To the Problem of Financial Safety Estimation: the Index of Financial Safety of Turkey

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Abstract

This paper proposes an approach to explore the strength of the financial system of Turkey against the possibility of financial disturbances appearing based on the construction of the Index of Financial Safety (IFS) of a country. For this purpose the macro-prudential approach, system analyses, the basic principles of the theory of logical inference, principal of parsimony, principal component analysis are used. The results showed that the *IFS* applied to Turkey is able to capture the main perturbations in its financial system.

JEL Classifications: G01, C38, E50, G17

Keywords: Financial safety, index of financial safety (IFS), financial risks

1. INTRODUCTION

Financial systems play the dominant role in maintaining global stability. Also, finance is the channel through which a country can possibly be controlled from outside its borders. Therefore, violations in the financial system safety may lead to the strengthening of such control. Therefore, the macro-prudential approach focused on safety and safeguarding the financial system, attracts increasing attention.

Many economists have investigated the symptoms of threats to the economy caused by the financial system and indicators: among others Frankel and Rose (1996), Kaminsky, Lizondo and Reinhart (1998), Edison (2003), and Jakobs, Lestan and Kuper (2003). One may distinguish the following indicators related to financial system: Financial Soundness Indicators (FSI) (see IMF, 2004); Monetary Condition Index (MCI) and Financial Conditions Index (FCI) (see van den End, 2006); Early Warning Indicators (see Edison, 2003; Frankel & Rose, 1996; Jakobs, Lestano & Kuper, 2003; Schwaab *et al*, 2011), and finally indicators of financial crises (see Burkart, Oliver & Coudert, 2002; Kaminsky *et al*., 1998).

One can also find authors focused on the construction of systemic risk measures (see, among others, Segoviano & Goodhart, 2009; Acharya *et al*., 2010; Huang, Zhou & Zhu, 2009, 2010), while there is a stratum of literature in which financial imbalances, such as credit and asset market bubbles, are analysed (see, among others, Misina & Tkacz, 2008; Barrell *et al.*, 2010). The short comparative analysis of the main approaches for estimation of conditions of financial systems is proposed in Table A1. in the Appendix.

Certain aspects of the problems associated with economic and financial safety have been analysed by Księżopolski (2004), Frejtag-Miki *et al.* (1996), Kłosiński (2006), Suchorukow (1996) and others. However, there are still many gaps in the study of financial safety of a country.

The aim of this research is to estimate financial safety of Turkey with the application of the Index of financial safety of a country (see Matkovskyy, 2012 for the technical details of the IFS estimation).

The methodological base of the research is formed by means of the macro-prudential approach, system analyses, the basic principles of the theory of logical inference, principal of parsimony, principal component analysis.

2 CONSTRUCTION OF THE INDEX OF FINANCIAL SAFETY OF A COUNTRY

2.1 Financial safety of a country and its main indicators

For the purpose of this paper, the financial safety of a country is defined as a state in which the financial system, and all elements of this system, is shielded against real and potential internal and external threats. When the financial system is in a state of safety it should be able to provide for the implementation of all the functions of financial system: fiscal, re-distributional, promotional, and controlling functions.

The evaluation of financial safety of a country should be based on the key indicators that provide leading information on current and future performance. For international comparison as well as wide application it is also important that these indicators should also be able to capture the financial system's functions on macro-level, be suitable for most countries, (based on publicly available statistics), and be relatively easy to estimate and use.

Thus, a central issue is to choose the correct combinations of variables which can offer consistent signals of changing conditions in financial safety for a country. This paper follows a Monetarist approach and the focus is therefore on monetary data. Together with GDP projections, the monetary data is used in order to assess the dynamics of monetary aggregate (such as *M1*, *M2* or *M3*) as the key monetary indicators as well as the velocity of money circulation. The interest rate may also assist in monetary conditions estimation, while the credit counterpart of financial safety may give an indication of incipient debt problems – following the theory of debt and financial fragility.

According to the main sub-systems of the financial system it is possible to distinguish the following main sub-types of financial safety: monetary safety, currency safety, and stock market safety.

Monetary safety may be defined as a state of guarding a country's monetary system to ensure money performs its functions, i.e. that it serves as a medium of exchange, as a store of value, as a unit of accounting and as a standard of deferred payment. The aim of many monetary safety indicators is to identify the shares of the money aggregates and their dynamics, since the growth of "money in circulation" may complicate the control of the monetary system and money turnover.

Currency safety refers to the ability of a financial system to provide an economic system with foreign currency in order to abide to the active balance of payments and the honouring of

international obligations, and to keep macro-economic indicators in the specified ranges to increase export and investments.

Stock market safety refers to stock market institutions that ensure the further development of the financial system and an adequate inter-sector, inter-industrial and inter-regional capital transfer.

Table 1 summarises the collection of financial safety indicators which will be used for the model of financial safety (stimulants and non-stimulants are explained below).

Table 1. The collection of financial safety indicators for the model of financial safety of a country

Financial safety counterparts indicators	Character of financial safety indicators; S – stimulant, NS - non-stimulant*
1. Monetary safety and its indicators	
1.1. Money in circulation/M2*100%	NS
1.2. Money in circulation/GDP*100%	NS
1.3. M2/Money in circulation (credit multiplicator)	NS
1.4. M1/M2*100%	S
1.5. M2/GDP*100% (financial depth)	S
1.6. M2/monetary base*100% (money multiplier (ratio))	S
1.7. GDP/M2 (velocity of money circulation)	S
1.8. PPI / WPI	NS
1.9. Money market interest rates %	NS
1.10. Total domestic credit/GDP	NS
2. Currency safety and its indicators	
2.1. Monetary base/international reserves (monetary rate)	NS
2.2. Coverage of import by international reserves	S
2.3. Real effective exchange rate	NS
3. Stock market safety and its indicators	
3.1. M2/ market capitalisation	NS
3.2. Changes in the stock exchange index in % related to the previous quarter	S

* The difference between stimulants and non-stimulants lies in the nature of the influence i.e. direct or indirect: the relationship between the Index of Financial Safety (*IFS*) and indicator's stimulants is direct, and the relationship between *IFS* and the indicator's non-stimulants is indirect

2.2 Constructing the Index of financial safety

2.2.1. Data normalisation I: Optimum, cordon and extreme values

The following values can be distinguished:

- ± 5% optimum values of the selected indicators of financial safety, x_{optim} (these values tend not to put the functioning of the financial system at risk);
- ± 15% cordon values of the selected indicators of financial safety, x_{cordon} (these values may tend to put the functioning of the financial system at a slight risk); and
- ± 25% extreme values of the selected indicators, $x_{extreme}$ (these are values that put the functioning of the financial system at risk).

These values were chosen experimentally and tested on European countries to identify European crisis. In the case of percentage borders usage, the indices of different countries may be compared

Since financial safety is estimated through the collection of indicators, x_{ij} , it is necessary to aggregate them into one complete set. Because the selected indicators have different information "directions", it is necessary to normalise information in order to perform the additive aggregation. There are different methods of normalisation, but all of them in this situation will have an equalisation of empiric (x_i) values with the optimum (x_{optim}) values, cordon (x_{cordon}) values, and extreme ($x_{extreme}$) values.

To normalise variables the following method is applied:

$$z_{ij} = \begin{cases} 1, x_{optym}^{min} \le x_{ij} \le x_{optym}^{max}, x - stimulant/no\ stimulant; \\ \frac{x_{ij} - x_{cordon}^{min}}{x_{cordon}^{max} - x_{cordon}^{min}}, x_{cordon}^{min} \le x_{ij} \le x_{cordon}^{max}, x - stimulant; \\ \frac{x_{cordon}^{max} - x_{ij}}{x_{cordon}^{max} - x_{cordon}^{min}}, x_{cordon}^{min} \le x_{ij} \le x_{cordon}^{max}, x - no\ stimulant; \\ \frac{x_{ij} - x_{extreme}^{min}}{x_{extreme}^{max} - x_{extreme}^{min}}, x_{extreme}^{min} \le x_{ij} \le x_{extreme}^{max}, x - stimulant; \\ \frac{x_{extreme}^{max} - x_{ij}}{x_{extreme}^{max} - x_{extreme}^{min}}, x_{extreme}^{min} \le x_{ij} \le x_{extreme}^{max}, x - no\ stimulant. \end{cases}, \quad (1)$$

where, z_{ij} is the normalised value of indicator x_{ij}, x_{ij} is the raw data for the index of the financial safety calculation; x_{optym}^{min} and x_{optym}^{max} are the minimum and maximum optimum values; x_{cordon}^{min} and x_{cordon}^{max} are the minimum and maximum of the cordon values; and $x_{extreme}^{min}$ and $x_{extreme}^{max}$ are the minimum and maximum of the extreme values, respectively.

2.2.2 Data normalisation II: Calculation of the weighted coefficients (w_{ij})

The purpose of this step is to transform data, possibly strongly correlated between themselves, in new, uncorrelated components' factors by means of factor analysis, especially principal component methodology.

To make the transformation into the set with the values from '0' to '1', a varimax rotation will be applied (Kaiser, 1958):

$$R_{VARIMAX} = \arg\max_{R} \left(\sum_{j=1}^{k}\sum_{i=1}^{p}(\Lambda R)_{ij}^{4} - \frac{\gamma}{p}\sum_{j=1}^{k}\left(\sum_{i=1}^{p}(\Lambda R)_{ij}^{2}\right)^{2}\right), \quad (2)$$

where γ = 1 for *VARIMAX*.

There are three stages in building the main component parts of models:

- the calculation of the correlation matrix, *R*, or the calculation based on the data, normalised by the method (1);
- the calculation of the weights of the factors, d_{ij};
- the identification of main component parts.

Relations between primary signals and component parts are described by the linear combination:

$$y_i = \sum_{j}^{m} c_{ij} G_j , \quad (3)$$

where y_i is a standardised value of the signal *i*; and c_{ij} is a loading of component *j* in the summarised dispersion of the collection of indicators of the element I of the financial safety (% total of variance). G_j can further be depicted as the following linear combinations:

$$G_j = \sum_{j}^{m} d_{ij} x_{ij} , \quad (4)$$

where d_{ij} is the weight of the factor and x_{ij} is the indicator of the factor. The weight coefficients a_{ij} are calculated as follows:

$$a_{ij} = \frac{c_{ij} \cdot | d_{ij} |}{\sum c_{ij} | d_{ij} |} . \quad (5)$$

The calculation of the integral index of financial safety (*IFS*) of a country is then as follows:

$$IFS_j = \sum_i a_{ij} \cdot z_{ij} , \quad (8)$$

where a_{ij} - are the weight coefficients, obtained from the equation (5), z_{ij} - are the normalised values of indicators x_{ij}, obtained from the equation (1).

3. EMPIRICAL RESULTS

3.1. Data

The following time-series are used for the Index of Financial Safety of Turkey building (the source of the data: International Financial Statistics database; in millions; national currency; not seasonally adjusted; 2001Q4-2011Q2): M0, M1, M2, M3, money in circulation, GDP, total reserves (minus gold), exchange rate (to Euro), real effective exchange rate, import, money market interest rate, Istanbul Stock Exchange National 100, market capitalization, domestic credits. All other indicators, needed for the Index of Financial Safety construction, have been calculated based on the abovementioned data.

3.2 Index of Financial Safety of Turkey construction

The optimum (±5%), cordon (±15%), and extreme (±25%) values of the chosen variables for Turkey are as following (Table 2):

Table 2. The optimum, cordon and extreme values of the chosen variables for the IFS of Turkey

Variable	*Extreme value, min*	*Cordon value, min*	*Optimum value, min*	*Optimum value, max*	*Cordon value, max*	*Extreme value, max*
Money in circulation/M2*100	7,36	8,34	9,33	10,31	11,29	12,27
Money in circulation/GDP*100	8,66	9,82	10,97	12,13	13,29	14,44
M1/M2*100%	17,70	20,06	22,42	24,78	27,14	29,50
M2/GDP*100%	96,85	109,77	122,68	135,60	148,51	161,42
M2/M0	3,29	3,73	4,16	4,60	5,04	5,48
Money market interest rates %	15,85	17,97	20,08	22,19	24,31	26,42

GDP/M2	0,72	0,81	0,91	1,01	1,10	1,20
M2/Money in circulation	8,05	9,12	10,20	11,27	12,34	13,41
Monetary base / international reserves	0,49	0,55	0,62	0,68	0,75	0,81
Exchange rate changes, in % to previous quarter	1,07	1,21	1,35	1,49	1,64	1,78
Coverage of import by international reserves	118,91	134,77	150,63	166,48	182,34	198,19
Total domestic credits/GDP	0,66	0,75	0,84	0,93	1,02	1,11
PPI / WPI	81,12	91,94	102,75	113,57	124,39	135,20
M2/ market capitalization	932,93	1057,3	1181,7	1306,1	1430,49	1554,88
Changes of stock exchange index, in % to a previous quarter	-20,00	-10,00	-5,00	15,00	80,00	100,00
real effective exchange rate	81,70	92,59	103,49	114,38	125,27	136,17

After applying the normalization I (2) and normalization II (principle components analysing) the following result will be available (the weights), Table 3:

Table 3. The results of principle components analysing and weights calculation

	Factor 1 loadings (varimax normalise)	***Factor 2 loadings (varimax normalise)***	d_{ij}	c_{ij}	$c_{ij}\|d_{ij}\|$	***a***
*Money in circulation/M2*100*	**-0.795174**	0.407874	-0.795174	19.30967	15.3545	0.080308397
*Money in circulation/GDP*100*	**0.771681**	0.115689	0.771681	19.30967	14.9009	0.077935713
*M1/M2*100%*	**0.563609**	0.074683	0.563609	19.30967	10.883	0.056921547
*M2/GDP*100*	-0.099647	**0.868811**	0.868811	23.26120	20.2096	0.105701488
M2/M0	-0.384325	**0.640367**	0.640367	23.26120	14.8957	0.077908495
PPI / WPI	**0.867499**	0.298997	0.867499	23.26120	20.179	0.105541895
Money market interest rates %	**0.333483**	0.266980	0.333483	23.26120	7.757	0.040572314
GDP/M2	0.138468	**0.656582**	0.656582	23.26120	15.27	0.079881264
M2/Money in circulation	**-0.191866**	-0.015503	-0.191866	19.30967	3.70487	0.019377423
Monetary base / reserves (Monetary rate)	**0.803052**	0.216910	0.803052	19.30967	15.5067	0.081104043
Coverage of import by reserves	0.110689	**0.353787**	0.353787	23.26120	8.2295	0.043042487

Total Domestic credit/GDP	0.127616	**0.877892**	0.877892	23.26120	20.421	0.106806381
M2/ market capitalization	0.157938	**0.482010**	0.482010	23.26120	11.212	0.058642423
Changes of share price index % to a previous quarter	**-0.141497**	-0.035782	-0.141497	23.26120	3.2914	0.017214904
real effective exchange rate	**0.485582**	-0.123416	0.485582	19.30967	9.3764	0.049041227
Expl. Var	3.577020	3.133997		sum	191.195	1
Prp. Total	0.238468	0.208933				

The largest weighs are observed for the following variables: *Money in circulation/M2*100, Money in circulation/GDP*100, M2/GDP*100, Total Domestic credit/GDP, Monetary base / reserves (Monetary rate), PPI/WPI, GDP/M2.*

By usage of (8) the index of financial safety (*IFS*) is calculated. The dynamics of this index are shown in Figure 1:

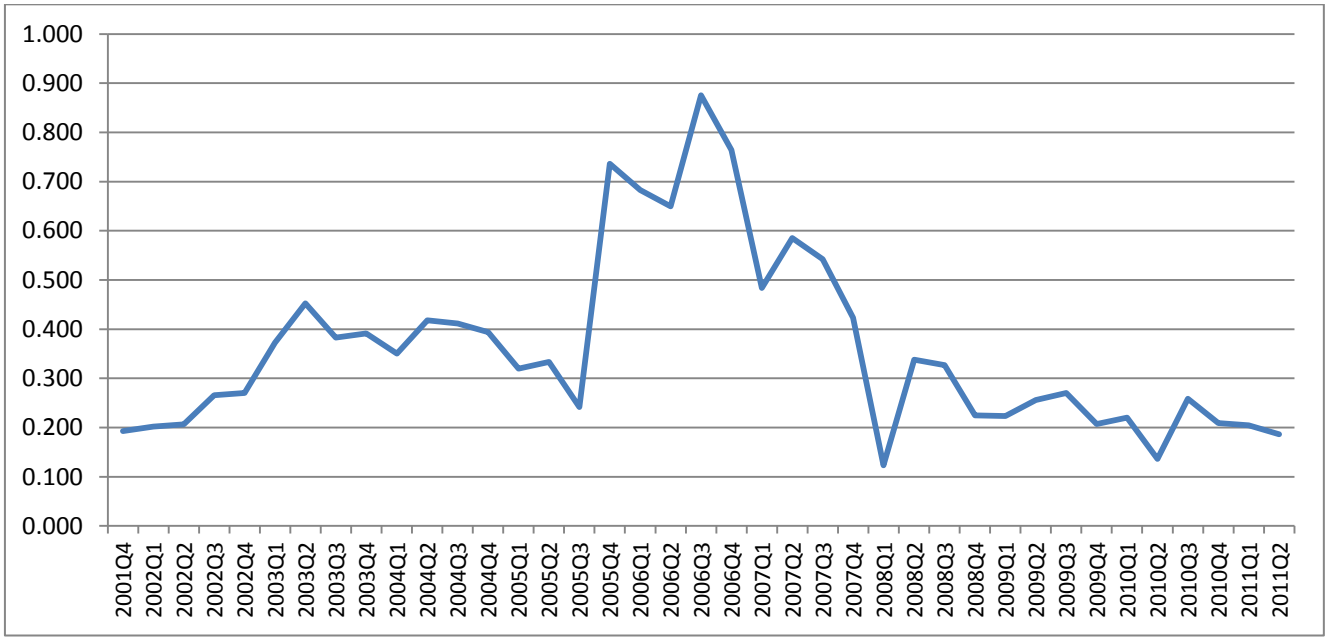

Figure 1. Dynamics of the estimated Index of Financial Safety (IFS) of Turkey (2001Q4-2011Q2)

In general, the Index of financial safety of Turkey caught the main perturbations in the financial system of this country: crisis 2000-01, economic catching-up from 2002, its accelerating from 2005 and ending in 2006Q4, crisis of 2008-09.

If to analyse the both crisis periods 2001Q4-2005Q3 and 2008Q3-2011Q2, the following counterparts make the lowest contribution to the integrated IFS: *M2/GDP; M2/M0; GDP/M2; Total*

domestic credit/GDP; *PPI/WPI*; *REER;M2/market capitalization*. During the first crisis period analysed here, the most tangible positive influences are made with following variables: *M1/M2; money in circulation/GDP; monetary rate; coverage of import by reserves; changes of share price index*. During the second period of crisis the positive impacts are made also with *M1/M2*; *monetary rate; coverage of import by reserves; and slightly with changes of share price index.* In addition to mentioned variables, the positive stimuli are created with *money in circulation/M2; M2/market capitalisation.* The difference between two analysed periods of crisis is that the second one has two more negative tendencies described by the following pairs of variables: *interest rate* and *money in circulation/GDP*. In details, the structure of the factors of the low dynamic of Turkish IFS during 2001Q4-2005Q3 is shown in Figure 2 and the counterparts of IFS during the crisis time 2008Q3-2009Q4 is illustrated in Figure 3.

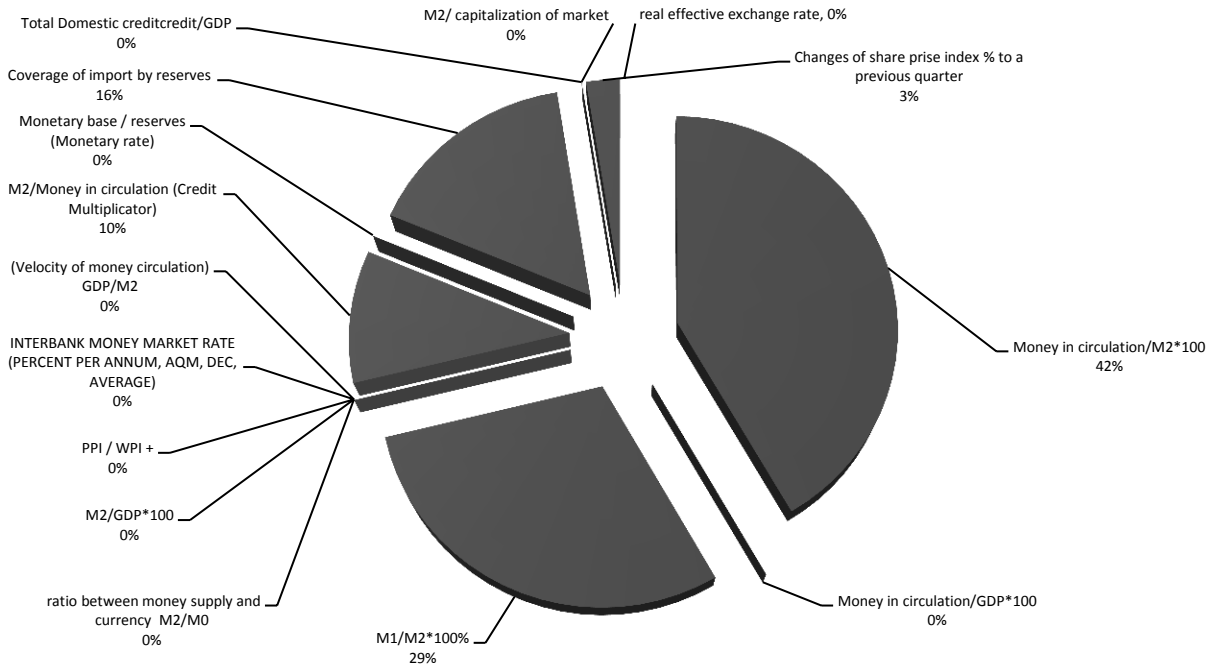

Figure 2. Contribution of the IFS counterparts of Turkey in the period from 2001Q4 till 2005Q3

As it is shown, the main positive contribution is made by the following variables: *Money in circulation/M2* (42%), *M1/M2* (29%), *coverage of import by reserves* (16%), *M2/Money in circulation* (10%) and *changes in share price index* (3%). Therefore it is possible to assume, that during the crisis in Turkey in the period from 2001Q4 till 2005Q3 the positive dynamics in money aggregates M1 and M2, existence of enough reserves and positive dynamics of share price index played the dominant positive role.

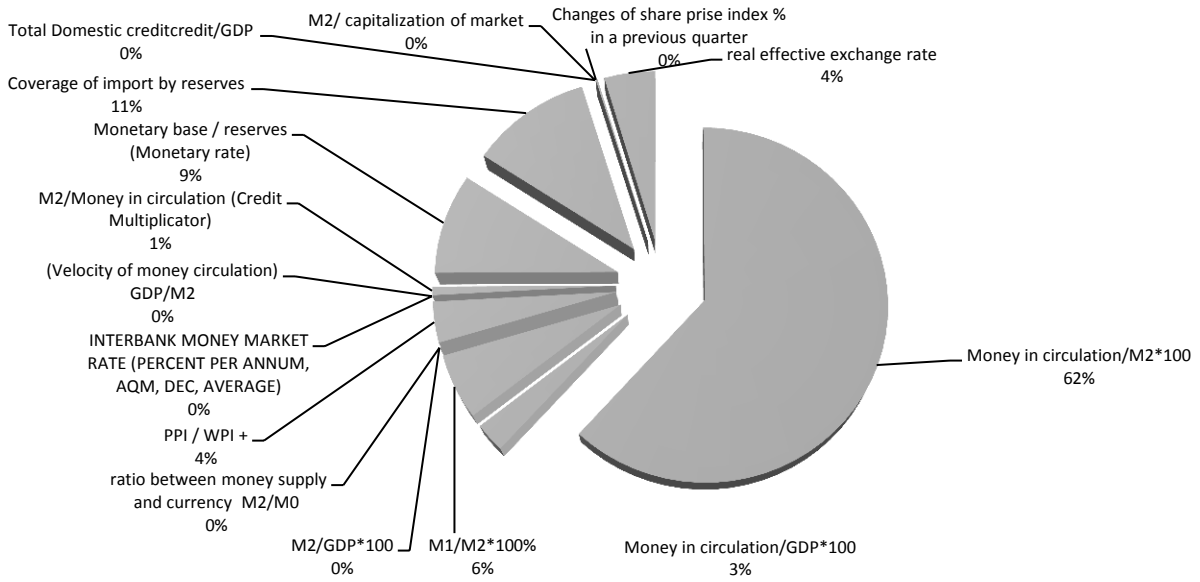

Figure 3. Contribution of the IFS counterparts of Turkey in the period from 2008Q1 till 2011Q2

Based on Figure 3, it is possible to notice differences in the nature of the crisis. In the period from 2008Q1 till 2011Q2 the most positive effects were made by the following variables: *money in circulation/M2* (62%), *coverage of import by reserves* (11%), *monetary rate* (9%), *M1/M2* (6%), *PPI/WPI* (4%), *real exchange rate* (4%) and *money in circulation/GDP* (3%).

If to analyse the time of rapid growth of 'health' of financial system (2005Q3-2006Q3), the following counterparts have the influence (see Figure 4):

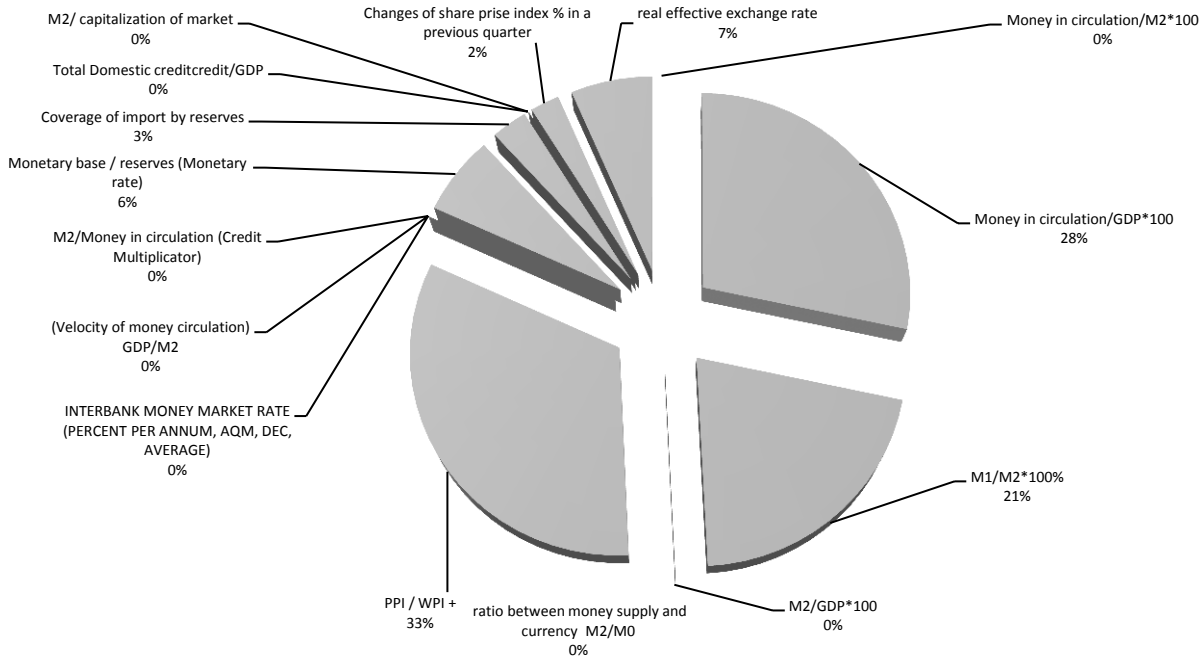

Figure 4. *Contribution of the IFS counterparts of Turkey in the period of time from 2005Q3 till 2006Q3.*

3 CONCLUDING REMARKS

In this study, the Index of Financial Safety (*IFS*) has been built and used to explore the strength of the Turkish financial system. The results showed that the *IFS* applied to Turkey is able to capture the main disturbances in the financial system. Additionally, an analysis of the Turkish *IFS* counterparts indicate the following counterparts make the smallest contribution to the integrated *IFS* of: *M2/GDP; M2/M0; GDP/M2; Total domestic credit/GDP*; *REER;M2/market capitalization; M1/M2*; *monetary rate; coverage of import by reserves.* This provides the base for identification of the weakest sides of the financial system during the stress.

Future research may focus on testing similar IFS using different countries. Furthermore, research could be expanded to determine whether the *IFS* can be used as a common integrated indicator to determine violations in financial systems or as a way to estimate the investment risk level of different countries.

APPENDIX

Table A1. The main approaches for estimation of conditions of financial systems

Approach	Authors	The main idea of the approach
Financial Soundness Indicators (FSI)	IMF, 2006	FSI is a set of the core indicators developed and promoted by the IMF, indicating the current financial health and soundness of the financial institutions in a country and of their corporate and household counterparties. The FSI includes the indicators that mainly capture the efficiency of resource allocation by deposit-takers. The core set of indicators is widely agreed to be important and operationally useful for the periodic monitoring of the soundness and vulnerabilities of the banking sector. This set is organized similar to the so-called CAMELS
Monetary Condition Index (MCI)	Freedman (1994), Duguay (1994), Hansson and Lindberg (1994), Stevens (1998), Eika (1996),	An MCI is a weighted sum of changes in short term interest rates and exchange rates relative to the values in a baseline year, with the weights reflecting these variables' estimates on the longer term target variable, e.g. output or inflation. An MCI is useful to analyse both interest rates and exchange rates as transmission channels of policy changes on inflation.

		MCIs are limited because they do not make allowance for other transmission channels such as asset prices.
Financial Conditions Index (FCI)	Hatzius *et al.* (2010); Beaton (2009); Dudley and Hatzius (2008); Gumata *et al*. (2012)	A FCI summarizes the information about the condition of the economy contained in current financial variables and can be used as an indicator for short-term economic activity and also as a tool to assess financial conditions across time. There are two broad approaches for constructing FCIs: a weighted-sum approach and a principal components approach. Most FCIs include some measure of long- and short-term interest rates, risk premia, equity market performance, and exchange rates. In some FCIs a stock market wealth or market capitalization variable is also included, but none of the FCIs include measures of any broader categories of credit. In the frames of FCIs, an extreme negative impact of the financial sector on the economy usually relates to financial stress. An advantage of FCIs is that it is not necessary to make an assessment of stress for its composition, which is more difficult. However, FCIs have their limitations as stress indicator, mainly because FCIs assume that shocks feed through in a linear and symmetric manner. This may not be the case in stress situations. In addition, FCI as a synthetic indicator is primarily an information variable that summarise the transmission process and do not perform forecast.
Early Warning Indicators (Early Warning Systems	Edison (2003), Caprio and Klingebiel (1996), Lindgren, Garcia and Saal (1996), Dermirguc-Kunt and Detragiache (1997), Kaminsky and Reinhart (1999), Lindgren, Garcia and Saal (1996), Kaminsky and Reinhart (1998), Eichengreen, Rose, and Wyplosz (1995, 1996), Frankel and Rose (1996),	Early warning indicators (EWI) aim to forecast a banking crisis on the basis of economic, market and banking sector variables. An early warning system (EWS) consists of a definition of a crisis and a mechanism for generating predictions of crises. It is based on an empirical structure with indicators that describe to a country's vulnerability to a future crisis and forecasts the likelihood of that crisis. In the frames of EWS three varieties specified of financial crises are distinguished: currency crises, banking crises, and debt crises. At the same time EWS models differ in terms of their definition of financial crisis.

	Kaminsky, Lizondo and Reinhart (1998), McFadden *et al. (*1985), Berg and Sachs (1988), Lee (1991); Balkan (1992), Lanoie and Lemarbre (1996), Marchesi (2003), Hajivassiliou (1989,1994) Demirgüç-Kunt and Detragiache (1997, 1998, 2000); Sachs, Tornell, and Velasco (1996); Subbaraman, Jones and Shiraishi (2003)	
financial stress index for emerging (EM-FSI) and advanced economies (AE-FSI)	Cardarelli, Elekdag, and Lall (2009)	The difference between EM-FSI and AE-FSI is in the inclusion of a measure of exchange market pressure, which is a more common source of stress in emerging economies than in advanced economies. EM-FSI comprises five variables, which are aggregated into an overall index to capture credit conditions in three financial market segments (banking, securities markets, and exchange markets).The aggregation of sub-indexes is based on a variance-equal weighting, similar to Kaminsky and Reinhart (1999).
Spillover index approach	Diebold and Yilmaz (2009, 2012)	The spillover index to evaluate the extent to which financial markets strengthen their interdependence. It is based on the generalized impulse response approach (Koop, Pesaran and Potter (1996) and Pesaran and Shin (1998)). This method is also regarded as a revised version of Diebold and Yilmaz's (2009) spillover index, which is based on the traditional orthogonalized impulse response function.

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