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Financial Stability and Fragile Banking Systems

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I declare that I wrote my diploma thesis independently and exclusively with the use of the cited sources.

In Prague 23.7.2009 Svatopluk Svoboda

Abstract

Diploma thesis deals with questions about financial sectors stability assessment. Within the theoretical part, overview of current state of research is presented, along with so-far reached frameworks for such an analysis on international basis. It focuses mainly of results obtained by two most renowned international financial institutions, International Monetary Fund and European Central Bank. The practical part of diploma thesis is dedicated to construction of aggregated Banking Sector Fragility Index (BSFI), and comparison of its outputs to actual banking sector fragility development in chosen countries. Second underlying motivation is to test, whether evolution of BSFI for given countries coincide with "hypothetical banking sector crisis" model. The model is also introduced in the thesis. BSFI is constructed for 6 countries, and obtained results are discussed with respect to mentioned motivation in 3 of them, for banking sectors of Czech Republic, Estonia and Japan.

Abstrakt

Diplomová práca sa zaoberá otázkami týkajúcimi sa hodnotenia stability finančného sektoru národnej ekonomiky. V rámci teoretickej časti je poskytnutý prehľad o súčasnom stave výskumu v tejto oblasti, ako aj doposiaľ vykryštalizované systémové rámce pre takúto analýzu. Pozornosť je zameraná na výsledky dvoch renomovaných medzinárodných finančných inštitúcií, Medzinárodného Menového Fondu a Európskej Centrálnej Banky. Praktická časť diplomovej práce je venovaná konštrukcii agregovaného Indexu Fragility Bankového Sektoru (BSFI), a porovnania jeho výstupov so zdokumentovaným vývojom fragility bankového sektoru vo vybraných krajinách. Druhou ašpiráciou diplomovej práce je testovať, či vývoj BSFI v sledovaných krajinách zodpovedá vývoju podľa modelu „hypotetickej krízy bankového sektoru". Tento model je v diplomovej práci taktiež predstavený. BSFI je skonštruovaný pre 6 krajín, a získané výsledky sú diskutované pre 3 z nich. Českú Republiku, Estónsko a Japonsko.

Used abbreviations

IMF – International Monetary Fund

FSAP – Financial Sector Assessment Program

FSI – Financial Soundness Indicator

ECB – European Central Bank

ESCB – European System of Central Banks

BSFI – Banking Sector Fragility Index

FSR – Financial Stability Report

CPS – Claims on Private Sector

TDEP – Total Deposits

FL – Foreign Liabilities

CNB – Czech National Bank

MPI – Macro-prudential Indicator

GFSR – Global Financial Stability Report

CCA – contingent claim analysis

NPL – Non-performing loans

PD – probability of default

LGD – Loss given default

SME – Small and Medium-sized enterprises

KoB – Konsolidační Banka

CPI – Consumer Price Index

IFS – International Financial Statistics

SBCS – State Bank of Czechoslovakia

FSA – Financial Supervisory Agency

CONTENT

Introduction

Throughout modern economic history it became evident that transparently and efficiently working financial sector is inevitable prerequisite for smooth functioning of modern economy. During 1990s many transition countries have experienced severe financial crises, and also developed countries have witnessed periods of financial fragility and currency turmoil. High costs of financial crises as well as their increased frequency made national authorities worldwide turn their attention to question of financial stability. Moreover, in the last decade volume of financial transactions considerably increased and financial markets deepened, which has made question of financial soundness even more important.[1]

Starting point of official joint international research in way to financial sectors' stability assessment became October 1998. In the "Report of the Working Group on Strengthening Financial Systems", 22 finance ministers and governors of central banks gave prominence to assessing the soundness of financial sectors as part of IMF`s surveillance work (Evans et al 2000). Consequently, IMF in cooperation with World Bank started in May 1999 project called "Financial sector assessment program (FSAP)". Its proclaimed aim was *"…to identify financial system strengths and vulnerabilities and to help develop appropriate policy responses."*[2]

From the 1999, when program FSAP originated, in the field of assessing financial soundness has been made considerable progress. Central banks and international institutions have developed many models and adopted various approaches towards financial markets monitoring. In modern literature, assessment of financial sector`s stability is usually known as Macro-prudential analysis.

"Macro-prudential analysis is the assessment and monitoring of the strengths and vulnerabilities of financial systems. This encompasses quantitative information from both FSIs and indicators that provide a broader picture of economic and financial

[1] Čihák (2006) gives high costs of crises, their increased frequency and complexity of new financial instruments as main reasons for growing interest about financial soundness.

[2] Evans et al. (2000), p. 1

circumstances, such as GDP growth and inflation, along with information on the structure of the financial system, qualitative information on the institutional and regulatory framework, …, and the outcome of stress tests."[3]

Obviously, Macro-prudential analysis faces difficult task to embrace vast web of financial interrelationships between numerous players on financial markets, as well as to take into account non-financial sector of economy. During years, two main approaches towards financial stability assessment have gradually distinguished. The first is Indicator-based approach, the second so-called Model-based approach. Also broad general frameworks of financial stability assessment have gradually started to materialize.

The first chapter of diploma thesis contains definition of financial stability, along with practical problems connected with it. In the second chapter I will describe evolution of Indicator-based approach. I will present overview of so-far constructed partial indicators, and dwell on their classification and underlying questions of methodology. With respect to partial indicators of financial fragility two initiatives stand out among others, i.e. projects launched by IMF and ESCB. These two projects as well as comparison of their results will constitute separate subchapters, respectively. After that, I will describe results in the field of aggregation of partial indicators – cosmopolite aggregate indexes and financial stability maps.

Third chapter will be dedicated to model-based approach. I will focus mainly on Stress testing and Contagion analyses. They will be described only briefly however, as my main objective lies within indicator-based approach.

Framework for assessing financial system fragility, utilizing both indicator approach and model approach, along with other non-quantifiable aspects of economy, will be introduced in chapter 4.

By chapter 5 will begin the analytical part of the diploma thesis. I will construct "Banking sector fragility index (BSFI)" based on monthly data, for banking sector of Czech Republic and 5 other countries. I will compare development of BSFI to the model of hypothetical banking crisis, which will be introduced in subchapter 5.4, as proposed in Kibritcioglu (2003). Special attention will be paid to BSFI of Czech Republic (chapter 6), Estonia (chapter 7), and Japan (chapter 8). Estonia was chosen because it is another

[3] Evans et al. (2000), p. 2, box with definitions

example of transition country, but with different macro and financial characteristics than that of Czech Republic[4], whereas Japan represents classical example of financial crisis in developed country. I will compare periods of financial fragility in observed countries as suggested by BSFI to documented real periods of financial turmoil and financial crises, with aim to find out if BSFI is able to adequately capture banking fragility evolution, i.e. if BSFI can be used as one of the tools for detecting banking fragility/crises periods. Second goal will be to compare evolution of BSFI to the model of hypothetical banking crisis. BSFI outputs for Mexico, Georgia and Moldova will be added in appendix.

[4] Baltic country, in 1990 without own currency, currency board experience, no NPL inherited from Soviet era.

1. Financial stability - Definition

Before talking about approaches towards assessing overall stability of financial sector, definition of financial stability itself is needed. Question of defining financial stability is basic and at the same time the most difficult one; it has been problematic spot from the very beginning of research in this field. There is general understanding that financial stability refers to smooth functioning of the components of financial system, nevertheless, exact definitions differ.

Definitions of financial stability provided by various national central banks in their Financial Stability Reports (FSRs) are nicely summarized e.g. in Čihák (2006)[5]. After examining more than 50 FSRs, he concluded that although exact definitions vary across countries, there is mutual understanding *"…that the financial stability analysis covers phenomena that (i) impair the functions of financial system; (ii) create vulnerabilities in financial system; and (iii) lead to a negative impact on financial system and thereby economy as a whole."*[6]

Attempts to define financial stability were conducted also in many academic works on financial markets. Overview of scholar definitions is presented for example in Shinasi (2005). Shinasi argues that approach taken by majority of researchers is not to define financial stability, but financial *instability*. Thus definition of stability is avoided by defining what it is not, and effort to maintain financial stability is turned into effort to prevent (and manage if not prevented) financial fragility. Another way how researchers approached financial stability was that they examined systemic risk to financial sector. Thus problem of managing financial stability turned into problem of managing systemic risk.[7] Almost identical approach is to try to assess risk of financial sector bankruptcy and present it as indicator of financial fragility.[8]

So far, there is no general agreement about financial stability exact definition. I will present definition by Shinasi (2005) and that of the Czech National Bank. The first, being

[5] Concretely, Čihák provided definitions from CBs of Canada, Denmark, Euro Area, Iceland, Norway, Sweden, and United Kingdom.
[6] Čihák (2006), p. 7
[7] De Bandt and Hartmann (2000), Hoelsher and Quintyn (2003), Summer (2003), and others
[8] For example Čihák (2007), Van Den End and Tabbae (2005)

not expressed in formal way, may serve as definition just for operational purposes, whereas the second is definition by CB of our country.

"Financial stability is a condition in which an economy's mechanism for pricing, allocating, and managing financial risks (credit, liquidity, counterparty, market and so forth) are functioning well enough to contribute to the performance of the economy"[9]

CNB on its webpage defines financial stability in following way.

"Financial stability is a situation where the financial system operates with no serious failures or undesirable impacts on the present and future development of the economy as a whole, while showing a high degree of resilience to shocks."[10]

Importance of monitoring and managing financial stability was recognized by Czech Republic monetary authorities in the "Act on Integration of Financial Market Supervision, amending Act No. 6/1993 Coll.", on the Czech National Bank. *"As from 1 April 2006, this Act explicitly obliges the CNB to analyze the evolution of the financial system, see to the sound operation and development of the financial market in the Czech Republic and contribute to the stability of its financial system as a whole."*[11]

[9] Shinasi (2005) p. 83
[10] CNB: official webpage; http://www.cnb.cz/en/financial_stability/what_is_fs/index.html
[11] CNB: official webpage; http://www.cnb.cz/en/financial_stability/basic_info/index.html

2. Indicator-based approach

Indicator-based approach to financial stability assessment stands upon following of quantitative, easily constructed indicators of fragility in partial areas within financial markets. Its official origin dates back to the year 1999, when the need of such indicators were for the first time officially recognized by international institutions. During the last 11 years considerable progress in this field has been made. Quantitative indicators of fragility for various types of financial institutions, wide range of financial risks, as well as indicators embracing relations between financial and non-financial sectors were introduced.

Nowadays usual practice is either to observe one indicator in various countries to obtain cross-country comparison, or to follow development of one indicator over time so as to capture fragility of observed aspect of financial market. As partial indicators are often constructed to observe particular financial risks, their evolution reveals exposure of financial institution to this risk in time. Another way how to work with financial indicators is compare their value to (explicitly or implicitly) set threshold limit. Value of indicator above/under the threshold signals growing fragility and/or growing exposure to particular risk.

Recently, main efforts have started to focus on the aggregation of partial indicators. There were conducted many attempts to construct *cosmopolite aggregate indexes*, or to aggregate partial indicators to so-called *financial stability maps*. These two initiatives (aggregate indexes and financial stability maps) seem to promise to be the final achievement that indicator-based approach has to offer.

2.1. Development of indicators

Development of financial indicators arose out of the need to monitor financial markets. To this end quantitative, easily constructed and computed indicators were needed.

"The ability to monitor financial soundness presupposes the existence of indicators that can be used as a basis for analyzing the current health and stability of financial system."[12]

[12] Evans et al. (2000), p. 3

In 1999, among others[13], two major initiatives in this respect (to formulate financial soundness indicators) were launched.

1) Project on developing financial soundness indicators by IMF.
2) Project on developing macro-prudential indicators for assessing soundness of financial systems by ECB.

Results of these two projects are nowadays mainly used as main instruments for assessing stability of financial sectors on indicator basis. I will look more closely on both of them, and to present their comparison, following Geršl and Heřmánek (2008), Mortinnen et al. (2005), IMF's Compilation Guide (2006), Sudarajajan et al. (200) and others.

2.1.1. Project of Financial Soundness Indicators by IMF

Starting by 1999, IMF in cooperation with international organizations, national monetary authorities and representatives of private sectors embarked upon a project to formulate, develop and use financial soundness indicators (**FSIs**).

"FSIs are indicators compiled to monitor the health and soundness of financial institutions and markets, and of their corporate and households counterparts. FSIs include both aggregated information on financial institutions and indicators that are representative of markets in which financial institutions operate."[14]

Along with FSIs IMF started to develop so-called macro-prudential quantitative indicators (**MPIs**) with aspiration to assess financial stability conditions from broader perspective.

"MPIs include FSIs and other indicators that support the assessment and monitoring of the strengths and vulnerabilities of financial systems, notably macroeconomic indicators."[15]

Special emphasis had been put on the condition that both **FSIs** and **MPIs** were constructed using the same methodology, so as to make all indicators comparable on international basis. Preliminary results of IMF's effort were summarized in Evans et al.

[13] Other International institutions with similar initiatives are e.g. BIS, Eurostat, OECD, as well as market analysts in many countries.
[14] Sudarajajan et al. (2002), p. 2; box with definitions
[15] Sudarajajan et al. (2002), p. 2; box with definitions

(2000) and Sudararajan et al. (2002). Final sets of **FSIs** were presented in IMF's Compilation Guide (2006). Developed FSIs were divided into two groups. The first group was labeled **Core set** and consists of 12 FSIs for assessing stability of *banking sector*, as banking sector forms the most important part of financial system. IMF recommended these core indicators to all countries for systematic monitoring over their financial sectors. The second group, so-called "encouraged set" had a broader focus. It contains 27 additional indicators. Apart from still other indicators for banking sector, it provides **FSIs** for corporate sector, real estate markets, and nonbank financial institutions and markets. By labeling this set "encouraged", IMF reflects the fact that construction of these additional **FSIs** is conditioned by reasonable availability of data in given country. Each country is encouraged to compute those **FSIs** that best suit the data it collects. Both sets of **FSIs** are given in following tables.

Core set

Deposit takers	Indicators
Capital adequacy	Regulatory capital to risk-weighted assets
	Regulatory Tier I capital to risk-weighted assets
	Nonperforming loans net of provisions to capital
Asset quality	Nonperforming loans to total gross loans
	Sectoral distrubution of loans to total loans
Earnings and profitability	Return on assets
	Return on eqity
	Interest margin to gross income
Liquidity	Liquid assets to total assets (liquit assets ratio)
	Liquid assets to short-term liabilities
Sensitivity to market risk	Net open position in foreign exchange to capital

Source: IMF 2006; compilation guide

Encouraged set

Institutions	Indicators
Deposit takers	Capital to assets
	Large exposures to capital
	Geographical distribution of loans to total loans
	Gross asset position in financial derivatives to capital
	Gross liability position in financial derivatives to capital
	Trading income to total income
	Personnel expenses to noninterest expenses
	Spread between reference lending and deposit rates
	Spread between highest and lowes interbank rate
	Customer deposits to total (noninterbank) loans
	Foreign-currency-denominated loans to total loans
	Foreign-currency-denominated liabilities to total liabilites
	Net open position
Other financial corporations	Assets to total financial system assets
	Assets to gross domestic product (GDP)
Nonfinancial corporations sector	Total debt to equity
	Return on equity
	Earnings to interest and principal expenses
	Net foreign exchange exposure to equity
	Number of applications for protection from creditors
Households	Household debt to GDP
	Household debt service and principal payments to income
Market liquidity	Average bid-ask spread in the securities market*
	Average daily turnover ratio in the securities market
Real Estate Markets	Real estate prices
	Residential real estate loans to total loans
	Commercial real estate loans to total loans

Source: IMF 2006; Compilation Guide

The two sets provide collection of **FSIs** with micro-financial foundations. They are often referred to as "aggregated micro-indicators of financial soundness". But IMF in its effort to monitor financial stability did not limit itself to these indicators. It also recommended both national and international authorities to minutely follow development of "macro-variables", evolutions of which have impact on financial stability. The most common practice nowadays is to observe development of variables such as *Economic growth, Balance of payments, Inflation, Interest and exchange rates, Lending and asset price booms, and Contagion effects.*

Evans et al. (2000) in their summary of IMF's **FSIs** and **MPIs** recommended still other indicators that could uncover hidden fragility of financial sectors.

a) Changes in Direct Lending and Investment

b) Changes in Government Recourse to the Banking System (along with other Quasi-Fiscal Imbalances)
c) Changes in Arrears in the Economy

Reasons for observing these variables are at **a)** *"…channeling credit to specific activities or sectors based on nonmarket criteria often lead to the inefficient allocation of resources and can negatively affect the solvency of financial institutions."*[16] **b)** *"…a sudden increase in central bank credit to the government could lead to inflationary pressures and affect the financial system."*[17], and **c)** *"The buildup of arrears could signal debt-service difficulties by the government or by private sector borrowers. These problems negatively affect the solvency and liquidity of financial institutions."*[18]

2.1.2. Project on macro-prudential indicators by ECB

In 1999 there began also initiative by European System of Central Banks (ESCB). Within it, European Central Bank in cooperation with national central banks started a project to collect Macro-prudential indicators (**MPIs**) of financial stability. Proclaimed objective was to develop methodological and statistical framework for conducting macro-prudential analysis of European financial sector. The most tangible accomplishment stemming from their initiative is that nowadays ECB systematically collects and periodically publishes **more than 150 MPIs** of financial stability. On top of that, ECB encouraged individual central banks to conduct and publish their own FSRs, what majority of them currently does.[19] Morttinen et al. (2005) provided nice overview and detailed discussion about ECB's results in this field.

Following them, **MPIs** collected by ECB are typically divided into 8 groups according to separate areas of possible vulnerabilities within financial sectors.

1. Profitability, balance sheet quality, and capital adequacy indicators
2. Demand and supply (competitive conditions) indicators
3. Risk concentrations indicators

[16] Evans et al. (2000) p. 12
[17] Evans et al. (2000) p. 12
[18] Evans et al. (2000) p. 12
[19] See Čihák (2006) on thorough discussion on Financial Stability Reports.

4. Market assessment of risks indicators
5. Financial fragility indicators
6. Asset price developments indicators
7. Cyclical and monetary conditions indicators
8. Interbank markets indicators

The first four of these groups form the category of "**internal factors**[20]", groups five, six, and seven constitute category of "**external factors**", and the eighth group (which comprises indicators for Interbank markets monitoring) captures so-called "**contagion factors**". All indicators collected by ECB for macro-prudential analysis are presented in appendix at the end of the thesis.

As can be seen, ECB collection comprises far more indicators than IMF sets, and takes into consideration more possible areas from which could imbalances of European financial sector arise.

2.1.3. IMF's vs. ECB's indicators

Geršl and Heřmánek (2008) compare the **FSIs** to **MPIs**, following Mortinnen et al. (2005). They conclude that although both ECB's and IMF's goals were almost identical, namely to develop and use indicators of financial stability/fragility, fruits of their efforts did not fully match. Apart from the fact that ECB's collection contains more indicators than IMF's, there are also other important distinctions.

The most important difference lies in consolidation method (Mortinnen et al, 2005). **MPIs** by ECB are published on consolidated basis, i.e. the indicators for banks in one country also directly consider their branches and subsidiaries in other EU countries, as well as other financial institutions controlled by them. They are published from "European", or "Euro-area" point of view, while **FSIs** by IMF are published from "purely domestic" point of view, even for countries whose banking sectors are almost wholly foreign-controlled.[21] (Geršl and Heřmánek, 2008)

This may in some cases lead to not fully credible informational content of **FSIs**. On the other hand, although **MPIs** by ECB better reflect interconnections of European

[20] Internal and external from the point of view of banking sector
[21] Which is the case for vast majority of modern countries

financial markets as a whole, they may be not ideally suited for comparisons of countries on international basis. Specifically, their usage for comparing separate Euro countries to countries from "non-European world" is problematic.

Mortinnen et al. (2005) minutely observed **FSIs** and **MPIs** of both IMF and ECB. They came to conclusion that even in IMF's "core set" not all **FSIs** have their full equivalents among ECB's monitored **MPIs**. Core **FSIs**, not fully matched by ECB's **MPIs**, are

- Liquid assets to short term liabilities
- Net open position in foreign exchange to capital.

The former measures banks' exposure to *liquidity risk*, but indicators of liquidity risk used by ECB are different[22]. The latter indicator is constructed so as to measure banks' exposure to market risk (concretely exchange rate risk). ECB in its ratio doesn't use the "Net open position", but only "loans". Also for denominator it uses "total loans", and not "capital" as recommended by IMF. In "encouraged set" authors even found several FSIs that have no equivalents among MPIs collected by European Central Bank. Their conclusion was that …*"it can be said that the ECB's MPIs Indicators match around two thirds of the IMF's FSIs."*[23]

Čihák (2006) examined **MPIs** used by Central Banks worldwide and published in FSRs. Having compared them to IMF's **FSIs**, he stated that … *"the coverage of FSIs*[24] *is uneven. Consistency with the FSI Compilation Guide (by IMF) is not always clear and sometimes clearly not present."*[25]

As regards the relationship between IMF's **FSIs** and ECB's **MPIs**, ECB's interest is primarily focused on assessing financial stability in Euro-economy. As such it provides assistance to IMF efforts to collect **FSIs**, because compliance to IMF standards enables comparison of **FSIs** for Europe on international (outside Euro-area) basis. On the other hand, ECB would naturally like to have area-specific information included in indicators that it uses for assessing its own financial stability. Because of that **MPIs** compiled by ECB

[22] ECB's MPIs for measuring liquidity are "Ratio of non-bank deposits to M2" and "Ratio of total loans to non-bank deposits" (see appendix).
[23] Mortinnen et al. (2005), p. 55
[24] In FSRs in many countries
[25] Čihák (2006), p. 22

try to take into account as much of country relevant information as possible, as well as to follow links between financial markets of separate countries (so-called contagion effects).

2.2. Financial Stability Maps

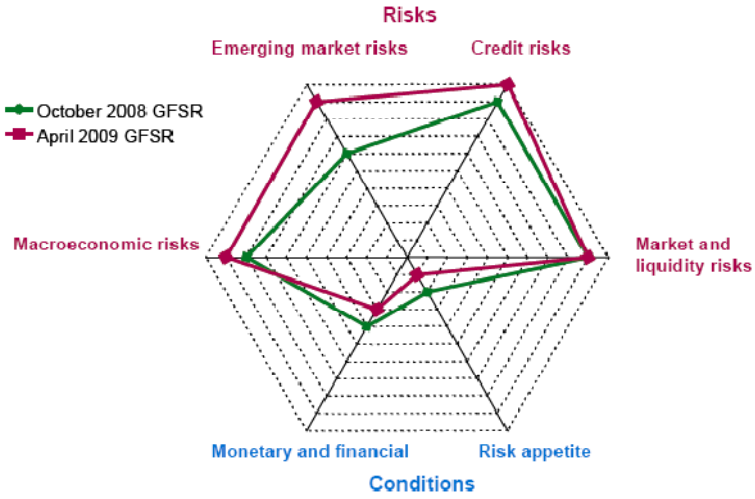
The most recent result stemming from indicator-based approach to financial stability assessment has been emergence of so-called Aggregate indexes and Financial Stability Maps. Aggregate indexes try to combine various partial indicators to construct one composite index, with respective weights assigned to each **FSI**.

Financial Stability Maps are constructed by IMF in its annual GFSRs. It …*"presents overall assessment of how changes in underlying conditions and risk factors bear on global financial stability in the period ahead"*[26]. Within financial stability map, 6 areas of interest are monitored, relying on values of worldwide relevant quantitative indicators. These areas include: Monetary and financial conditions, Risk appetite, Macroeconomic risks, Market and Liquidity risks, Credit risks, and emerging market risks. Quantitative measures of these risks and conditions are then depicted in hexagon to present overall financial stability map, as in picture.

As can be seen from the picture, overall global fragility according to IMF's financial stability map during the last year increased in all areas of measured risk, despite tightened monetary conditions.

[26] IMF's Global Financial Stability Report (2009), p. 2

Financial Stability Map of IMF



Source: IMF, GFSR 2009[27]

As to the Czech Republic, Czech National Bank in its FSRs also publishes Financial Stability Map for Czech financial sector.

Financial stability map for CR

Source: CNB's FSR[28]

Financial stability map for the Czech Republic contains these composite indicators: Macroeconomic risk, credit risk and market risk (i.e. composite indicators covering risks), monetary and financial conditions are covered in the forth composite indicator, and

[27] Closer to center signifies less risk, tighter monetary and financial conditions, or reduced risk appetite.
[28] CNB's FSR (2008/2009); Points further from the centre of the chart signifies more risks, tighter conditions or more vulnerable sector.

vulnerability of the real and financial sectors is captured by the remaining two composite indicators. On CNB's webpage there is also presented closer explanations of how particular indicators were arrived at.

1. **Indicator of macroeconomic** risk is the average of the GDP growth forecasts for next year in the euro area and the Czech Republic and the risk premia (CDS spreads) for Central European countries.
2. **Credit risk indicator** is composed using the current and expected rates of loan delinquency for households and corporations.
3. **Market risk indicator** is based on a volatility index, an index of market liquidity for the Czech financial markets and the expected volatility of short-term interest rates and the exchange rate.
4. **The indicator of the financial sector's vulnerability** uses the banking stability index and the results of standardized stress tests of banks.
5. **Indicator of the real sector's vulnerability** contains a number of indicators concerning the debt of individual real sectors and the economy as a whole, as well as an indicator of the creditworthiness of the corporate sector.
6. **The monetary and financial conditions** are calculated as the average of the risk premium in the Czech Republic, bank interest rates for the real sector, current and expected growth in new loans to the real sector and expected exchange rate movements at the one-year horizon.[29]

CNB's Financial Stability Map suggests the interpretation that overall financial fragility in Czech Republic during the last year increased, but remained in reasonable limits. Banking sector of Czech Republic remained untouched by worldwide financial turmoil, which confirms good shape of Czech banking system in recent years.

Informational content provided by Financial Stability Map for one given year is not very straightforward. But providing that it is published on regular basis, using the same methodology, it provides nice comparison of development in observed areas over time.

As yet, there is no unanimously agreed approach how to construct financial stability maps. Also methodologies by IMF and CNB presented above are different. In CNB's case

[29] Taken from CNB's financial stability report 2008/2009, box on p. 60

points further from the centre means "more risk and more vulnerability", whereas in IMF's map further from centre means "more risk and less vulnerability." Consequently, CNB's map contracts and expands, and IMF's map (resulting hexagon in given year) moves up and down. This behavior of both financial stability maps is visible on both above presented pictures.

2.3. Aggregated Fragility Indexes

From the "Indicator approach's" point of view, the most plausible result of monitoring fragility of financial system would be to develop one overall fragility index that would indicate level of financial sector fragility in given country. Output from such an aggregate index would be single number, which would indicate level of financial stability of whole financial sector in given time. Such an index would be constructed as weighed combination of chosen qualitative indicators (like FSIs and MPIs).[30] But this requires considerable simplification of complexity and inherent diversity of financial markets. Also to comprehensively detect and quantitatively describe interactions between financial institutions, numerous players on financial markets and influences from non-financial sector may prove to be impossible. Moreover, as every country is subject to its own country-specific institutional environment, construction of any single index that could be applied internationally is questionable.

"In the absence of broad range of indicators and an understanding of broader economic and financial environment in which indicators are being measured, excessive reliance on single-indicator analyses can lead to unsound financial-stability assessment."[31]

Attempts to construct such an index are ongoing in many countries worldwide, however. Nice overview of results in this field is presented for example in Geršl and Heřmánek (2008). I will generally follow their classification of constructed aggregate indexes on national levels. They regard so-far achieved results in this field as

[30] In practical part of the diploma thesis, starting in chapter 5, I will construct one proposition of such aggregate index.
[31] Shinasi (2005), p. 125

"…preliminary testing of alternative approaches to the construction of this indicator, not as consensual standards at the international level as is the case for the FSIs and MPIs"[32]

2.3.1. Indexes using banks` data

The most straightforward approach to construction of index is to take various partial indicators of the financial soundness of banks, aggregate them, and construct index as their weighted average. Partial indicators are chosen so as to monitor various areas of possible vulnerability, to which banking sector is exposed. It depends on the specifications of given country's economy and banking system, what weights will be assigned to respective indicators.

"Such an index is used, for example, by the Turkish central bank. …Its financial strength index consists of six sub-indices covering asset quality, liquidity, foreign exchange rate risk, profitability and capital adequacy."[33]

BSFI, that I will attempt to construct in following chapters, also falls to this category of composite indexes. The author of the BSFI, Kibritciouglu (2003), proposed to take into account aggregated indicators of credit risk, liquidity risk and foreign exchange rate risk.

2.3.2. Indexes using financial markets` data

Cosmopolite indexes in this category are not based on data from banks balance sheets nor data on banking sector collected by any supervisory institution. Instead, construction of these indexes is based on financial markets` data, which are available on day-to-day basis. Banks data are often not available in reasonable frequency (the highest frequency of publishing data on banking sector is on month to month basis). As market data reflect expectations of financial markets` participants, index that uses this information measures "expected" fragility of financial sector. For this reason, such indexes generally tend to signal the increased/decreased *probability of financial fragility*, as perceived by financial markets. They serve as *forward-looking* measure of financial stability.

[32] Geršl and Heřmánek (2008), p. 136
[33] Geršl and Heřmánek (2008), p. 136

Other important advantage of financial markets' data is that they are all encompassing. Different sources of risk, interactions between banks and other interactions in economy are assumed to be taken account of, and projected to prices on financial markets (Gropp 2004). Moreover, banks' data are often confidential, which is not the case for market data. Indexes using market data can therefore be more easily shared and their construction verified (Čihák 2007).

To use indicators based only on market data nevertheless brings few possible disadvantages. Pricing and valuation of financial assets are based on implicit assumptions about efficiency of the financial markets. Additionally, markets are often driven by general trends in development. Another possible problem is insufficient liquidity of markets. If markets of particular assets are not liquid enough, than indicators based on price development may not truly reflect existing risk (Čihák 2006).

"The financial fragility indicator presented by experts from the US Federal Reserve System and the financial stress index calculated by experts of the Canadian central bank are examples of such an approach."[34]

2.3.3. Indexes using both financial markets` and banks` data

Indexes of this category try to take into consideration as much data as is possibly available. Data on **a)** financial institutions (mostly banks) are obtained from collected statistics or directly from balance sheets of financial institutions. These indexes comprise also **b)** data on financial market development and, when possible, even **c)** additional supervisory information. "Stress index", constructed by Swiss Central Bank is example of this approach.

Collection of data chosen by Swiss CB's experts, were: as to data on financial institutions, they used indicators of *change in profitability, capital, asset quality and the number of bank branches.* As to financial markets data, they observed *change in prices of banking shares and bonds*. From other available relevant information, they utilized data on *share of bank assets in the regulator`s "watch list"* (Geršl and Heřmánek 2008).

[34] Geršl and Heřmánek (2008), p. 136

2.3.4. New approach to construction of aggregate index

There is also new approach to constructing aggregate index of financial system stability. Leading idea is to calculate *default risk* for whole financial system (or at least for important sectors), and to present it as a key measure of financial system' stability.

For this purpose "models of sector probability of default" are used. For example, Čihák (2007) proposed *the distribution of systemic loss* as a measure of default risk in the system, *distribution of systemic loss* being based on failures of individual institutions. He linked individual defaults to the stability of the whole sector, taking "credit portfolio risk theory" and applying them to portfolio of financial institutions. As to the study of stability of the financial system, his approach has three contributions: It…

1) *"Captures differences in loss given default across institutions,* 2) *Captures correlation across institutions failures* 3) *Focuses only on central tendencies*"[35].

Another advantage is that this measure is firmly based on micro financial background. It offers explicit link between default risk of separate institutions and default risk of whole financial sector. Construction of this index, however, runs to practical problems. Index is difficult to calculate (Čihák 2007), and "*requires demanding analysis, in some cases also the existence of a liquid stock market with a good representative sample of individual sectors.*"[36]

2.3.5. Index based on monetary conditions

Approach to aggregate fragility index as enlarged monetary conditions index was applied by Netherland Central Bank. Monetary Conditions Index accounts for wide range of variables in economy, which makes aggregate fragility index (which is based on it) account for them as well. Considered variables by Dutch experts were: interest rates, effective exchange rate, real estate prices, stock prices, solvency of financial institutions, and volatility of the stock index of financial institutions.

[35] Čihák (2007), from table on p. 18
[36] Geršl and Heřmánek (2008), p. 137

"An innovation in this index is, however, the introduction of upper and lower critical limits to take account of potential non-linear effects."[37]

Outputs of fragility index were considered good only if they fell between arbitrarily set threshold limits. Lower limit represents value when financial fragility is too high, upper limit represents situations when economy may be overheated, banks may be exposed to excessive risks, which is taken as signal for future problems.

[37] Geršl and Heřmánek (2008), p. 136

3. Model-based approach

Second approach to assessing financial stability, nowadays widely employed, is so-called *model-based approach*. It usually consists of two steps. The first step is to develop a model which would (in some way) capture interrelations between financial and real sectors of economy. Second step then consists of sensitivity analysis of such a model.[38] Main instruments used within model-based approach are stress tests for banking sectors, often accompanied by so-called contagion analysis that tries to estimate consequent, "second-order" effects of various shocks.

3.1. Stress tests

"*Stress testing is ... investigation of an impact of meaningfully defined scenarios of future development, extreme development in particular.*"[39]

Sensitivity analyses (stress tests) estimate impacts of various shocks to the model, these shocks being for example increase of interest rates, exogenous shocks to the economy etc. Among others, stress tests are integral part of FSRs in many countries, including Czech Republic. CNB conducts stress tests regularly from the year 2004. In FSR (2007), CNB examined impact of three possible scenarios of Czech Banking sector's evolution, labeled "Safe haven", "Property-market crisis", and "Loss of confidence", respectively.

Safe haven scenario examined impact on banking sector of *"…hypothetical significant deepening of the effects of global financial market turbulence on the real economies of the Czech Republic's euro-area trading partners."*[40]

Property-market crisis scenario simulated *"…domestic property market crisis. Property prices were assumed to fall by 30%, which would cause problems in property development sector."*[41]

The third possible extreme scenario of economy development, Loss-of-confidence, also examined impact of global financial turmoil on Czech Republic, but from different

[38] So-called "what-if" tests
[39] Kadeřábek, Slabý, and Vodička (2008), p. 340
[40] CNB; Financial Stability Report (2007), box on p. 21
[41] CNB; Financial Stability Report (2007), box on p. 25

perspective than the Safe-haven scenario. It assumed that *"Global risk aversion would rise further, reversing the previously positive attitude towards the Czech koruna and leading to a radical depreciation (a loss of confidence)".*[42]

Results of all three scenarios signaled good shape of banking sector of Czech Republic. Significance of conducted stress tests was above all doubts confirmed by subsequent economic development, when two of three analyzed scenarios materialized. Until September 2008 Czech economy evolved in line with "safe haven" scenario. In the third quarter of 2008 conditions changed and economic outcomes were close to "loss of confidence scenario". Costs of materialized scenarios were even lesser that stress tests had expected, because of timely intervention of CNB (cut in monetary policy rates) and good response of financial markets to this intervention – CNB's Financial Stability Report (2009).

Many stress tests for Czech Financial Sector were published also in academic journals. See for example Jakubík and Heřmánek (2008), Kadeřábek, Slabý, and Vodička (2008), Čihák (2004), Čihák, Heřmánek, and Hlaváček (2007).

3.2. Contagion analysis

Contagion analysis is mostly conducted as additional improvement to stress test analysis (Čihák 2006). It specifically focuses on contagion of financial fragility among banks and between nonbanking financial institutions. Following Calvo and Reinhart (1996), there are two main approaches to contagion analyses[43]. *The first approach* focuses on interrelationships within financial markets, and it analysis how risk of insolvency in one institution spreads through the market along established contractual financial connections. As first step, stress test is employed to simulate scenario of possible failure ("fundamental failure"). In the second step, contagion analysis is run to observe how the failure spread through the system, and if it can eventually trigger another round of failures. *The second approach* deals with observation of liquidity runs in the system. In this case contagion is not caused by direct trade and financial linkages between institutions, but is triggered by

[42] CNB's FSR (2007), box on p. 36

[43] They focused specifically on "cross-border" contagion effects, examining impact of domestic financial crisis on foreign financial sectors. Their broad distinction is usually applied also for contagion effects within one country.

“herding behavior” of people. (Or herd behavior of investors in case of cross-border contagion). For overview of literature on cross-border bank lending and contagion effects, see for example Geršl (2007).

4. Analytical Framework

As a result of growing concern about financial stability and its monitoring and overall assessment, general frameworks for such analyses have gradually started to materialize. Operational framework that would incorporate all aspects of financial stability assessment into one picture is needed. Given enormous complexity of modern economies and financial markets, no universally accepted framework has been yet agreed upon. In practice there are several partial frameworks that are being used. Broad framework should incorporate results of both indicator-and model-based approaches. In addition to them it should take into account others, non-quantifiable indicators and aspects of economy. World distinguished authorities on this field are IMF, World Bank and ECB. I will take closer look at their frameworks of financial stability assessment, and then provide picture of financial stability assessment in general steps.

4.1. IMF's framework

IMF presented general framework for financial stability analysis in its Compilation Guide (2006). Its underlying sense was to examine ways through which macroeconomic (and asset price) shocks transmit themselves through economy. To this end, they recommended to focus attention to four aspects:

1) To monitor **Macroeconomic and asset price shocks**.
2) To monitor transmission of these shocks through micro-economy. This includes monitoring of **conditions on nonfinancial sectors** (Corporate, real estate, and household). Changes in these sectors may uncover hidden vulnerabilities in **financial sector** (namely exposure of banks to credit risk, market risk, and liquidity risk).
3) To monitor **linkages from changes in nonfinancial and financial sectors to macro-economy** (these include for example role of banking sector in monetary policy transmission, possibilities of private sector to obtain financing from non-bank sector and others).

4) To monitor eventual impact of all these changes on **Macroeconomic conditions and Debt sustainability**.

Along with this, IMF proposed many types of indicators that had been developed for monitoring given aspects. IMF authorities admit, however, that this framework is only preliminary.

There are two main unanswered questions. The first is question of causal relationships between the four groups. IMF's framework is conducted as to monitor shock wave transmission through non-financial and financial systems of economy, which eventually has observable impact on macroeconomic conditions. But relationships in real economy work in many directions. To be able to embrace more of these relationships, other development of **FSIs** and understanding of links between their evolutions would be crucial. The second open question deals with links between various indicators. Are there correlations between developments of various **FSIs**? What are they? Although some linkages are clear, nowadays there are still many uncertainties, or simply blank places. – (based on IMF's Compilation Guide 2006)

Table depicting IMF's analytic framework for financial stability assessment is provided in appendix at the end of diploma thesis.

4.2. ECB's framework

I will present framework for macro-prudential analysis of ECB, as Czech Republic is part of the EU. Because in the European financial systems banking sectors have always played prominent role (Schwartz 1986, Padoa-Shioppa 1999, Houben et al. 2004, Shinasi 2005), analysis of *banking sector stability* usually constitutes the main part of financial stability analysis. This is reflected also by the fact that main emphasis of ECB's financial stability framework (and also of FSRs of many national Central Banks) is laid upon examining fragility of banking sector. During recent years attitude towards assessing financial fragility has gradually started to change however, as other important (nonbanking) institutions emerged as significant players on financial markets, and financial markets themselves underwent considerable restructuring.

Deep financial crisis that broke out in mid 1997 threw light to the fact that focusing only on banking sector fragility may had not been appropriate. As was said, attention of researchers have usually focused on measuring stability of banking sector as it constituted the main part of financial system. Relevantly, whole "core set" of **FSIs** presented by IMF consists of **FSIs** aimed to monitor banking sector only ("deposit takers"). Thus, potential fragility of financial system caused by state of nonbanking institutions was not specially considered. Although there were also **FSIs** for measurement of nonbanking institutions' fragility, they were all included in "encouraged set", to provide sort of additional insight to the functioning of financial market. During the last decade world have witnessed vast changes in financial landscape worldwide; following summary of most important changes brought about by financial innovations is based on Vesco (2007).

a) Gross financial assets have increased very rapidly.
b) Use of new derivative instruments[44] in recent years sharply increased, which have completely changed the functioning of financial markets. Market players can now diversify risks in manifold ways, and to allocate these separate risks between many investors. Investors in their side can hedge against market movements; they can also shift level of risk to which they are exposed by leveraging their portfolios.
c) New players on financial market themselves emerged; they have even become key drivers of innovation in many markets and transactions. Examples of these new important institutions are hedge funds and private equity funds.
d) Moreover, **swift financial development influenced behavior of banks**. Due to financial innovation they have new investment opportunities. Nowadays they are able to distribute high part of credit risk outside the banking system, which have enabled them to strengthen their lending capabilities.

Čihák (2006), having surveyed about 160 Financial Stability Reports (FSRs) published in 47 countries over period of 10 years, documented following development related to coverage of financial institutions. "*Most FSRs started as a very narrowly focused, typically on the banking sector, and over time evolved into more general reports,*

[44] Such as futures, options, interest rate swaps, more recently also credit default swaps and structured products such as collateralized debt obligations and asset backed securities.

covering also nonbank financial institutions, financial soundness counterparties (households, corporates), the payment and securities settlement systems, and regulatory framework."[45] Author stated that nowadays many central banks publish FSRs that include also monitoring of insurance companies, pension funds, securities intermediaries, hedge funds, and real estate investments.

Amidst of all these changes, need for developing new indicators of overall financial stability/fragility is even more urgent.

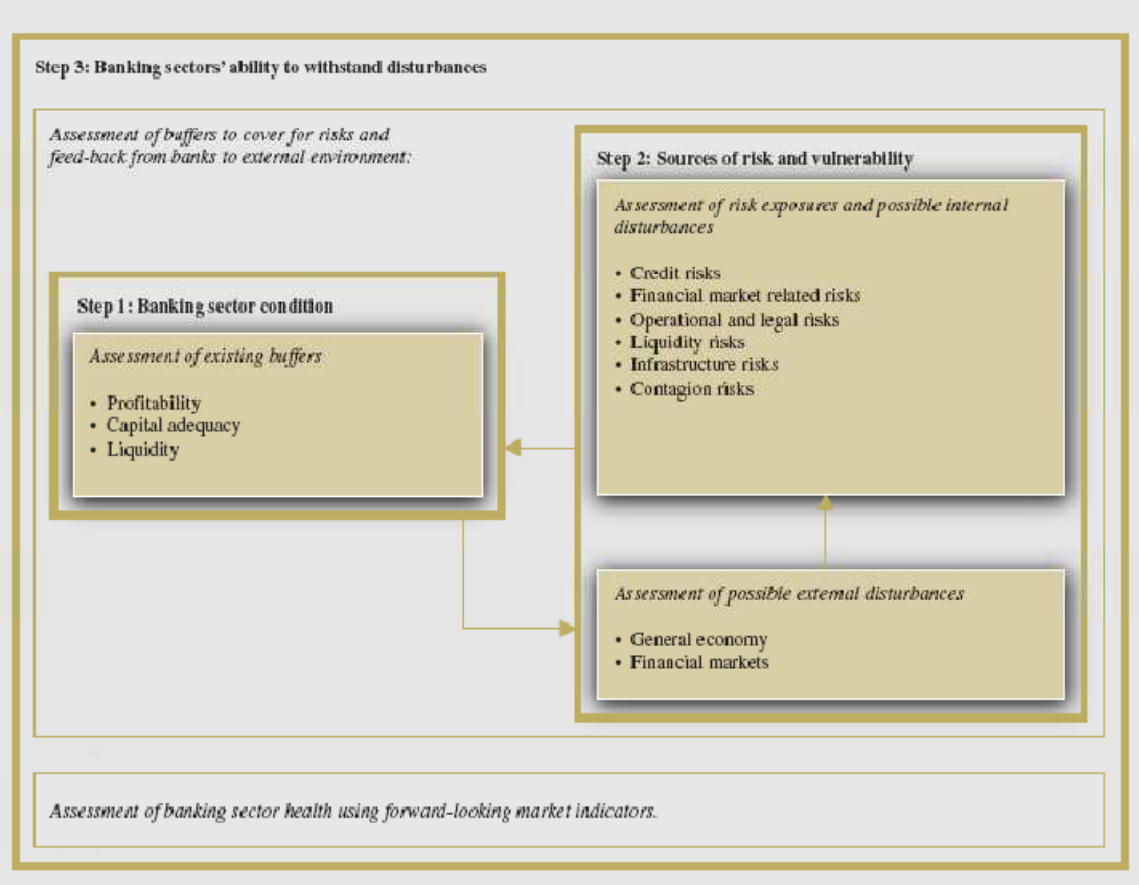
"*Most of indicators are not able to capture current depth of financial markets, including the development of complicated financial structured instruments and products. Nor are they able to take into account possible interrelationship within the financial systems themselves and several key risks, such as counterparty risk in capital and derivative markets."*[46]

Nevertheless, in spite of all recognized insufficiencies, banking sector surveillance is still the leading part of macro-prudential analysis in ECB's financial stability assessment framework and high majority of **FSIs** and **MPIs** concentrates on banking sector's fragility assessment.

The main parts of macro-prudential analysis, as adopted by ECB, are shown in following table:

[45] Čihák (2006), p. 21
[46] Geršl and Heřmánek (2008), p. 128

Main elements of the ESCB macro-prudential analysis framework



Source: Mortinnen et al. (2005)

As can be seen, analytical framework of ECB takes into consideration both data from banks' balance sheets and data from financial markets in assessing banking sectors' ability to withstand disturbances.

The first step of framework is to assess the current financial condition of the banking sector. This comprises so-called "internal factors" surveillance (**MPIs** for profitability, balance sheet quality, capital adequacy, as well as competitive conditions indicators and risk concentration indicators are employed for this purpose).

The second step is to assess "external factors" influencing banking sector. These factors are external from the banking sector point of view, and include among others macroeconomic development of a country, stance of monetary policy, asset prices, prices of commodities and others. (**MPIs** for overall financial fragility, indicators for asset price development and indicators of cyclical and monetary conditions are used for this purpose).

Thus second step of financial assessment tries to capture risk stemming "…*from external sectoral or financial market conditions, or from endogenous developments in the banking sector (e.g. over-extension of credit leading to a system-wide fragility)"*[47]

The third step of macro-prudential analysis is to submit financial/banking sector to stress testing, and contagion analysis[48], i.e. to assess how different scenarios of hypothetical unfavorable development will affect banking sector, and how fragility of one financial institution spreads to other institutions, respectively to whole financial system. The most common practice when searching for possibility of contagion is to concentrate on interbank markets or cross-border banking lending (Calvo and Reinhart 1996, Geršl 2007). For this purpose following three **MPIs** are mostly used.

a) Share in interbank liabilities in total liabilities
b) Share of assets of the three banks with largest exposure (separately for each counterparty country) to total banking sector assets, and
c) Share of assets of the five banks with largest exposures (separately for each counterparty country) to total banking sector assets[49].

To make the third step possible, data from financial markets (not only supervisory data from banks' balance sheets) are collected and used to make it possible to analyze scenarios of *future* development of fragility.

4.3. General framework

Sudararajan et al. (2002) gave following overview of methods that should be used for assessing stability of financial sectors. Main recommendations can briefly be described in following steps:

1) To begin with analysis of the macroeconomic environment and description of the structure of the financial system.
2) Within the financial system, to analyze health of banking sector by looking at levels and trends of selected **FSIs**.

[47] Mortinnen et al. (2005), p. 18
[48] Model-based approach applied
[49] This exactly corresponds to the eighth group of MPIs used by ECB (see the subchapter 2.1.2. and appendix)

3) Look more closely at linkages between these indicators and macroeconomic environment
4) To combine information on bank sector with information from the rest of financial system
5) To add qualitative information of financial system and economy

All this steps together should produce overall assessment of the stability of financial system (Sudararajan et al. 2002). Stress testing and contagion analysis than complements macro-prudential analysis, to make picture of conditions on financial market complete.

The fifth of above steps is worth discussing. In order to comprehensively assess stability of whole financial system, to look only on quantitatively expressed indicators of financial system vulnerability is not enough (**FSIs**, **MPIs** and various models). It is inevitable to take into account also aspects of national economies and national financial systems that are **qualitative** in nature. Quantitative indicators were discussed in previous chapters, but to pay attention to qualitative variables is equally important. Evans et al. (2000) enumerate these qualitative indicators of financial stability:

Adequacy of the institutional and regulatory frameworks governing the financial system; structure of the financial system and markets; regulations regarding accounting and other standards; disclosure requirements; loan classification; provisioning and income recognition rules; the quality of supervision of financial institutions; the legal infrastructure (including in the areas of bankruptcy and foreclosure); incentive structures and safety nets; liberalization and deregulation processes. Sudarajajan et al. (2002) summarized and proposed methods how to assess such qualitative aspects, and even how to embody several of them to financial sector analysis.

Recently, question of risk valuation by various institutions and players on financial markets emerged as possibly important qualitative indicator of state of financial markets. *Attitude to risk taking* and *valuation of risks* of possible actions may be changing in response to changes in legal and institutional frameworks, as well as to various changes within economy. Borilo and Zhu (2008) proposed to examination so called “Risk-taking

channel" of monetary policy. They argue that changes in interest rates[50] have impact on either risk perceptions or risk-tolerance on the degree of risk in portfolios, on the pricing of assets (many pricing techniques directly involves level of risk), and on the price and non-price terms of the extension of funding.

How qualitative changes in risk-approaching could be quantitatively captured is not straightforward at all.

Another important quantitative aspect that should not be missed out when assessing financial sector's stability is compliance to standards and codes. If institutions in economy have good history of playing fair and their compliance to laws, trade standards and moral codes is on high level, it should be taken as indicator in favor of financial stability.

4.4. New approach to framework of financial stability assessment

Nowadays, for assessing and managing financial vulnerability on level of financial institutions, so called Contingent claim[51] analysis (CCA) is successfully used. It started by introducing option pricing theory by Black-Sholes (1973) and Merton (1973), which had consequently been generalized to suit financial risk assessment of individual financial institutions. From the point of view of individual institutions, *"…the basic analytical tool is the risk-adjusted balance sheet, which shows the sensitivity of the enterprise's assets and liabilities to external shocks."*[52]

The possibility to utilize CCA method for assessment of financial stability of whole economy has been advocated mainly by IMF's risk experts in Gray, Merton and Bodie (2002), Gray, Merton and Bodie (2006), and Gray, Merton and Bodie (2007). They argued that the same principles of CCA that applie to analysis of a single firm can be applied to aggregation of firms, as well. They regard the economy *"…as set of interrelated balance sheets with four types of aggregate sectors – corporate, financial, household and*

[50] Representing monetary policy action in their article, but interest rate movement can be triggered also by causes that would be "financial-market-driven". For example rising in interest rate spread, or increased "premium" (Author of thesis' note).

[51] A contingent claim is any financial asset whose value depends upon the value of other asset or upon numerical indices

[52] Gray, Merton, and Bodie (2007), p. 4

sovereign"[53], sovereign sector being government and monetary authorities. Their proposition is to approach sectoral financial fragility assessment in following steps:

a) **To treat the corporate sector as one large firm and the financial sector as one large institution.** This is the first, very stylized general approximation. It serves to embrace main-risk features of whole sectors by examining their aggregated balance sheets.
b) Then **to focus on major financial institutions separately and to group corporate firms into subsectors.**
c) To pay attention **to various types of risk-transmission-channels between individual sectors.**

[53] Gray, Merton, and Bodie (2007), p. 7

5. Monthly Banking Sector Fragility Index

In this chapter I am constructing "Monthly Banking Sector Fragility Index" (**BSFI**), as proposed by Kibritçioglu (2003). This index falls to the first category of indexes presented in subchapter 2.3. It uses published data on banking sector[54] performance, and was proposed with aspiration to measure "up and downs" of national banking systems. Aim of construction is to decide whether national banking system was (is) in crisis at a particular point in time.

5.1. Risks

When assessing banking system fragility, exposures of banks to various risks are taken into account. Most typical is to consider exposure to credit risk, liquidity risk, and market risks, market risks comprising interest rate risk, exchange rate risk, equity price risk and commodity price risk. Our **BSFI** is constructed so at to take into account **liquidity risk, credit risk** and **exchange-rate risk**. These risks are indirectly indicated by observed data. Liquidity risk is measured by changes in total bank deposits (bank runs and bank withdrawals), credit risk by changes in amount of bank credits to private sector, and exchange rate risk by changes of banks` unhedged foreign currency liabilities.

5.1.1. Exposure to credit risk

Credit risk is recognized to be the most important risk to which banks are exposed, as banks are financial institutions whose main task is to grant credits to public. Nowadays credit risk estimation is mainly conducted on model-approach basis. There have been developed models of lender's exposure to credit risk that estimate potential losses on lender's site stemming from the non-performing loans (NPL). Generally, losses stemming from exposure to credit risk are taken as the product of the probability of default (DP) on the counterparty site, the credit exposure at the time of default and the Loss-given default (LGD) value[55]. Recent efforts have been focused primarily on estimating PD and LGD

[54] More precisely, data on "deposit takers"
[55] LGD is level of actual loss when counterparty defaults.

parameters. E.g. for banking sector of Czech Republic LGD estimation was conducted in Jakubík and Seidler (2009). Credit risk models with respect to Czech Republic were constructed and tested in Jakubík (2007)[56]. Author also discusses Aggregate Credit Risk Model (taking into account credit risk of aggregate loan portfolio), as developed by CNB in 2006.

On indicator basis, FSI that is mostly utilized is ratio of NPL to total loans.

In our **BSFI**, as indicator of *credit risk* will be taken variable "changes in amount of granted credits", i.e. occurrence of credit booms and/or credit contractions. Credit boom may happen when bank`s department responsible for granted credits judges credit application over-optimistically, or is more willing to grant credits to lower net-worth borrowers or lend money for more risky projects. A weak regulatory environment can also contribute to risky credit expansions of banks. Even more so when it includes various explicit or implicit public sector guarantees (Evans, 2000). Also sudden inflow of foreign currency to domestic banking sector – e.g. as consequence of opening of domestic economy – may contribute to risky behavior of banks.[57]

Still, credit expansion may not mean increase of non-performing loans. In periods of good performance of economy, increase of granted bank credits may be consequence of rapid rate of growth of real investments, export and import, employment growth and growth of wages (Festič and Romihi 2008), but need not be accompanied by higher ratio of non-performing loans to total loan. That's why ratio of NPL to total loans is more often used as indicator or growing credit risk exposure.

Still, lending mortgage booms preceded also the current crises that started in USA in 2007. This seems to reasonably justify using this variable in construction of our index.

5.1.2. Exposure to liquidity risk

Changes in bank total deposits serve as indirect indicators of *liquidity risk*. To observe changes in banks` total deposits is the most general way how to assess liquidity

[56] The macroeconomic Credit Risk Model for the Household Sector and The Model for the Corporate Sector
[57] See experiences of banking sectors of CR and Estonia, chapters 7 and 8.

risk exposure. It is not only indicator of liquidity risk that can be used, however. Other financial indicators connected to liquidity-risk monitoring are.[58]

- **Central bank credit to financial institutions** – high changes in amount of central banks` credit to banks and financial institutions often mean that financial sector experiences severe liquidity problems.
- **Deposits as a share of Monetary Aggregates** – Decline in loans relatively to M2 may be consequence of liquidity problems in banking sector (or of a loss of confidence from private sector. People turn to non-banking institutions to borrow money)
- **Loans-to-deposits ratios** – ratio of credit over deposits may indicate the ability of banking sector to mobilize deposits to meet credit demand. (viewed over time, inter-bank deposits are excluded)
- **Maturity Structure of Financial Institutions` Assets and Liabilities** – Observing of maturity structure in portfolio of assets and liabilities can show excessive maturity mismatches and urge a need for more careful liquidity management.
- **Secondary Market Liquidity** – structure and depth of markets of liquid assets, where banks can turn to in need for liquidity, is also important as potential indicator of how banks would be able to handle liquidity shocks

Obviously, savers' massive run on deposits may indeed trigger a new (or accelerate the ongoing) crises of the banking sector. Even today modern banking crises in western world were characterized and preceded by bank runs, which suggests that existence of massive withdrawals are still important indicator of banking crises. It also suggests that excessive liquidity risk taken by bank can in this way easily be exposed.

5.1.3. Exposure to exchange rate risk

Changes in foreign liabilities by banks are indirect indicators for *exchange rate risk.* It is usual that banks take high debt in foreign currency by acquiring funds from international financial markets. In this situation, devaluation of domestic currency (currency crisis) would mean sharp fall in bank`s net-worth, because they have high

[58] Presented summary of the indicators is from Evans et al. (2000)

foreign-currency debt. Every currency crisis thus may lead to huge losses for banks. For this reasons banks, foreseeing devaluation of domestic currency, may try to unburden themselves from foreign debt as much as possible (i.e. decrease in amount of foreign liabilities). On the other hand, when amount of foreign liabilities of banks increases (for any reason) their exposure to exchange rate risk also increases (Kibritçioglu, 2003).

Relationship between currency crisis (devaluation) and banking crises is therefore of relevant importance. Links between banking and currency crises are discussed, for example, in Kaminsky and Reinhart (1999) and Glick and Hutchison (2001). Hutchinson and Noy (2005) provide comprehensive overview of literature related to banking crises, currency crises and so-called "twin crises".[59]

Kaminsky and Reinhart`s (1999) famous conclusion of so-called vicious spiral is that currency crises deepens the banking crises, which in turn deepens impact of currency crises, and banking crises may consequently deepen again.

Expected currency crisis itself may lead to run on banks, when people are holding their accounts in foreign currencies.

[59] Financial and currency crises occurring simultaneously

5.2. Construction

Following above argumentation, fragility index is constructed to measure impact of three sectoral indicators.

1) Changes in bank deposits, that is proxy of changes in liquidity risk
2) Changes in bank claims on the domestic private sector, that is proxy for changes in credit risk
3) Changes in foreign liabilities of banks, that is proxy for changes in exchange rate risk

Monthly Banking Sector Fragility Index is constructed in following way:

$$BSFI_t = \frac{\left(\frac{CPS_t - \mu_{cps}}{\sigma_{cps}}\right) + \left(\frac{FL_t - \mu_{fl}}{\sigma_{fl}}\right) + \left(\frac{DEP_t - \mu_{dep}}{\sigma_{dep}}\right)}{3}$$

$$CPS_t = \frac{LCPS_t - LCPS_{t-12}}{LCPS_{t-12}}$$

$$Fl_t = \frac{LFL_t - LFL_{t-12}}{LFL_{t-12}}$$

$$DEP = \frac{LDEP_t - LDEP_{t-12}}{LDEP_{t-12}}$$

Where:

CPS = annual percent change in banking system`s total claims on the private sector.
FL = annual percent change in bank`s real foreign liabilities.
DEP = annual percent change in total real deposits on banks.
μ = arithmetic average of each of the three variables.
σ = standard deviation of each of the three variables.

Each variable in **BSFI** is statistically standardized to make variances equal. Possibility that one of the variables would dominate the index is thus avoided. Although

index is constructed according to month-to-month data, observed changes in the three variables are measured as **yearly percentual changes**.

"By using 12-month percent changes in the monthly data instead of using monthly changes, we avoid any seasonality, which may be incorporated into the data. We also hope to be kept away from the risk of deriving misleading interpretations, if we would consider simply month-to-month changes."[60]

"Banking crises should not be… signaled simply by "monthly" fluctuations in banking variables, such as the bank deposits, claims on private sectors, or foreign liabilities. They must be caused by longer term and powerful deteriorations in the banking sector."[61]

Results of **BSFI** are probable to suffer from several inaccuracies stemming from both chosen variables and method of construction. As **BSFI** takes into account only three risks to which banks may be exposed (albeit the most important ones), it may not be able to detect banking fragility that is caused by other factors. For example, indicators for *capital adequacy* and banks' *profitability* are not captured, but low profitability and problems with meeting capital adequacy may often mean fragile financial condition of bank. Also indicators that would take into account *interest rate ri*sk are not included.

Another possible inaccuracy in detection of fragility period may come from the fact that used indicator for measuring credit risk is quite proxy. As mentioned above, although increase in granted credits indicates higher exposure to credit risk, increased amount of credit by itself need not mean increased amount of NPL.

Also method of construction contains hidden possibility of error. Index reflects yearly percentage changes in observed variables, but is constructed on the basis of monthly data. In case of abrupt change in any variable within one month, this particular monthly change will influence 12 output values of the **BSFI** (as each month is included in computation 12times). This occurred for example in case of **BSFI** for Japan (more next pages). – This feature of **BSFI** is the most startling, because one of main motives behind construction method was to prevent this from happening.

[60] Kibritçioglu (2003), p. 4
[61] Kibritçioglu (2003), p. 4

5.3. Data

When possible, data were taken from *International Financial Statistic database* (IFS) of International Monetary Fund. It provides nominal time series. For their deflation Consumer Price Indexes (CPIs) of each particular country were used. CPIs were taken with base year 2000. For Czech Republic, data for "claims of banks on private sector" were used from the CNB's statistics system ARAD available on the CNB's webpage.

FL

Nominal Foreign Liabilities were taken from IFS`s line 26C, as *"foreign liabilities of deposit takers."*

CPS

Nominal Claims on Private Sector were taken from IFS`s line 22D, as part of *"Claims on Nongovernmental Sector"*. Only for Czech Republic data were taken from time series ARAD, section SDDS[62], under the heading "*Domestic credits to the rest of the economy (excluding government sector, including credits to nonfinancial public enterprises)"*.

TDEP

Nominal Total Bank Deposits were taken as sum of IFS` lines 24 and 25. Concretely it is a sum of "*Demand deposits*" and "*Time, savings and foreign currency deposits*" for Mexico, Japan, Georgia, Island and Moldova, whereas for Czech Republic and for Estonia it is sum of "*Demand deposits*" and "*other deposits*".

Before presenting results and their discussion, I say few words about how variances of BSFI and its development over time should be interpreted.

Higher values of BSFI represent situation when banks are more exposed to the three measured risks. The argumentation goes as follows: If banks provide too many loans, the probability of accumulating non-performing loans rises as well. In this way banks are exposed to higher credit risk. Increased foreign liabilities in balance sheets makes banks more vulnerable to changes in exchange rates, thus exposure to exchange rate risks is

[62] i.e. analytical accounts of banking sector

apparently higher. Higher total bank deposits signal higher exposure to liquidity risk, because in case of run on bank or huge withdrawal from the depositors' side banks would have it more difficult to be sufficiently liquid. Thus high values of BSF index, although they do not signal fragility per se, are regarded as indicator that banks are taking excessive risks. This in turn may be warning sign of future possible fragility.

That economic boom often leads to credit booms and excessive risk taking by banks is positively recognized. For example, Jiménez, Ongena, and Saurina (2007) documented positive effect of expansionary monetary policy on risk taking by banks. They conducted variety of duration models, and observed that lower short-term interest rates (representing monetary policy action) resulted in banks granting more risky new bad loans. Banks were also willing to soften lending standards and grant credits to lower net-worth borrowers.

Willingness of banks to take excessive risks may be triggered also by good macroeconomic performance of country's economy, as banks' behavior is usually procyclical and reinforces the current development of the business cycle (Festič and Romih, 2008). In this case, risks taken by banks tend to materialize into losses when macroeconomic conditions deteriorate.

Decreasing values of BSFI represent situation of higher banking sector fragility. In the proxy for credit risk, low credit growth may be sign of banks facing high share of non-performing loans, which makes them more cautious in granting new credits. Credit contraction may also be caused by unfavorable macroeconomic development. Negative values of credit growth signal high credit problems of banks. Declining growth in bank total deposits is a signal of lower liquidity of banking sector. Mismatch between loans and deposits may then cause liquidity distress and be a trigger for banks financial fragility. Low growth in foreign liabilities (or even negative growth) is also indicator that banks foreign exchange rate risk started to materialize. This may be consequence of depreciation of domestic currency (currency crisis), or by deteriorated banks expectations about future currency development.

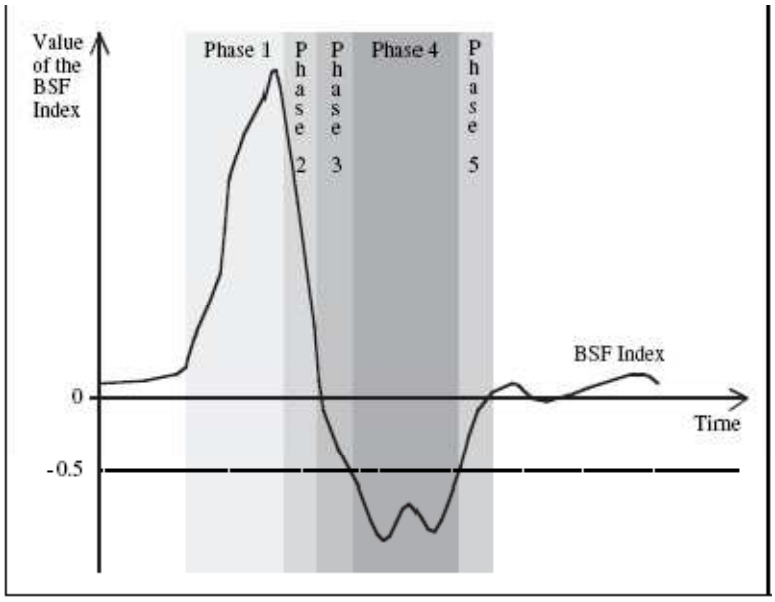
It depends on researcher`s view what level of **BSFI** index he considers too high or too low. Thus optimal level of **BSFI**'s values is to keep within both downwards and upwards limits. This feature of **BSFI** is similar to the index of Van den End (2006)

discussed above, where optimal behavior of index is also to keep within brackets, too high and too low values being undesirable.

5.4. Hypothetical banking crisis model with respect to BSF index

From the development of **BSFI** values over time, it is thus theoretically possible to detect whole period of banking crisis, or at least detect periods of high/low fragility of banking sector. Kibritçioglu (2003) suggested pattern of **BSFI** behavior that is supposed to accompany every banking crisis. He divides such hypothetical banking crisis to 5 phases (picture).

Time path of BSFI and Five Phases of Hypothetical Banking Crisis



Source: Kibritçioglu (2003)

Each phase represents specific behavior of banking system in connection to changes of **BSFI**.

5.4.1. First phase

The first phase is characterized by **BSFI** significantly rising above zero. Although increase in **BSFI** implies lower fragility of banking sector, it is interpreted as indicator of

impeding crises, especially when it lasts for a certain period of time. It signalizes that banks during this time take excessive risks. It may signal possibility of existing bubble and overheating economy.

5.4.2. Second phase

In the second phase **BSFI** suddenly starts to fall. It may be taken as beginning of distress, so probability of banking sector crisis rises further. Banking fragility increases as well. Behavior of banks during this phase is considered to be generally risk-avoiding.

5.4.3. Third phase

The third phase begins when value of **BSFI** falls below zero, but is still above value (arbitrarily chosen by researcher[63]) representing fragile banking sector. During this phase banking system is approaching line under which actual banking crisis occurs. Fragility of banking sector significantly increases. Behavior of banks in this stage is strongly risk avoiding.

5.4.4. Fourth phase

The fourth phase of hypothetical banking crises is reached when value of **BSFI** crosses arbitrarily chosen value of banking crisis. Fragility of banking sector continues to increase. Most probably, banking crisis is under way during this stage. Bank behavior in this phase is definitely risk avoiding.

5.4.5. Fifth phase

When value of **BSFI** begins again to shift upwards towards zero, hypothetical banking crisis enters the fifth stage. From the point of view of banking sector fragility, it is recovery period. Fragility level starts to fall. Banks are willing gradually to take risks again. When value of **BSFI** reaches zero or value very close to zero, banking sector crisis can be said to be over.

[63] From the picture it is evident that Kibritçioglu chose the threshold value to be -0.5

6. Czech Republic

To see if constructed **BSFI** successfully proxied fragility of Czech banking sector over time, I will compare obtained **BSFI** path to actual development of Czech banking sector. Results of **BSFI** have to be considered with regard to relevant country-specific information, such as development of overall economy, political situation, legal and institutional framework and so on. Country-specific information could even explain variability in **BSFI** index itself, without actual changes in fragility.

6.1. BSFI for Czech Republic

From the closer look on the evolution of **BSFI** for Czech Republic over period of 15 years, it is seen that "hypothetical banking crisis development of **BSFI**", as presented in previous subchapter, is relatively nicely followed.

Path of **BSFI** suggests that banking sector of Czech Republic during years 1994 up to 1996 experienced high boom. Closer look on the data reveals that increase of **BSFI** was driven by sharp increase in foreign liabilities. Value of **BSFI** peaked in the year 1996. After that, value of **BSFI** abruptly falls, signaling beginning of problems of banking sector. At the end of 1997 banking sector entered period of high fragility. This period of high fragility lasted for a long period of time. **BSFI** indicates that it was not until beginning of 2003 that banking sector returned to the area of stability. Since then on, banking sector has been operating in area of steady stability; in years 2005 – 2007 value of **BSFI** indicates that banks were willing to take more risks again. Year 2008 was more cautionary, but stability of banking sector doesn't seem to be threatened, as value of **BSFI** index at the end of the previous year was still above zero (0.25).

In connection to model of hypothetical banking crisis presented above, development of **BSFI** values suggests following interpretation.

a) The first phase of the hypothetical crises occurred in years 1994 up to 1996. Peak was reached in the middle of 1996.

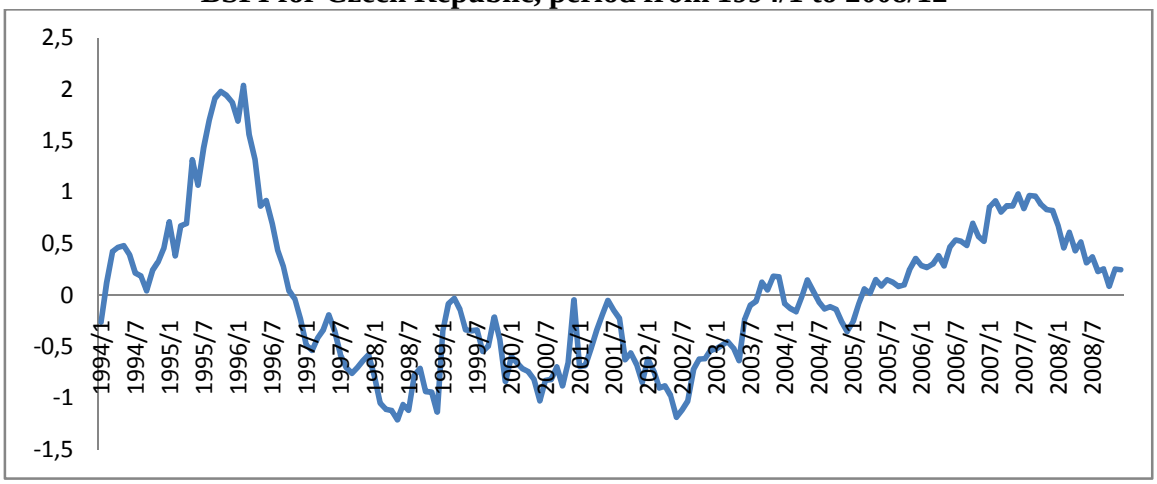
b) After that, second phase started. CPS fell, as banks limited their lending strategies, respectively foreign liabilities of banks declined. People lost part of their trust towards banking system.

c) Problems of banking sector indicated by our **BSFI** seem to be very serious, as phase 3 lasted relatively very shortly, and banking sector quickly plunged to the area of significant fragility.

d) Phase 4; Index indicates serious banking crisis that lasted to the year 2002.

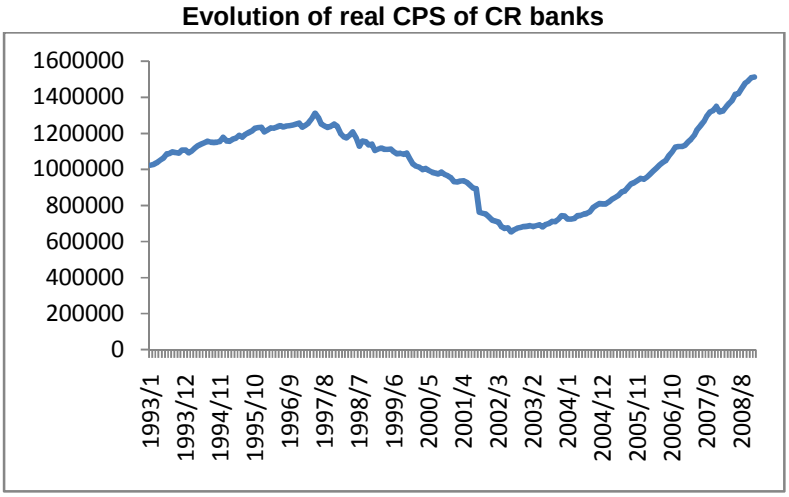
e) The fifth phase (recovery) is indicated from the year 2003.

BSFI for Czech Republic, period from 1994/1 to 2008/12

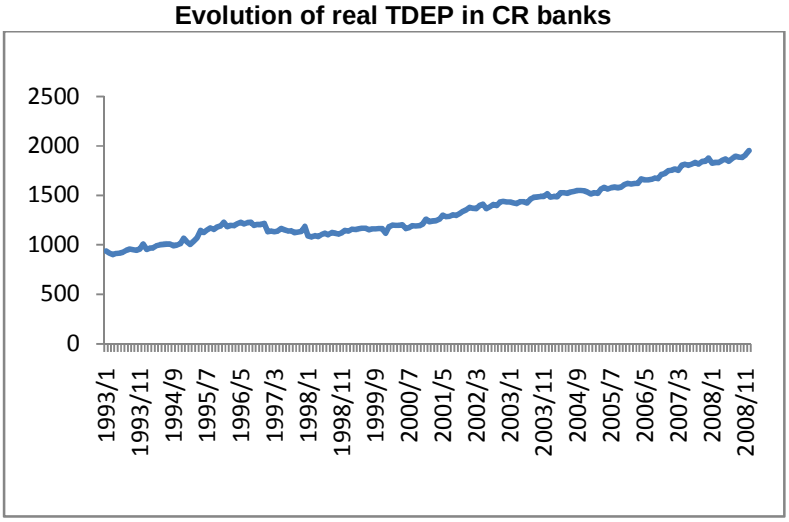


Source: own calculations

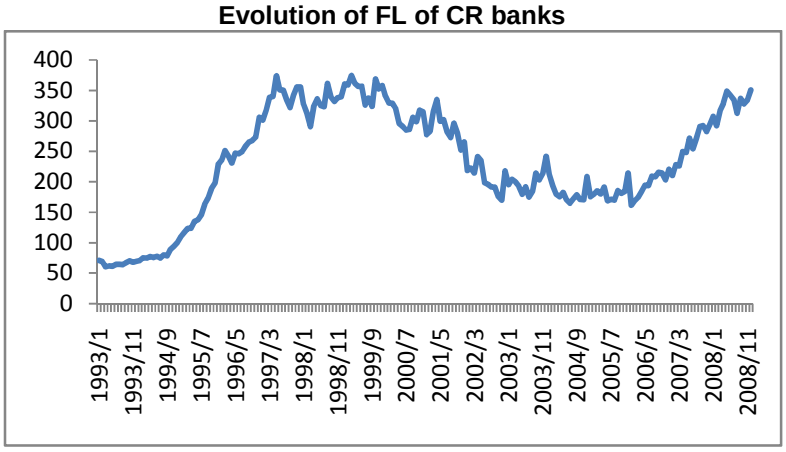
Following three tables show development of each variable included in **BSFI** separately. It can be helpful in explaining underlying forces behind variance in **BSFI** values, to see by which particular variable(s) changes in **BSFI** were driven.



Source: IMF – International Financial Statistics



Source: IMF – International Financial Statistics



Source: IMF – International Financial Statistics

6.2. Banking sector of Czech Republic

My description of creation and evolution of Czech banking sector during transition period will be based mainly on Tůma (2002), Dědek (2001), Singer and Bárta (2006) and CNB's Financial Stability Reports (2004, 2006, 2007 and 2008/2009).

Following breaking up of Soviet Union, Czech Republic entered transition period from communism to capitalism. Throughout the years there have been conducted many studies of Czech banking sector development; transition period was divided according to many points of view. My general division of evolution of Czech banking sector will follow "fragility of banking sector`s" point of view, bearing in mind planned comparison with results of our BSF index (If possible).

a) Forming of banking sector;
b) Boom – higher risk exposure (related to increasing competitiveness in banking sector);
c) Increased fragility (related to problems of newly formed small banks);
d) Crisis of banking sector;
e) Recovery – consolidation of banking sector;

7.2.1. Forming of banking sector

"The building of a competitive banking sector started virtually from scratch. The first step was the splitting of the former socialist "monobank", State Bank of Czechoslovakia (SBCS), and the creation of a two-tier banking system."[64]

Difficulties for Czech Republic' banking sector were the same like for every transition economy. Non-existing legal and institutional framework, no credit history of potential borrowers, so their creditworthiness could not be judged, only guessed; no supervisory and managerial know-how etc. (Tůma, 2002)

Former state "monobank" was split to four large (state owned) banks[65]. From communism era they inherited huge amounts of NPL. To unburden banks of them, project called "Consolidation Programme I" was launched. Its main purpose consisted of

[64] Bárta and Singer (2006), p. 2
[65] Komerční banka, Česká spořitelna, Investiční banka and State Bank of Czechoslovakia.

establishing special institution, Konsolidační banka (KoB), as a vehicle to which NPLs from banks were transferred and consequently bought by state.

This period of forming banking sector is not accounted for in **BSFI**, because of unavailability of data for this period.

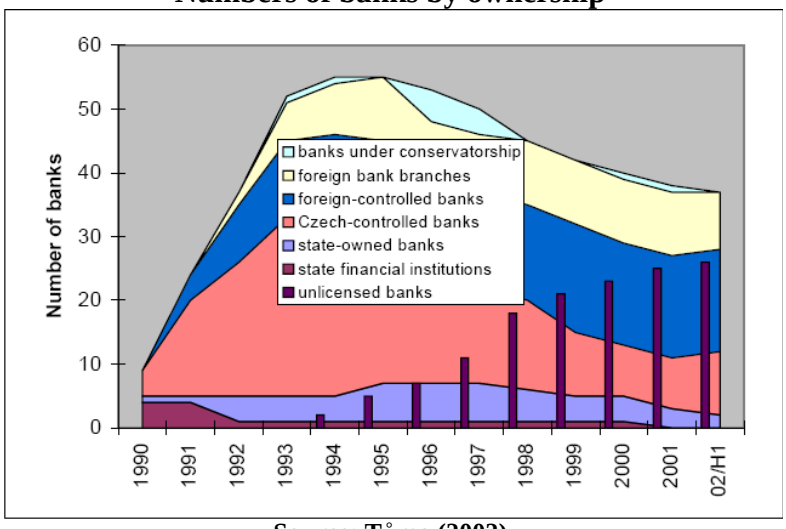
7.2.2. Increasing competitiveness – excessive risk taking

Important feature of forming Czech banking sector in early 1990s was emergence of large number of small, private banks. Legal settings at the time were set very favorably for entering new banks to banking industry, so as to make banking sector more competitive.[66]

"In the early 1990s, licences were granted quite freely to newly created banks, and the market was opened to foreign bank branches in 1992. This led to a fast increase in the number of banks during the early 1990s."[67]

Following chart shows massive increase in number of banks during the half of 1990s.

Numbers of banks by ownership



Source: Tůma (2002)

[66] Evolution of competitiveness in Czech banking sector and its impact on performance was examined e.g. in Podpiera and Weill (2007)

[67] Tůma, (2002) p. 3

New banks tried to get as big share of the market as possible and to compete with large banks. In this situation many banks *"…took risks comparable to those usually assumed by venture capitalist"*[68].

Discussing BSFI

During this period FL sharply increased, which caused increase of **BSFI**. Czech banks made extensive use of foreign cash inflow, as benefit of new openness to foreign developed countries[69]. Foreign liabilities of banks shot upwards. This, in combination with documented aggressive credit attitude, is in accordance with evolution of **BSFI**, which signals the first period of "hypothetical banking crisis", as presented in subchapter 5.4.

"*The period of 1994–96 was marked by rather sharp credit growth, reaching almost 20% in nominal terms and 8–16% in real terms."*[70]

7.2.3. Problems of small banks – increased fragility

High portion of newly established private banks run into difficulties. Many of them were forced to default. Because of this, at the beginning of 1996 second consolidation programme was introduced.

"The Czech National Bank … initiated at the beginning of 1996 a comprehensive programme …. consolidation Programme II clarified the negative financial situation facing a number of small domestic banks."[71]

According to Consolidation programme 2 all banks that at the beginning of the year 1996 did not meet required level of capital adequacy (which was 8%), were demanded to meet capital adequacy limit at the end of the year. At the same time they had to present consolidation programmes showing how they were planning to do so.

Discussing BSFI

BSFI output suggests rapid deterioration of state of Czech banking sector from July 1995 to the beginning of 1997[72]. Closer look at the data shows that decrease is driven by

[68] Bárta and Singer (2006)
[69] As can be seen also in chart above, many newly open banks were directly foreign controlled or were branches of foreign banks
[70] Tůma (2002), p. 4
[71] Bárta and Singer (2006), p. 3

decline in CPS, whereas total deposits and foreign liabilities remain relatively stable. This behavior of CPS can most probably be understood as consequence of Consolidation Programme 2, as banks' response to this programme.

Institutional development suggests that in reality fragility of banking sector was caused by stricter capital adequacy requirement. Thus capital-adequacy-indicators should be more suitable for revealing banking sector fragility. However, **BSFI** does not have capital adequacy indicators among its inputs. Nevertheless, behavior of banks with respect to CPS is enough for **BSFI** to detect period of rapidly growing fragility, which corresponds to actual development.

7.2.4. Crisis of banking sector

It was in the year 1997 when whole banking sector started to experience problems. In this year macroeconomic environment of Czech economy deteriorated and economy slid to recession (see following chart). Moreover, contractionary measures taken by Czech Central Bank put additional constraints on liquidity of banking sector.

"In May 1997, the Czech Republic … experienced a period of currency turmoil… This currency turmoil and the subsequent economic recession had a clear negative impact on the banks' financial position."[73]

Real GDP growth, Czech Republic

Source: Czech Statistical Office[74]

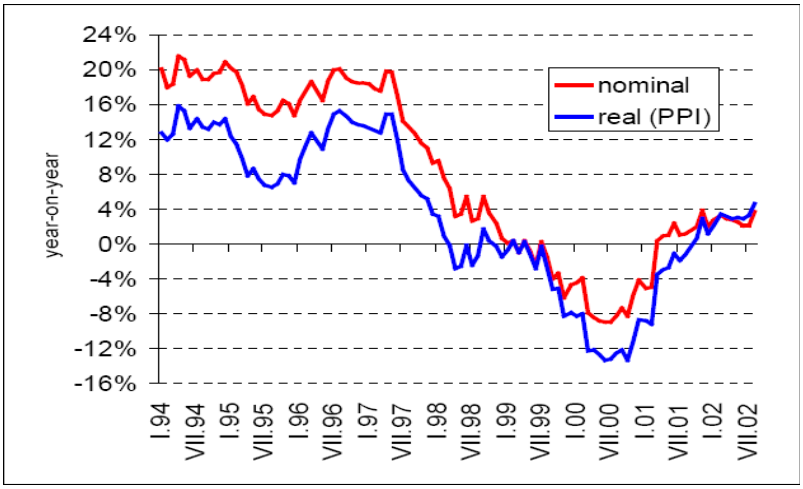
[72] Growing fragility continues even after, but this period is taken as the second part of our "Hypothetical banking sector crisis", as presented above.
[73] Tůma (2002), p. 6

Throughout period from 1997 till 2000, many banks which had been under Consolidation Programme 2, bankrupted, or were merged with other banks. Fraction of NPL rocketed. For the banking sector as a whole, during 1999 the share of classified credits in total credits rose to 32% (Dědek 2001).

Another aspect of banking crisis was that in the period from 1998 to 2001, amount of granted credits significantly decreased. This decrease in granted credits was partly caused by legislative influences. Fall of Investiční banka in 1999 was one of them. Also, high portion of classified loans was transferred from balance sheets of banks to KoB[75], and thus credits "disappeared" from banks' balance sheets. All observed reduction in NPL during this period was caused by these transfers (Dědek 2001).

Nevertheless, following chart documents that even with adjustment of clean-up operations, both nominal and real granted credits sharply fell. From half of the year 1999 to the beginning of 2002 growth was even negative.

Bank credit growth (adjusted for clean-up operations)



Source: Czech National Bank, taken from Tůma (2002)

[74] Macroeconomic indicators, yearly data
[75] Konsolidační Banka

Discussing BSFI

BSFI indicates period of high banking sector fragility (crisis) in period from the beginning of 1997 to the beginning of 2003. This corresponds with actual banking sector experience. Thus it seems that changes in the three observed variables (as proxies of three risks) are able to relatively well explain variability of banking sector fragility.

On the other hand, sharp decrease of CPS, which can be interpreted as unfavorable by **BSFI**, in this case partly means the opposite. Decrease of CPS was caused also by above mentioned transfer of bad credits out of banks balance sheets, i.e. act that was favorable from banks' point of view. **BSFI** cannot distinguish among various factors standing behind movement of its variables.

7.2.5. Consolidation of banking sector - recovery

It became evident that consolidation of banking sector and relieving from crisis would not be possible without privatizations of state owned banks. Privatization had been planned as part of restructuring of banking sector from the very beginning. Also there were enough potential foreign investors available, willing to purchase high stakes in Czech banks. But decision to begin privatization process in 1990s had usually been blocked by political pressures, *"…typically due to pressures from smaller parties in the coalition government and to very vocal leftwing opposition on this issue."*[76] But in face of grave situation in Czech banking sector, privatization process were again resumed in the year 1998. Privatization took place successfully; major stakes in large state-owned banks were sold to big multinational banks.

"*By 2001, the privatization of the banking sector had basically been completed, and further restructuring followed an evolutionary pattern without any active government involvement."*[77]

By the end of 2008, in Czech banking sector operated 37 banks. Only 7 of them were Czech-controlled, 30 (that is more than 81%) were foreign-controlled. 16 of them were direct branches of big foreign banks (CNB statistics)[78].

[76] Bárta and Singer (2006), p. 6
[77] Bárta and Singer (2006), p. 6
[78] Available at:

Discussing BSFI

BSFI does not indicate recovery until 2003, as all actual development that took place (privatization, increased trust of people towards Czech banks not accompanied by growing deposits) is not considered by variables used for construction of index. Consequently, **BSFI** output is not able to comprehensively match real development. It indicates relatively high volatility, but always remaining in negative numbers (below zero). Values of CPS are still affected by bad loans transfer to KoB, and also FL witnessed decline due to privatization. BFSI is unable to explain it otherwise than as continuing fragility, which might be taken as proof that BFSI cannot be taken as explanatory tool in defining banking sector fragility by itself. Country-specific development that is not taken into account by **BSFI** is in this case highly relevant.

6.3. Concluding remark

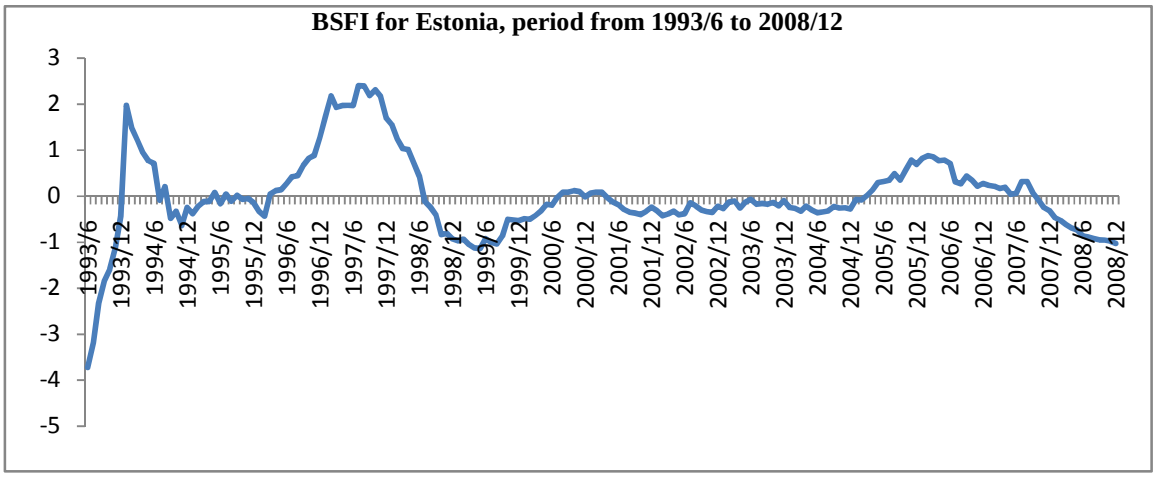
Comparing development as depicted by evolution of **BSFI** to actual development on banking sector of Czech Republic, we can see that informational content in **BSFI** is quite high. It relatively successfully caught periods of high expansion of credits booms and excessive risk taking as well as periods of high fragility and banking crisis, by examining exposure of banks to three main risks. As such, **BSFI** proved itself as useful tool for detecting volatility of banking sector fragility. Still, **BSFI** was not able to detect banking sector fragility that was caused by factors other than changes in three observed variables. **BSFI** did not adequately detect changes in banking sector fragility that had stemmed from changes in legal setting (bankruptcies and mergers caused by Consolidation programmes) and institutional changes (Transfer of NPL do KoB).

http://www.cnb.cz/cs/dohled_fin_trh/bankovni_dohled/bankovni_sektor/zakl_uk_bank_sekt/ukazatele_tab01.html

7.Estonia

BSFI indicates occurrence of higher fragility of banking sector and banking crisis in Estonia during periods:

a) **Up to the beginning of 1994[79]; crisis**
b) **June 1994 – January 1996; period of increased fragility**
c) **June 1998 – August 2000; period of deeper fragility/crisis**
d) **2004 – now; period of growing fragility/crisis**



Source: own calculations

7.1. Up to the 1994

After breaking up of Soviet Union, Estonia banking sector's initial conditions were similar to that of Czech Republic. Like CR, Estonia needed to split former socialist Monobank to several banks and to create functional two-tier system. Moreover, Estonia's political authorities decided to face these challenges in a way similar to CR's experience.

They set legal settings enabling many new banks to freely enter into the banking industry, in order to increase competitiveness and to meet borrowing need of private sector (Chen, Funke, and Mannasoo 2006). Like in CR[80], these banks profited from openness to

[79] Year of beginning of crisis is not stated due to unavailability of data
[80] And in other post-soviet countries, e.g. Poland and Hungary

foreign countries, which led to inflow of foreign cash and excessive risk taking. Results of such an attitude were also the same as in CR, i.e. new banks quickly ran into difficulties and forming banking sector experienced crisis. Initial condition of Estonia's banking sector had also unique features[81], which are dealt with e.g. in Knobl, Sutt, and Zavoico (2002)

"The first systemic full-blown banking crisis to hit Estonia surfaced in 1992-1993. A large proportion on the newly founded credit institutions was not in a position to withstand the numerous stresses and strains associated with such a crisis."[82]

As to the BSFI, data on Estonian banking sector are available only from June 1993. In that time Estonia banking sector was already experiencing deep crisis, which **BSFI** detects. On the other hand, forming banking sector at the time was very volatile, diminishing its size significantly because of many bankruptcies. **BSFI** output (showing values deep below zero) thus needs to be taken with appropriate caution.

7.2. Period from 1994 to 1996

indicated as quite un-volatile period of medium fragility by BSFI, was period of restructuralization of banking system. CB demanded commercial banks to meet very strict prudential requirements, and its supervision over banking sector increased.

"Stringent capital standards were aimed at consolidating the banking sector, thereby ensuring the improved efficiency and competitiveness. By the end of 1996 the number of banks had shrunk to … level of 13 institutions."[83]

7.3. 1998 – 2000

In this case BSFI well detects period of financial crisis[84], which is confirmed by literature on Estonian banking sector development.[85] Crisis was immediate consequence of

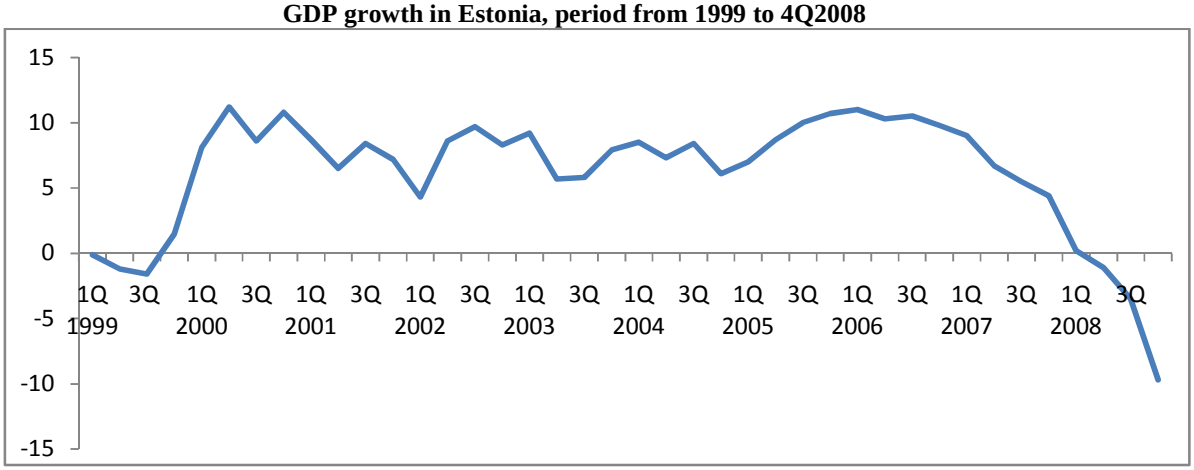
[81] The most important of these features were: Abandoning Ruble (Estonia was the first post-Soviet country to do so); Introduction of own currency; Estonian currency board; Additionally, Estonia (in contrast to CR) had not inherited bad loans from Soviet era, which may have contributed to rapid expansion and unbridled risk taking by banks.
[82] Chen, Funke, and Mannasoo (2006), p. 3
[83] Chen, Funke and Mannasoo (2006), p. 4
[84] The lowest values of BSFI are from April 1999 to August 1999, reaching values lower than -1.
[85] Surprisingly, this financial crisis is not mentioned in IMF's "new crises database" (Laeven and Valencia, 2008)

both Estonian stock markets' crash and Russian's 1998 crisis. As all major Estonian banks were either highly exposed to securities or/and were highly involved in projects related to Russia, they almost immediately experienced grave financial difficulties.

7.4. 2004 – nowadays

Fragility during the last years indicated by BSFI is consequence of current worldwide financial crisis, and its confirmation is found in FSRs published by Estonia Central Bank[86]. The last report on stability of financial sector by Estonian national bank reports decline in credits following uncertainty about economic growth. Due to great uncertainty on the markets, loyalty of customers towards bank visibly weakened. But overall liquidity condition of Estonian banking sector, which is almost wholly owned by cross-border banks, depends more on willingness of their mothers to fund their Estonian branches. Thus fragility of Estonian sector, quite high in itself, is furthermore conditioned on developments on world financial markets (ECB's Financial Stability Report, 2008).

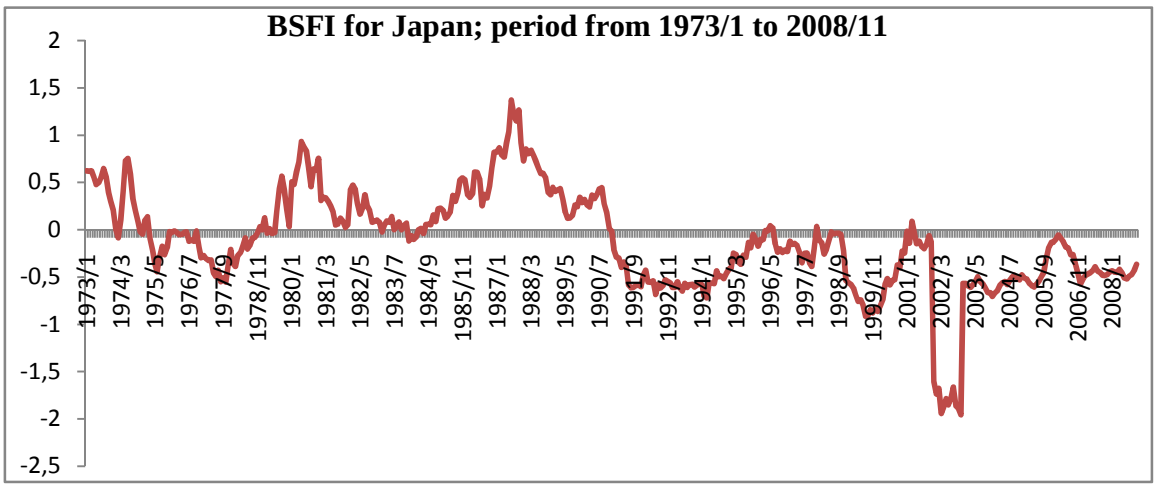
GDP growth in Estonia, period from 1999 to 4Q2008



Source: Estonia Statistical Office

[86] Eesti Pank

8. Japan



Source: own calculations

Although data for **BSFI** are available from the year 1973, period of interest from modern-banking point of view started in 1985, when financial innovation and financial deregulation bore profound influence on structure of Japanese financial markets and on behavior of financial market's players. Experiences of Japan economy and banking sector were thoroughly examined in many academic works by many researchers. As Japan banking sector had been traditionally among the most important in the world, its development was especially significant.

a) Up to 1985
b) 1985 – 1989 – bubble economy
c) 1990 – 2000 – long banking sector crisis
d) 2000 – now – restructuring of banking sector, mergers and acquisitions
e) Now

8.1. Up to 1985

History of modern Japanese banking started in 1952, when Japan regained its sovereignty that it had lost after World War II. Starting from this period, Japanese banks

started to be oriented on growth and profit.[87] During the 1960s and 1970s, as was the case for many industrial countries at the time, the financial system in Japan was highly regulated and protected.

"Exchange controls were maintained on both outward and inward movements of capital, securities markets were underdeveloped, financial institutions were rigidly segmented, and interest rates were extensively controlled."[88]

It was era of high economic growth, and regulations imposed on financial market were designated to steer both borrowers and savers towards banks (Hoshi and Kashyap, 1999).[89] Being traditionally robust and sophisticated, Japanese banking sector had been considered to be among the strongest worldwide (Kanaya and Woo, 2001). Nevertheless, structure of Japanese financial market was distinct from the rest of the world, in that from Japan's feudal history it inherited "quasi-feudal" structure of institutions.[90] "Feudal pattern" was reflected in the fact that the most important player on financial market (by far) was Ministry of Finance (MoF). Banks and other financial institutions depended on MoF's decisions more than on their own market-based assessment of risks and revenues, which led to financial market being not fully based on free competition. Regulated market, high cost of information, and non-fully competitive environment contributed to emergence of other typical feature of Japanese banking sector, so-called connected lending (Oyama and Shiratori, 2001). This feature of Japanese banking sector has persisted to these days, although banking sector has underwent considerable restructuring during last decades[91]. See e.g. Uchida, Udell, and Watanabe (2007).

[87] Evolution of Japanese banking from 1859 till 1959, during which period banks had underwent development from merchants (money holders), through experiences during the World Wars, until gaining sovereignty and becoming pro-growth oriented is comprehensively mapped in Tamaki (1995)

[88] Fries (1993), p. 8

[89] See p. 62 for Japanese real GDP growth

[90] This "quasi-feudal" structure of institutions is by many researchers considered to be the main cause of inability of banks to deal with consequent banking sector crisis. E.g. Wood (1992)

[91] Important segment of Japanese banking sector have always formed so-called regional banks, i.e. small banks focusing on retail banking in relatively small geographical regions. Even nowadays they are still operating on the basis of good "bank – firm" relationship.

8.1.1. Deregulation of Japanese financial markets

Regulations on domestic financial market started to relax in late 1970s and early 1980s. Gradual easing of existing constraints was caused both by economic development and legislative changes.

a) **Economic development** – Large corporations, which had been in Japan traditionally most significant banks' borrowers, started to fund greater share of their investments with internal funds[92]. Moreover, they were able partly to switch to equity financing, which was a result of domestic securities market having experienced rapid progress due to the surge of high-quality government bonds[93]. On international fronts, firms and corporations were allowed to invest abroad, because government exercised sizable current account surpluses in the 1970s and 1980s, and wanted to allocate them effectively.[94]
b) **Legislative changes** – In 1980, system of capital controls was officially relaxed, by introducing the "Foreign Trade Control Act". In April 1984, Japanese residents were allowed to purchase foreign-currency-denominated certificates of deposits, as well as commercial papers. Also banks gained higher freedom in foreign-currencies trade, when in June 1984 limits on banks' open short positions in foreign currencies were lifted.[95]

From the point of view of banking sector, the most important step in deregulation was deregulation of interest rates on deposits, which started in 1985.

"Prior to that time banks were not allowed to charge interest on deposits. The removal of this prohibition led to competition between banks for deposits and hence interest payments."[96]

Thus modern era of competitive banking system of Japan started, by financial innovation and market deregulation.[97] Banks started to be subject to market and credit risk.

[92] Large corporations had been able to accumulate large internal funds during previous period of high economic growth (Hoshi and Kashyap, 1999)
[93] As consequence of the oil price shock in 1973
[94] For involvement of Japan in international financial markets see e.g. Katada (2001).
[95] Based on Fries (1993)
[96] Watkins, San José State University, available at: http://www.sjsu.edu/faculty/watkins/bubble.htm

That's why I will start comparing development of Japanese banking sector to our **BSFI** from this point.

8.2. 1985 – 1990; Bubble economy (boom period)

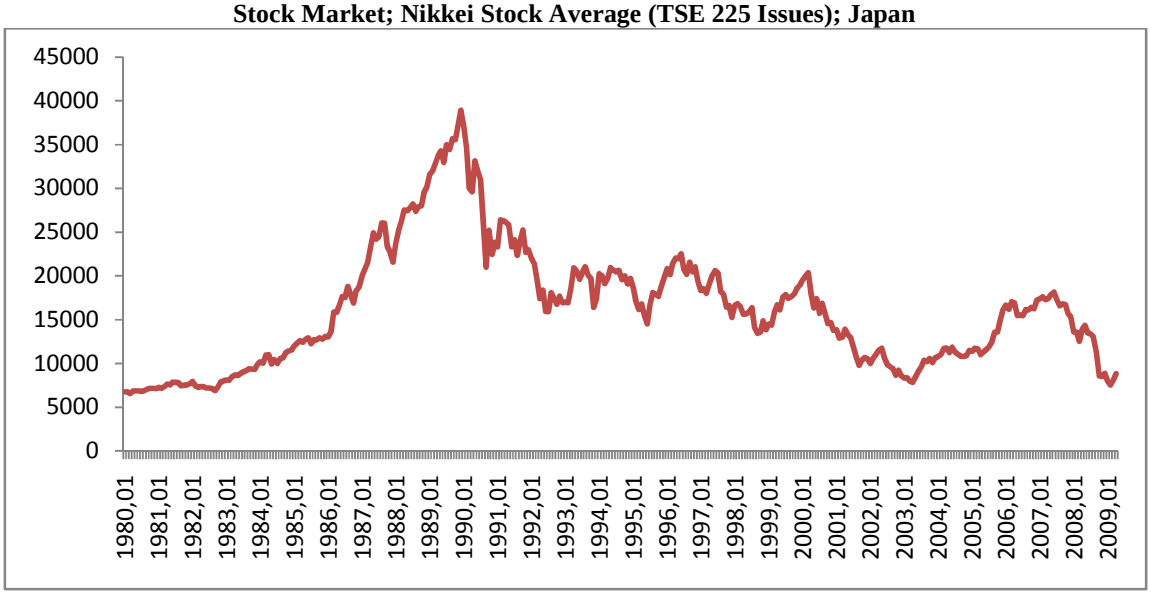
Period from 1985 to 1989 in Japan is well known as "boom economy". Asset prices experienced high boost, driven mainly by rapid increase in prices of stock and prices of real estate property.

Boom in real estate prices - Origin of high property-prices could be traced to deeper history, when Japanese government had wanted to discourage land-speculation, and for that purpose imposed high taxes on land. It discouraged people from marketing land, but consequently investors that needed land for projects were forced to pay high prices to make people sell it. As a result, price of land was artificially inflated. Because of land prices being high, houses became also very expensive, their market value highly over-reaching their real value.[98]

Boom in stock market - *"In the second half of the 1980's, Japanese stock prices rose sharply. In four years (1985-1989) share prices virtually tripled. At the same time, the total market value of all Japanese shares traded on organized exchanges increased to 1.5 times GNP at the end of 1989 from 0.6 times GNP at the end of 1985."*[99]

[97] For detailed overview of deregulation of interest rates' process in Japan see Kanaya and Woo (2001), pages 5-6; Takeda and Turner (1992) for overview of liberalization of Japan's financial markets
[98] More by Watkins, based on Wood (1992) and Wood (1994)
[99] M. Fries (1993), p. 2

Stock Market; Nikkei Stock Average (TSE 225 Issues); Japan



Bank of Japan; Financial end Economic Statistics

8.2.1. Economic boom and banking sector

Economic boom and financial liberalization brought abrupt changes to the structure and functioning of Japanese banking sector. Large corporations were now able to switch their financing to growing securities market, and thus were less dependent on banks.[100] Banks in their turn had to look for other potential borrowers. They started to be much more oriented on small and medium size enterprises (SMEs), and growing portion of credits started to be tied to property (Hoshi and Kashyap, 1999). Between fiscal years 1985 and 1989, outstanding loans of all banks to real estate sector were rapidly growing, reaching average annual growth of 17.9%. Banks also started to be further linked to real estate sector by the fact that growing fraction of overall loans had been granted on basis of property collateral (Up to 63%) – (Fries, 1993). Banks, which had not had previous experience from real free competitive environment, did not put much emphasis on borrower's cash-flow analysis. Instead, they relied on simple collateral requirements (Kanaya and Woo, 2001).

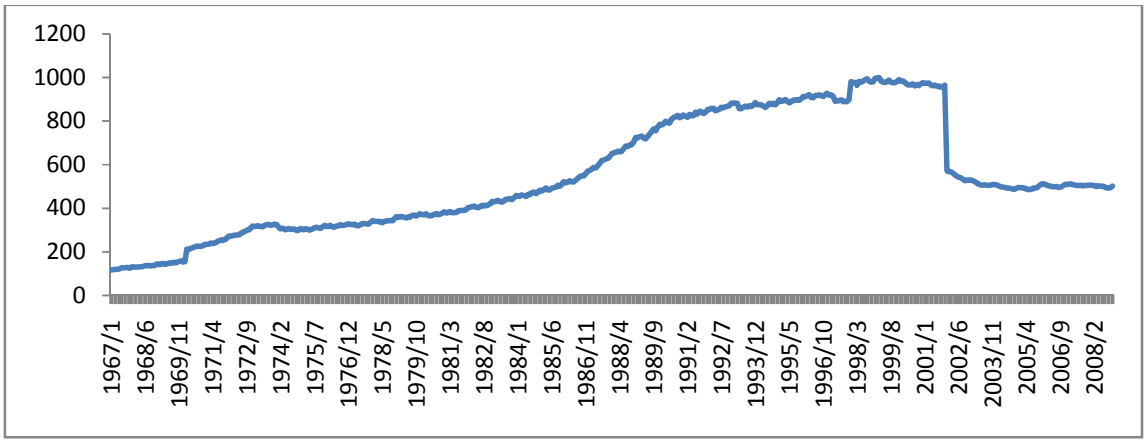
This, combined with the fact the real estate prices were highly exaggerated, caused direct involvement of banking sector in growing bubble.

[100] Hoshi and Kashyap (1999) documented that by 1999 large Japanese borrowers (particularly manufacturing firms) had become almost as independent of banks as comparable U.S. firms.

8.2.2. Discussing BSFI

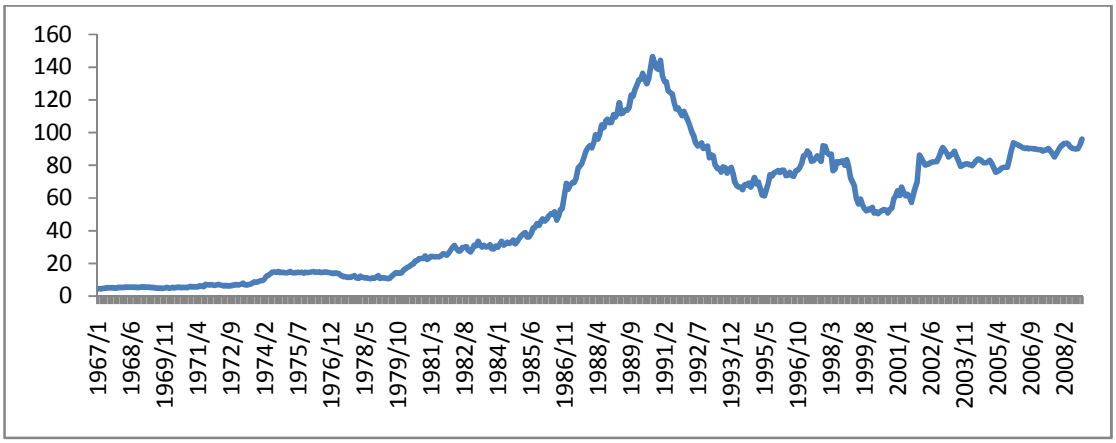
Closer look at **BSFI** suggests that this period can be viewed as the first phase of "hypothetical banking crisis" development, as described in subchapter 5.4. Sharp increase of **BSFI** during these years was driven by rise in CPS (as consequence of boom of credits to real estate sector and to SMEs), but even more so by rise in FL.

Claims on private sector of Japanese banks



Source: IMF – International Financial Statistics

Foreign liabilities of Japanese banks



Source: IMF – International Financial Statistics

Documented increase in foreign liabilities of Japanese banks was a consequence of abrupt appreciation of Yen within the second half of 1980s. In august 1986 yen rose to the

level of 244/1dollar, comparing to 153/1dollar in September 1985[101]. Financial deregulation led to Japanese banks being highly active in international financial markets, as well. *"During the "Bubble Economy" Japanese banks borrowed extensively in the Euro-dollar markets, 186 trillion Yen by June of 1990"*[102] On international level, role of Japan in settling financial crises worldwide is described in Katada (2001). Author stated that in the latter half of 1980s Japan began acting like a leading international economic power, and between years 1987 and 1989 provided a $65 billion to indebted developing countries. *"Since autumn 1976, we (Mof) have resumed a policy of encouraging the Japanese banks to provide medium and long-term financing abroad"*[103]

With respect to patterns of **BSFI's** evolution, Kibritçioglu's (2003) proposition was that high increase of **BSFI** is accompanied by banks' taking excessive risks. For Japan, this was indeed the case[104]. E.g. Fries (1993) constructed simple model to test hypothesis that financial liberalization had led to increased risk taking by banks.[105] His conclusion was following:

"Financial liberalization and innovation, leading to reduced market power appears to have been associated with greater risk taking by banks."[106]

Thus, although **BSFI** is constructed so as to take into account only three variables, it transpires that it was relatively well able to detect increasing risk taking by banks during this period. Pattern of **BSFI** evolution in this period characterizes the first phase of "hypothetical banking crisis".

8.3. Banking sector crisis period

Asset bubble crashed in the beginning of 1990s. Chart of stock index shows that Nikkei stock average 225 reached its peak at the end of 1989, with Nikkei's value of

[101] Bank of Japan: statistics; Sharp appreciation relative to dollar was consequence of Plazza agreement that had been signed in the September 1985 (Fries 1993).
[102] Watkins; http://www.sjsu.edu/faculty/watkins/bubble.htm
[103] Fujioka (1979), quoted in Katada (2001), p. 51
[104] See e.g. Fukao 1988, Tsutsui 1990 and others
[105] Concretely, he used proxy measures for both financial liberalizations and risk taking, and examined correlation between the two variables.
[106] Fries (1993), p. 11

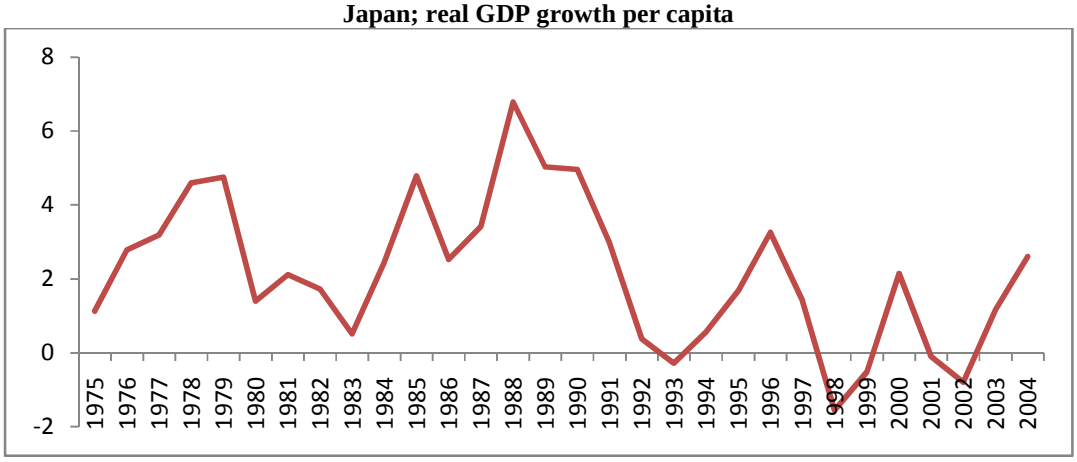
38915.87 Yen. After bursting of the bubble stock index sharply declined, and in October 1992 it reached only 16767.4 Yen.

Also prices of property rapidly declined. It was consequence of government's measures adopted specifically for dampening the real estate market, following the pressure from public that had been concerned over the too high land prices (Fries, 1993).

Banking sector condition was adversely affected by both declines of stock and real estate prices (Kanaya and Woo, 2001). Decline in real estate prices immediately caused deterioration of loan portfolio, as high fraction of loans was secured by property. As to the stock prices, their exorbitant values had previously contributed to high stock prices of banks and credit institutions. According to Wood (1992) and Wood (1994)[107], in 1991 most Japanese City Banks'[108] stock price-earnings ratio reached value of 60, while Industrial Bank of Japan's (BIJ) price-earnings ratio was even 100. Along with its market value of $60 billion, BIJ was probably the world most overvalued company.

Thus Japanese banks during 2 years at the beginning of 1990s witnessed rapid decrease in their equity value and loan deterioration, further enhanced by overall economic slowdown (see chart).

Japan; real GDP growth per capita



Source: Penn world database

There is one particular feature of Japanese banking sector crisis, because of which it received so much attention worldwide; it is its length. Deteriorating of banking sector

[107] Described by Watkins at: http://www.sjsu.edu/faculty/watkins/bubble.htm

[108] City Banks are major banks within Japanese banking sector. They offer banking services mainly to large corporate customers. They operate across a wide spectrum of financial activities, dominating most segments in the domestic market, and are active also internationally (Loukoianova, 2008).

continued over a decade, starting in the beginning of 1990s and recovering only in mid 2010s, albeit still not to full extent. There was much research conducted with objective to understand underlying causes of this fact. Fukao (1988) proposed non-functioning system of corporate governance as main reason for banking sector eventual collapse and long recovery period. Kanaya and Woo (2001) documented that after financial deregulation neither banks' internal risk-management control nor external regulatory framework of Japanese banking sector adjusted appropriately. Oyama and Shiratori (2001) also concluded that inability of banks to change their behavior (concretely widely spread connecting lending) in response to changes in external environment (financial deregulation, innovation) is one of main reason of persistent low profitability of Japanese banks later on.[109] According to Nishimura (1999)[110], Japanese government could have prevented banking crisis, but chose not to interfere and relied on false hope that future economic recovery would improve banking sector conditions. Also banks were unwilling to accommodate to changed circumstances, but rather engaged themselves in sham practices to artificially improve their accounts, to make use of lax regulatory and supervisory practices and to hide true scope of their problems. Thus the first restructuring programme of Japanese government came as late as in 1997, when situation in banking sector was already incurable.

"Loans classification rules were lax compared to international standards of best practice, and banks and regulators consequently took too long to recognize the extent of nonperforming loans in the system. When, at the end of March 1998, the major banks used the more stringent U.S.-related standards for reporting, their nonperforming loans were about 50% greater than those reported under the old system."[111]

Several examples of "gimmickry" played by Japanese banks to meet capital-adequacy requirement are provided in Watkins[112], based on Wood (1992) and Wood (1994). Japanese banks were also known to provide credits on relationship basis, which often resulted in continuous granting credit to even obviously insolvent borrowers.

[109] Low profitability has been characteristic of Japanese banks during the last decade. In international comparison they were behind the banking sectors of comparable developed countries; see e.g. Drake and Hall (2003), Loukianova (2008) for analysis of profitability and efficiency of Japanese banks.
[110] Referred to in Kanaya and Woo (2001)
[111] Kanaya and Woo (2001), p. 32, based on Levy (1998)
[112] http://www.sjsu.edu/faculty/watkins/bubble.htm

Consequences of this behavior of Japanese banks were examined in Caballero, Hoshi, and Kashyap (2006).

8.3.1. Discussing BSFI

a) **BSFI** begins declining in November 1987. All three observed variables (CPS, FL, and TDEP) kept increasing, but with slowing rate, which may be reflection of the thirst wave of banking risk taking being over.

b) High fragility of banking sector is indicated from December 1990, when **BSFI** plunges into negative numbers. Most probably it was the immediate impact of stock market crash. In academic literature official recognition of banking crisis in Japan is usually given in the year 1992[113], while Caprio and Klingebiel (2003)[114] sets beginning of Japan's banking crisis at year 1991. Problems facing "jusen companies" (housing-loan corporations), were publicly recognized in 1992, although most of the financial sector was able to hang on at least to 1995 (Kanyana and Woo, 2001). This ability of financial sector to avoid revealing their problems was mostly enabled by lack of supervision, weak corporate governance structure and not reporting their NPL. This has no effect on our **BSFI**, which observes exclusively the three variables that are used for its construction, without taking into consideration "gimmickry" that have been played by Japanese banks to meet capital-adequacy requirements.

c) **BSFI** indicates high banking sector fragility to last for a long period of time. In fact, according to **BSFI** banking sector hasn`t got over high fragility period even till present – **BSFI** reaches positive numbers only for very short periods throughout the last 19 years; concretely in May and June of 1996, December 1997, and March 2001.

Although **BSFI** is limited by way of construction and used variables, it seems it can relatively well be used for description of banking sector fragility development, even for approximation of experience of such a complex banking system as is that of Japan.

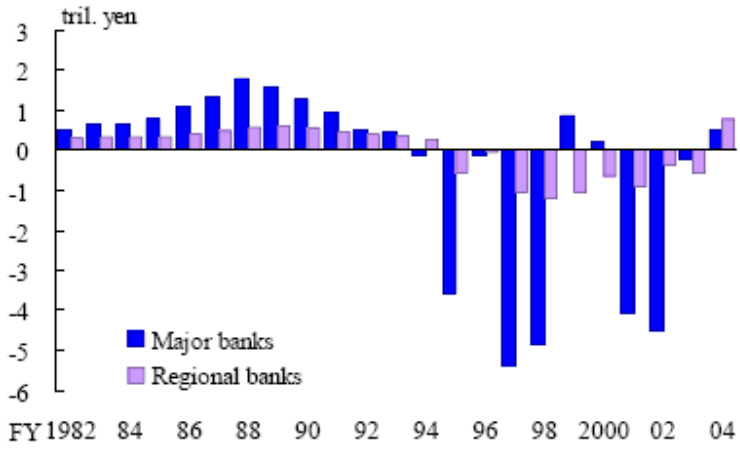
[113] Lindgren, Garcia and Saal (1998), Hardy and Pazarbacioglu (1998), Demirguc-Kung and Detragiache (1998), Martinez Peria (2000), Kashyapa and Woo (2001), Bordo and Eichengreen (2002)
[114] Database of banking crises

8.4. Restructuring and "low profit" period

During the last decade there were many attempts of government to restructure banking sector. Main events are summarized in following enumeration.

- In 1990 MoF gave permission for banks to sell subordinated debts to raise their equity.
- In 1997 occurred the first bankruptcies, which was change from previously held course of Japanese government to prevent bankruptcies as much as possible.
- In 1998 there was established Financial Supervisory Agency (FSA), to take over supervision from MoF and to consolidate the segmented supervisory function that had previously been held by several bodies.
- During the last decade many mergers occurred within Japanese banking sector, to help to improve efficiency and low profitability of Japanese banks.
- The most persistent problem that had weighed on banking sector had been amount of non-performing loans, inherited from the era of high property prices used as collateral that eventually collapsed. Japanese banks during a decade experienced net losses almost every year from 1994 to 2004[115] (see chart).

Net Income/loss of Japanese banking sector between 1982 and 2004



Source: Bank of Japan

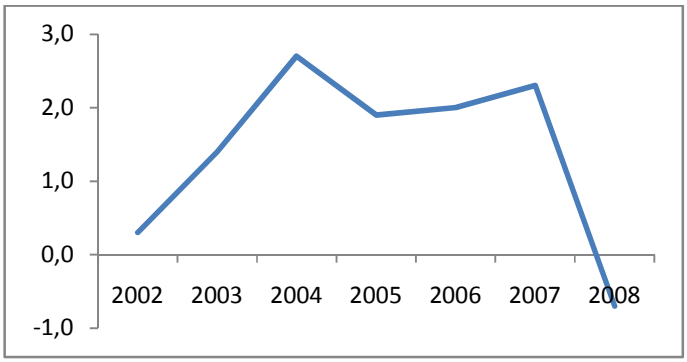
[115] Presented enumeration was collected on the basis of the literature that that had been cited throughout previous pages.

8.5. Nowadays

From the August 2005, Bank of Japan started publishing Financial Stability Reports on the regular semiannual basis. Nowadays it provides coverage of 12 major banks and 109 regional banks.

The higher fragility in the last years reflects ongoing financial crises throughout the world. Reports on banks performance in year 2008 by Bank of Japan were not optimistic: *"…downtrend of the major banks and the regional banks has become obvious, reflecting the deterioration in the domestic and global economic environments. Looking at net income for the first half of fiscal 2008, the major banks posted their second consecutive declines year-on-year. … The decline in profits became even more pronounced when the books were closed for the October-December quarter of 2008.*[116]

Real GDP growth



Source: Japan statistical office

Although BSFI index shows period of severe banking crisis during whole year 2002, this was not actually the case. This "puzzling" behavior of **BSFI** deserves explanation.

Closer look at the data used for construction of **BSFI** reveals that between October and December 2001 total bank deposits and banks' claims on private sector **decreased substantially and rapidly**, on month-to-month basis. After that, values of observed variables remained on new, decreased level without significant variability.

[116] Bank of Japan (2009), p. 2

In 2001 government announced that he will lose its guarantee on bank deposits to the date 1st of April 2002[117]. Thus in case of bankruptcy of financial institution people would not get back their deposits. This information led to immediate huge withdrawal of deposits from banks (captured by data), which put additional pressure on already stressed banking institutions. But banking crisis eventually did not take place. While stability of banking sector during these events was definitely endangered, crisis did not happen. Withdrawals did not reach such an extent that would force banks to bankruptcy. It showed that trust of people in growing strength of banking sector, combined with Bank of Japan's interventions on stock markets, was strong enough to prevent crisis.[118]

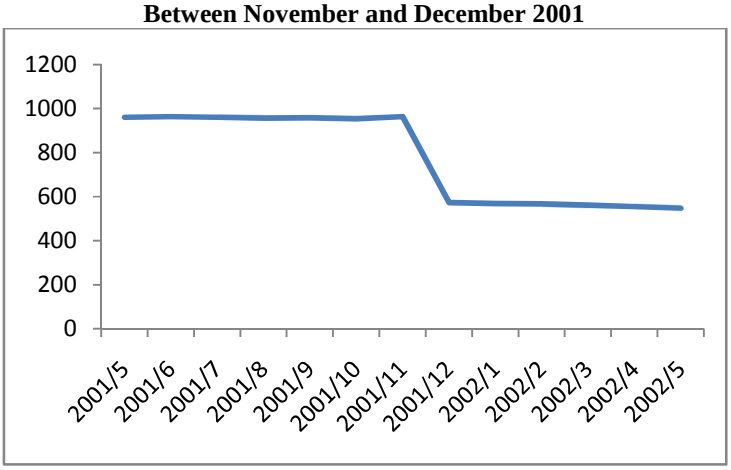
From the point of view of our **BSFI**, there are two important remarks.

- First, this proves that taking **BSFI** as only indicator of stability would not be sensible. It can interpret such abrupt negative changes in variables only as enormous increase in banking sector fragility and crisis. Variations in **BSFI** are caused by changes in the three variables that are used for its construction. Every other relevant information is exogenous. Observations about country specifics that could explain or add informational content to variations in **BSFI** are definitely needed.
- Second remark has technical character. **BSFI** is constructed using monthly data, but output value shows changes over 12 month period. Thus percentual change of one month was projected to whole year values of **BSFI**. This fact should always be in mind, when observing results of **BSFI**.

[117] In the one third of banks

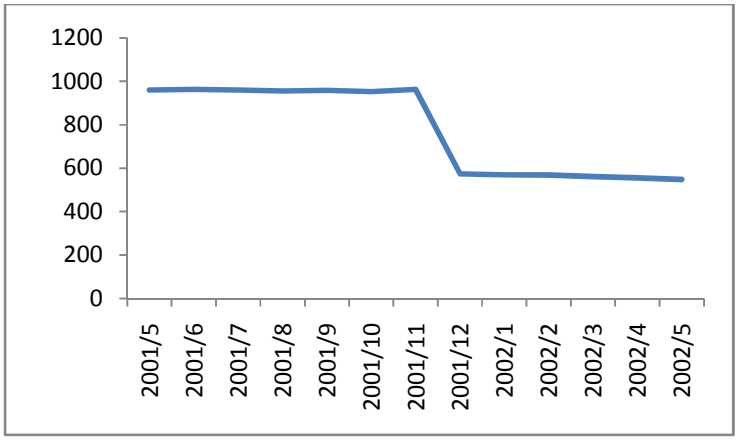
[118] Taking away protective governmental hand from banks was important (and inevitable) step for restructuralization and modernization of banking sector;

Change in Total deposits
Between November and December 2001



Source: IMF – International Financial Statistics

Change in Claims on Private Sectors
Between November and December 2001



Source: IMF – International Financial Statistics

9. Conclusion

During 1980s and 1990s, waves of financial and banking crises swept through large number of economies worldwide, which made authorities on both national and international levels turn increased attention to the question of surveillance and supervision of financial markets. Importance of financial-sector-stability assessment has become even more urgent during the last years, because volume of financial transactions worldwide has rapidly increased and financial networks have interconnected virtually whole modern world. In 1999 the two most renowned international financial institutions, International Monetary Fund and European Central Bank, launched long-term projects with objective to construct, collect and employ techniques for monitoring and assessing soundness of financial sectors on international level. Nowadays their FSIs and MPIs, developed for this purpose, are widely used worldwide.

In the first 4 chapters I mapped results of current state of research in this field. I approached the task from two perspectives. Firstly I focused on current results of IMF's and ECB's projects and their comparison. Although both projects had started with identical aspirations, their outcomes did not fully match. Main differences between them are in the number of indicators used and underlying methodology behind their construction. Secondly I divided currently employed techniques of financial soundness assessment into two general strands, so-called indicator-based approach and model-based approach, and dedicated individual chapters to both of these approaches separately.

In practical part of diploma thesis, beginning by chapter 5, I constructed Banking Sector Fragility Index (BSFI), using monthly data from International Financial Statistics database. BSFI is constructed as arithmetic average of three followed variables, representing exposure of aggregated banking sector to three main risks – credit risk, liquidity risk and exchange rate risk. Underlying motivation was to test if BSFI would be able to adequately approximate real evolution of banking sector fragility in given countries, and to rightly detect periods of banking sector crises. After comparing BSFI paths for Czech Republic, Estonia and Japan with actual real development in banking sectors of these countries, the answer seems to be "Yes". Although BSFI suffers from limitations with respect to both small number of observed variables and method of construction, it

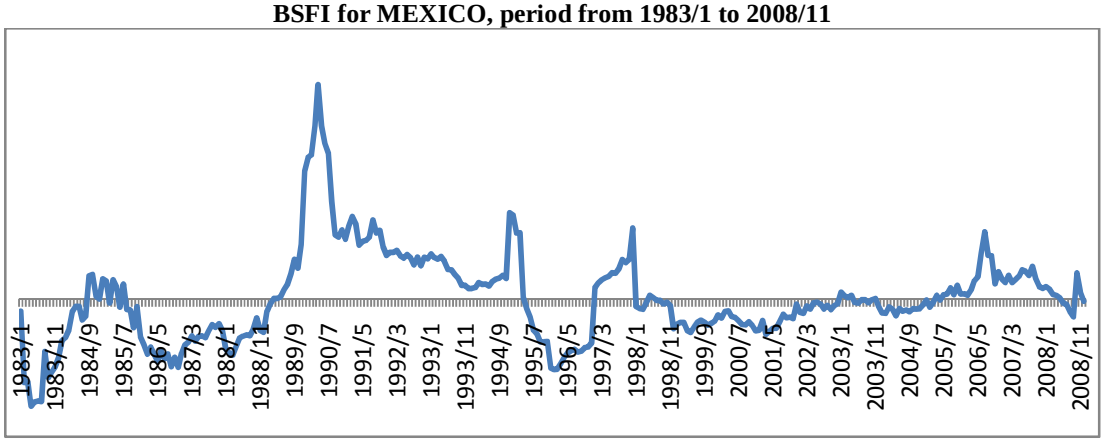
transpired that in all three countries BSFI's suggested evolution of banking sector fragility relatively well coincided with actual development. Still, BSFI was not able to detect changes of banking sector fragility that was caused by other sources, e.g. changes in legal and institutional settings, tightened capital-adequacy requirements, or structural changes caused by bankruptcies, mergers etc. Thus, BSFI cannot aspire to be the only tool for assessing banking sector fragility itself.

Second underlying motivation was to compare behavior of BSFI with respect to "the model of hypothetical banking crisis", introduced in subchapter 5.3. According to this proposition, crisis of banking sector should be connected to specific pattern of BSFI behavior, divided into 5 stages. In my view this proposition was in the diploma thesis reasonably justified. Pattern of interest was detected in all three countries.

The last three chapters dealt with experience of banking sectors of Czech Republic, Estonia and Japan, respectively. Czech Republic was chosen for obvious reasons. Estonia was chosen because it represents another example of transition country, but with different financial and institutional setting than that of Czech Republic. Japanese experience is in its turn classic example of banking sector crisis in developed country. BSFI in all three cases followed the pattern given in model of hypothetical banking crisis, which suggests its good general applicability.

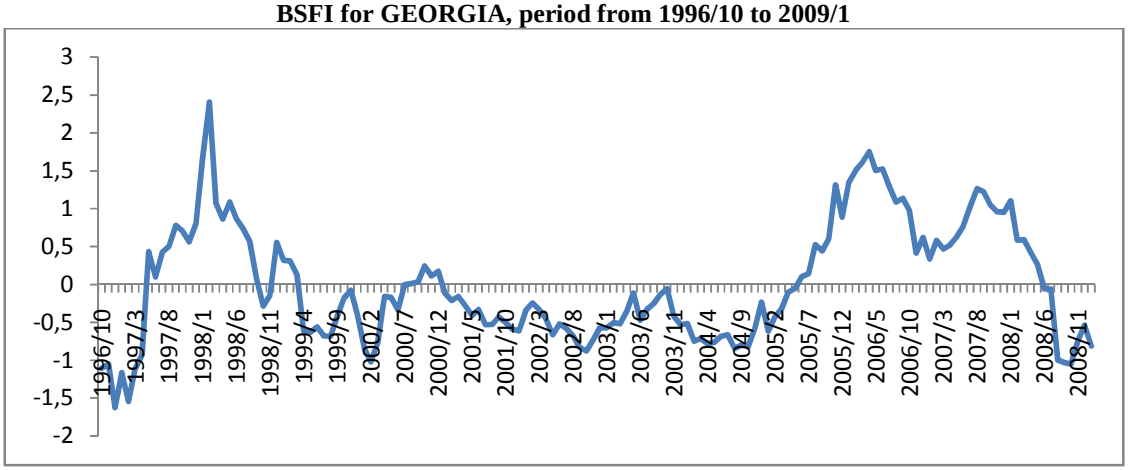
Appendix

BSFI for MEXICO, period from 1983/1 to 2008/11



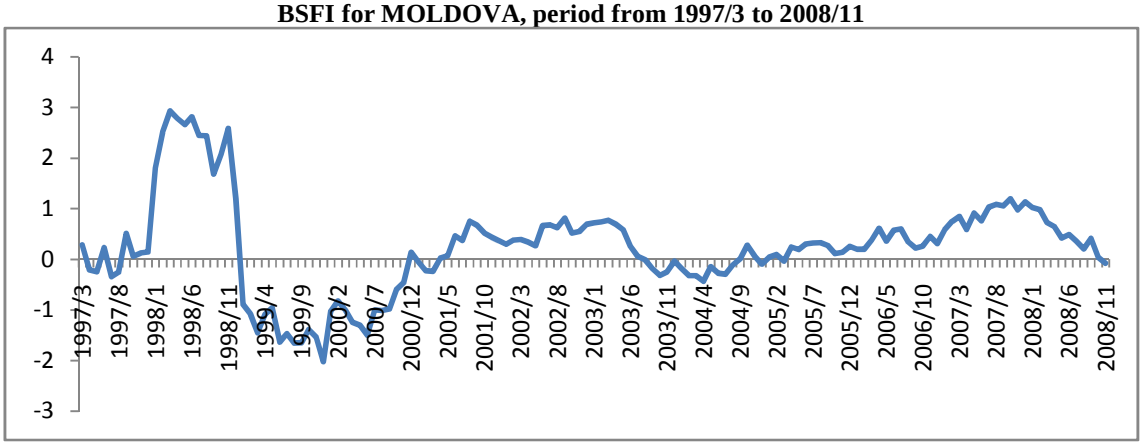
Source: own calculations

BSFI for GEORGIA, period from 1996/10 to 2009/1



Source: own calculations

BSFI for MOLDOVA, period from 1997/3 to 2008/11



Source: own calculations

Macro-prudential Indicators Regularly Monitored by ECB

I. INTERNAL FACTORS

1. Profitability, balance sheet quality and capital adequacy

Income – cost developments and profitability

Income composition

Net interest income per operating income
Income from securities (dividends) per total operating income
Net non-interest income per total operating income
Commissions (net) and fees per total operating income
Trading and forex results per total operating income
Other operating income per total operating income

Cost composition

Staff costs per total costs
Other administrative expenses per total costs
Other operating charges (excl. value adjustments and specific taxes) per total costs
Value adjustments and specific taxes per total costs

Efficiency

Operating cost (excl. value adjustments and specific taxes) per total operating income
Number of banks with cost-to-income ratio above 80%
Asset share of banks with cost-to-income ratio above 80%
Range of cost-to-income ratio

Profitability indicators

Profits II (after provisions, before tax and extraordinary items) per own funds (ROE II)
Profits II (after provisions, before tax and extraordinary items) per total assets (ROA II)
Profits III (after provisions, tax and extraordinary items) per own funds (ROE III)
Profits III (after provisions, tax and extraordinary items) per total assets (ROA III)
Distribution of ROE III: number of banks in each ROE category
Distribution of ROE III: share of assets of banks in each ROE category
Number of banks below ROE III of 5%
Share of banks below ROE III of 5% in total assets
Endowment effect as % of total profit before tax

Income and costs as percent of total assets

Net interest income per total assets
Interest receivable per total assets
Interest payable per total assets
Net non-interest income per total assets
Commissions and fees per total assets
Trading and forex results per total assets
Other operating income per total assets
Staff costs per total assets
Other administrative expenses per total assets
Other operating charges (excl. value adjustments and specific taxes) per total assets
Total operating expenses per total assets
Net value adjustments per total assets
Fund for general banking risks per total assets
Extraordinary profit or loss per total assets
Tax charges per total assets

Balance sheet

Coverage:

Total assets of the banking sector

Total assets of the reporting institutions per total assets of the banking sector

Asset composition

Cash and balances per total assets

Treasury bills per total assets

Loans and advances to credit institutions per total assets

Loans and advances to customers per total assets

Debt securities per total assets

Shares and participating interests per total assets

Liability composition

Amounts owed to credit institutions per total assets

Amounts owed to customers (deposits) per total assets

Debts evidenced by certificates per total assets

Funds for general banking risks per total assets

Provisions (stock) per total assets

Subordinated liabilities per total assets

Equity capital per total assets

Off-balance sheet items

Contingent liabilities

Commitments

Derivatives (market values)

Capital adequacy

Total capital ratio

Tier 1 capital ratio

Own funds requirement under CAD (trading book)

Risk-weighted balance sheet items

Risk-weighted off-balance sheet items

Number of banks with risk based capital ratio below 9%

Share of banks with risk based capital ratio below 9% in total assets

Distribution of risk-based capital ratio: number of banks in each category

Distribution of risk-based capital ratio: share of risk weighted assets of banks in each category

Distribution of tier 1 ratio: number of banks in each category

Asset quality

Total non-performing and doubtful loans (net of provisions) per total loans and advances

Total non-performing and doubtful loans (net of provisions) per total own funds

Range of non-performing and doubtful loans (net of provisions) per capital

Range of non-performing and doubtful loans (net of provisions) per total loans and advances

Provisioning (stock) per total non performing and doubtful loans

Flow of provisions

Net value adjustments and fund for general banking risks (provisioning) per own funds

Net value adjustments and fund for general banking risks (provisioning) per total operating income

Net value adjustments and fund for general banking risks (provisioning) per loans and advances

2. Demand and supply (competitive) conditions

Interest receivable per total loans and advances, treasury bills and debt securities

Interest payable per amounts owed to credit institutions, customers (deposits), debts evidenced by certificate and subordinated liabilities

Average margin on new lending

Average margin on new lending to households

Average margin on new lending to non-bank corporations

Average margin on retail deposits

Overall margin

3. Risk concentrations

Credit growth and sectoral concentration

Aggregate lending

Total lending

Loans to residents

Loans to other MUMs

Loans to the rest of the world

Aggregate new lending

Total lending

Loans to residents

Loans to other MUMs

Loans to the rest of the world

Lending to non-MFI private sectors

Total lending

Loans to residents

Loans to other MUMs

Loans to the rest of the world

Lending to households

Lending to non-bank non-financial corporations

Lending to non-bank financial corporations

Residential mortgage lending to households

Commercial mortgage lending

Industry exposures

Exposure to construction

Exposure to real estate

Exposure to TMT

Exposure to Tourism

Exposure to Energy

Exposure to Airline

Exposure to Insurance

Composition of other assets

Aggregate fixed income securities holdings

Total

Issued by residents

Issued by other MUMs

Issued by rest of the world

Aggregate equity holdings

Total

Issued by residents

Issued by other MUMs

Issued by rest of the world

Aggregate balance sheet

Total

Claims on residents

Claims on other MUMs

Claims on rest of the world

Currency and maturity structure of domestic lending

Share of less than one year lending to non-MFIs

Share of lending in foreign currency

Global credit exposures

Aggregate lending to non-bank customers

Aggregate securities holdings

Aggregate balance sheet total

Aggregate credit equivalent of off-balance sheet items

Liquidity risk
Ratio of non-bank deposits to M2
Ratio of total loans to non-bank deposits
Share of foreign short-term liabilities
Spread between the unsecured deposit rate and EONIA swap rate
Spread between the unsecured deposit rate and secured repo rate
Ratio of liquid assets to total assets

Exposures of EU15 to new EU member countries
Aggregate gross credit exposure to central and eastern Europe

Exposures towards emerging and developing countries
Aggregate total gross credit exposure
Aggregate gross credit exposure to Asian countries
Aggregate gross credit exposure to Latin American countries

Market risk exposures
Value-at-risk (VaR)
Interest rate VaR
Equity VaR
Ratio of VaR to Tier I

4. Market assessment of risks

All bank share price index vs. all share price index
Average yield spread between bank bonds and government bonds
Average yield spread between interbank CDs and treasury bills
Range of spreads between bank bonds and government bonds
Number of bank rating downgrades within the observation period
Distance to default of major EU banks
Credit default swap spreads
Range of interbank and CD rates

II. EXTERNAL FACTORS

5. Financial fragility

Aggregate total debt to equity ratio in the (non-bank) corporate sector
Ratio of household total debt to household financial (and real) assets
Household savings ratio
Ratio of corporate debt servicing payments to corporate net earnings
Ratio of private households' debt servicing costs to disposable income
Number of arrears
Number of bankruptcies

Median expected default frequencies (EDFs) for key industries
Basic goods and construction (BaC)
Consumer cyclicals (Ccy)
Consumer non-cyclicals (CNC)
Capital goods (Cap)
Financial (Fin)
Technology and telecommunications (TMT)
Energy and utilities (EnU)
Residual category (Oth)

6. Asset price developments

General stock index
Euro STOXX index
US stock index
Commercial real estate prices
Residential real estate prices

7. Cyclical and monetary conditions

Rate of real GDP growth
Rate of nominal GDP growth
Rate of growth in real aggregate investment
Rate of growth in real private consumption
Rate of growth of unemployment rate
Rate of change in M2
Rate of change in the money market interest rate (3 month)
Rate of change of long-term real interest rate (10 yr. govt. bond)
Rate of change in the exchange rates (EUR, DKK, GBP, GRD and SEK)
Rate of change in the consumer price index

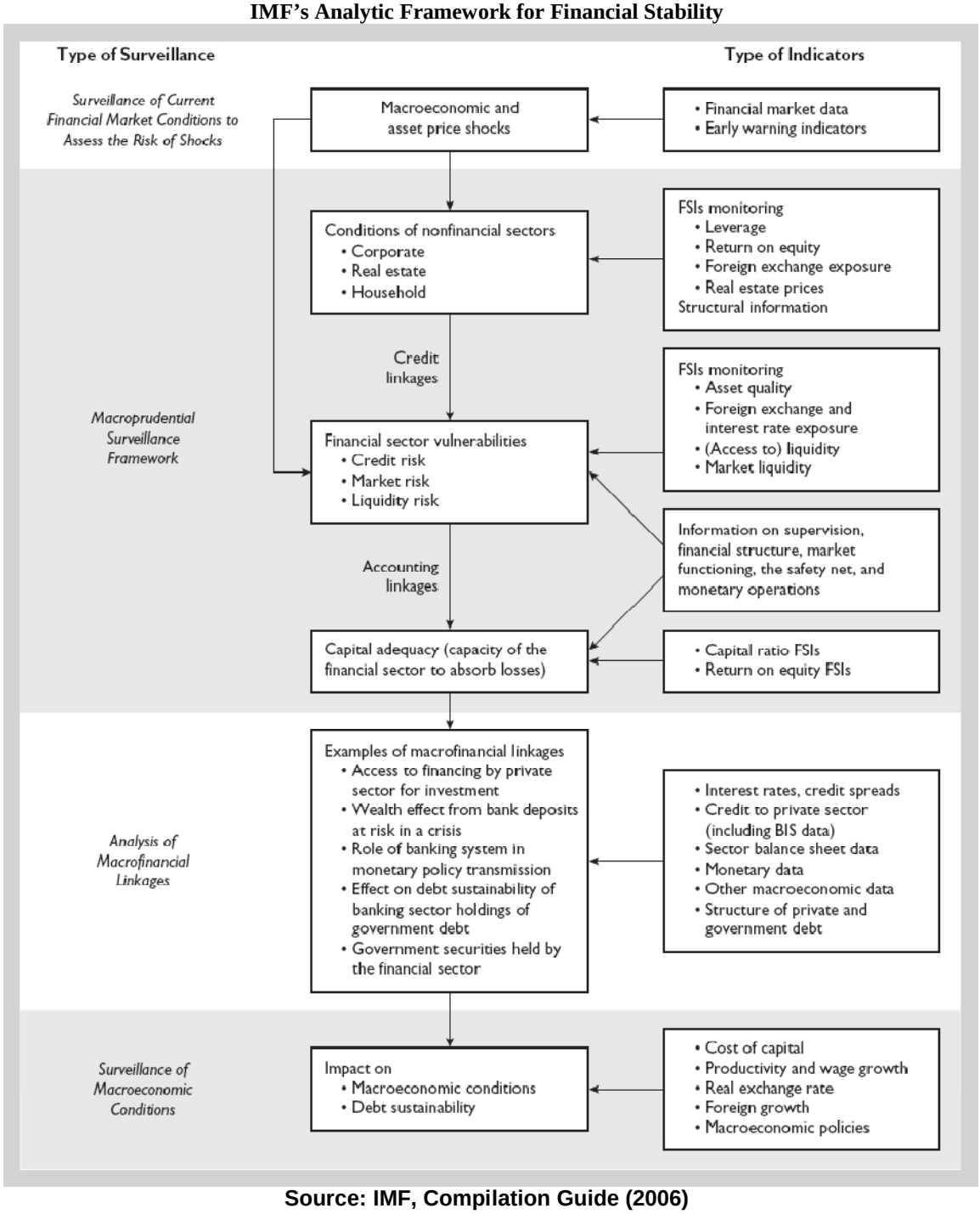
III. CONTAGION FACTORS

8. Interbank markets

Share of interbank liabilities in total liabilities
Share of assets of the three banks with largest exposures (separately for each counterparty country) vis-à-vis total banking sector assets
Share of assets of the five banks with largest exposures (separately for each counterparty country) vis-à-vis total banking sector assets

Source: ECB; occasional paper No. 26 (2005)

IMF's Analytic Framework for Financial Stability



Source: IMF, Compilation Guide (2006)

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Initial Project of Diploma Thesis

Term of master examination:	**September 2009**
Author:	**Bc. Svatopluk Svoboda**
Supervisor of diploma thesis:	**PhDr. Adam Geršl PhD.**
Preliminary title:	**Fragile banking sector and transmission channels of monetary policy**

Characteristics of the theme

In my diploma thesis I would like to analyze how fragility of the banking sector influences applicability of monetary policy. Firstly I will give an overview of existing theories about transmission mechanisms of monetary policy. Until now, there has been a growing amount of literature, including empirical works, related to these channels.

Majority of transmission channels works through the banking system. To these I will pay closer attention in my thesis. The more recent literature is directed to examining the impact of the so-called *balance-sheet* and *bank-lending channels.*

It is obvious that soundness of banking sector is an important prerequisite for monetary authorities to be able to predict results of monetary actions. There are many ways how to assess degree of soundness of banking sectors. One example is so-called *fragility index,* which I will try to construct for the banking sector of Czech Republic. I will present an overview of existing theories and finally focus on one method of construction, using the multivariate logit approach.

Recent global financial crisis again turned increased attention to the issue of how monetary policy influence the economy if banks are in stressed conditions. How does the degree of banking sector fragility influence the possibilities of monetary authorities to influence the real economy? I will attempt to answer this question, using (a) anecdotic evidence from the recent as well as past crises, (b) logical arguments based on existing literature and theories, and (c) formal empirical analysis, which is however subject to reasonable availability of suitable data.

Basic outline:

1. Introduction

2. Transmission mechanisms of monetary policy - Theory

- **2.1.** Traditional approach to transmission channels
- **2.2.** Modern specifications of transmission channels

3. Banking sector

- **3.1.** Role of banking sector in transmission mechanisms of monetary policy

4. Fragility of banking system

- **4.1.** Theory, fragility index, methods of measurement
- **4.2.** Fragility index of the banking sector – Czech Republic

5. Influence of banking sector fragility on applicability of monetary policy

- **5.1.** Methods of measurement, general theory
- **5.2.** Review of past studies
- **5.3.** Empirical analysis

6. Conclusion

Key words: Transmission channels of monetary policy, fragility index, multivariate logit approach

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I agree with the above diploma thesis project/proposal and I am ready to supervise the thesis.

S výše uvedenými tezemi souhlasím a jsem ochoten diplomovou práci vést.

Prague/Praha, 11 November 2008

Adam Geršl