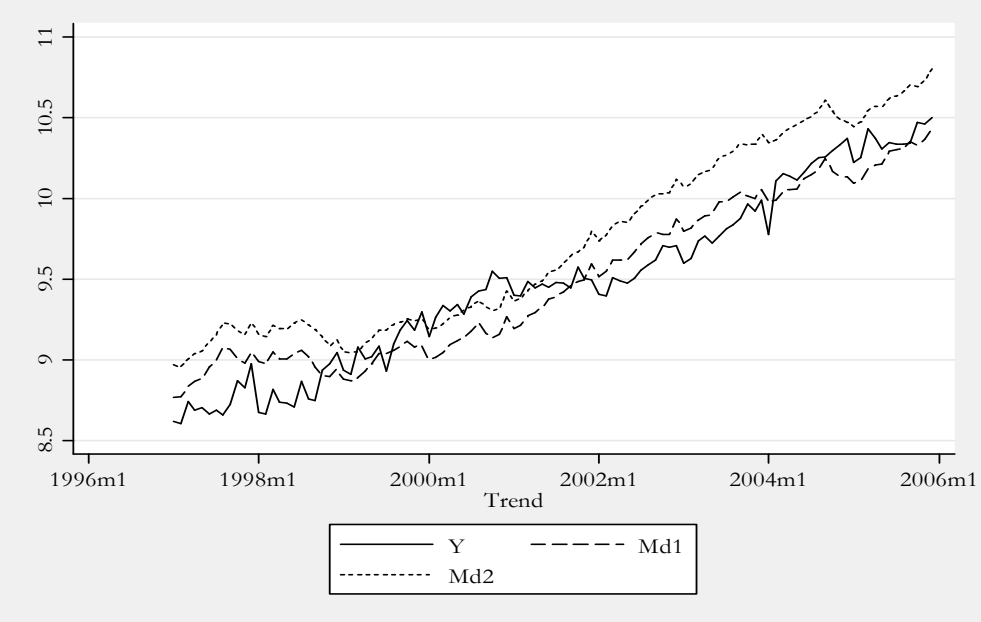
Table 5.2. **Description of the Variables Used in Research**

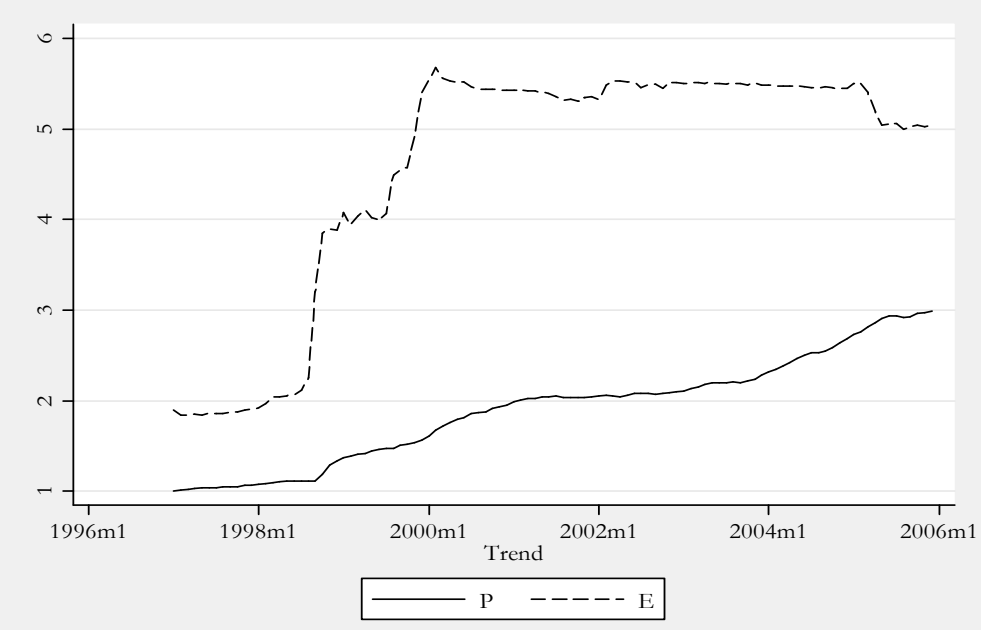
Notation	Description	Mean	Standard Deviation	Min	Max
M_1^d	$M_1^d = \ln\left(\frac{M1^{adj}}{P}\right)$	9.50	0.50	8.77	10.43
M_2^d	$M_2^d = \ln\left(\frac{M2^{adj}}{P}\right)$	9.73	0.58	8.96	10.81
Y	$Y = \ln\left(\frac{VIP}{P}\right)$	9.49	0.55	8.61	10.50
R	Interest rate on deposits in national currency	0.13	0.06	0.06	0.28
π^e	Expected inflation	1.90	0.58	1	2.99
E	UAH/USD official exchange rate	4.59	1.36	1.84	5.68
$	Level of dollarization in the economy	0.28	0.06	0.19	0.42
FI	Adjusted Index of Financial Innovations	0.20	0.08	0.05	0.40

All variables presented in the Table 5.2 were checked with the help of Dickey-Fuller unit root test and proved to be nonstationary and integrated of order one (i.e. I(1) (Appendix B)).

Figure 5.2. and Table 5.3. are very useful for understanding of the behavior and relationship of chosen variables, as well, as for outlining of the main hypothesis for our money demand investigation. Looking at the Table 5.3 we can conclude that there is, in general, positive relationship between financial innovations money in the Ukrainian economy.

Figure 5.2. **Data Representation, January 1997- December 2005**





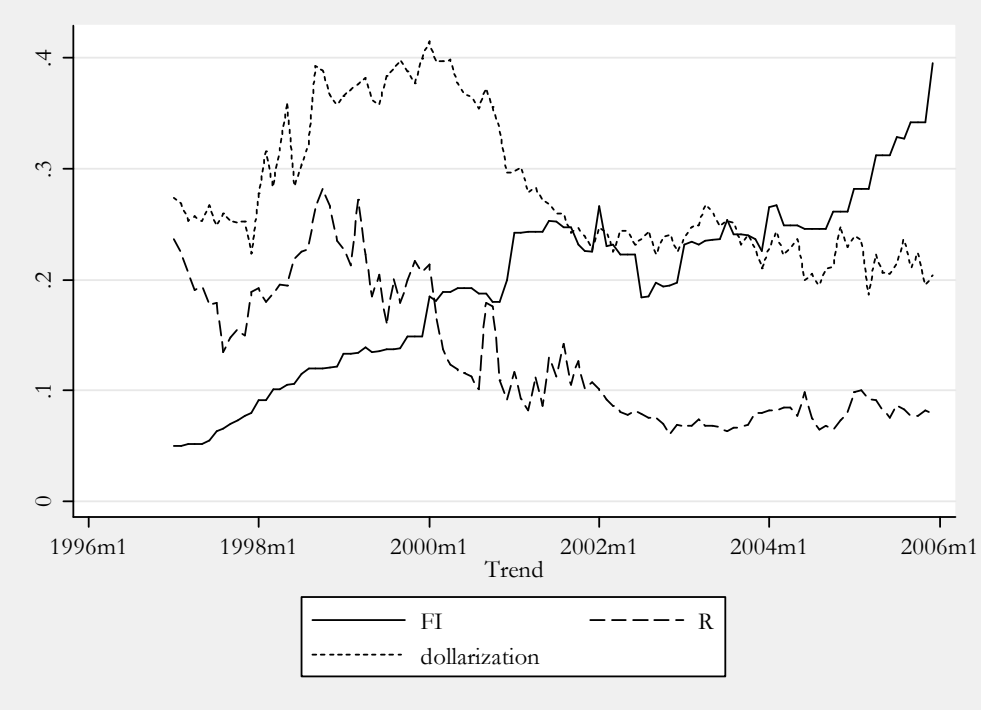


Table 5.3. **Correlation Matrix**

	M_2^d	M_1^d	Y	R	E	P	$	FI
M_2^d	1.0000							
M_1^d	0.9984	1.0000						
Y	0.9448	0.9475	1.0000					
R	-0.8073	-0.8282	-0.7836	1.0000				
E	0.5972	0.6166	0.7463	-0.6790	1.0000			
P	0.9214	0.9295	0.9810	-0.8072	0.7845	1.0000		
$	-0.7389	-0.7405	-0.5847	0.6922	-0.1512	-0.5734	1.0000	
FI	0.8499	0.8616	0.9211	-0.7631	0.8042	0.9640	-0.4879	1.0000

5.2. METHODOLOGY

As it was stated before, we study the relationship between the financial innovations and money demand in Ukraine with the help of the vector error-correction model. The reason for this is straightforward. The vector error correction model (VECM) has proven to be the most efficient tool for measuring money demand (Sriram, 1999). This model has a clear advantage over other econometric techniques in terms of functionality and use. In particular, it gives a possibility for researchers to analyze a short-run dynamics for variables of interest rather than only to explore long-run relationship between money demand and explanatory variables predicted by theory.

In our model we have the following assumptions:

- Money supply is exogenous;
- Money market is in equilibrium before any shock happens to the economy;
- Prices in economy are sufficiently flexible in order to ensure money market equilibrium in the long run.

Setting $M^s = M^d = M$ we can write the long run relationship for the demand for money in Ukraine in the following log-linear (Table 5.3) form:

$$M_t^d = \alpha + \beta_Y Y_t + \beta_R R_t + \beta_{E^e} E_t^e + \beta_{\pi^e} \pi_t^e + \beta_\$ \$_t + \beta_{FI} FI_t + \varepsilon_t, \quad (5.1)$$

Where (5.1) holds for all $t \in 1997:1 - 2005:12$ and

α - constant;

β_y - income elasticity;

β_R, β_{E^e} β_{π^e} - marginal coefficients representing percentage change in the money demand with respect to the one unit change in the subsequent opportunity cost of holding money rather than an alternative asset.

$\beta_{\$}$ - marginal coefficient representing percentage change in the money demand with respect to the one unit change in the level of dollarization in the economy;

$\beta_{\$}$ - marginal coefficient representing percentage change in the money demand with respect to the one unit change in the level of financial innovations in the country;

ε_t is an error term.

We need to test the following hypotheses:

$$H_0 : \beta_{FI} < 0 \qquad \text{versus} \qquad H_0 : \beta_{FI} > 0$$

$$H_1 : \beta_{FI} = 0 \qquad\qquad H_1 : \beta_{FI} = 0$$

If we do not reject H_0 then financial innovations impact on the demand for money in Ukraine.

As we concluded in subsection 5.1, all our variables are nonstationary and integrated of order one which means there should be at least one cointegrating vector which ensure the long-run equilibrium relationship. This is very important feature of the vector error correction model.

In general, representation of the vector error-correction model has the following form:

$$\Delta \mathrm{A}_t = \alpha + \gamma\beta' \mathrm{A}_{t-1} + \Gamma(L)\Delta \mathrm{A}_{t-1} + \varepsilon_t , \qquad (5.2)$$

where $A = \begin{bmatrix} M^d \\ Y \\ R \\ E^e \\ \pi^e \\ \$ \\ FI \end{bmatrix}$, α is a vector of constants, $\beta' = \begin{bmatrix} 1 \\ -\beta_Y \\ -\beta_R \\ -\beta_{E^e} \\ -\beta_{\pi^e} \\ -\beta_{\$} \\ -\beta_{FI} \end{bmatrix}$ is a cointegrating vector.

Consequently, (5.1) is the vector error-correction model developed for the purposes of our further empirical investigation.

In order to analyze the response of the Ukrainian money demand to the financial innovations' shock in the short-run, the impulse-response function is essential. Impulse-response function is aimed to study the contemporaneous effect of financial innovations on the demand for money.

The general representation of the impulse-response analysis for our study is the following (Sigayov, 2003):

$$\begin{bmatrix} FI_t = f(\varepsilon^{FI}) \\ \$_t = f(\varepsilon^{FI}, \varepsilon^{\$}) \\ Y_t = f(\varepsilon^{FI}, \varepsilon^{\$}, \varepsilon^{Y}) \\ R_t = f(\varepsilon^{FI}, \varepsilon^{\$}, \varepsilon^{Y}, \varepsilon^{R}) \\ \pi_t^e = f(\varepsilon^{FI}, \varepsilon^{\$}, \varepsilon^{Y}, \varepsilon^{R}, \varepsilon^{\pi^e}) \\ E_t^e = f(\varepsilon^{FI}, \varepsilon^{\$}, \varepsilon^{Y}, \varepsilon^{R}, \varepsilon^{\pi^e}, \varepsilon^{E^e}) \\ M_t^d = f(\varepsilon^{FI}, \varepsilon^{\$}, \varepsilon^{Y}, \varepsilon^{R}, \varepsilon^{\pi^e}, \varepsilon^{E^e}, \varepsilon^{M^d}) \end{bmatrix} = \alpha + \begin{bmatrix} \beta_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_{21} & \beta_{22} & 0 & 0 & 0 & 0 & 0 \\ \beta_{31} & \beta_{32} & \beta_{33} & 0 & 0 & 0 & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} & 0 & 0 & 0 \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & \beta_{55} & 0 & 0 \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & \beta_{66} & 0 \\ \beta_{71} & \beta_{72} & \beta_{73} & \beta_{74} & \beta_{75} & \beta_{76} & \beta_{77} \end{bmatrix} \Gamma(L) \begin{bmatrix} \varepsilon_t^{FI} \\ \varepsilon_t^{\$} \\ \varepsilon_t^{Y} \\ \varepsilon_t^{R} \\ \varepsilon_t^{\pi^e} \\ \varepsilon_t^{E^e} \\ \varepsilon_t^{M^d} \end{bmatrix} \quad (5.3)$$

Chapter 6

EMPIRICAL RESULTS

Empirical investigation of the impact of financial innovations on the demand for money in Ukraine proved to be significant in the long-run for both narrow and broad money specifications. Several robustness checks were done in order to state that the estimates are robust with respect to the changes in the empirical specification, as well as to the significance of the financial innovations in the study (Appendix H). Impulse-response function analysis indicates a negative impact of the financial innovations' shock on the Ukrainian money demand in the short run while the long run impact of financial innovations is positive.

Demand for real money balances in Ukraine:

1. Narrow money specification:

(i) With financial innovations (R^2 =0.3373):

$$M_1^d = -17.11 + 3.28Y + 1.81R + 0.09E^e - 2.73\pi^e - 2.01\$ + 3.29FI \quad (6.1)$$

St. d.	(0.40)	(1.37)	(0.06)	(0.55)	(1.07)	(2.01)
P>$\|z\|$	(0.000)	(0.189)	(0.128)	(0.000)	(0.059)	(0.104)

(ii) Without financial innovations (R^2=0.2790)

$$M_1^d = -14.47 + 2.90Y + 1.80R + 0.09E^e - 1.92\pi^e - 1.60\$ \quad (6.2)$$

St. d.	(0.36)	(1.40)	(0.06)	(0.35)	(1.08)
P>$\|z\|$	(0.000)	(0.20)	(0.144)	(0.000)	(0.142)

2. Broad money specification:

(i) With financial innovations (R^2 =0.3955):

$$M_2^d = -18.63 + 3.50Y + 2.19R + 0.07E^e - 2.83\pi^e - 2.58\$ + 3.34FI \quad (6.3)$$

St. d.	(0.41)	(1.41)	(0.06)	(0.55)	(1.09)	(2.05)
P>$\|z\|$	(0.000)	(0.189)	(0.274)	(0.000)	(0.018)	(0.104)

(ii) Without financial innovations (R^2=0.3510)

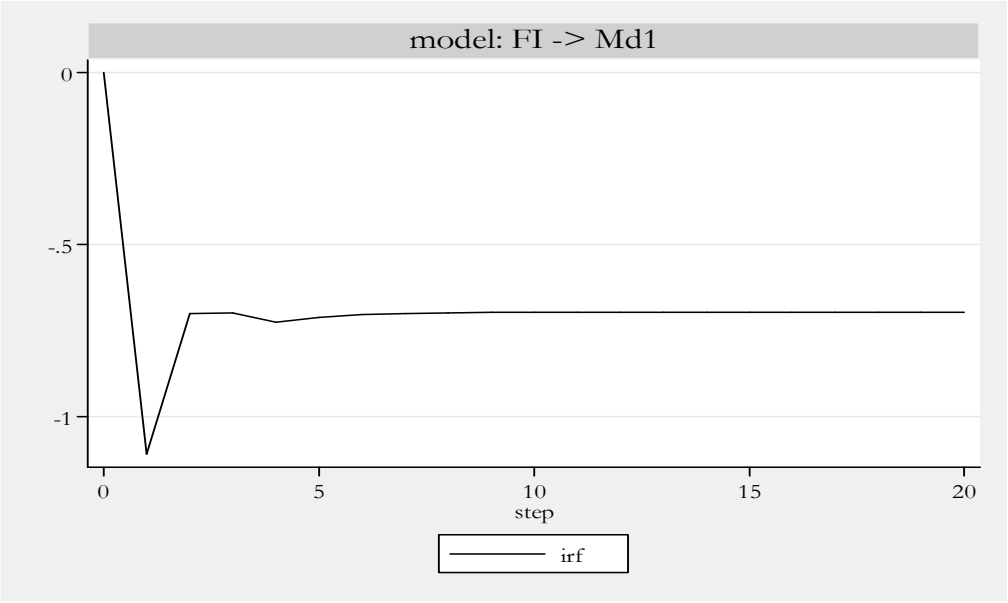
$$M_2^d = -16.42 + 3.17Y + 2.78R + 0.10E^e - 2.11\pi^e - 2.61\$ \quad (6.4)$$

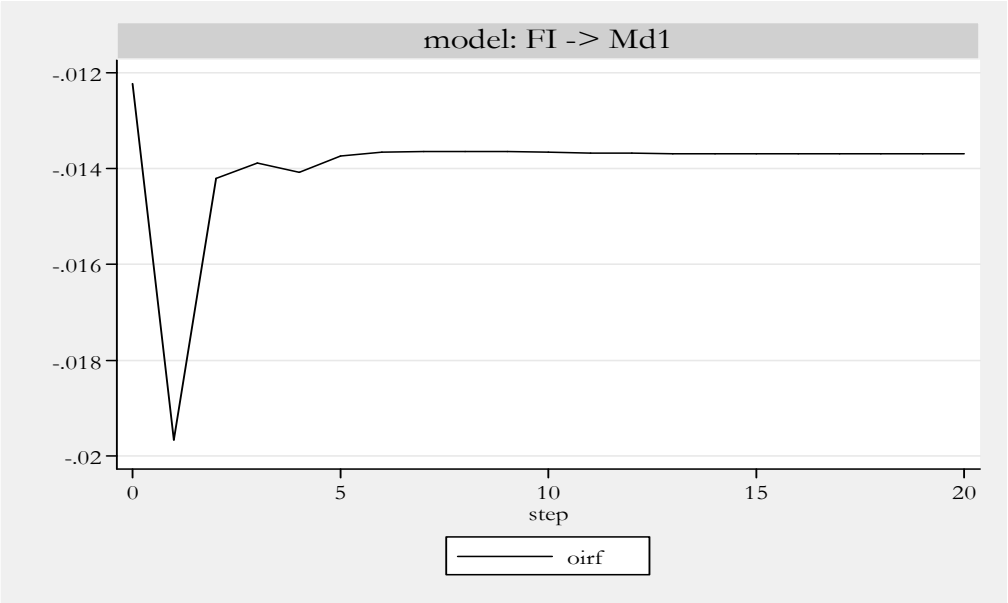
St. d.	(0.38)	(1.48)	(0.06)	(0.37)	(1.15)
P>$\|z\|$	(0.000)	(0.061)	(0.125)	(0.000)	(0.023)

Specification of the appropriate lag structure for all the above models indicated that there are two lags in levels (i.e. one lag in differences (Appendix C)). Estimation of the cointegrating rank (Appendix D) indicated that within 10% significance level the maximum rank of integration is equal to one, so that the above models have one cointegrating equation. These models were tested for the autocorrelation at the lag order by the Lagrange multiplier test (Appendix F). Obtained statistics allowed us not to reject the Ho that "there is no autocorrelation at lag order. Checking for stability condition proved to be fulfilled in all the above specifications (i.e. (6.1), (6.2), (6.3), (6.4) (AppendixG)).

In order to make an impulse-response analysis, the general idea of which is presented by relationship in expression (5.3) was applied. This allowed us to get the following results (Figure 6.1. and Figure 6.2 (IRF table results are presented in Appendix I)).

Figure 6.1. **Impact of Financial Innovations on the Demand for Narrow Money (IRF, OIRF, and FEVD)**





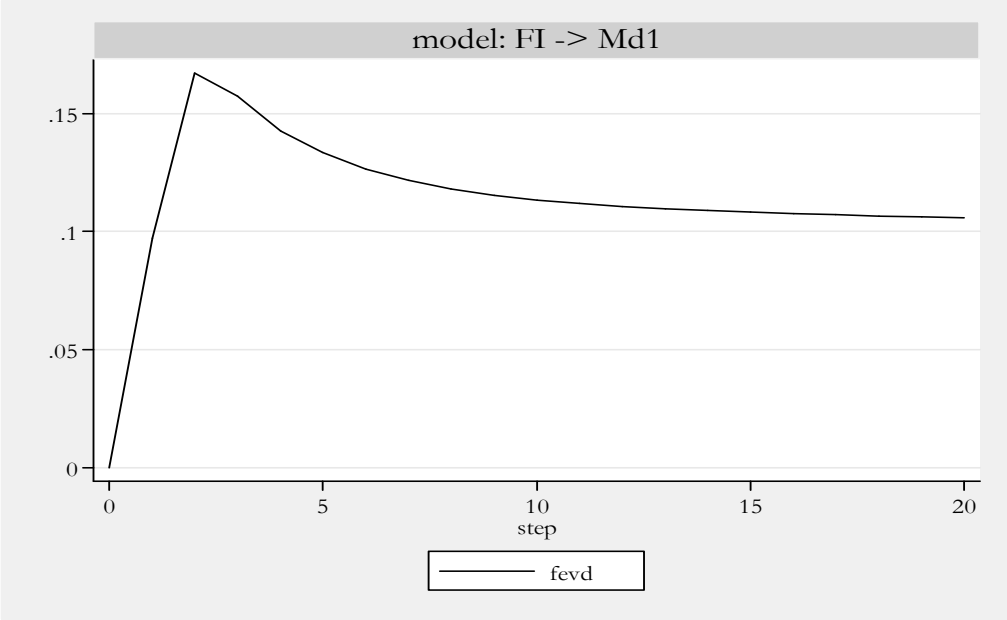
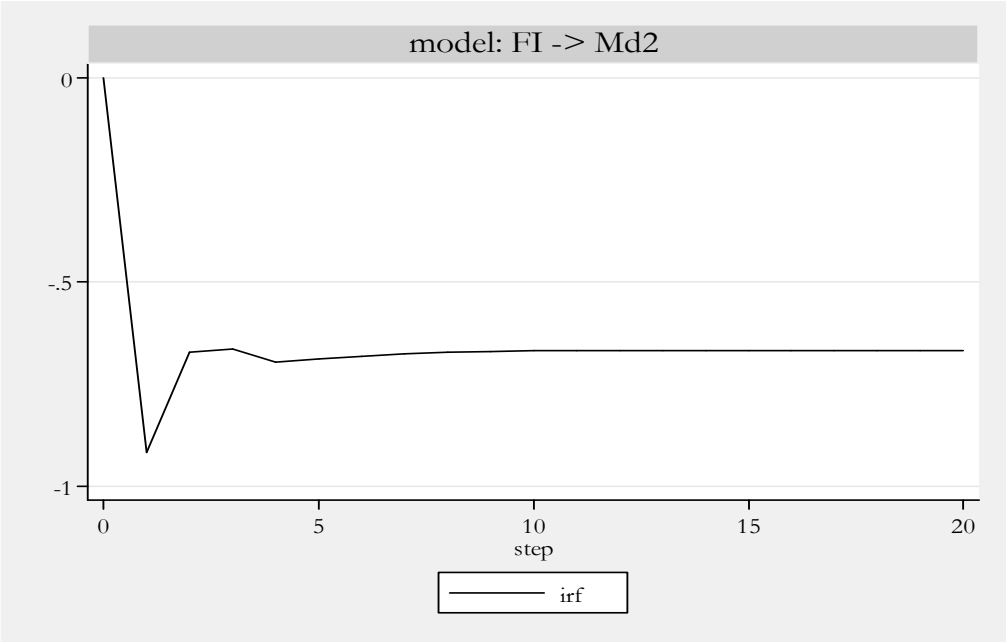
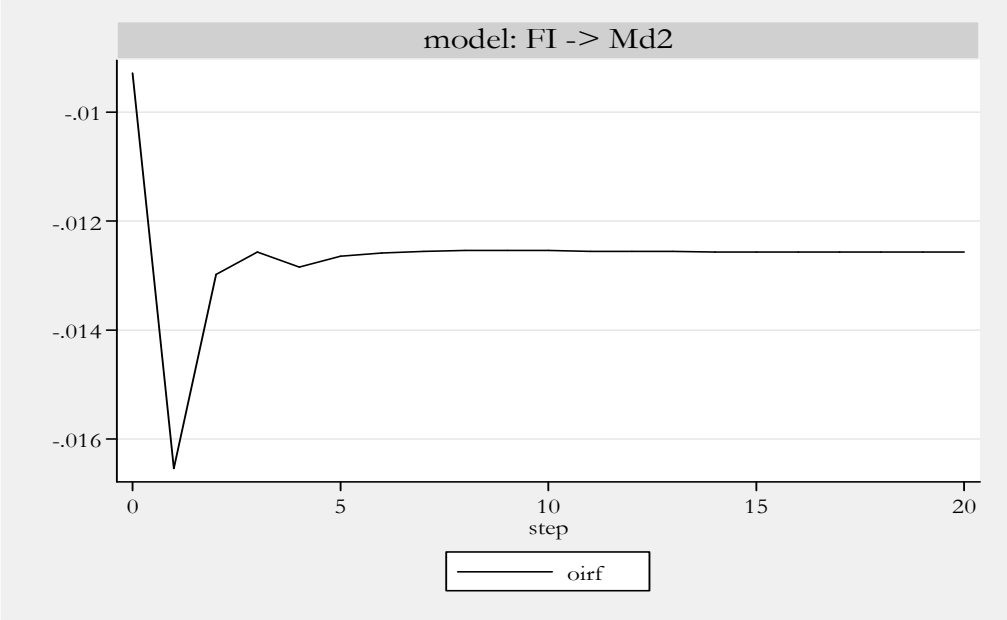
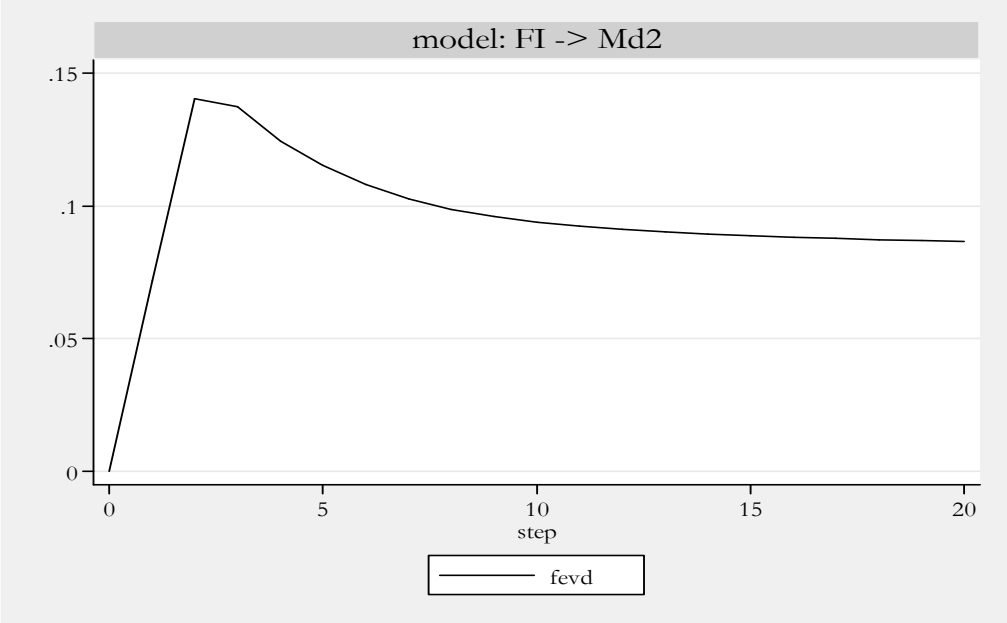


Figure 6.2. **Impact of Financial Innovations on the Demand for Broad Money (IRF, OIRF, and FEVD)**







Impulse-response function analysis (Figure 6.1. and Figure 6.2) shows that the impact of financial innovations is stronger within the narrow demand for money specifications. However, within the broad money specification the shock to the money demand produced by the financial innovations is more persistent.

Consequently, at the ten percentage level of significance we can state that financial innovations have negative impact on demand for money in Ukraine in the short run, while the overall effect of financial innovations on narrow and broad demand for money is positive ((6.1) and (6.2), respectively).

Chapter 7

CONCLUSIONS

Most of the important things in the world have been accomplished by people who have kept on trying when there seemed to be no hope at all.
D. Carnegie

The main goal of our research has been to find the level impact of financial innovations on Ukrainian demand for money. The methodology has been based on the general practices applied in the field of money demand analysis (e.g., Sriram, 1999; Bilan et. al, 2003; Sigayov, 2003 and others). The empirical part of the thesis has been conducted by means of the vector error-correction model (VECM). Empirical investigation has shown that within ten percent significance level there is positive impact of financial innovations on the money demand in Ukraine in the long run. However, their impact in the short run is negative.

Several specifications of the functional relationship were applied in order to define the long run relationship of the money demand in Ukraine. Particularly, the narrow and broad (M1 and M2 less foreign currency component, respectively) money demand specifications were explored. While in both cases the effect of financial innovations proved to be significant, impulse-response analysis has shown that the impact of financial innovations is stronger within the narrow demand for money specifications. However, within the broad money specification the shock to the money demand produced by the financial innovations is more persistent.

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APPENDIX A. EXAMPLE OF THE QUESTIONNAIRE

Questionnaire on Banking Sector in Ukraine during 1997-2005

How would you characterize the situation of the Ukrainian banking sector during 1997-2005? Please evaluate the level of the development of the financial products/instruments in subsequent years according to the following principle:

0- absent
1- extremely poor
2- poor
3- average
4- good
5- highly developed

Type of financial product/instrument	1997	1998	1999	2000	2001	2002	2003	2004	2005
Credit Cards	0	0	1	1	1	1	2	2	2
Debit Cards	0	0	1	2	2	2	2	2	2
Automated Teller Machines	0	0	1	2	2	2	3	3	3
Collateralized mortgages	0	0	0	0	1	1	1	1	2
Corporate Bonds	0	0	0	0	1	2	2	2	2
Treasury Bills	2	2	2	2	2	2	2	2	2
Automated Clearing Houses	4	4	4	4	4	4	4	4	4
Wire Transfers	2	2	3	3	3	3	4	4	4
Electronic Banking	2	2	2	3	3	3	4	4	4
Forward Contracts	1	1	0	0	0	0	0	1	1

Comments:

J. Bunar

APPENDIX B. DICKEY-FULLER TEST FOR UNIT ROOT

VARIABLE		M_1^d	M_2^d	Y	R	FI	π^e	E	$
I(0)	TEST STATISTIC	0.332	0.931	-0.55	-2.15	0.073	1.408	-2.40	-1.447
	P-VALUE	0.979	0.994	0.883	0.224	0.964	0.997	0.142	0.559
I(1)	TEST STATISTIC	-10.96	-10.44	-14.86	-13.05	-10.93	-4.763	-5.99	-12.85
	P-VALUE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

APPENDIX C. TEST ON THE APPROPIATE LAG STRUCTURE

FIGURE C1. SPECIFICATION (6.1)

```
Selection order criteria
Sample:  1997m4  2005m12                        Number of obs      =       105
+---------------------------------------------------------------------------+
|lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
|----+----------------------------------------------------------------------|
|  0 |   654.88                       1.0e-14  -12.3406  -12.2689  -12.1636  |
|  1 |  1588.85  1867.9   49  0.000  4.9e-22  -29.1972  -28.6236  -27.7818* |
|  2 |  1669.55  161.39   49  0.000  2.7e-22* -29.8009* -28.7254* -27.1469  |
|  3 |  1707.63   76.16*  49  0.008  3.5e-22  -29.5929  -28.0156  -25.7004  |
+---------------------------------------------------------------------------+
Endogenous:  Md1 Y E P dollarization R FI
 Exogenous:  _cons
```

FIGURE C2. SPECIFICATION (6.2)

```
                        Selection order criteria
 Sample:  1997m4  2005m12                        Number of obs      =       105
+---------------------------------------------------------------------------+
|lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
|----+----------------------------------------------------------------------|
|  0 |  374.948                       3.6e-11  -7.02757  -6.96612  -6.87592  |
|  1 |  1259.91  1769.9   36  0.000  3.4e-18  -23.1982  -22.7681  -22.1366* |
|  2 |   1321.7  123.58   36  0.000  2.1e-18* -23.6895* -22.8906*  -21.718  |
|  3 |  1349.07  54.754*  36  0.023  2.5e-18  -23.5252  -22.3576  -20.6438  |
+---------------------------------------------------------------------------+
Endogenous:  Md1 Y E P dollarization R
 Exogenous:  _cons
```

FIGURE C3. SPECIFICATION (6.3)

```
Selection order criteria
Sample:  1997m4  2005m12                        Number of obs      =       105
+---------------------------------------------------------------------------+
|lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
|----+----------------------------------------------------------------------|
|  0 |  634.115                       1.5e-14  -11.9451  -11.8734  -11.7681  |
|  1 |  1602.21  1936.2   49  0.000  3.8e-22  -29.4516  -28.8781  -28.0362* |
|  2 |  1685.24  166.05   49  0.000  2.0e-22* -30.0997* -29.0243* -27.4458  |
|  3 |  1721.55  72.636*  49  0.016  2.7e-22  -29.8582  -28.2809  -25.9657  |
+---------------------------------------------------------------------------+
Endogenous:  Md2 Y E P dollarization R FI
 Exogenous:  _cons
```

FIGURE C4. SPECIFICATION (6.4)

Selection order criteria
Sample: 1997m4 2005m12 Number of obs = 105

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	354.165				5.3e-11	-6.63171	-6.57026	-6.48006
1	1274.81	1841.3	36	0.000	2.6e-18	-23.4821	-23.052	-22.4205*
2	1338.21	126.8*	36	0.000	1.5e-18*	-24.0041*	-23.2052*	-22.0325
3	1363.71	50.994	36	0.050	1.9e-18	-23.804	-22.6364	-20.9226

Endogenous: Md2 Y E P dollarization R
Exogenous: _cons

APPENDIX D. TEST ON THE NUMBER OF COINTEGRATING EQUATIONS

FIGURE D1. SPECIFICATION (6.1)

Johansen tests for cointegration
Trend: constant Number of obs = 106
Sample: 1997m3 2005m12 Lags = 2

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	56	1622.305	.	129.5475	124.24
1	69	1645.008	0.34842	84.1413*	94.15
2	80	1661.1457	0.26250	51.8659	68.52
3	89	1670.1802	0.15672	33.7970	47.21
4	96	1677.2662	0.12515	19.6249	29.68
5	101	1681.8003	0.08199	10.5568	15.41
6	104	1686.1032	0.07798	1.9510	3.76
7	105	1687.0787	0.01824		

FIGURE D2. SPECIFICATION (6.2)

Johansen tests for cointegration
Trend: constant Number of obs = 106
Sample: 1997m3 2005m12 Lags = 2

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	42	1283.4294	.	102.9076	94.15
1	53	1303.7862	0.31893	62.1939*	68.52
2	62	1318.185	0.23790	33.3963	47.21
3	69	1326.4741	0.14478	16.8182	29.68
4	74	1330.7318	0.07719	8.3027	15.41
5	77	1333.8335	0.05684	2.0993	3.76
6	78	1334.8832	0.01961		

FIGURE D3. SPECIFICATION (6.3)

Johansen tests for cointegration
Trend: constant Number of obs = 106
Sample: 1997m3 2005m12 Lags = 2

maximum				trace	5% critical

rank	parms	LL	eigenvalue	statistic	value
0	56	1635.6322	.	134.7915	124.24
1	69	1659.0151	0.35673	88.0257*	94.15
2	80	1675.4767	0.26699	55.1024	68.52
3	89	1685.1994	0.16760	35.6569	47.21
4	96	1692.0272	0.12087	22.0014	29.68
5	101	1696.8538	0.08705	12.3481	15.41
6	104	1701.0708	0.07648	3.9142	3.76
7	105	1703.0279	0.03625		

FIGURE D4. SPECIFICATION (6.4)

.

Johansen tests for cointegration

Trend: constant — Number of obs = 106
Sample: 1997m3 2005m12 — Lags = 2

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	42	1297.778	.	108.1224	94.15
1	53	1318.8727	0.32835	65.9330*	68.52
2	62	1333.1981	0.23684	37.2821	47.21
3	69	1342.3991	0.15937	18.8802	29.68
4	74	1347.2984	0.08830	9.0814	15.41
5	77	1351.2332	0.07155	1.2119	3.76
6	78	1351.8392	0.01137		

APPENDIX E. VECTOR ERROR-CORRECTION MODEL RESULTS

FIGURE E1. SPECIFICATION (6.1)

Vector error-correction model

Sample: 1997m3 2005m12 — No. of obs = 106
AIC = -29.736
Log likelihood = 1645.008 — HQIC = -29.0333
Det(Sigma_ml) = 7.82e-23 — SBIC = -28.00225

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_Md1	9	.039258	0.3373	49.3702	0.0000

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	6	304.6076	0.0000

Identification: beta is exactly identified
Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_ce1						
Md1	1	.	.	.	.	.
Y	-3.281908	.4016269	-8.17	0.000	-4.069082	-2.494734
E	-.0909312	.0597511	-1.52	0.128	-.2080412	.0261788
P	2.739218	.5492197	4.99	0.000	1.662768	3.815669
dollarizat~n	2.013156	1.065128	1.89	0.059	-.074456	4.100769

```
           R |  -1.810044   1.376909    -1.31   0.189    -4.508736     .888649
          FI |  -3.285142   2.018677    -1.63   0.104    -7.241676    .6713922
       _cons |   17.10679          .        .       .            .           .
------------------------------------------------------------------------------
```

FIGURE E2. SPECIFICATION (6.2)

```
Vector error-correction model

Sample:  1997m3  2005m12                            No. of obs      =       106
                                                    AIC             = -23.59974
Log likelihood =  1303.786                          HQIC            = -23.05999
Det(Sigma_ml)  =  8.35e-19                          SBIC            = -22.26802

Equation           Parms      RMSE     R-sq      chi2     P>chi2
-------------------------------------------------------------------
D_Md1                  8     .040739   0.2790   37.91911   0.0000
-------------------------------------------------------------------

Cointegrating equations

Equation           Parms    chi2     P>chi2
-----------------------------------------
_ce1                   5   292.7374   0.0000
-----------------------------------------

Identification:  beta is exactly identified
                 Johansen normalization restriction imposed
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
         Md1 |          1          .       .       .            .           .
           Y |  -2.898318   .3576634    -8.10   0.000    -3.599325    -2.19731
           E |  -.0870769   .0595742    -1.46   0.144    -.2038401    .0296863
           P |   1.920998   .3542874     5.42   0.000     1.226607    2.615388
dollarizat~n |   1.592398   1.083478     1.47   0.142     -.531179    3.715975
           R |  -1.796945   1.401541    -1.28   0.200    -4.543915    .9500237
       _cons |   14.47497          .        .       .            .           .
------------------------------------------------------------------------------
```

FIGURE E3. SPECIFICATION (6.3)

```
Vector error-correction model

Sample:  1997m3  2005m12                            No. of obs      =       106
                                                    AIC             = -30.00028
Log likelihood =  1659.015                          HQIC            = -29.29759
Det(Sigma_ml)  =  6.00e-23                          SBIC            = -28.26654

Equation           Parms      RMSE     R-sq      chi2     P>chi2
-------------------------------------------------------------------
D_Md2                  9     .034624   0.3955   63.45802   0.0000
-------------------------------------------------------------------
Cointegrating equations

Equation           Parms    chi2     P>chi2
-----------------------------------------
_ce1                   6   349.4704   0.0000
-----------------------------------------

Identification:  beta is exactly identified
                 Johansen normalization restriction imposed
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
_ce1          |
         Md2 |          1          .       .      .            .           .
           Y |  -3.504894   .4074988    -8.60   0.000    -4.303577   -2.706211
           E |  -.0669009   .0611124    -1.09   0.274     -.186679    .0528771
           P |   2.824578   .5558937     5.08   0.000     1.735047    3.91411
dollarizat~n |   2.579474   1.089962     2.37   0.018     .4431887    4.71576
           R |  -2.185746   1.409406    -1.55   0.121    -4.948131    .5766386
          FI |  -3.335411   2.052903    -1.62   0.104    -7.359027    .6882051
       _cons |   18.62955          .       .      .            .           .
------------------------------------------------------------------------------
```

.

FIGURE E4. SPECIFICATION (6.4)

```
.
Vector error-correction model

Sample:  1997m3  2005m12                         No. of obs      =       106
                                                  AIC             = -23.88439
Log likelihood =  1318.873                        HQIC            = -23.34464
Det(Sigma_ml)  =  6.28e-19                        SBIC            = -22.55267

Equation           Parms      RMSE     R-sq      chi2     P>chi2
-------------------------------------------------------------------
D_Md2                  8      .03569   0.3510   53.01205   0.0000
-------------------------------------------------------------------
Cointegrating equations

Equation           Parms    chi2     P>chi2
-----------------------------------------
_ce1                   5   307.7112   0.0000
-----------------------------------------

Identification:  beta is exactly identified
                 Johansen normalization restriction imposed
------------------------------------------------------------------------------
       beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
         Md2 |          1          .       .      .            .           .
           Y |  -3.174263   .3777371    -8.40   0.000    -3.914614   -2.433912
           E |  -.0966779   .0630319    -1.53   0.125    -.2202182    .0268623
           P |    2.10474   .3738957     5.63   0.000     1.371918    2.837563
dollarizat~n |   2.605722   1.147327     2.27   0.023      .357003    4.854441
           R |  -2.781876   1.484365    -1.87   0.061    -5.691178    .1274258
       _cons |   16.42154          .       .      .            .           .
------------------------------------------------------------------------------
```

APPENDIX F. TEST FOR AUTOCORRELATION AT LAG ORDER

H0: no autocorrelation at lag order

FIGURE F1. SPECIFICATION (6.1)

```
  Lagrange-multiplier test
  +---------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |   43.1087    49     0.70976   |
  |   2  |   39.0616    49     0.84436   |
  +---------------------------------------+
```

FIGURE F2. SPECIFICATION (6.2)

```
Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+------------------------------|
  |   1  |   38.4594    36     0.35878   |
  |   2  |   34.2116    36     0.55384   |
  +--------------------------------------+
```

FIGURE F3. SPECIFICATION (6.3)

```
Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+------------------------------|
  |   1  |   42.8470    49     0.71955   |
  |   2  |   42.3283    49     0.73859   |
  +--------------------------------------+
```

FIGURE F4. SPECIFICATION (6.4)

```
 Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+------------------------------|
  |   1  |   39.0014    36     0.33634   |
  |   2  |   34.8365    36     0.52382   |
  +--------------------------------------+
```

APPENDIX G. TEST FOR STABILITY

FIGURE G1. SPECIFICATION (6.1)

```
vecstable, graph
```

```
 Eigenvalue stability condition
  +---------------------------------------+
  |        Eigenvalue         |   Modulus   |
  |---------------------------+-------------|
  |          1                |         1   |
  |          1                |         1   |
  |          1                |         1   |
  |          1                |         1   |
  |          1                |         1   |
  |          1                |         1   |
  |   .6023624 +  .2155626i   |   .639772   |
  |   .6023624 -  .2155626i   |   .639772   |
  |  -.4256648                |   .425665   |
  |  -.1245573 +  .2797874i   |   .306261   |
  |  -.1245573 -  .2797874i   |   .306261   |
  |  -.2682186                |   .268219   |
  |   .1048992 +  .1608212i   |   .192009   |
  |   .1048992 -  .1608212i   |   .192009   |
  +---------------------------------------+
  The VECM specification imposes 6 unit moduli
```

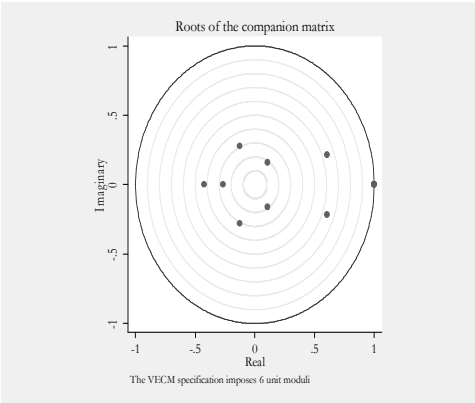


FIGURE G2. SPECIFICATION (6.2)

```
 Eigenvalue stability condition
  +---------------------------------------+
  |        Eigenvalue         |   Modulus   |
```

```
|--------------------------+-------------|
|          1               |          1  |
|          1               |          1  |
|          1               |          1  |
|          1               |          1  |
|          1               |          1  |
|   .5597325 +  .1627253i  |   .582906   |
|   .5597325 -  .1627253i  |   .582906   |
|  -.4223145               |   .422314   |
|  -.3141125               |   .314112   |
|   .3017619               |   .301762   |
| -.02378172 + .01984284i  |   .030973   |
| -.02378172 - .01984284i  |   .030973   |
+-----------------------------------------+
 The VECM specification imposes 5 unit moduli
```

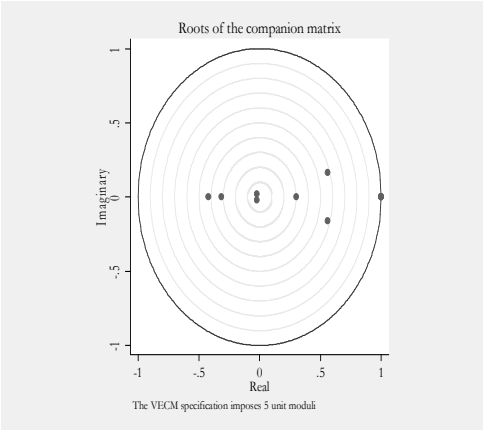


FIGURE G3. SPECIFICATION (6.3)

```
. vecstable, graph

  Eigenvalue stability condition
+-----------------------------------------+
|        Eigenvalue        |   Modulus    |
|--------------------------+--------------|
|          1               |          1   |
|          1               |          1   |
|          1               |          1   |
|          1               |          1   |
|          1               |          1   |
|          1               |          1   |
|   .6239877 +   .235043i  |   .666788    |
|   .6239877 -   .235043i  |   .666788    |
|  -.4259858               |   .425986    |
|    .103884 +  .2647839i  |   .284434    |
|    .103884 -  .2647839i  |   .284434    |
|  -.1242941 +  .2513753i  |   .280426    |
|  -.1242941 -  .2513753i  |   .280426    |
|  -.2462783               |   .246278    |
+-----------------------------------------+
 The VECM specification imposes 6 unit moduli
```

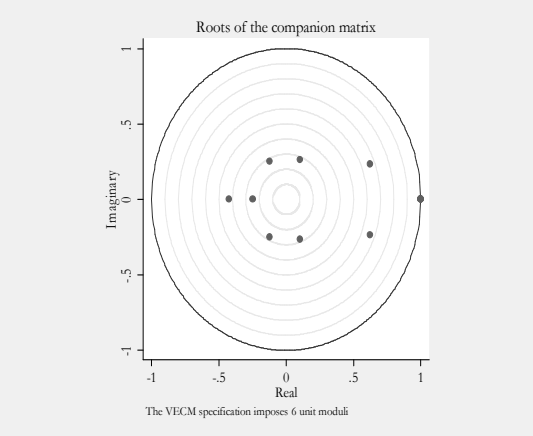
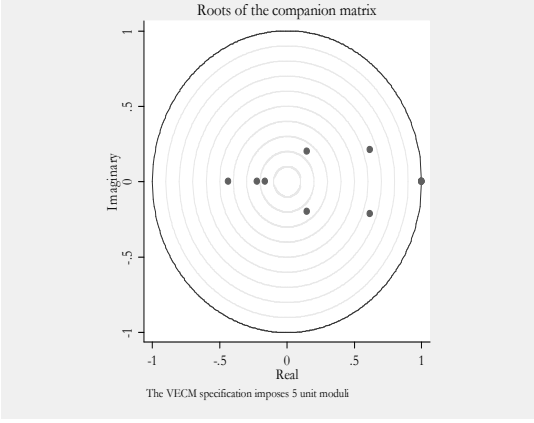


FIGURE G4. SPECIFICATION (6.4)

```
. vecstable, graph

  Eigenvalue stability condition
+-----------------------------------------+
|        Eigenvalue        |   Modulus    |
|--------------------------+--------------|
|          1               |          1   |
|          1               |          1   |
|          1               |          1   |
|          1               |          1   |
|          1               |          1   |
|    .614289 +  .2118826i  |   .649804    |
|    .614289 -  .2118826i  |   .649804    |
|  -.4354866               |   .435487    |
|   .1455379 +  .1993196i  |   .246799    |
|   .1455379 -  .1993196i  |   .246799    |
|  -.2237786               |   .223779    |
|  -.1626999               |     .1627    |
+-----------------------------------------+
 The      VECM      specification      imposes
```



APPENDIX H. ESTIMATION RESULTS

Table H1. Econometric Results from the Estimation of the Narrow Demand for Money Specification

Independent Variables	Dependent Variable M_1^d (one cointegrating equation; "no autocorrelation at lag order" hypothesis cannot be rejected)														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
constant	3.44	-17.15	-18.74	-10.94	-14.17	-24.32	-14.47	-11.50	1.85	-13.23	-25.35	-22.01	-14.91	-0.65	-17.11
Y	0.79*** (0.08)	3.22*** (0.40)	3.39*** (0.45)	2.45*** (0.32)	2.92*** (0.37)	4.18*** (0.57)	2.89*** (0.36)	2.51*** (0.29)	0.97*** (0.13)	2.75*** (0.35)	4.18*** (0.62)	3.88*** (0.49)	3.02*** (0.35)	1.15*** (0.26)	3.28*** (0.40)
π^e	-	-2.14*** (0.37)	-2.22*** (0.43)	-1.47*** (.29)	-2.42*** (0.49)	-3.66*** (0.79)	-1.92*** (0.35)	-1.49*** (0.28)	-	-2.03*** (0.47)	-3.17*** (0.82)	-3.05*** (0.68)	-2.41*** (0.49)	-0.24 (0.23)	-2.73*** (0.55)
E	-0.16*** (0.03)	-	-	-	-	-	0.09 (0.06)	0.02 (0.03)	-0.19*** (0.03)	-	-	0.00 (0.05)	0.03 (0.04)	-	0.09 (0.06)
$	-	-	-	-0.73 (0.67)	-1.08* (0.65)	-	-1.59 (1.08)	-0.95 (0.64)	-	-0.70 (0.60)	-	-	-1.15 (0.73)	-1.18*** (0.45)	-2.01** (1.07)
R	-6.03*** (0.63)	-	0.73 (1.34)	0.02 (0.96)	-	-	1.80 (1.40)	-	-5.67*** (0.82)	0.16 (0.84)	2.37* (1.38)	-	-	-	1.81 (1.37)
FI	-	-	-	-	3.81** (1.82)	5.04* (2.78)	-	-	-0.05 (1.09)	2.84* (1.61)	3.14 (2.76)	3.12 (2.52)	2.92* (1.80)	-	3.29* (2.01)
Number of lags included	1	3	2	2	3	2	2	3	3	3	3	2	2	5	2
R^2	0.1429	0.2261	0.2401	0.2423	0.2493	0.2496	0.2790	0.2935	0.2948	0.2976	0.2986	0.3020	0.3066	0.3186	0.3373

- -10% significance level, ** -5% significance level, *** -1% significance level

Table H2. Econometric Results from the Estimation of the Broad Demand for Money Specification

Independent Variables	Dependent Variable M_2^d (one cointegrating equation; "no autocorrelation at lag order" hypothesis cannot be rejected)														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
constant	-1.48	2.53	-23.08	-23.43	-30.40	-14.63	4.25	-0.20	-28.95	-25.17	3.37	-33.63	-16.42	-16.58	-18.63
Y	1.29*** (0.15)	0.94** (0.10)	3.98*** (0.51)	4.05*** (0.50)	4.95*** (0.67)	3.02*** (0.35)	0.69*** (0.12)	1.24** (0.17)	4.6*** (0.6)	4.31*** (0.53)	1.51*** (0.32)	5.19*** (0.74)	3.17*** (0.37)	3.26*** (0.27)	3.5*** (0.41)
π^e	-	-	-2.74*** (0.48)	-2.70*** (0.5)	-4.35*** (0.91)	-2.45*** (0.48)	-	-	-3.07*** (0.55)	-3.31*** (0.73)	-0.45 (0.28)	-3.93*** (0.99)	-2.1*** (0.37)	-2.52*** (0.50)	-2.82*** (0.55)
E	-	-0.20*** (0.03)	-	0.00 (0.05)	-	-		-0.24*** (0.04)	-	-0.05 (0.05)	-	-	0.1 (0.06)	0.00 (0.04)	0.07 (0.06)
$	-3.01*** (0.65)	-	-	-	-	-1.87*** (0.64)	-2.20*** (0.86)	-	-	-	-1.41*** (0.55)	-	-2.6** (1.15)	-1.51** (0.77)	-2.58*** (1.09)
R	1.41 (0.90)	-7.13*** (0.77)	-	-	-	-	-3.43*** (1.28)	-6.22*** (1.02)	3.31** (1.70)	-	-	3.52** (1.68)	2.78** (1.48)	-	2.18 (1.41)
FI	-2.57*** (1.02)	-	-	-	5.52* (3.32)	3.62** (1.78)	-	-0.53 (1.32)	-	3.44 (2.70)	-	3.49 (3.32)	-	3.00* (1.85)	3.33* (2.05)
Number of lags included	1	1	2	2	2	2	3	3	3	2	5	3	2	2	2
R^2	0.1680	0.2098	0.2429	0.2944	0.2964	0.3019	0.3199	0.3429	0.3450	0.3483	0.3513	0.3513	0.3510	0.3597	0.3955

* -10% significance level, ** -5% significance level, *** -1% significance level

APPENDIX I. IRF RESULTS

FIGURE I1. SPECIFICATION (6.1)

Results from model

step	(1) irf	(2) irf	(3) irf	(4) irf	(5) irf	(6) irf
0	1	0	0	0	0	0
1	1.0014	.355707	-1.3959	-.062642	.200683	-.202904
2	.879608	.167557	-.31516	-.05702	.306853	.225737
3	.931366	.16577	-.567903	-.087613	.349974	-.228916
6	.938554	.168058	-.678757	-.095978	.379435	-.548154
12	.936685	.169193	-.677478	-.093168	.362645	-.578567
24	.936569	.169342	-.676349	-.092994	.362365	-.572473
36	.936568	.169343	-.676348	-.092994	.36236	-.572483

step	(7) irf	(8) irf	(9) irf	(10) irf	(11) irf	(12) irf
0	0	0	1	0	0	0
1	-1.1086	-.050307	.734604	-.556015	.06988	-.003
2	-.7007	-.07646	.7637	.470886	.042817	-.043425
3	-.698314	-.070532	.741047	.120675	.058257	-.098317
6	-.703246	-.091147	.757622	.296455	.078574	-.209645
12	-.69632	-.096036	.761882	.323868	.0862	-.232917
24	-.69683	-.095666	.761629	.322199	.085673	-.230541
36	-.696827	-.095667	.761631	.32221	.085675	-.230549

step	(13) irf	(14) irf	(15) irf	(16) irf	(17) irf	(18) irf
0	0	0	0	0	1	0
1	.489382	-.276695	-.009399	.005556	.445083	-.007754
2	.551833	.053227	.006504	.019062	.396582	-.011453
3	.240878	-.019348	.021994	.025098	.280707	-.02278
6	.305983	.046638	.039622	.011412	.225795	-.051215
12	.447723	.037436	.045004	.005943	.185864	-.059085
24	.444991	.036967	.044557	.00626	.187961	-.058442
36	.445036	.036965	.044559	.006259	.187949	-.058445

step	(19) irf	(20) irf	(21) irf	(22) irf	(23) irf	(24) irf
0	0	0	0	0	0	0
1	.036643	-.062024	-.129711	.02603	.16135	-.60035
2	.09978	.207366	-.155023	-.029699	.05082	-.084229
3	.172804	.337642	-.229098	.004751	.073386	-.290878
6	.307131	.254952	-.253479	.004647	.067875	-.311767
12	.330017	.083733	-.243972	.004491	.067725	-.314827
24	.32724	.088178	-.243566	.004401	.067813	-.314187
36	.327247	.088125	-.243563	.004401	.067813	-.314188

	(25)	(26)	(27)	(28)	(29)	(30)
step	irf	irf	irf	irf	irf	irf
0	1	0	0	0	0	0
1	.730007	.093456	-.104681	-.47714	.041523	-.248485
2	.795228	.132375	.115786	-.232859	.055238	-.346917
3	.76455	.156044	-.096522	-.285299	.054288	-.373467
6	.76297	.181519	-.198677	-.282053	-.002968	-.34693
12	.763065	.177915	-.227763	-.278349	-.033289	-.320983
24	.763198	.177513	-.22507	-.278489	-.031781	-.321819
36	.763198	.177512	-.225079	-.278488	-.031791	-.321811

	(31)	(32)	(33)	(34)	(35)	(36)
step	irf	irf	irf	irf	irf	irf
0	0	0	1	0	0	0
1	.891922	-.188342	1.43299	-2.17407	.410607	.016162
2	.895674	-.247931	1.47269	-4.68069	.751965	.01502
3	.725628	-.251911	1.33133	-6.21405	.947365	.018547
6	.840596	-.169495	.85696	-6.89301	1.1553	.028333
12	1.02185	-.12549	.698265	-6.26149	1.14168	.029201
24	1.01684	-.127636	.709225	-6.25883	1.1381	.029029
36	1.0169	-.127622	.709174	-6.25864	1.1381	.02903

	(37)	(38)	(39)	(40)	(41)	(42)
step	irf	irf	irf	irf	irf	irf
0	0	0	0	0	1	0
1	.016579	.089714	.003087	.049017	1.46376	-.073722
2	.011331	.13118	-.006527	.102752	1.60593	-.103402
3	.003111	.141759	-.01477	.142352	1.59665	-.100603
6	-.003121	.084552	-.027666	.191582	1.44564	-.103737
12	-.004399	.074431	-.028955	.19219	1.38537	-.098049
24	-.004253	.075447	-.028706	.191284	1.38885	-.098113
36	-.004254	.075444	-.028706	.191284	1.38883	-.098111

	(43)	(44)	(45)	(46)	(47)	(48)
step	irf	irf	irf	irf	irf	irf
0	0	0	0	0	0	0
1	.133956	.057187	-.721414	.004574	-.013965	-.361488
2	.078148	.052381	-.195027	.005546	-.054105	-.420813
3	.063009	.019397	-.126869	.015038	-.12642	-.664807
6	.045196	.03867	-.061003	.044898	-.282443	-.680471
12	.037971	.045571	-.013707	.055729	-.316993	-.48044
24	.038483	.045231	-.015909	.054997	-.313654	-.48372
36	.038481	.045233	-.015894	.055	-.313665	-.483658

	(49)	
step	irf	
0	1	
1	.663682	
2	.777522	
3	.863619	||
6	.90851	||
12	.898659	||
24	.897964	||
36	.897961	||

(1) irfname = model, impulse = FI, and response = FI

```
(2) irfname = model, impulse = FI, and response = dollarization
(3) irfname = model, impulse = FI, and response = Y
(4) irfname = model, impulse = FI, and response = R
(5) irfname = model, impulse = FI, and response = P
(6) irfname = model, impulse = FI, and response = E
(7) irfname = model, impulse = FI, and response = Md1
(8) irfname = model, impulse = dollarization, and response = FI
(9) irfname = model, impulse = dollarization, and response = dollarization
(10) irfname = model, impulse = dollarization, and response = Y
(11) irfname = model, impulse = dollarization, and response = R
(12) irfname = model, impulse = dollarization, and response = P
(13) irfname = model, impulse = dollarization, and response = E
(14) irfname = model, impulse = dollarization, and response = Md1
(15) irfname = model, impulse = Y, and response = FI
(16) irfname = model, impulse = Y, and response = dollarization
(17) irfname = model, impulse = Y, and response = Y
(18) irfname = model, impulse = Y, and response = R
(19) irfname = model, impulse = Y, and response = P
(20) irfname = model, impulse = Y, and response = E
(21) irfname = model, impulse = Y, and response = Md1
(22) irfname = model, impulse = R, and response = FI
(23) irfname = model, impulse = R, and response = dollarization
(24) irfname = model, impulse = R, and response = Y
(25) irfname = model, impulse = R, and response = R
(26) irfname = model, impulse = R, and response = P
(27) irfname = model, impulse = R, and response = E
(28) irfname = model, impulse = R, and response = Md1
(29) irfname = model, impulse = P, and response = FI
(30) irfname = model, impulse = P, and response = dollarization
(31) irfname = model, impulse = P, and response = Y
(32) irfname = model, impulse = P, and response = R
(33) irfname = model, impulse = P, and response = P
(34) irfname = model, impulse = P, and response = E
(35) irfname = model, impulse = P, and response = Md1
(36) irfname = model, impulse = E, and response = FI
(37) irfname = model, impulse = E, and response = dollarization
(38) irfname = model, impulse = E, and response = Y
(39) irfname = model, impulse = E, and response = R
(40) irfname = model, impulse = E, and response = P
(41) irfname = model, impulse = E, and response = E
(42) irfname = model, impulse = E, and response = Md1
(43) irfname = model, impulse = Md1, and response = FI
(44) irfname = model, impulse = Md1, and response = dollarization
(45) irfname = model, impulse = Md1, and response = Y
(46) irfname = model, impulse = Md1, and response = R
(47) irfname = model, impulse = Md1, and response = P
(48) irfname = model, impulse = Md1, and response = E
(49) irfname = model, impulse = Md1, and response = Md1
```

FIGURE I2. SPECIFICATION (6.3)

Results from model

step	(1) irf	(2) irf	(3) irf	(4) irf	(5) irf	(6) irf
0	1	0	0	0	0	0
1	.977533	.32611	-1.1613	-.063203	.236669	-.281451
2	.875474	.150344	-.303759	-.066742	.320608	.035603
3	.91722	.149995	-.466021	-.089635	.359091	-.35923
6	.926164	.149635	-.589423	-.099192	.391855	-.689775
12	.923871	.150256	-.585904	-.096243	.372986	-.735038
24	.923772	.150503	-.584877	-.09606	.37287	-.726032
36	.92377	.150504	-.584871	-.096057	.372855	-.726041

step	(7) irf	(8) irf	(9) irf	(10) irf	(11) irf	(12) irf
0	0	0	1	0	0	0
1	-.917104	-.05386	.710163	-.421861	.071775	.052336
2	-.672729	-.084691	.732593	.625984	.033071	.003439
3	-.66442	-.081898	.701837	.287565	.053492	-.051086
6	-.681663	-.10241	.723637	.428637	.074726	-.181365
12	-.668018	-.107467	.729941	.45477	.083305	-.204552
24	-.668676	-.106848	.72943	.452146	.08241	-.200737
36	-.668667	-.10685	.729434	.452164	.082414	-.200744

step	(13) irf	(14) irf	(15) irf	(16) irf	(17) irf	(18) irf
0	0	0	0	0	1	0
1	.351427	-.261986	-.008322	.011534	.403402	-.00944
2	.233515	.040388	.009727	.031915	.323143	-.011298
3	-.181439	.008541	.026061	.040399	.214875	-.020294
6	-.147351	.103078	.042756	.025462	.183015	-.048722
12	.048778	.098283	.047245	.018619	.151316	-.055925
24	.041426	.09678	.046619	.019173	.154081	-.055005
36	.041557	.096774	.046621	.019169	.154065	-.055008

step	(19) irf	(20) irf	(21) irf	(22) irf	(23) irf	(24) irf
0	0	0	0	0	0	0
1	.02398	-.029318	-.119135	.017039	.150255	-.530408
2	.073888	.309912	-.148404	-.033325	.046208	-.106925
3	.144962	.495039	-.232425	.000918	.068772	-.294976
6	.27819	.427523	-.292263	.004623	.061286	-.331524
12	.296211	.223406	-.286034	.004857	.059849	-.337765
24	.292466	.232791	-.284746	.004661	.060084	-.336672
36	.29247	.232661	-.284737	.004661	.060083	-.336674

step	(25) irf	(26) irf	(27) irf	(28) irf	(29) irf	(30) irf
0	1	0	0	0	0	0
1	.730132	.122124	-.113721	-.459369	.098794	-.244493
2	.787981	.155078	.108349	-.279429	.091533	-.36767
3	.761054	.188753	-.05905	-.331368	.090207	-.428677
6	.753964	.235102	-.180172	-.349399	.037893	-.411453
12	.753211	.232435	-.248835	-.342516	.004643	-.376953
24	.753514	.231445	-.243022	-.342441	.00714	-.378354
36	.753514	.231441	-.243058	-.342436	.007122	-.378331

step	(31) irf	(32) irf	(33) irf	(34) irf	(35) irf	(36) irf
0	0	0	1	0	0	0
1	.619652	-.180379	1.54501	-2.36726	-.035377	.014399
2	.88908	-.262328	1.66873	-5.09772	.208448	.014858
3	.728119	-.276957	1.56907	-6.99805	.425669	.018386
6	.773457	-.20298	1.09567	-8.1774	.771712	.028516
12	.940115	-.15282	.912675	-7.4276	.811281	.028925
24	.932061	-.156289	.930041	-7.42657	.801726	.028699
36	.932166	-.15626	.929948	-7.42599	.801731	.028698

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+-------------------------------------------------------------------------------> -+

+-------------------------------------------------------------------------------> -+
|        |    (37)   |    (38)   |    (39)   |    (40)   |    (41)   |    (42)  > |
|  step  |   irf     |   irf     |   irf     |   irf     |   irf     |   irf    > |
|--------+-----------+-----------+-----------+-----------+-----------+----------> -|
|0       | 0         | 0         | 0         | 0         | 1         | 0        > |
|1       | .014954   | .102783   | .003078   | .051788   | 1.46354   | -.064612 > |
|2       | .009844   | .131279   | -.007087  | .107513   | 1.59818   | -.110899 > |
|3       | .002115   | .141346   | -.015681  | .147897   | 1.58983   | -.122026 > |
|6       | -.005574  | .087169   | -.02912   | .200063   | 1.42149   | -.139382 > |
|12      | -.007473  | .07997    | -.030111  | .19799    | 1.34308   | -.131906 > |
|24      | -.007209  | .081206   | -.029763  | .196822   | 1.34945   | -.13178  > |
|36      | -.007209  | .081204   | -.029763  | .196817   | 1.34941   | -.131774 > |
+-------------------------------------------------------------------------------> -+

+-------------------------------------------------------------------------------> -+
|        |    (43)   |    (44)   |    (45)   |    (46)   |    (47)   |    (48)  > |
|  step  |   irf     |   irf     |   irf     |   irf     |   irf     |   irf    > |
|--------+-----------+-----------+-----------+-----------+-----------+----------> -|
|0       | 0         | 0         | 0         | 0         | 0         | 0        > |
|1       | .15438    | .034851   | -.697558  | .007701   | .073619   | -.5967   > |
|2       | .099533   | .018113   | -.135137  | -.010707  | .065459   | -.972694 > |
|3       | .079445   | -.029691  | -.042692  | -.002641  | -.008148  | -1.45259 > |
|6       | .058379   | -.008984  | -.006084  | .032034   | -.206678  | -1.64831 > |
|12      | .048553   | .00283    | .049043   | .047432   | -.255621  | -1.34143 > |
|24      | .049533   | .002113   | .045262   | .046031   | -.249309  | -1.34892 > |
|36      | .049528   | .00212    | .045294   | .046039   | -.249329  | -1.3487  > |
+-------------------------------------------------------------------------------> -+

+--------------------+
|        |    (49)   |
|  step  |   irf     |
|--------+-----------|
|0       | 1         |
|1       | .705112   |
|2       | .798378   |
|3       | .914282   |
|6       | 1.03427   |
|12      | 1.03598   |
|24      | 1.03314   |
|36      | 1.03313   |
+--------------------+
(1) irfname = model, impulse = FI, and response = FI
(2) irfname = model, impulse = FI, and response = dollarization
(3) irfname = model, impulse = FI, and response = Y
(4) irfname = model, impulse = FI, and response = R
(5) irfname = model, impulse = FI, and response = P
(6) irfname = model, impulse = FI, and response = E
(7) irfname = model, impulse = FI, and response = Md2
(8) irfname = model, impulse = dollarization, and response = FI
(9) irfname = model, impulse = dollarization, and response = dollarization
(10) irfname = model, impulse = dollarization, and response = Y
(11) irfname = model, impulse = dollarization, and response = R
(12) irfname = model, impulse = dollarization, and response = P
(13) irfname = model, impulse = dollarization, and response = E
(14) irfname = model, impulse = dollarization, and response = Md2
(15) irfname = model, impulse = Y, and response = FI
(16) irfname = model, impulse = Y, and response = dollarization
(17) irfname = model, impulse = Y, and response = Y
(18) irfname = model, impulse = Y, and response = R
(19) irfname = model, impulse = Y, and response = P
(20) irfname = model, impulse = Y, and response = E
(21) irfname = model, impulse = Y, and response = Md2
(22) irfname = model, impulse = R, and response = FI
(23) irfname = model, impulse = R, and response = dollarization
(24) irfname = model, impulse = R, and response = Y
(25) irfname = model, impulse = R, and response = R
(26) irfname = model, impulse = R, and response = P
```

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(27) irfname = model, impulse = R, and response = E
(28) irfname = model, impulse = R, and response = Md2
(29) irfname = model, impulse = P, and response = FI
(30) irfname = model, impulse = P, and response = dollarization
(31) irfname = model, impulse = P, and response = Y
(32) irfname = model, impulse = P, and response = R
(33) irfname = model, impulse = P, and response = P
(34) irfname = model, impulse = P, and response = E
(35) irfname = model, impulse = P, and response = Md2
(36) irfname = model, impulse = E, and response = FI
(37) irfname = model, impulse = E, and response = dollarization
(38) irfname = model, impulse = E, and response = Y
(39) irfname = model, impulse = E, and response = R
(40) irfname = model, impulse = E, and response = P
(41) irfname = model, impulse = E, and response = E
(42) irfname = model, impulse = E, and response = Md2
(43) irfname = model, impulse = Md2, and response = FI
(44) irfname = model, impulse = Md2, and response = dollarization
(45) irfname = model, impulse = Md2, and response = Y
(46) irfname = model, impulse = Md2, and response = R
(47) irfname = model, impulse = Md2, and response = P
(48) irfname = model, impulse = Md2, and response = E
(49) irfname = model, impulse = Md2, and response = Md2
```