Quantification of Central Bank Supervisory Power

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Abstract
Financial crisis which started in 2007/2008 again raised the question about the central bank function in financial sector supervision. Giving the financial sector's supervisory function to a central bank offers advantages and disadvantages. To quantify and to better understand the central bank involvement in different countries, Financial Supervision Herfindahl Hirschman (FSHH) Index has been created. The aim is to measure the supervisory power concentration in some country, as well as the Central Bank Share in Supervision (CBSS) Index. This paper presents enhanced FSHH index (eFSHH), which includes shares of three main parts of the financial system: banking, insurance and securities in their total. On a sample that was used to describe FSHH index, differences between FSHH and eFSHH are explained and new CBSS is calculated. If one part of the financial system has bigger share of the entire financial system then supervisory agency of this part will have higher index using eFSHH comparing to FSHH. Consequently, CBSS results will display higher values if that agency is the central bank of a country.

Keywords: central bank, supervision, quantification, financial system
JEL codes: E58, G18, G21, G22, G23

1. Introduction

Today supervisors and policymakers around the world are carefully reconsidering the structure and agencies involved in financial sector supervision, because many experts (Cecchetti, 2008; Buiter 2009; Leijonhufvud 2009; Claessens et al., 2010; Merlin, 2012; Masciandaro et al. 2012) pointed out supervisory architecture as one of the financial crisis cause. In most countries, an important role in the governance of the financial system has traditionally been performed by the central bank (Di Noia and Di Giorgio, 1999). Because of theoretical and historical reasons, the central bank is primus inter pares among financial authorities (Masciandaro, 2007).

But international experience varies considerably. In some countries, the central bank is responsible for the supervision of banks and only banks. In others, it is responsible for banking and insurance and/or securities trading, known as hybrid model of supervision (banking and insurance or banking and securities) or integrated model with central bank involved in supervision (central bank supervises all three financial sectors: banking, insurance, securities) (Oreški and Pavković, 2014). In some countries, which adopted the Twin Peaks model, the central bank has been made the prudential peak, but in other countries with Twin Peaks model it is not involved in financial supervision. In many countries with hybrid, integrated or sectoral model, on the other hand, responsibility for prudential supervision of all financial institutions (including banks) has been withdrawn from the central bank (Llewellyn, 2006).

The development of economic ideas, the changing state of the world, and experience – at times favorable, but for a significant portion of the period under review, unfavorable – have combined to change the environment in which central banks operate (Cagliarini et al., 2010). That is why supervisory architectures are under serious revision today, especially in economies faced with financial crisis (Oreški and Pavković, 2014).

The aim of this paper is to revise and enhance the measure of the supervisory power concentration in financial sector, Financial Supervision Herfindahl Hirshman index developed by Masciandaro et al. (2012), to get more accurate measure of supervisory power concentration. This is

done by the development of the enhanced Financial Supervision Herfindahl Hirschman (eFSHH) Index which measures the supervisory power concentration in financial sector, as one of the factors that influence financial supervision efficiency, and is necessary to calculate the central bank involvement, using Central Bank Share in Supervision (CBSS) Index, in that process. The eFSHH and newly calculated CBSS index more accurately express the true position of the financial supervisors in some country and represent more adequate input for the establishment of the optimal supervisory model in some country.

The paper is organized as follows. Section 2 reviews the relevant literature through its main phases: summarizing the main advantages and disadvantages of assigning the supervisory task to the central bank, explaining the Financial Supervision Unification Index (FSU) and Central Bank as Financial Authority Index (CBSE), and introducing the need for further measure development. Section 3 introduces enhanced Financial Supervision Herfindahl Hirschman (FSHH) index. In Section 4, differences between standard FSHH index and enhanced FSHH index are explained. Section 5 concludes the paper and gives some guidelines for future work.

2. Literature

Since the main task of the central bank is to maintain price stability, the assignment of other "optional tasks", such as supervision has been subject to debate amongst academics and policymakers for several years (Ioannidou, 2005). That is why the first phase in trying to determine the optimal supervisory architecture was discussing advantages and disadvantages in giving the financial sector supervision to a central bank. The major disadvantage of assigning to central banks the joint responsibility for the two functions is the "conflict of interest" argument. A general problem of inconsistent policy assignment can emerge, given that with just one policy instrument there are two objectives to control (Di Noia and Di Giorgio, 1999). There have been a number of instances when it is believed that interest rates were held down, in some large part because of concern with the health of (parts of) the financial system, when purely monetary considerations might have led to higher rates (Goodhart and Schoenmaker, 1995). Di Giorgio and Di Noia concluded that the value of the inflation variation coefficient is higher (13%) in countries where the central bank is in charge of bank supervision, which suggests that these central banks face more problems in lowering inflation trough time. The second objection may be viewed as concentrating excessive power in the hands of an unelected central bank whose accountability may be weak (Llewellyn, 2006). Furthermore, if the credibility of the central bank as a prudential supervisor is undermined, this could also negatively affect its credibility in the area of monetary policy (Goodhart, 2002).

On the other hand, the main argument for combining the functions of monetary and supervisory management within the central bank is the central bank's concern for the systemic stability of the financial system (Goodhart and Schoenmaker, 1995). Combination is particularly needed in times of financial crisis when only direct supervision can deliver the essential information on time (Haubrich, 1996). The central bank will be able to acquire valuable insights into the overall state of the economy by being involved in the supervision and regulation of financial institutions (Di Noia and Di Giorgio, 1999). Another fundamental macro argument supporting a unified agency is the protection of the payment system, a key channel for the potential spread of contagion risk (Di Noia and Di Giorgio, 1999). Furthermore, proponents of that idea think that the central bank can significantly contribute to this function because of its knowledge and expertise. The very important argument is the fact that if the central bank is not responsible for prudential supervision, this means certain duplication of efforts and gathering of information between central bank and supervisory agency (Oreški and Pavković, 2015).

Before the crisis, the argument for assigning prudential supervision to an agency separate from the central bank had been gaining adherents (Dincer and Eichengreen, 2012). But, the outbreak of the great financial crisis of 2007-2009 seems to have challenged all the designs of the supervisory settings, whether they are unified or not (Masciandaro and Quintyn, 2009). Moreover, the financial crisis has shaken not only financial institutions, but also long-held beliefs and theories on how the regulation of finance should be structured (Caprio et al., 2010). Recent events have shown the importance of anticipating and defusing threats to financial stability before they can inflict damage on the financial system and the economy. In particular, the crisis illustrated some important benefits of involving

central banks in financial supervision (Bernarke, 2011). The "integration view" seems to be the new consensus in Europe (Masciandaro and Nieto, 2014). But every model has pros and cons that is why experts are no longer trying to determine all the advantages and disadvantages of some model, but are trying to track the central bank involvement in supervision in measureable way.

The literature tried to go in depth in the analysis of the supervisory reforms measuring the degree of consolidation in the actual supervisory regimes, as well as the central bank involvement in supervision itself (Masciandaro 2004, 2006, 2007 and 2008; Masciandaro and Quintyn, 2009). The first quantified measure was the financial supervision unification index (FSU) (Masciandaro, 2004). This index was created through an analysis of which, and how many, authorities in each of the examined countries are empowered to supervise the three traditional sectors of financial activity: banking, securities markets and insurance. To transform the qualitative information into quantitative indicators, a numerical value has been given to each regime, to highlight the number of the agencies involved. The index was built on the following scale:

Table 1: Description of the Financial Supervision Unification Index (FSU)

FSU Value	Description
7	Single authority for all three sectors (total number of supervisors=1)
5	Single authority for the banking sector and securities markets (total number of supervisors=2)
3	Single authority for the insurance sector and the securities markets, or for the insurance sector and the banking sector (total number of supervisors=2)
1	Specialized authority for each sector (total number of supervisors=3)

Source: Mascinadaro (2004)

To better highlight the role which central bank plays in the various national supervisory regimes the Central Bank as Financial Authority Index (CBFA) is created (Masciandaro, 2004). For each country, and given the three traditional financial sectors (banking, securities and insurance), the CBFA index is equal to:

Table 2: Description of the Central Bank as Financial Authority Index (CBFA)

CBFA Value	Description
1	the central bank is not assigned the main responsibility for banking supervision
2	the central bank has the main (or sole) responsibility for banking supervision
3	the central bank has responsibility in any two sectors
4	the central bank has responsibility in all three sectors

Source: Masciandaro (2004)

But shortcomings of these two indices were subjective weights. To overcome the shortcoming, there was a need for a new measure. Masciandaro and Quintyn (2009) proposed the Financial Supervision Herfindahl Hirschman (FSHH) Index and the Central Bank Share in Supervision (CBSS) Index.

In accordance with the above, the objective of this study is to measure properly the supervisory power concentration in some country and the central bank involvement in supervision process. This will be done through revision and enhancement of the Financial Supervision Herfindahl Hirschman (FSHH) Index which is necessary to calculate Central Bank Share in Supervision (CBSS) Index.

3. Methodology

Masciandaro and Quintyn (2009) proposed the Financial Supervision Herfindahl Hirschman (FSHH) Index to measure the level of consolidation of the supervisory powers in some country. To be able to calculate the index, both geographical (in each country) and institutional dimension (different sectors) of each supervisory market must be possible to define. Financial market classification given in literature on banking, securities and insurance activities is adopted with the assumption that all three

sectors are equally important, and ratios are equal in every country. Secondly, between different kinds of supervisory activity (banking supervision, securities market supervision, and insurance supervision) there is perfect substitutability. Therefore, it is possible to sum the share of the supervisory power for each authority in every country.

FSHH index is calculated by summing up the squares of the supervisory shares of all the supervisors of a country. For each country the FSSH index is equal to:

$$H = \sum_{i=1}^{n} s_i^{\,2} \tag{1}$$

Where s_i is the share of supervisory power of the authority i and n is the total number of authorities. For each authority i, and given that in each country there are more sectors to supervise (three sectors in this paper: banking, securities and insurance) the following formula is used to calculate the shares:

$$s_i = \sum_{J=1}^{m} s_j \tag{2}$$

$$s_j = \frac{1}{\mathrm{m}} \frac{1}{\mathrm{q_j}} \tag{3}$$

Where m is the number of sectors for supervision (constant because there are three sectors), and q is the number of authorities involved in supervision in every sector. In other words, if in one sector there is more than one authority, the supervisory power is equally divided among the incumbent supervisors.

However, even though FSHH index developed this way overcomes the subjectivity of the Financial supervision unification index (FSU), it fails to take into account the relevance of each of the three financial sectors because it presumes that all three sectors are equally relevant (m=3) in every country.

Table 3 shows that sector relevance is not equal in every country, nor it is equal for all three financial sectors. It presents sector relevance in several countries, using as a criteria private credit by deposit money banks to GDP, ratio of total assets of insurance companies to GDP and securities market (securities market traded value) in GDP of every country.

Table 3: Financial Sector Share in Selected Countries in 2011

Country	Denmark		Italy		Bosnia		USA	
	%GDP	Share	%GDP	Share	%GDP	Share	%GDP	Share
Securities	45	13%	33	18%	0.4	0.5%	205	68%
Banks	208[1]	60%	122	64%	55	93%	52	17%
Insurance	92	27%	34	18%	4	6.5%	45	15%
Total	345	100%	189	100%	59.4	100%	302	100%

Note: [1] data refers to 2008

Source: World bank data (2015)

Our preferred financial intermediary development measure is private credit. This measure equals banking institution credits to the private sector as a percent of GDP (Boyd et al. 2000). It is preferred indicator because it improves on other measures of financial development used in the literature (Levine et al., 1999). Second measure, ratio of total assets of insurance companies to GDP, is used to capture the size of both the life and non-life sectors (Feyen et al., 2011). The ratio of stock market total value traded to GDP measures the trading volume of the stock market as a share of national output and should reflect the degree of liquidity that stock markets provide to the economy. Total value traded equals the value of total shares traded on the stock market exchange (Beck et al., 2000). This measure is included because the ratio of stock market capitalization to GDP does not indicate liquidity of the stock market which is relevant for FSHH index.

To overcome the before mentioned weakness, the usage of enhanced Financial Supervision Herfindahl Hirschman (eFSHH) Index which uses ponder of relative importance of every sector (banking, insurance and securities market) (w_r) in the total of three main sectors, is proposed. Formulas are given below:

$$H = \sum_{i=1}^{n} s_i^{\,2} \tag{4}$$

$$s_i = \sum_{J=1}^{m} s_j \tag{5}$$

$$s_j = w_r * \frac{1}{q_j} \tag{6}$$

The relative importance of every sector is used to calculate the relative importance of the authority in the each of the three sectors. That way, comparing to standard FSHH index, greater attention is given to the real size of each sector in a country, and consequently the relative importance of the authority is more accurately determined. Subsequently, the sum of the relative importance of the authority in all three sectors is reckoned to calculate the eFSHH index.

This index is necessary to calculate Central Bank Share in Supervision (CBSS) Index which was created to measure central bank involvement in supervision. Central bank involvement will reach maximum when central bank is unified supervisor, while central bank involvement will be smaller when central bank is in charge of supervision of a smaller number of sectors. This index ranges from 0 to 1.

4. Results

To better explain the differences between FSHH and eFSHH, the same countries, used in Masiandaro and Quintyn (2009) to describe FSHH, are used. The only different country is Denmark because United Kingdom no longer uses integrated supervisory approach. It adopted twin peaks model in 2014. That is why Denmark is used as an example country with an integrated supervisor (which is not the central bank). Italy is chosen as a bank-based financial system which adopts hybrid model with central bank involved in supervision. To point out the differences, United States is shown as an example of a country with market-based financial system which adopts the hybrid supervisory model with central bank involved in supervision, while Bosnia and Herzegovina represents a country with lower financial system development. Calculation for Denmark is as follows:

eFSHH			**FSHH**		
S_{bank}	= 0.60 * 1/1	= 0.60	S_{bank}	= 0.33 * 1/1	= 0.33
$S_{insurance}$	= 0.27 * 1/1	= 0.27	$S_{insurance}$	= 0.33 * 1/1	= 0.33
$S_{securities}$	= 0.13 * 1/1	= 0.13	$S_{securities}$	= 0.33 * 1/1	= 0.33
s_i	= 0.60 + 0.27 + 0.13 = 1		s_i	= 0.33 + 0.33 + 0.3 = 1	
H	= 1^2=1		H	= 1^2=1	

Because of the fact that one authority supervises all three sectors, no matter what share a sector has in the total of all three sectors, Herfindahl Hirschman index will generate maximum concentration, i.e. 1. Also, Central Bank Share in Supervision (CBSS) Index will be zero because Denmark accepted integrated model of supervision without central bank involvement in that process.

In the case of Italy, we have three authorities – the Central Bank, the Securities Authority and the Insurance Authority – and two of them – the Central Bank and the Securities Authority– share supervision over two sectors (Banking market and Securities market). Therefore the three shares are respectively:

eFSHH			**FSHH**		
S_{bankCB}	= 0.64 * 1/2	= 0.32	S_{bankCB}	= 0.33 * 1/2	= 0.165
S_{bankSA}	= 0.64 * 1/2	= 0.32	S_{bankSA}	= 0.33 * 1/2	= 0.165
$S_{insurance}$	= 0.18 * 1/1	= 0.18	$S_{insurance}$	= 0.33 * 1/1	= 0.33
$S_{securitiesCB}$	= 0.18 * 1/2	= 0.09	$S_{securitiesCB}$	= 0.33 * 1/2	= 0.165
$S_{securitiesSA}$	= 0.18 * 1/2	= 0.09	$S_{securitiesSA}$	= 0.33 * 1/2	= 0.165
CBSS	$= S_{bankCB} + S_{securitiesCB}$	= 0.41	CBSS	$= S_{bankCB} + S_{securitiesCB}$	= 0.33
S_{SA}	$= S_{bankSA} + S_{securitiesSA}$	= 0.41	S_{SA}	$= S_{bankSA} + S_{securitiesSA}$	= 0.33
S_I	= 0.18		S_I	= 0.33	
H	$= CBSS^2+S_{SA}^2+S_I^2$	= 0.37	H	$= CBSS^2+S_{SA}^2+S_I^2$	= 0.3

Italy shows higher concentration degree using eFSHH comparing to FSHH (0.37 vs 0.3) because higher banking relevance in comparison to other two financial sectors in the total financial system is taken into account. Since CBSS index in Italy is composed from central bank supervision of banking and securities, it is higher comparing to the usage of standard FSHH Index (0.41 vs 0.33).

In the case of Bosnia, there are five authorities, where three of them share supervision over the banking sector. Therefore the five shares are respectively:

eFSHH				**FSHH**		
$S_{bankCB=CBSS}$	= 0.93* 1/3	= 0.31		$S_{bankCB=CBSS}$	=0.33* 1/3	= 0.11
S_{bankB1}	= 0.93* 1/3	= 0.31		S_{bankB1}	=0.33* 1/3	= 0.11
S_{bankB2}	= 0.93* 1/3	= 0.31		S_{bankB2}	=0.33* 1/3	= 0.11
$S_{insurance}$	= 0.065* 1/1	=0.065		$S_{insurance}$	=0.33* 1/1	= 0.11
$S_{securities}$	= 0.005* 1/1	= 0.065		$S_{securities}$	=0.33* 1/1	= 0.11
H	= $S_{CB}^2+S_{B1}^2+S_{B2}^{2+}S_S^2+S_I^2$		=0.29	H	$= S_{CB}^2+S_{B1}^2+S_{B2}^{2+}S_S^2+S_I^2$	=0.25

Bosnia has higher degree of concentration calculated with eFSHH comparing to calculation using FSHH because of highly bank-based system which represents more than 90% of the three main financial sectors. FSHH shows that central bank and two bank supervisors have smaller relevance than insurance or securities supervisor, but using eFSHH this ratio is radically changed. Using this index the three agencies supervising banks are five and six times (each) more relevant than the insurance and securities supervisors.

Finally, in the case of the United States, we count four federal authorities – FED, FDIC, OCC and OTS – in the banking sector, two federal authorities – SEC and CRTC - in the securities markets, one federal authority in the insurance sector. Furthermore we have to consider that for each of the three sectors we have also a state level of control (that we consider for each sector as one more authority). Therefore the shares are:

eFSHH			**FSHH**		
$S_{B1,2,3,4,CBSS}$	= 0.17* 1/5	= 0.034	$S_{B1,2,3,4,CBSS}$	=0.33*1/5	= 0.066
$S_{S1,2,3}$	=0.68* 1/3	= 0.23	$S_{S1,2,3}$	=0.33* 1/3	= 0.11
$S_{I1,2}$	=0.15* 1/2	= 0.075	$S_{I1,2}$	=0.33*1/2	= 0.165
$H=CBSS^2+S_{B1}^2+S_{B2}^2+S_{B3}^2+S_{B4}^2+S_{S1}^2+S_{S2}^2+S_{S3}^2+S_{I1}^2+S_{I2}^2=0.17$			H=0.11		

Higher degree of supervisory concentration using eFSHH and FSHH is also visible in US because of market-based financial system. Securities sector forms almost two thirds of the total of the three main financial sectors. Because of that, securities supervisors have more power, and banking supervisors less comparing to standard FSHH index. In addition to this, CBSS is smaller using eFSHH than using FSHH (0.034 vs 0.066).

The summary of the results is given in the Table 4.

Table 4: Comparison of the FSHH and eFSHH results

Country	FSHH	eFSHH
Denmark	1	1
Italy	0.3	0.37
Bosnia	0.25	0.29
United States	0.11	0.17

Source: authors' calculations

The Table 4 presents the differences in calculating the Financial Supervision Herfindahl Hirschman index using the assumption that all three sectors are equally important and using the weighted sector size. In calculating the eFSHH index, bigger attention to individual sector size is given by including the weight instead of simple constant m=3. If, for example in extreme case -planned economy, securities market do not exist, like it is the case in many world countries today, then the agency responsible for that sector supervision will not get equal importance as the agency which supervises highly developed banks, instead, its significance will be minimal i.e. it will be zero, in comparison to standard FSHH index where it would be one third. If there is only one supervisor, the calculation of enhanced FSHH index will give the same result as the standard FSHH index, its maximum value 1, as shown in Table 3 (Denmark). However, if there are multiple supervisors, result value will change if three sectors do not have the same importance (what is most probable in real life). If one agency supervises bigger share of entire financial system, the result will be higher using enhanced comparing to standard FSHH index, as shown in Table 3 (Italy, Bosnia, the United States).

Significantly disparate results of the Financial Supervision Herfindahl Hirschman index and Central Bank Share in Supervision index can shed new light in answering how countries choose their model of supervision. Literature offers many factors that influence the choice of the supervisory model in a country. To be able to determine the statistical correlation of these factors and eFSHH and CBSS index, first necessary step is to calculate CBSS and eFSHH index on a bigger sample of countries.

5. Conclusion

As learned from the global financial crisis, price and general macroeconomic stability are not a guarantee of financial stability. It is apparent that the central bank role in the economy has changed over the years. One of the central bank secondly functions is financial sector supervision. Some countries embraced the model of supervision with central bank involved in the supervision of the financial sector, but for others disadvantages are bigger than the advantages of such model. Today, many countries are carefully reexamining their decisions about appropriate supervisory model in order to prevent similar future crisis.

To better understand countries decision and to facilitate their decision making regarding this problem, CBSS and newly presented enhanced Financial Supervision Herfindahl Hirschman index were created. The purpose of this paper was to present eFSHH index, which quantifies supervisory concentration power in some country same as FSHH index, which was developed by Mascinadaro et al. (2012), but it also takes into account country specificity of financial sector organization. That way, agencies responsible for the supervision of bigger parts of the financial sector are gaining more relevance and the index shows different concentration power of an agency comparing to FSHH calculation results. Using the eFSHH index, Central Bank Share in Supervision (CBSS) index shows more accurately the position of the central bank in that process and represents more adequate input for the establishment of optimal supervisory model in some country. The next step forward in this process will be to calculate the CBSS index using eFSHH on a bigger sample of countries and to potentially determine supervisory trends regarding central bank involvement in financial supervision.

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