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SYSTEMIC RISK ANALYSIS OF TURKISH FINANCIAL INSTITUTIONS WITH SYSTEMIC EXPECTED SHORTFALL

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ABSTRACT This study utilizes Turkish financial institutions stock market returns and balance sheet data through 2000–2001 banking sector crisis and 2007–2009 global financial crisis in order to investigate applicability of systemic expected shortfall (SES) measure introduced by Acharya et al. (2010). SES is assumed to measure contribution of each institution to systems total risk in case of a financial distress. Our regression results indicate that SES model, which includes both marginal expected shortfall and leverage ratios of institutions calculated prior to the crisis period, explains financial sector losses observed crisis periods better than generally accepted risk measures like expected shortfall, stock market beta and annualized stock return volatility estimated with the same data set. Empirical results have proved that SES is a powerful alternative in tracking potential riskiness of the financial stocks.
JEL C21, C58, G01
Keywords Systemic expected shortfall, Marginal expected shortfall, Systemic risk

ÖZ Bu çalışmada, Türk finansal kurumlarının 2000 – 2001 bankacılık krizi ve 2007–2009 küresel finansal kriz dönemine ait hisse senedi getirileri ve bilanço verileri kullanılarak, Acharya ve diğerlerine (2010) ait sistemik beklenen kayıp (SES) ölçüm metodunun Türkiye için uygulanabilirliği araştırılmıştır. SES, finansal sistemin genelini etkileyen stres dönemlerinde her bir finansal kurumun sistemin bütün olarak taşıdığı riske olan katkısının hesaplanmasında kullanılmaktadır. Regresyon analizi ile kriz öncesi veriler kullanılarak hesaplanan marjinal beklenen kayıp ve kaldıraç oranlarını içeren SES modeli, kriz döneminde gözlenen finansal sektör kayıplarını açıklamada aynı veri seti kullanılarak hesaplanan beklenen kayıp, beta katsayısı, yıllıklandırılmış oynaklık gibi genel kabul görmüş risk ölçülerine göre daha iyi sonuç verdiğini göstermiştir. Ampirik sonuçların da gösterdiği gibi SES finansal hisselerin taşıdığı potansiyel risklerin ölçülmesinde güçlü bir alternatif yöntemdir.
TÜRK FİNANSAL KURUMLARININ SİSTEMİK BEKLENEN KAYIP YÖNTEMİ İLE SİSTEMİK RİSK ANALİZİ
JEL C21, C58, G01
Anahtar Kelimeler Sistemik beklenen kayıp, Marjinal beklenen kayıp, Sistemik risk

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1. Introduction

The financial crisis triggered by the burst of the housing price bubble and consequent problems in the sub-prime mortgage portfolios of financial institutions in United States (US) has spread to all segments of the country's financial system through securitized debt instruments. The writedowns in positions, which are highly leveraged, insufficiently capitalized, and heavily reliant on short-term financing forced institutions to fire sales. Illiquid and frozen markets also contributed to the accretion of losses. The effects of deleveraging and unwinding of risky positions have not only experienced in the US. Global melt down of asset values, counterparty risk concerns, increasing illiquidity in funding markets caused emergence of weaknesses carried in the balance sheets of developed market countries' financial institutions and deterioration in their capital adequacy ratios.

As the developed market economies were jolted by financial shocks, emerging markets continued to enjoy equity market rallies for a while and provided support for the economic decoupling hypothesis. However, global financial institutions' deleveraging process and asset writedowns have eventually deteriorate the external financing conditions. As a result of depletion in the stock of funds, increased credit risk concerns of advanced market agents and raising funding costs, both capital inflows to emerging markets and demand for their assets have diminished significantly. The collapse of cross-border funding is identified as a critical element in the intensification of the crisis in several countries by IMF (2009). Banks in many emerging market countries had to call back some of their credits or turned down plenty of credit roll-over requests and reflected increasing fund raising costs to their credit customers. Deceleration in private sector credit growth triggered economic output contractions, decline in expected return on equities and further deterioration in asset quality. The result was widening in external debt spreads and sharp losses in stock market values.

Extreme downward pressure observed in equity prices of financials all over the world is described as a run on bank capital (IMF, 2008). The massive amounts of equity sales in financials are said to resemble bank runs. In periods of such uncertainty and stress, the common stock contagion appears indiscriminate, potentially affecting almost the entire financial universe and reflecting a general loss of confidence in all segments. Solvent parties are not differentiated from the insolvent. In the short-run, any liquidity problems caused by these runs are likely to spill over to institutions

which are not directly affected by the initial shock. In this case, many financial institutions have seen their market capitalizations plunged and it has become difficult to raise capital in equity markets. This is the realization of systemic risk which is defined by Mishkin (1995) as the likelihood of a sudden, usually unexpected event that disrupts information in financial markets, making them unable to effectively channel funds to those parties with most productive investment opportunities.

Many firms have to bear high losses on the asset side and declining market to book values, although they have implemented necessary risk management practices on an individual basis. A possible explanation can be found in the high degree of interconnectedness of financial institutions in interbank funding markets as well as similarities in their portfolio compositions which reduce the expected gains of portfolio diversification on a macro level. Under normal market conditions, whenever a financial institution has experienced hard times generally there have been other firms willing to provide capital in return for shares of the stranded institution. However, in case of such a widespread threat to almost all segments of economy the commitment of public resources to contain systemic risk and economic fallout has been required.

Usage of public resources that have high social opportunity cost have forced regulators to look for macro financial risk solutions. Since it has become obvious that institution centric risk management practices are insufficient in times of systemic events, detailed analysis of systemic risk, measurement and reduction of financial institutions' contributions to systemic risk has become popular research topics.

Financial crisis has a long history; therefore there exists a vast amount of research in this area. In this brief literature review, we concentrate only on a few of the relatively recent research studies that directly focused on systemic risk measurement using interconnectedness and/or correlations between financial institutions. Huang et al. (2009) propose a measure of systemic risk which is called the *distress insurance premium* and based on the price of insuring banks against financial distress using ex-ante bank default probabilities and forecasted asset-return correlations. Adrian and Brunnermeier (2008) utilize quantile regression in their systemic risk measure, *CoVaR* that captures value-at-risk of a financial sector conditional on institution *i* being in distress. A set of measures based on rare outcomes and information entropy has been proposed by Duggey (2009), and Gray and Andreas (2010) use CDS spreads in a contingent claims analysis to measure the systemic risk from market implied expected losses. Kritzman et al. (2010) introduce a measure of implied systemic risk called *absorption ratio*, which uses principle component analysis to determine the fraction of

the total variance of a set of asset returns absorbed by a fixed number of eigenvectors.

In this paper we use *systemic expected shortfall* (SES) *and marginal expected shortfall* (MES) introduced by Acharya et al. (2010) and test their applicability to Turkish financial sector. SES is designed to measure each publicly traded financial institution's contribution to systemic risk. It is defined as an institution's propensity to be undercapitalized when financial system as a whole is undercapitalized. MES is defined as a measure of an institution's losses in the tail of the system's loss distribution. The most important features of SES are its usage of only publicly available share prices and balance sheet values and its elegant simplicity that makes it easy to compute.

Efficiency of SES model which utilizes both financial institutions MES and leverage ratios prior to stress periods are tested through two major financial crises that Turkish economy experienced in the last decade. The first one, 2001 Turkish banking sector crisis was triggered by realization of liquidity, exchange rate and interest rate risks carried in balance sheets of insufficiently capitalized banking sector. Negative effects of the crises spread from financial sector through real sector and resulted with economic contraction, major restructuring, and consolidation in Turkish banking sector as well as changes in monetary and fiscal policies. Contrary to 2001 crisis, stronger and extensively regulated Turkish banking sector was not directly hit by the global financial problems in 2007-2009 period, the contraction in the global economy and worsening of foreign financing conditions adversely affected Turkish real sector. While the real sector has suffered from the worsening of credit conditions and reduction in foreign demand, financial sector balance sheet contractions have been caused by declining credit portfolios as well as declining values of tradable securities due to the portfolio outflows and foreign funding sources scarcity.

Explanatory power of conventional risk measures like expected shortfall, stock return volatility or stock beta is compared with leverage ratio and MES of financial institutions prior to the crises. According to results of the regressions that ran with crises period losses as dependent variable and pre-crisis period risk measures as independent variables, it is observed that leverage and MES explains both crises period losses better than other risk measures. In spite of different origins and impact areas of two crises, empirical results highlight SES as a powerful alternative in tracking potential riskiness of the financial stocks.

The rest of the paper is organized as follows: Section 2 briefly summarizes SES and MES measures. In Section 3, a general overview of the Turkish economy in two financial crisis episodes is discussed. SES

methodology is applied to the Turkish financials data in Section 4. Section 5 concludes with final remarks.

2. Systemic Expected Shortfall

In a two period model of Acharya et al. (2010), it is assumed that there are N financial institutions in the system. Each financial institution's main concern is maximizing its utility in the following period. In this setting, w_0^i is firm *i*'s capital and b^i is the amount of debt raised at the first period. Therefore at the first period, the value of total assets of firm *i*, a^i is equal to $w_0^i + b^i$. Moreover, it is assumed that state guarantees a certain ratio $\alpha^i \in (0,1)$ of the face value of the raised debt (f^i), using insurance taxes (τ^i) collected from these financial institutions. In the next period, total income of an institution is determined by the total return of its asset portfolio. Authors represent total income of the institution from its assets by $\hat{y}^i$ and add a cost for financial distress to the firm, ϕ^i. By subtracting ϕ^i from the total income of the firm they derive firm's net income. The net worth of the financial institution at the second period, w_1^i, is equal to the net income of the firm minus the face value of its debt.

On the other hand, regulation authorities face a more complicated optimization problem which is the maximization of total welfare of society. This welfare function is assumed to be the sum of three components. The first component is the sum of financial institutions' utilities. The second part covers the cost of guaranteed debt to the state in case of a financial institution's bankruptcy. The third part of the problem, which constitutes the essence of systemic expected shortfall measure, estimates the externality cost resulted from a system wide capital shortage. The formulation of the expected cost of systemic capital shortfall (CCS_1), is given as follows:

$$CCS_1 = E\left[e.I_{[W_1<zA]}.(zA - W_1)\right] \quad (1)$$

where *e* is the parameter of externality cost created by distressed financial sector. W_1 is the total net value of the financial system, i.e. $\sum_{i=1}^{N} w_1^i$ and *A* is the aggregate assets of the system, $\sum_{i=1}^{N} a_i$. The threshold level for the expected capital shortfall cost in Equation 1 is a linear function of total asset value of the system. Threshold level depends on the level of assets since it is assumed that if the total net worth of the financial system falls below a certain proportion of total asset value, there will be interruptions in the financial services. Considering the definition made in Mishkin (1995), this

type of interruptions preventing efficient capital allocation is identified as a realization of systemic risk. Therefore, the third pillar in regulators' problem is assumed to capture the costs bared by the rest of the economic agents resulted from such an interruption in the financial services.

Moreover, by using the linearity of the conditional expectation operator, one can show the contribution of each institution to aggregate capital shortfall. Contrary to the sub-additivity property of expected shortfall, CCS_1 is additive.

$$CCS_1 = e \cdot E\left[zA - W_1 \middle| W_1 < zA\right] \cdot P(W_1 < zA) \tag{2}$$

$$= e \cdot \sum_{i=1}^{N} \underbrace{E\left[za_i - w_i^1 \middle| W_1 < zA\right]}_{I} \cdot P(W_1 < zA) \tag{3}$$

In Equation 3, *I* is the measure of financial institution *i*'s contribution to the systemic expected capital shortfall, it is the expected capital shortage of the institution *i* at time period 1 when the whole financial system is undercapitalized. *I* is named as systemic expected shortfall of the firm *i*, SES_i and represents systemic risk contribution of the firm. By dividing both sides of SES_i equation to the initial equity, ratio of the initial capital that the financial institution would lose in case of a systemic crisis can be estimated.

$$\frac{SES^i}{w_0^i} = \underbrace{\frac{za^i}{w_0^i}}_{II} - 1 - \underbrace{E\left[\frac{w_1^i - w_0^i}{w_0^i} \middle| W_1 < zA\right]}_{III} \tag{4}$$

In Equation 4, *II* measures institutions leverage at the beginning of the period. Leverage ratio greater than 0 is taken as an indicator of over leverage. Higher leverage ratios increase institution's systemic risk, since it creates fragility in illiquid market conditions and increase roll over risk. Standard approximation of leverage which considers only on-balance sheet items is given in Equation 5.

$$LVG^i = \frac{\text{quasi book value of assets}}{\text{market value of equity}} = \frac{\text{book value of assets - book value of equity +market value of equity}}{\text{market value of equity}} \tag{5}$$

Argument *III* in Equation 4 is the expected equity return of institution *i* in case of a systemic capital shortage. Acharya et al. (2010) suggest that taking z equal to 8% is a reasonable assumption in accordance with capital adequacy calculations. However, systemic capital shortages are extreme tail events and on a daily frequency, probability of observing such an extreme event is very low. In a typical sample used for estimation, the number of these extreme events is so small that conclusions based on their statistical properties can be unreliable. Therefore authors suggest the use of 5% tail

events of the market returns empirical distribution. This empirical distribution consists of market returns one year prior to the crisis. Expected loss of firm *i*'s stocks in a 5% systemic event is *Marginal Expected Shortfall* ($MES_{5\%}$).

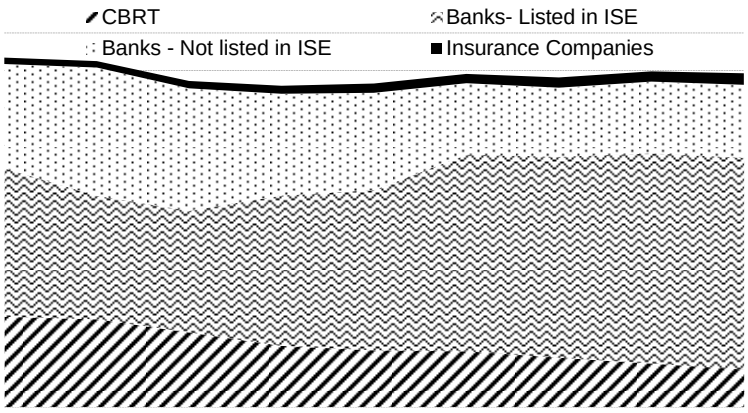
$$MES_{5\%} = E\left[r^i \middle| r^m \in I_{5\%} \right] \quad (6)$$

where r^i is the firm *i*'s return, r^m is the market return and $I_{5\%}$ is the set of worst 5% daily market returns. Using extreme value theory and power-law distributions, Acharya et al. (2010) show that *SES* in Equation 4 is linearly related to the *MES* measure given in Equation 6.

3. 2000-2001 and 2007-2009 Financial Crises in the Turkish Financial Sector

Looking at the past decade in Figure 1, it can be stated that Turkish financial sector has been dominated by the banks. While the asset share of insurance companies relative to the total assets of the financial sector has been relatively stable, banks listed in Istanbul Stock Exchange (ISE) have the highest share throughout the examined period.

Figure 1. Share of Banks, Insurance Companies and CBRT According to Asset Values in Turkish Financial Sector



At the end of economically turbulent 90's, in December 1999 the 17th stand-by agreement with IMF, which is accompanied by a disinflation program, was signed. The nominal anchor of the program was pre-announced crawling peg exchange rate system. Structural reforms in the financial sector, achievement of budgetary discipline and downsizing of public sector were also among the objects of the program (Uygur, 2010). Although the program was initially designed for three years as a result of two tiers crisis in November 2000 and February 2001 the program was terminated.

According to the stand-by agreement, monetary expansion was strictly bounded to the Central Bank of the Republic of Turkey's (CBRT) net foreign asset growth, in other words to foreign exchange flows into the country. At the end of the third quarter of the year 2000, as a result of the liquidity shortage caused by recession in foreign asset opportunities, short-term interest rates started to increase. In addition to this deterioration, some of the institutions had to sell securities due to the shrink in their funding facilities since the short term liquidity was crucial for the asset portfolio funding strategy of many banks. This led to a further deterioration of the asset side of banks' balance sheets.

In the second half of November, rapid capital outflows and sharp stock price declines were observed and one of the important actors in government debt securities, a medium-scale bank was transferred to the state's Saving Deposit Insurance Fund (SDIF) in this period. In order to secure the continuity of the program, various measures were taken. Despite the relative improvement maintained for a while, due to loss of confidence and credibility, the program was terminated with a speculative attack to the Turkish Lira in February 2001. A detailed discussion of 2001 banking sector crisis and its repercussions can be found in BRSA (2010).

On the other hand, recent global financial crisis which started in 2007 has no direct roots from structure or dynamics of the Turkish financial sector, it has been effective on Turkish economy through the decline in international demand of Turkish goods, diminishing external funds and capital inflows, and portfolio outflows due to deteriorating risk perception. In order to contain the effects of the global crisis, countercyclical monetary and fiscal policies were implemented. The decline in credit volume started in the last quarter of 2008 was reversed with the help of countercyclical monetary policies.

In the next section, using data of these two significantly different periods, we discuss the applicability and signaling performance of SES measure for Turkish financial sector data.

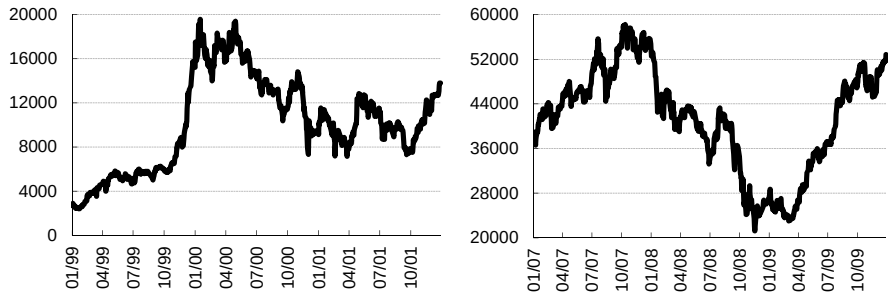
4. SES of the Turkish Financial Sector

In this section SES and some of the other well known risk measures are computed by using financial institutions data prior to two financial crises discussed in the previous section. Each crisis period is divided into two sub-periods. The first period covers data prior to the emergence of the financial stress in the system and the second period consists of the realization of systemic risk. The aim is to compare the ex-ante performance of different risk measures like expected shortfall, annual volatility, and market beta with MES, leverage ratio and determining whether SES is better in forecasting systemic loses in different financial crises environments.

For 2001 banking sector crisis, the first period is from January 1999 to April 2000. As seen in Figure 2, systemic event data starts from May 2000 and ends with March 2001 when ISE 100 index the main indicator of the stock market which is composed of 100 highly liquid stocks traded in the national stock exchange reached its minimum level in 1999-2001 period. January 2007 - December 2007 constitutes the observation period preceding the global financial crisis and January 2008 - March 2009 is determined as the crisis period.

Figure 2. ISE 100 Index

01/01/99-31/12/01 01/01/07-31/12/09



The banks, brokerage firms, and insurance companies including individual pension companies quoted in the national stock exchange are used in the analysis. List of the companies used in the computations are provided in Table 1.

Table 1. The List of Financial Institutions

2000- 2001 Crisis		2007- 2009 Crisis	
Banks[1]	**Insurance Companies**	**Banks**[2]	**Insurance Companies**
Akbank A.Ş.	Aksigorta A.Ş.	Akbank A.Ş.	Aksigorta A.Ş.
Alternatifbank A.Ş.	Anadolu Sigorta A.Ş.	Albaraka Türk Katılım Bankası A.Ş.	Anadolu Hayat Emeklilik A.Ş.
Demirbank A.Ş.	Commercial Union Sigorta	Alternatifbank A.Ş.	Anadolu Sigorta A.Ş.
Türk Dış Ticaret Bankası A.Ş.	Güneş Sigorta A.Ş.	Asya Katılım Bankası A.Ş.	Aviva Sigorta A.Ş.
Finans Bank A.Ş.	Halk Sigorta A.Ş.	Finans Bank A.Ş.	Güneş Sigorta A.Ş.
Türkiye Garanti Bankası A.Ş.	Ray Sigorta A.Ş.	Fortis Bank A.Ş.	
Türkiye İş Bankası A.Ş.		Türkiye Garanti Bankası A.Ş.	
Şekerbank T.A.Ş.	**Brokerage Firm**	Türkiye Halk Bankası A.Ş.	**Brokerage Firm**
Tekstil Bankası A.Ş.	Global Menkul Değerler A.Ş.	Türkiye İş Bankası A.Ş.	İş Yatırım Menkul Değerler A.Ş.
Türkiye Sınai Kalkınma Bankası A.Ş.		Şekerbank T.A.Ş.	
Yapı ve Kredi Bankası A.Ş.		Türk Ekonomi Bankası A.Ş.	
		Tekstil Bankası A.Ş.	
		Türkiye Sınai Kalkınma Bankası A.Ş.	
		Türkiye Vakıflar Bankası T.A.O.	
		Yapı ve Kredi Bankası A.Ş.	

1) State owned development bank Türkiye Kalkınma Bankası A.Ş is left out of the list due to the small number of its shares traded in the stock exchange.
2) Additional to Türkiye Kalkınma Bankası A.Ş, Denizbank A.Ş. is also left out of the list due to the same reason.

In MES calculations, firstly ISE 100 index pre-crisis period tail events are used to determine the worst 5% market outcomes (stock market return following the earthquake in 1999 is left out of the observation set). Then, simple averages of the listed stocks' returns for these determined 5% worst days are recorded as MES's of stocks like it is formulated in Equation 6. The leverage ratios of firms which are formulated in Equation 5 are computed using the last available quarterly balance sheet values before the start of the crisis period.

Other individual risk measures that we use in this paper are expected shortfall (ES), stock market beta, and annualized volatility of stock returns. ES is taken as the simple average of 5% left tail of stock's empirical return distribution in the pre-crisis period. Stock's beta is estimated as covariance between stock return and ISE 100 index return divided by variance of ISE 100 index return. Annualized volatility is calculated as square root of 250 times standard deviation of daily stock returns. Finally, the realization of the systemic risk is measured by cumulative drops in the equity values of the financial firms through the crisis periods. Descriptive statistics for the calculated risk measures and realized systemic losses are given in Table 2.

By looking at Table 2, we can see that despite to the completely different conditions of two crises and relative shallowness of the stock markets at the beginning of 2000's, descriptive statistics of realized event returns, MES seems relatively similar. Leverage statistics on the other hand, points a distribution change between the periods, where it has been evaluated through a more symmetric distribution around the mean. Higher volatility in 1999-2000 can be attributed to both domestic and international economic and political instabilities. In the lower panel, we see that in 2007 volatility was declined substantially relative to the previous period. Similarity of MES and ES statistics in 2007-2009 is an indicator of harmonization between the main stock index and financials. Significantly higher ES than MES and beta lower than 1 on average in 1999-2000 period indicates a diversion in financials returns from the stock index. The minimum realized return equal to -1 in 2000-2001 crisis represents bankrupt Demirbank. We need to emphasize that high market capitalization rule of Acharya et al. (2010) is loosened; because of the data shortage almost all of the available data is utilized.

Table 2. Descriptive Statistics of Risk Measures and Realized Systemic Event

	2000-2001 Crisis					
	Realized Return	**MES**	**Leverage**	**ES**	**Volatility**	**Beta**
Mean	-0.62	0.05	3.90	0.09	0.77	0.71
Median	-0.62	0.05	2.42	0.09	0.76	0.73
Std	0.16	0.01	2.65	0.01	0.08	0.24
Min	-1.00	0.03	1.21	0.07	0.64	0.24
Max	-0.25	0.08	9.81	0.12	1.00	1.04
	2007-2009 Crisis					
	Realized Return	**MES**	**Leverage**	**ES**	**Volatility**	**Beta**
Mean	-0.58	0.04	3.59	0.05	0.42	0.95
Median	-0.64	0.04	3.63	0.05	0.43	0.99
Std	0.20	0.01	1.46	0.01	0.07	0.29
Min	-0.84	0.01	1.14	0.03	0.29	0.34
Max	-0.11	0.05	6.37	0.08	0.57	1.45

Table 3. Correlation Between Variables

	2000-2001 Crisis					
	Realized Return	**MES**	**Leverage**	**ES**	**Volatility**	**Beta**
Realized Return	1.00					
MES	-0.22	1.00				
Leverage	-0.48	-0.40	1.00			
ES	-0.31	0.13	-0.25	1.00		
Volatility	-0.41	0.26	-0.31	0.85	1.00	
Beta	-0.24	0.87	-0.24	-0.01	0.11	1.00

	2007-2009 Crisis					
	Realized Return	**MES**	**Leverage**	**ES**	**Volatility**	**Beta**
Realized Return	1.00					
MES	-0.42	1.00				
Leverage	-0.40	0.18	1.00			
ES	-0.15	0.53	0.22	1.00		
Volatility	-0.05	0.44	-0.41	0.71	1.00	
Beta	-0.45	0.85	0.13	0.24	0.46	1.00

The correlations between the variables are presented in Table 3. Looking at the first column for 2000-2001, leverage has the highest correlation with realized losses, where correlation of MES and realized losses is the lowest. Relatively poor correlations between realized losses with MES and beta in 2000-2001 are due to the high losses of low scale banks contrary to their low MES and beta levels. Moreover, Demirbank which has the highest realized loss is in the middle of % MES ranking and according to absolute MES measure, which is equal to % MES multiplied by market capitalization of the firm at the beginning of the crisis period, is at the fifth place among 18 institutions. According to 2007-2009 data MES, leverage and beta have high correlations with the realized losses.

In Table 4 results of the OLS regression analysis for different exploratory variables are given. For 2000-2001, while MES is not statistically significant in Model 1, when leverage is added both of the variables become significant. According to adjusted $R^{2'}$s Model 3 including both MES and leverage is the best fitting model to the realized losses and Model 2 including only leverage ratio as independent variable is the second.

The structural weaknesses of the Turkish financial system have contributed to the failure of 2000-2001. Relative to its peer countries, smaller banking sector in Turkey was centered on public finance rather than real sector, deposit to credit transformation was weak and lack of a risk management culture was adding to the fragility. With the high budget deficits rolled over with high interest rates, the banking sector placed its

funds into these profitable debt instruments which had zero risk weight in capital adequacy calculations. Moreover, the banking sector was working with low capital levels and high leverage ratios. Besides the dollarization in the economy which also affected the currency composition of the banking sector deposits, the maturity mismatch between the sector's assets and liabilities caused the banking system to become oversensitive to liquidity, interest rate and exchange rate risks. When these risks were realized fire sales in highly leverages treasury debt instruments portfolios triggered losses. As a result of this crisis, 22 banks licenses were suspended and USD 53.6 billion (one third of the national income) was spent to restructuring of the sector.

Lower panel of Table 4 shows OLS regression results for 2007-2009 crisis. MES, leverage and beta are statistically significant in the first, second and sixth models, again Model 3 including both leverage and MES dominates the other models with the highest adjusted R^2 value.

Thanks to the extensively regulated and supervised financial system that has been constituted starting from the year 2000 to date and relative underdevelopment of the sector in financial innovations, none of the institutions license was suspended by the authorities in 2007-09 period. Moreover, the capital adequacy ratio of the banking sector has been higher than the target ratio of 12%. Banking sector profitability declined in December 2008 relative to the end of the previous year which can be attributed to the provisions for increasing non-performing loans (CBRT, 2009). Real sector took the primary hit with economic activity contraction and rising unemployment.

As a result it can be concluded that in spite of the differences in origins, transmission channels and impact areas of 2000-2001 Turkish banking sector crisis and 2007-2009 global credit crisis are different, models including both MES and leverage ratios as independent variables are more powerful in explaining the realized losses in both of the cases.

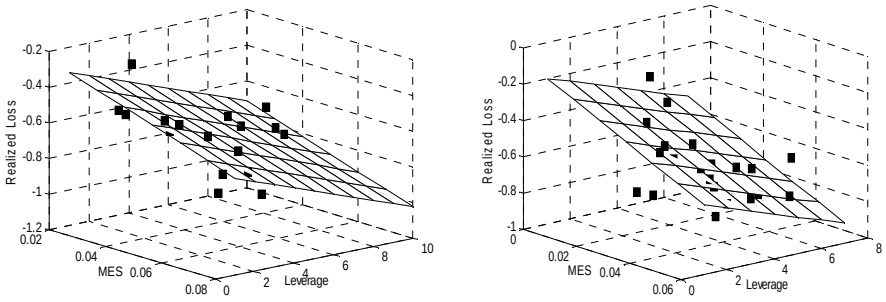
Table 4. OLS Regression Analysis
(Dependent Variable is Realized Losses in Crisis Periods)

	2000-2001							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Intercept	-0.50 (-3.57)	-0.51 (-8.09)	-0.19 (-1.29)	-0.24 (-0.83)	0.06 (0.15)	-0.51 (-4.09)	-0.17 (-0,55)	-0.49 (-3.35)
MES	-2.37 (-0.89)		-5.27** (-2.29)				-1.96 (-0.74)	-1.07 (-0.21)
Leverage		-0.03** (-2.21)	-0.04*** (-3.19)					
ES				-4.29 (-1.32)			-3.97 (-1.20)	
Volatility					-0.88* (-1.82)			
Beta						-0.16 (-0.92)		-0.10 (-0.30)
Adj-R^2	-1.20%	18.53%	35.65%	5.20%	11.94%	0%	1.5%	-7.3%
No. of obs.	18	18	18	18	18	18	18	18
	2007-2009							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Intercept	-0.27 (-1.72)	-0.38 (-3.56)	-0.15 (-0.91)	-0.41 (-1.66)	-0.52 (-1.97)	-0.29 (-2.18)	-0.34 (-1.43)	-0.27 (-1.68)
MES	-8.19** (-2.05)		-7.00* (-1.80)				-9.21* (-1.92)	-2.63 (-0.35)
Leverage		-0.06* (-1.96)	-0.05* (-1.71)					
ES				-3.15 (-0.68)			2.07 (0.4)	
Volatility					-0.14 (-0.22)			
Beta						-0.30** (-2.23)		-0.23 (-0.87)
Adj-R^2	13.23%	11.88%	20.81%	-2.66%	-4.74%	16.02%	9.43%	12.16%
No. of obs.	22	22	22	22	22	22	22	22

Note: t- statistics are given in parenthesis, ***, ** and * indicates significance at 1, 5 and 10% respectively.

Figure 3. Regression Using MES and Leverage as Explanatory Variables

2000-2001 period 2007-2009 period



The planes implied by the estimated coefficients of Model 3 for both of the periods and realized returns are given in Figure 3. In Models 7 and 8 we run horse race between MES – ES and MES – beta. In column (7) for 2007-2009 crises it is seen that MES is significant at 10% level while coefficient of ES is insignificant.

5. Conclusion

Turkish financial sector has been dominated by the banking sector which has been extensively regulated and closely supervised by the regulatory system constituted following 2000-2001 banking sector crisis. However, the recent global financial crisis reveals that risk assessment of a bank should not be limited with an isolated evaluation of bank's balance sheet or portfolio composition. In this context Acharya et al. (2010) propose an easily applicable measure, SES, which anticipates a financial institutions propensity to undercapitalize when the whole financial system is experiencing capital shortage. SES can be updated every day and consequently can help regulators or investors to track potential riskiness of the related stock.

In order to test the applicability of SES to Turkish financial institutions, multivariate regression model with leverage ratio and MES of each financial firm as independent variables are fitted to institutions' stock value losses that are observed through crisis periods. Application is not restricted with the recent global financial crisis, the data related to 2000-2001 banking sector crisis is also used. Although high market capitalization requirement of Acharya et al. (2010) cannot be satisfied due to data shortage, regression results indicate that SES model including both MES and leverage ratio has a superior explanatory power over its rivals; ES, volatility, and stock market beta.

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