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THE ANALYSIS OF SECTORAL RISKS IN ISE DURING THE ECONOMIC CRISIS

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by

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To my wife...

APPROVAL PAGE

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1. The material included in this thesis has not been submitted wholly or in part for any academic award or qualification other than that for which it is now submitted.

2. The program of advanced study of which this thesis is part has consisted of:

i) Research Methods course during the undergraduate study

ii) Examination of several thesis guides of particular universities both in Turkey and abroad as well as a professional book on this subject.

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ABSTRACT

Gökhan KARAAHMET **August 2009**

THE ANALYSIS OF SECTORAL RISKS IN ISE DURING THE ECONOMIC CRISIS

Value at Risk (VaR) has become a commonly used method in risk management for calculating the risk. Main purpose of this study is to calculate the risks of all sectors traded in Istanbul Stock Exchange with the help of the Value at Risk. Two major financial crises hitting the Turkish economy in the past decade are used as benchmark to evaluate the Value at Risk in assessing risk. In addition, especially during financial crises, Value at Risk is used in order to compare the most risky sectors with the least risky ones. Then, the performance of historical simulation and variance/covariance method are compared for the ISE case.

Key words:

Value at Risk, Currency Crisis, Banking Crisis, Istanbul Stock Exchange, Risk Measurement

KISA ÖZET

Gökhan KARAAHMET **Ağustos 2009**

KRIZ DONEMLERINDE IMKB'DE YER ALAN SEKTORLERIN RISK ANALIZI

Bu tez, kriz yılarında İstanbul Menkul Kıymetler Borsası'nda yer alan sektörlerin riskinin karşılaştırılmasını amaçlamıştır. Tezin genel yapısı hakkında genel bilgi veren giriş bölümünden sonra dört kısmı kapsamaktadır. İkinci kısım, İstanbul Menkul Kıymetler Borsası ile ilgili genel bir açıklamadır. Üçüncü kısım kriz teorileri hakkında bilgi verdikten sonra bu teoriler ışığında Türkiye'de yaşanan son üç krizin incelemesini içermektedir. Dördüncü kısım, risk ve risk olcumu konusuna giriş yaptıktan sonra risk ölçümünde Riske Maruz Değer tanımlanmış ve farklı metotları incelenmiştir. Besinci kısımda ise Riske Maruz Değer'in farklı metotları yardımıyla İstanbul Menkul Kıymetler Borsası'nda yer alan sektörlerin riskleri analiz edilmiştir.

Anahtar Kelimeler

Riske Maruz Değer, Para Krizi, Banka Krizi, İstanbul Menkul Kıymetler Borsası, Risk Olcumu

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LIST OF ABBREVIATIONS

CPI	Consumer Price Index
GDP	Gross Domestic Product
GNI	Gross National Income
IFC	International Finance Corporation
IMF	International Money Fund
ISE	Istanbul Stock Exchange
SDIF	Savings Deposit Insurance Fund
TL	Turkish Lira
US$	United States Dollar
VaR	Value at Risk
WB	World Bank

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CHAPTER 1
INTRODUCTION

Assume that you are an investor holding some numbers of stocks. You have been hearing about the big losses suffered by other investors. At this point, you want to know if the same thing could happen to you, how big losses would have suffered by you. In other words, you want to know how much market risk you are taking. Hence, you need to measure the risk you are taking.

Value at Risk may help you to compute the risk you are exposed. In brief, Value at Risk is a widely used measure of risk, which provides a way of calculating the risk of assets. The Value at Risk (VaR) was appeared in 1993 in response to several financial disasters. Selection of Value at Risk by the Basel Basel Committee on Banking Supervision as the international standard for external regulatory purpose had increased the popularity of Value at Risk. In recent years, non-bank energy traders and end-users have begun to use Value at Risk as a part of risk management.

Value at Risk can be defined as the maximum expected loss on an asset over a specified horizon at the given confidence interval.

An extensive review of the literature on the Value at Risk can be found in Duffie and Pan (1997), Lopez (1997), Dowd (1998), Holton (1998), Linsmeier and Pearson (2000), Jorion (2001), Shapiro (2001), Engel and Manganelli (2001).

In Chapter 2, brief history of the securities market in Turkey, the organization of the Istanbul Stock Exchange, listing requirements, stock markets in the Istanbul Stock Exchange, and market indices of the Istanbul Stock Exchange are analyzed. Then, some ratios and values are used to show the evaluation of the Istanbul Stock Exchange as an emerging market.

In Chapter 3, economic and financial crises are defined and outlook and brief history of Turkish economy are studied. Subsequently, the 1994, the November 2000 and the February 2001 crises are analyzed in terms of literature on crises.

Definition of risk, sources of risk and risk measurement are the starting point of the Chapter 4. And then, the importance of Value at Risk in risk measurement is emphasized. In the last section of Chapter 4, the parameters in calculating Value at Risk and the methods of it are analyzed.

In Chapter 5, the Values at Risk of sectors at the Istanbul Stock Exchange are computed by historical simulation and variance/covariance method. Then, Value at Risk is used to compare the sectors traded at the ISE. In addition, the results of Value at Risk are compared to actual returns in order to evaluate the performances of historical simulation and variance/covariance method.

CHAPTER 2
THE ISTANBUL STOCK EXCHANGE AS AN EMERGING MARKET

2.1 Emerging Markets

Emerging stock markets have recently been given great importance by the international investment community. Emerging stock markets don't have a universally accepted definition. However, there exist some definitions of emerging stock markets, created by financial institutions. The International Finance Corporation (IFC), a subsidiary of the World Bank, considers the market as an 'emerging market' if it meets at least one of the two criteria: It is in a low-income or middle-income economy and its investable market capitalization is low relative to its most recent gross domestic product (GDP). The World Bank defines the low income economy as an economy with gross national income (GNI) per capita of $935 or less, while middle economy is that with a GNI per capita of between $936 and $11,455.

In addition, Keppler and Lechner (1997) define emerging markets as the rapidly growing markets or stock markets in newly industrialized countries.[1] In 1981 the IFC emerging market index included stocks of publicly traded

companies from nine countries. By 2002, the total number of countries covered in the IFC emerging market indices had reached 33. Today, 30 countries are considered to be in transition to higher levels of economic development and have hence earned the title "emerging market" from the IFC. The ISE is one of them among 30 countries which are considered as emerging stock markets.

The motivations for the foreign investments to invest in emerging stock markets are decreasing risk of portfolio and increasing return of portfolio. Analysing the 1986-1989 period, Divecha, Drach and Stefek (1992) realized that in a portfolio in which 20% from the assets were destined for the shares which belonged to emerging markets, the profitableness increased 2.1%, while the risk was diminishing with 0.81%, in comparison with the case in which all the funds placed in shares on a single developed market.[2]

The Istanbul Stock Exchange became a typical emerging equity market after its inception on January 2, 1986, and it has been growing ever since its inauguration. According to Harris and Kucukozmen (2002), ISE achieved to be the 12th largest emerging market in the world.[3]

2.2 Brief History of the Securities Market in Turkey

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[1] Keppler, M., Lechner, M. (1997), *Emerging Markets: Research, Strategies and Benchmarks*, Chicago: Irwin Professional Publishing, p. 9.
[2] Divecha, A., Drach, J., Stefek, D. (1992), *Emerging markets – A quantitative perspective*, The Journal of Portfolio Management, Fall;
[3] Harris, R.D.F. and Kucukozmen, C.C. (2002), *Linear and Nonlinear Dependence in Turkish Equity Returns and its Consequences for Financial Risk Management*, European Journal of Operational Research, 134(3): 481-492.

Securities market in Turkey has its roots in 1800s. Dersaadet Securities Exchange was established in 1866 in order to organize buying and selling domestic and foreign bonds. In the 1890s, Dersaadet Security Exchange was the second leading exchange in Europe after the London Stock Exchange in the terms of transaction volume.[4]

Following the proclamation of the Turkish Republic on the ruins of the Ottoman Empire, Istanbul Securities and Foreign Exchange Bourse was founded in 1929 to reorganize the capital markets and to fund the requirements of new enterprises.

The beginning of 1980s was the turning point for the Turkish economy because the legislative framework and the institutions were actualized in order to implement market liberalization. In 1981, the "Capital Market Law" was enacted. The Capital Markets Board was established in 1982 to supervise and regulate the Turkish securities market.

The new Istanbul Stock Exchange (ISE) was established on January 1, 1986. The trading system in the Istanbul Stock Exchange was a call market until November 17, 1987. After that date, the Istanbul Stock Exchange adopted the continuous auction trading system. Under Turkish legislation, the Istanbul Stock Exchange is responsible for developing and maintaining the central securities market of Turkey.

The ISE is the unique legal market established for securities trade in Turkey, and all kinds of such trade must go through the ISE. The ISE has the latest hi-tech electronic software and hardware for all kinds of transactions since November 1994. Operations carried at the ISE are transparent to all parties, and the data belonging to these operations are made available through the official website of ISE (www.ise.org).

Foreign traders are enabled to participate in the ISE by a decree passed in August 1989 which had removed all restrictions on foreign traders. Also, this decree allows Turkish citizens to buy foreign securities.

Now, ISE provides trading in equities, bonds and bills, revenue-sharing certificates, private sector bonds, foreign securities, real estate certificates and international securities.

2.3 Overview of the ISE

Executive Council which composed of five members elected by the General Assembly is authorized to govern ISE. Chief executive officer is appointed by the government and the four other members represent the exchange members. In this sense, ISE is an autonomous, professional, semipublic and self-regulator organization. In addition, ISE is supervised by the Capital Markets Board which is

[4] Istanbul Stock Exchange, www.ise.org

the regulatory and supervisory authority for Turkish capital markets. The Capital Markets Board has the right to suspend or prohibit the trading activities of member intermediaries

The ISE has its own budget and its revenues are generated from fees charged on transactions, listing procedures, and miscellaneous services.

All Istanbul Stock Exchange members are the investment and development bans; the commercial banks; and brokerage houses. Table 2.1 shows the numbers of members in different markets. Stock market has 104 members, bonds and bills market has 131 members, repo-reverse repo market has 97 members and foreign securities market 131 members by the date of April 2009.

The members are authorized by the ISE to operate in the stocks; bonds, bills and real estate certificates; repo-reverse repo; odd-lot; and foreign securities market international bonds markets.

Table 2.1 ISE Members

ISE MEMBERS, April 2009					
Year	**Market**	**Brokerage Houses**	**Investment& Development Banks**	**Commercial Banks**	**Total**
2009/04	Stock Market	104	0	0	104
	Bonds and Bills Market	90	11	30	131
	Repo-Reverse Repo Market	57	11	29	97
	Foreign Securities Market International Bonds Market	90	11	30	131

Source: Istanbul Stock Exchange

The Stock Market, Bonds and Bills Market, the International Market, and the Derivatives Market are the four markets of the ISE. There are two sessions for transactions in 5 days of the week. Trading operations are between 09:30-12:00 for the first session and 14:00-16:30 for the second session. Currently the National Market has about 320 papers belonging to national companies being traded. ISE indices are updated continuously throughout the transactions and the return indices are announced daily at the end of the day. The ISE National-100 Index is the most widely used as the main indicator of the ISE. The other prominent indices are ISE National-30, ISE National-50, ISE National-100, and the ISE Second National Market Index.

2.4 Comparison of ISE's Performance Among Years

In this section, the ISE will be analyzed from the different aspects with more descriptive detail. Number of listed companies and market capitalization, trading value and number of contracts, Price/Earning ratio and gross dividend yields, closing value of price indices, and returns by sectors are emphasized below.

2.4.1. Number of Listed Companies and Market Capitalization

Market capitalization in emerging stock markets is relatively low compared to developed countries, but the market capitalization in emerging markets is increasing quickly. Market capitalization in developed and emerging countries is showed in Table 2.2. The quantity of market capitalization in developed markets is higher than the quantity of market capitalization in emerging markets.

In 1990 Tokyo Stock Exchange had 2,928,534 million USD$ and in 2007 Tokyo Stock Exchange had 4,330,922 million USD$ market capitalization. The total change between 1990 and 2007 is 48%. On the other hand, in 1990 the ISE had 19,065 million USD$ and in 2007 the ISE had 286,572 million USD$. The total change in market capitalization between 1990 and 2007 is 1,403%. That is to say, Tokyo Stock Exchange has numerically more market capitalization than the ISE, while change of market capitalization in the ISE is more than Tokyo Stock Exchange.

As shown in Table 2.2, emerging stock markets have more growth rate in market capitalization, for instance Sao Paulo SE (Brazil) with 12,128%, Indonesia SE with 2,520%, Buenos Aires SE (Argentina) with 1,479%. Developed markets have lower market capitalization relatively to emerging markets; NYSE (New York Stock Exchange) with 481%, Borsa Italiana (Italy) with 621%, Deutsche Borse (Germany) with 492%, London SE (United Kingdom) with 353%. Keppler and Lechner (1997) predict that the emerging market's share of total world stock market capitalization will increase to about 43% in the year 2025. [5]

Table 2.2 Indicators of Stock Market Development for Selected Markets, 1990-2007

	MARKET CAPITALIZATION		
Exchange	**End 1990 (in Million USD$)**	**End 2007 (in Million USD$)**	**CHANGE (%)**
Americas			
American SE	102,302	257,797	152%
Buenos Aires SE	3,615	57,070	1479%
Lima SE	812	69,386	8445%
Mexican Exchange	41,054	397,725	869%
Nasdaq	310,800	4,013,650	1191%
NYSE	2,692,123	15,650,833	481%
Santiago SE	13,636	212,910	1461%
Sao Paulo SE	11,201	1,369,711	12128%
Asia - Pacific			

[5] Keppler, M., Lechner, M. (1997), *Emerging Markets: Research, Strategies and Benchmarks*, Chicago: Irwin Professional Publishing, p. 9.

Australian SE	107,936	1,298,315	1103%
Bursa Malaysia	47,869	325,290	580%
Colombo SE	917	7,553	724%
Hong Kong Exchanges	83,386	2,654,416	3083%
Indonesia SE	8,081	211,693	2520%
Korea Exchange	110,301	1,122,606	918%
New Zealand Exchange	8,824	47,486	438%
Philippine SE	6,632	103,007	1453%
Singapore Exchange	34,269	539,177	1473%
Taiwan SE Corp.	98,927	663,716	571%
Thailand SE	20,777	197,129	849%
Tokyo SE	2,928,534	4,330,922	48%
Europe - Africa - Middle East			
Athens Exchange	15,309	264,961	1631%
BME Spanish Exchanges [6]	111,449	1,799,834	1515%
Borsa Italiana	148,766	1,072,535	621%
Deutsche Börse	355,311	2,105,198	492%
Istanbul SE	*19,065*	*286,572*	1403%
JSE	136,869	828,185	505%
London SE	850,012	3,851,706	353%
Oslo Børs	26,130	353,353	1252%
Swiss Exchange	157,635	1,271,048	706%
Tehran SE[7]	1,333	43,885	3193%
Tel Aviv SE	8,274	235,056	2741%
Wiener Börse	26,320	236,448	798%

Source: World Federation of Exchange

At the end of 2007 the number of listed companies was 319, although it was 110 at the end of 1990. Also, at the end of 2007 the value of market capitalization was 19,065 million USD$ while it was 286,571 million USD$ at the end of 2007. The value of market capitalization represents an increase of 1,403% between 1990 and 2007. Table 2.3 shows the number of listed companies and market capitalization in Turkey between the years 1990 and 2007.

[6] Total value of share trading started at 2000.
[7] Market Capitalization started at 1992.

Table 2.3 Numbers of Listed Companies and Market Capitalization, ISE, 1990-2007

Year End	Number of Listed Companies	Market Capitalization Value (in million USD$)
1990	110	19,065.0
1991	134	15,508.0
1992	145	9,755.9
1993	160	36,612.7
1994	176	21,605.1
1995	205	20,771.7
1996	228	30,311.8
1997	259	61,095.0
1998	278	33,645.6
1999	286	112,715.8
2000	316	69,658.9
2001	311	47,149.9
2002	289	34,216.7
2003	285	68,379.2
2004	297	98,298.9
2005	304	161,537.6
2006	316	162,398.9
2007	319	286,571.7

Source: World Federation of Exchange

The numbers of listed companies have increased continuously except for the years 2001, 2002 and 2003. While the numbers of listed companies were 316 in 2000, they were 311 in 2001, 289 in 2002 and 285 in 2003. This may be the results of economic and financial crises in 2000 and 2001.

2.4.2. Trading Volume and Number of Contracts

Total trading volume had increased from 5,854 million USD$ in 1990 to 300,842 million USD$ in 2007. The daily average of trading volume had increased from 24 million USD$ in 1990 to 1,194 million USD$ in 2007. In addition, the number of contracts had also increased continuously, from 766,000 to 48,340,000 between 1990 and 2007. Table 2.4 shows the trading volume and the number of contracts between 1990 and 2007.

2.4.3. Price/Earning Ratio and Gross Dividend Yields

Price/Earning ratio was 23.3% in 1990 while it was 12% in 2007. P/E ratio decreased in 2007 compared to its value in 1990. Gross dividend yields also decreased in 2007 compared to 1990. It was 2.6% in 1990 while it was 1.9% in 2007. Table 2.5 shows the P/E ratios and gross dividend yield between 1990 and 2007.

Table 2.4 Trading Value and Number of Contracts, ISE, 1990-2007

	TOTAL	DAILY AVERAGE

Year	Trading Volume (million USD$)	Number of Contracts (000)	Trading Volume (million USD$)	Number of Contracts (000)
1990	5,854	766	24	3
1991	8,502	1,446	34	6
1992	8,567	1,682	34	7
1993	21,770	2,815	88	11
1994	23,203	5,085	92	20
1995	52,357	11,667	209	46
1996	37,737	12,446	153	50
1997	58,104	17,639	231	70
1998	70,396	21,571	284	87
1999	84,034	25,785	356	109
2000	181,934	32,427	740	132
2001	80,400	31,380	324	127
2002	70,756	28,967	281	115
2003	100,165	29,944	407	122
2004	147,755	41,508	593	167
2005	201,763	43,943	794	173
2006	229,642	45,491	919	182
2007	300,842	48,340	1,194	192

Source: Istanbul Stock Exchange

Table 2.5 Price/Earning Ratio and Gross Dividend Yield, ISE, 1990-2007

Year End	Price/Earning Ratio	Gross Dividend Yield (%)

1990	23.3	2.6
1991	13.6	4.7
1992	11.4	7.2
1993	25.8	1.9
1994	24.8	2.8
1995	9.2	3.6
1996	12.2	2.9
1997	24.4	1.6
1998	8.8	3.4
1999	37.5	0.7
2000	16.1	1.3
2001	824.4	1
2002	27	1.2
2003	12.3	0.9
2004	13.3	1.4
2005	19.4	1.7
2006	14.9	2.1
2007	12	1.9

Source: World Federation of Exchange

2.4.4. Closing Value of Price Indices

ISE National 100 Index had increased continuously, with the exception of the years 1998, 2000 and 2002. ISE National 100 Index was 32.56 in 1990 while it was 55,538 in 2007. ISE National 50 Index was 9,267 in 2000 while it was 55,548.77 in 2007. ISE National 30 Index was 4,060 in 1997 while it was 70,457.30 in 2007 in Turkish Lira terms. Table 2.6 shows the closing of ISE National 100 Index, ISE National 50 Index, and ISE National 30 Index.

2.4.5. Return by Sectors

Table 2.7 shows the average monthly and yearly returns by sectors in Turkish Lira and USD$ as of December 2008. 'Insurance Companies' sector has the highest monthly return in TL with 3.30% while 'Brokerage Houses' sector has the lowest monthly return in TL with (-5.66)%. 'Medical and Other Health Service' sector has the highest monthly return in USD$ with 1.39% while 'Brokerage Houses' sector has the lowest monthly return in USD$ with (-6.28) %. 'Insurance Companies' sector has the highest yearly return in TL with 50.83% while 'Brokerage Houses' sector has the lowest yearly return in TL with (-50.28)%. 'Medical and Other Health Service' sector has the highest yearly return in USD$ with 17.97% while 'Brokerage Houses' sector has the lowest monthly return in USD$ with (-54.09) %. General average of monthly return in TL is 1.35% and in USD$ is (-0.49) %. General average of yearly return in TL is 21.00% and in USD$ is (-4.36) %.

Table 2.6 Closing Value Price Indices, ISE, 1990-2007

	ISE NATIONAL 100			ISE NATIONAL 50		ISE NATIONAL 30	
	TL	USD$	EURO	TL	USD$	TL	USD$
	(Jan. 1986=1)	(Jan. 1986=100)	(31.12.98=484)	(28.12.99=15208.78)	(28.12.99=1654.17)	(27.12.96=976)	(27.12.96=534)
1990	32.56	642.63	---	---	---	---	---
1991	43.69	501.50	---	---	---	---	---
1992	40.04	272.61	---	---	---	---	---
1993	206.83	833.28	---	---	---	---	---
1994	272.57	413.27	---	---	---	---	---
1995	400.25	382.62	---	---	---	---	---
1996	975.89	534.01	---	---	---	---	---
1997	3,451.--	982.--	---	---	---	4,060.--	1,155.--
1998	2,597.91	484.01	---	---	---	3,118.65	581.03
1999	15,208.78	1,654.17	1,912.46	---	---	19,367.95	2,106.54
2000	9,437.21	817.49	1,045.57	9,267.51	802.79	11,909.72	1,031.67
2001	13,782.76	557.52	741.24	13,605.85	550.37	17,516.43	708.56
2002	10,369.92	368.26	411.72	10,165.35	361.00	12,886.20	457.62
2003	18,625.02	778.43	723.25	18,594.76	777.16	24,310.03	1,016.03
2004	24,971.68	1,075.12	924.87	24,988.27	1,075.83	32,152.87	1,384.29
2005	39,777.70	1,726.23	1,710.04	39,423.44	1,710.86	50,467.53	2,190.14
2006	39,117.46	1,620.59	1,441.89	38,834.76	1,608.88	48,551.38	2,011.43
2007	55,538.13	2,789.66	2,221.77	55,548.77	2,790.19	70,457.30	3,539.04

Source: Istanbul Stock Exchange

Table 2.7 Returns by Sectors as of December 2008, ISE[8]

	RETURN by SECTORS as of Dec. 2008.[9]			
	Average Monthly Return (%)		Average Yearly Return (%)	
Sectors	**TL**	**USD$**	**TL**	**USD$**
Mining	1.47	(0.13)[10]	19.15	(1.59)
Manufacturing Industry	1.87	(0.30)	27.26	(2.70)
Manufacture of Food, Beverage and Tobacco	0.95	(0.78)	14.64	(7.85)
Textile, Wearing Apparel and Leather Industries	1.00	(1.09)	14.07	(11.82)
Manufacture of Wood Products including Furniture	2.57	(0.32)	36.44	(3.20)
Manufacture of Paper and Paper Products, Printing and Publishing	1.60	(0.28)	22.80	(2.81)
Manufacture of Chemicals and of Chemical Petroleum, Rubber and Plastic Products	2.66	0.13	38.28	2.06
Manufacture of Non-Metallic Mineral Products	2.94	0.39	42.55	5.25
Basic Metal Industries	2.34	0.14	34.06	2.20
Manufacture of Fabricated Metal Products, Machinery and Equipment	1.83	(0.30)	27.58	(2.49)
Other Manufacturing Industry	0.97	(0.48)	12.90	(5.38)
Electricity, Gas and Water	0.07	(0.83)	0.86	(9.46)
Construction and Public Works	1.03	0.00	13.21	1.53
Wholesale and Retail Trade, Hotels and Restaurants	0.68	(0.88)	12.85	(8.28)
Wholesale Trade	(0.35)	(1.40)	(1.30)	(15.01)
Consumer Trade	0.53	(0.85)	13.34	(5.71)
Restaurants and Hotels	1.34	(0.66)	19.43	(7.49)
Transportation, Communication and Storage	1.26	(0.50)	21.23	(3.77)
Transportation	1.42	(0.56)	24.58	(3.95)
Communication	0.63	(0.26)	7.79	(3.05)
Education, Health, Sports and Other Social Services	1.48	1.18	20.36	16.08
Medical and Other Health Services	2.29	1.39	31.21	17.97
Sports Services	1.30	1.09	18.27	15.30
Entertainment Services	1.38	1.34	17.91	17.31
Financial Institutions	0.91	(0.71)	16.18	(6.12)
Banks and Special Finance Corporations	1.84	(0.13)	28.71	0.14
Insurance Companies	3.30	0.68	50.83	8.73
Financial Leasing and Factoring Companies	0.73	(1.01)	14.26	(9.28)
Holding and Investment Companies	1.08	(0.83)	18.69	(7.02)
Real Estate Investment Trusts	0.02	(1.23)	3.38	(11.74)
Investment Trusts	0.47	(0.76)	8.89	(7.27)
Brokerage Houses	(5.66)	(6.28)	(50.28)	(54.09)
Technology	(0.54)	(1.53)	(3.01)	(15.56)
Information Technology	(0.86)	(1.68)	(7.08)	(17.12)
Defence	3.19	0.27	45.76	3.26
GENERAL AVERAGE	1.35	(0.49)	21.00	(4.36)

[8] *Source: Istanbul Stock Exchange*
[9] Returns are calculated with the assumption that dividends are reinvested in the concerning stock.
[10] The values which are expressed in parenthesis are minus values.

CHAPTER 3
ECONOMIC AND FINANCIAL CRISES: THE CASE OF TURKEY

3.1 Introduction

The main goal of the investors or/and producers is to maximize their profits, while the main goal of the consumers is to maximize their utilities. In this regard, investors try to find the most profitable sectors in real economy in order to produce or service. They also simply use their capital in money markets or exchange markets or stock markets. As the borders of countries are disappeared, they begin to have many alternatives to invest in different countries. On the other hand, consumers have an incentive to consume or to save. At this point, expectations play an essential role in investing, producing, consuming and saving. Briefly, expectations are the acting today regarding the future. That is to say expectations direct the routes of investment, production, consumption, and saving. We may regard the movement of capital as a result of expectations. Global and local economic atmosphere reflect the expectations. As a result of free movement of capital and existence of many alternatives to invest, local economies start to be more sensitive on speculative attacks and loss of welfare.

In recent decades both developed and less developed countries have faced economic and financial crisis. Thus the structure of an economy and general economic environment are not only the indicators of crisis. If the structure of economies was the only key indicator of crisis, developed countries would not

face an economic or financial crisis. However, having a fragile economic structure means that this economy is more open or more sensitive to crisis.

3.2 Defining Economic and Financial Crises

Studies of crisis become widespread after the publication of Krugman, who try to explain the money crisis, in 1979. The definition of crisis differs across the studies. Dooley (2000) defined the crisis as the temporary and massive declines in production, decrease in income and rise in unemployment.[11] Kibritcioglu (2001) defined the crisis as the strong fluctuations in any certain good, service, production factor or quantity or/and price in foreign exchange market which is actualized above the acceptable border of a change.[12]

Edison (2000) argued that a crisis is an episode in which an attack on the currency leads to a sharp depreciation of the currency, a large decline in international reserves, or a combination of both these effects.[13] The definition of Edison (2000) is intended to be comprehensive, including successful and unsuccessful attacks on the currency under different exchange rate regimes, including fixed exchange rates, crawling pegs or exchange rate bands.

It is impossible to say that there will be a crisis absolutely or to predict the exact time of crisis. As Dornbush (1997) said "Crisis can be seen only when it

[11] Dooley, Michael P. (2000), *Can Output Losses Following International Financial Crises Be Avoided?*, National Bureau of Economic Research, NBER Working Paper Series, Working Paper: p.23
[12] Kibritcioglu, A. (2001), *Economic Crisis and Governments in Turkey, 1969-2001*, Specail Edition of Yeni Turkiye Dergisi for the Economic Crisis: p.4.

occurs".[14] On the other hand, there are some indicators of crisis. In addition general environment reflects the existence of crisis. If the time of crisis may be known, required precautions will be fulfilled and thus governments prevent states from crisis.

It may be argued that crisis takes place in an atmosphere in which consumers spend less, investors invest less. Then, because of less consumption and investment, production declines. As a result, firms begin to discharge their employees. Thus unemployment increases and speculative attacks on currencies and stocks become increased.

While there is not an exact definition of crisis, there are some factors that lead on crisis and there are some indicators that show the indication of crisis. Not only one single force lead to crisis, but also, as Edison (2000)15 said, many of the same forces have been at work in different crises, including the buildup of unsustainable fiscal and external imbalances and the misalignment of asset prices, especially exchange rates. In view of the large costs that economies undergo in a financial crisis, the challenge some crises may pose to the international financial system and more generally, the sense that there may be common elements underlying financial crises, researchers have been focusing on

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[13] Edison, Hali J. (2000), *Do Indicators of Financial Crises Work?:An evaluation of an Early Warning System*, Board of Governors of the Federal Reserve System, International Finance Discussion Papers: p.3
[14] Dornbusch, Rudiger (1997), *The Folly, the Crash and Beyond: Economic Policies and the Crisis*, in Sebastian Edwards and N. Naim (editors), Washington, D. C: Carnegie Endowment.
[15] Edison, Hali J. (2000), *Do Indicators of Financial Crises Work? An evaluation of an Early Warning System*, Board of Governors of the Federal Reserve System, International Finance Discussion Papers: p. 7.

developing models that could help policymakers anticipate problems and react appropriately.

In his research, Edison (2000)[16] used some variables as indicators of crisis:

- Current account indicators: deviations of the real exchange rate from the trend, the value of imports, and the value of exports.

- Capital account indicators: foreign exchange reserves, the ratio of M2 to foreign exchange reserves, and the domestic - foreign real interest rate differential on deposits.

- Real sector indicators: industrial production and index of equity prices.

- Financial indicators: M2 multiplier, the ratio of domestic credit to nominal GDP, the real interest rate on deposits, the ratio of lending-to-deposit interest rates, excess real M1 balances, and commercial bank deposits.

It is important to express that changes in these variables are concerned as the indicators of crisis by Edison. Any unexpected or unnatural changes in these variables may lead to a crisis.

Fisher (1932)[17] argued that financial crises are an integral part of the business cycle. Financial crises are an inevitable result of booms. To lead new investment opportunities and to make market work efficient financial crises are natural part of business cycles.

[16] *Ibid.*, p.7
[17] Fisher, I. (1933), *The Debt Deflation Theory of Great Depressions, Econometrica*: p. 338.

Manasse, Rubini and Schimmelpfennig (2003)[18] asserted that high dept level, political uncertainty, fiscal delusion or overvalued exchange rates and tight connection with international capital markets could be shown in the factors that cause crisis.

Kaminsky and Reinhart (1999)[19] stated that there are possible causality patterns between challenge of banking and payment balances and financial liberalization concerning the historical development of banking and foreign sectors.

Frankel and Rose (1996)[20] argued that when the ratio of direct foreign capital to total debt is decreased, external interest rates are increased, the growth of domestic credits is increased and the rise of production is decreased, the crisis may come up.

Wolf (1999)[21] argued that economic crisis are widely shown with the combination of external factors such as wrong political applications with terms of trade shocks, changes in capital movements and enlargement in capital markets.

As well as there is not any consensus about the definition of crisis, there is also no consensus about the types of crisis. However, in economic literature

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[18] Manasse, Paolo, Nouriel Roubini and Axel Schimmelpfennig 2003, "*Predicting Sovereign Debt Crises*", IMF Working Paper/02/221.

[19] Kaminsky, Graciela L., and Carmen M. Reinhart (1999) "The Twin Crises: The Causes of Banking and Balance of Payments Problems," *The American Economic Review*, 89(3): p.481.

[20] Frankel, Jeffrey A. and Andrew K. Rose (1996), Currency Crashes in Emerging Markets: An *Empirical Treatment*, Journal of International Economics, 41: p. 351-366.

[21] Wolf, Charles Jr. (1999), *Markets, Not Architects, Will Solve Economic Crises*, Wall Street Journal, 20 July 1999. (http://www.imfsite.org/reform/wolf.html) (November 2004).

three types of crisis can be noticed: Currency (balance of payments), debt, and banking crises.

3.2.1 Currency Crisis

Krugman (2000) defined currency crisis as large deviations in an index of currency marker pressure, where such pressure is a weighted average of changes in nominal exchange rates and changes in international reserves.[22] In his earlier study, Krugman (1979) explained the process of currency crisis in following manner: 'A country will have a pegged exchange rate; for simplicity, assume that pegging is done solely through direct intervention in the foreign exchange market. At that exchange rate the government's reserves gradually decline. Then at some point, generally well before the gradual depletion of reserves would have exhausted them, there is a sudden speculative attack that rapidly eliminates the last of the reserves. The government then becomes unable to defend the exchange rate any longer.'[23]

In the same study Krugman (1979) showed a similar argument that can be used to explain currency crises: Through a speculative attempt on a government's reserves investors can reduce the rate of domestic currency and increase the rate of foreign currency so that the make-up of their portfolios is

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[22] Krugman, Paul (2000), *Currency Crisis*, NBER Research Conference Report, ed. Paul Krugman, The University of Chicago Press: National Bureau of Economic Research: p.2.

[23] Krugman, Paul (1979), *A Model of Balance-of-Payments Crises*, Journal of Money, Credit, and Banking, 11(3), p: 316.

altered. Then an alteration in relevant areas justifies this alteration in the make-up because the currency commences to decrease when the exchange rate is not able to be defended by the government any more. To sum up, decreasing demand of domestic currency, and at the same time, increasing demand of foreign currency can lead to a currency crisis as a result of depreciation of domestic currency until the central bank unable to maintain existing exchange rate regime.

A currency crisis can occur under both fixed and floating exchange rates. The reasons of currency crisis may be gathered in two aspects. First, speculations lead to an exhaustion of foreign exchange reserves, then the central bank stops its defense of the original parity. Second, as Eichengreen, Rose, and Wyplosz (1996)[24] emphasize the problems of macroeconomic policy, not the mechanical depletion of foreign exchange. A government, though the increased interest rates, can maintain a fixed exchange rate to an indefinite extend. Yet it can be decided that the cost of defense is bigger than the cost regarding credibility and political consequences that follow the abandonment of defense and the permission for currency float. Since the interest rates is to be raised by the doubts about the government's willing to maintain parity, a currency crisis may exist, and subsequently the cost of maintaining the parity is raised to a level,

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[24] Eichengreen, B., A. Rose, and C. Wyplosz (1996), *Speculative attacks on pegged exchange rates: An empirical exploration with special reference to the European Monetary System*, In The new transatlantic economy, ed. M. Canzoneri, W. Ethier, and V. Grilli, New York: Cambridge University Press.

which the government finds unacceptably high, by the necessity of keeping interest rates high.

In Krugman's theoretical study, he emphasizes that governments which go emission and practice to protect the money in fixed exchange rate system may encounter problems such as depletion of official reserves, borrowing in huge amounts, and expansion in domestic credits.[25]

In the new approach to the currency crisis, these kind of crisis are not emerged as a result of collapse of central bank's foreign currency obligations. According to Kumhof (2000), crisis are characterized by the sudden boost in central bank's national assets as a result of that investors sell their assets to the central bank which begins with speculative attacks against the domestic credits.[26]

Production, domestic and foreign interest rates are considered as the indicators of crisis in models which are improved after the Krugman model which based on collapse of fix exchange rates system. Velasco (1987)[27] and Calvo et al. (1995)[28] argued that rise in domestic interest rates in order to sustain fix exchange rate system causes the rise in financial cost of governments and this

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[25] Krugman, Paul (1979), *A Model of Balance-of-Payments Crises*,, Journal of Money, Credit, and Banking, 11(3): p. 311-312.

[26] Kumhof, Michael (2000), *A Quantitative Exploration of the Role of Short-term Domestic Debt in Balance of Payments Crises*, Journal of International Economics, 51: p.195-197.

[27] Velasco, A. (1987), *Financial and Balance of Payments Crises: A Simple Model of the Southern Cone Experience*, Journal of Development Economics, 27: p. 268.

[28] Calvo, Guillermo A., Carmen M. Reinhart and Carlos A. Vegh (1995), *Targeting the Real Exchange Rate: Theory and Evidence*, Journal of Development Economics, 47: p. 98-101.

triggers abandoning of fix exchange rate system. On the other hand, high interest rates weaken banking system, consequently, instead of suffering to the costs of bankruptcy of banks which are induced open or virtual official guarantee of money authorities over banking system, money authorities prefer to make devaluation.

3.2.2 Debt Crisis

Borrowing is a way of financing government expenses. Other states or international financial institutions, such as International Money Fund, can lend to the governments that need money. The debt crisis starts when the governments reached a point where their foreign debt exceeded their earning power and they were not able to repay it. In other words, government's inability to roll over its debt causes debt crisis.

The definition of a debt crisis also differs across studies. Manasse, Roubini and Schimmelpfenning (2003)[29] regard a debt crisis as having taken place if the country had led access to non-concessional finance from the IMF in excess of 100 percent of its quota.

Why do governments repay their debt although there are only few legal institutions to apply or sanctions to impose for creditors to enforce their claims? The basic answer is that governments want to avoid a loss of reputation that

[29] Manasse, Paolo, Nouriel Roubini and Axel Schimmelpfennig (2003), *Predicting Sovereign Debt Crises*, IMF Working Paper/02/221, Washington: International Monetary Fund, November.

would make it impossible or at least very expensive to issue new debt in the future. Therefore, inability of governments to repay is a loss of reputation and this situation leads to finance initial debts more costly.

3.2.3 Banking Crisis

A bank is a financial institution whose primary activities include borrowing and lending money. In other words, a bank receives demand deposits and time deposits, honors instruments drawn on them, and pays interest on them; discounts notes, makes loans, and invests in securities. That is to say, borrowed money does not physically appear in a bank's cashbox, on the contrary it is used for lending in order to have profit.

The literature on bank failures can be separated into two major groups. The first groups argue that banking crises stems from macroeconomic causes which are beyond the control of individual financial institutions. This group involves two different views: monetarist and fragility views.

Friedman et al.'s (1963) and Cagan's (1965)[30] studies appeared in the monetarist view. They assume that banking crisis occurs as a result of a loss of public trust in the ability of banks to repay deposits. The loss of trust may be precipitated by decline in the quality of bank loans. Furthermore, Friedman and

[30] Cagan, P. (1965), *Determinants and Effects of Changes in the U.S. Money Stock*, 1875-1935, National Bureau of Economic Research.

Schwartz (1963)[31] claim that a bank may go bankrupt even if the bank has an ability to liquidate assets in a brief time in order to repay deposits because this conversion will make money supply and money income smaller.

According to fragility view, a banking crisis occurs when banks don't have sufficient liquid assets to meet their liabilities. Banks are forced to sell their assets in under the market price in order to meet their liabilities. As a result, this selling can cause a banking crisis that the managers of banks and central banks can not intervene.

The second group focuses on banking system or individual financial institutions. Sinkey (1995)[32] assumes that mismanagement, wheeling and dealing cut-rate lending; aggressive liability management and lack of controls are the main causes of bank failures. Credit risk, interest rate risk, operational risk and exchange rate risk are the several types of risks that have to be managed by monetary authorities.

3.2.4 Twin Crises

In many examples of crisis, we don't see the only one type of crisis, in other words, at the same time more than one types of crisis can be seen in a country

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[31] Friedman, M. and Anna J. S. (1963), *Money and Business Cycles*, Review of Economics and Statistics, Vol. 45, No. 1, Part 2.

[32] Sinkey, Joseph F., Jr. (1985), *The Characteristics of Large Problem and Failed Banks*, Issues in Bank Regulation, Vol. 8, No. 3.

or in a region. Kaminsky et al. (1999)[33] argue that 'Episodes where two or more types of crises occur simultaneously are not uncommon and are often referred to as "twin crises"'

Well known twin crises are 'banking and currency crises', and 'debt and currency crises'.

3.2.4.1 Banking and Currency Crisis

In some circumstances a banking crises causes a currency crises. For instances, Obstfeld (1994)[34] disputes that a currency crisis may be led by a weak banking sector when policymakers are expected to select inflation rather than a fixed exchange rate on the ground of preventing bankruptcies. According to Velasco (1987)[35] and Calvo (1997)[36], a currency crisis can be developed by a banking failure if the raised liquidity, which is allied to a rescue plan of the government for banking system, is incompatible with exchange rate stability. Miller(1999)[37] argues that currency devaluation is one of the reasonable policies

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[33] Kaminsky, Graciela, Carmen Reinhart, and Carlos Vegh (2004), *When It Rains, It Pours: Procyclical Capital Flows and Macroeconomic Policies,* NBER Working Paper 10780. Cambridge, Mass.: National Bureau of Economic Research, September.

[34] Obstfeld, M. (1994), *The Logic of Currency Crises*, Cahiers Economique and Monetaires, 43: p. 192.

[35] Velasco, A. (1987), *Financial and Balance of Payments Crises: A Simple Model of the Southern Cone Experience*, Journal of Development Economics, 27: p. 276.

[36] Calvo, Guillermo (1997), *Varieties of Capital-Market Crises*, ed. Guillermo Calvo and Mervyn King, The Debt Burden and Its Consequences for Monetary Policy, London: MacMillan Press: p. 27.

[37] Miller, Victoria (1996), *Speculative Currency Attacks with Endogenously Induced Commercial*

that a government deploys during its encounter with a banking failure in a period of stable exchange rate. Gonzalez-Hermosillo (1996)[38] displays that a currency attack can be caused by a banking crisis in an insufficiently developed financial system, in which domestic assets may act as a substitute for foreign assets.

A currency crisis leads to a banking crisis if money authorities raise interest rates acutely as a response to the distress on the exchange rate. Miller (1996)[39] asserts that a speculative attack on a currency may cause a bank crisis if deposit money is used to speculate in the foreign exchange market. Balance sheets of banks become worse when there is a currency crisis, as a consequence of depreciation in domestic currency.

Furthermore, as Chang and Velasco (1999)[40] don't distinguish between which of the banking crisis and the currency crisis cause the occurrence of the other. They consider them as simultaneous results of common factors.

3.2.4.2 Debt and Currency Crisis

If a government can not finance its expenditures, in other words, if the budget deficits of a government increase suddenly, the government may decrease its

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Bank Crises, Journal of International Money and Finance, 15, June: p. 397.

[38] Gonzalez-Hermosillo, Brend (1996), *Banking Sector Fragility and Systemic Sources of Fragility*, IMF Working Paper, WP/96/12, February.

[39] Miller, Victoria (1996), *Speculative Currency Attacks with Endogenously Induced Commercial Bank Crises*, Journal of International Money and Finance, 15, June: p. 399.

expenditure or increase its income by increasing taxes to finance budget deficits. When these two options are undesirable or unavailable, a devaluation or/and a debt default are the only options of government in order to balance budget. In this circumstance, government has four policy options: neither devaluation nor debt default, debt default but not devaluation, devaluation but not debt default, both devaluation and debt default. These four options are shown in Table 3.1

Table 3.1 Debt, Currency and Twin Crisis

	No Default	**Default**
No Devaluation	No Crisis	Debt Crisis
Devaluation	Currency Crisis	Twin Crisis

The interrelationship between debt and currency crises is discussed in the study of Obstfeld (1994)[41]. On the one hand a government can finance its expenditures by printing money, causing inflation and devaluation in order to avoid the costs such as the loss of reputation on the international capital markets and the loss of GDP (Gross Domestic Product) during the economic turmoil

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[40] Chang, Roberto and Andres Velasco (1999). *Liquidity Crises in Emerging Markets: Theory and Policy*, NBER Working Paper, 7272: p. 23.

typically following a debt crisis. One the other hand a government can finance its expenditures by debt default in order to avoid the welfare costs of inflation and devaluation. Herz and Tong (2004)[42] assert that as it is typical for escape clause models, this can give rise to multiple equilibria with self-fulfilling twin debt and currency crises. The expectation of a debt crisis can increases the debt service due to the higher interest rates thereby inducing a government to inflate and making a currency crisis more likely.

Now, the recent crises in Turkey will be studied in the next section with the lights of discussed literature of crises.

Turkey has been experiencing many economic problems ranging from high and persistent inflation to singe digit CPI, from stagflation to high growth, therefore one can use the Turkish economy just like an open lab for applied research.

In conclusion, from the establishment of Republic of Turkey until now Turkey had experienced many crises which have become frequent and whose intensities have been increased. In this study three of these crises will be researched. These are April 1994, November 2000 and February 2001 crises. Each of them

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41 Obstfeld, M. (1994), *The Logic of Currency Crises*, Cahiers Economique and Monetaires, 43: p. 189-213.

42 Herz, Bernhard and Tong, Hui (2004), *The Interactions between Debt and Currency Crises – Common Causes or Contagion?*, Universität Bayreuth Rechts- und Wirtschaftswissenschaftliche Fakultät Wirtschaftswissenschaftliche Diskussionspapiere, December: p. 7-8.

will be analyzed separately in the point of causes and results with regards of general economic condition both in Turkey and in the World.

3.3 The 1994 Currency Crisis in Turkey

Trade liberalization between 1980 and 1983 resulted in high GNP growth. Especially, real exchange rate depreciation and export promoting policies enabled high export growth. After 1983 imports were liberalized partially and in 1990 almost all import restrictions were canceled. At the same time capital liberalization was completed. Consequently, real exchange rate begun to appreciate. Remove of restrictions on import deteriorated the trade balance in the end of 1990. In conclusion, with accepting liberal policies in 1980s in other words market oriented reforms Turkey succeeded relatively high GNP growth. Table 3.2 shows the GNP growth rates. Starting from the year 1980, GNP continued to grow until 1994 with an average growth rate of 5.2.

Table 3.2 GNP Growth Rates, Turkey, 1980-1995

GROWTH RATES				
	AGRICULTURE	**INDUSTRY**	**SERVICES**	**GNP**
1980	1.1	-3.3	-3.7	-2.8
1981	-1.9	9.2	6.2	4.8
1982	3.1	4.9	3.2	3.1
1983	-0.9	6.3	7.0	4.2
1984	0.5	9.9	7.9	7.1
1985	-0.5	6.2	5.1	4.3
1986	4.6	11.1	6.0	6.8
1987	0.4	9.1	12.9	9.8
1988	7.8	1.8	0.5	1.5

1989	-7.6	4.6	0.9	1.6
1990	6.8	8.6	10.3	9.4
1991	-0.9	2.7	0.6	0.3
1992	4.3	5.9	6.5	6.4
1993	-1.3	8.2	10.7	8.1
1994	-0.7	-5.7	-6.6	-6.1
1995	2.0	12.1	6.3	8.0

Source: State Planning Organization

On the other hand, in 1994 GNP reduced 6.1% which is the highest level of annual output loss in the history of the Turkish Republic. In fact, next year of crisis GNP grew once again by 8%.

Between 1980 and 1993 agriculture had grown with an average of 1.1%. It had the smallest share in GNP growth because agriculture is sensitive to weather conditions. Thus, evaluation of an economy only looking to growth in agriculture may be misleading. Industry had grown with an average of 6.8% and services had grown with an average of 6%.

However, as a result of ensuring the economic growth, increased domestic and foreign debt raised the fragility of the economy. In addition, high inflation rates, weakness of external balances, high public deficits, and current account deficits were the chronicle problems of Turkey. That is to say, not only the negative performance of economic policy in 1994 caused the 1994 Crisis, but also lack of fiscal discipline and macroeconomic instability led to the 1994 Crisis.

Table 3.3 shows the consolidated budget balance of Turkish economy (percentage share in GNP). Public sector expenditures of Turkey rose steadily between 1985 and 1993, as shown in Table 3.3, where the gap between public sector revenue and expenditure is widening between 1988 and 1993, as interest payments on existing debt became an increasing burden. In 1993, 5.83% of GNP was interest payments including 4.63% of GNP to domestic borrowing and 1.2% to foreign borrowing. In 1993 budget balance had the highest deficit with 6.7% of GNP.

The reasons for this growth in public expenditures were abundant agricultural support policies of the government, deteriorating performance of the state owned economic enterprises (SEE) and implicit subsidies to money losing state owned enterprises, weak positions of social security institutions, the increased cost of military operations in the southeastern region of the country, and increased interest payments. In 1993, 1.2% of GNP transferred into state owned enterprises and 0, 69% of GNP transferred into Social security system to finance their deficits.

The financing of the public sector became increasingly dependent on domestic borrowing after 1983, thus the share of foreign borrowing was to be declined. Domestic borrowing was desirable in the beginning of 1990s. However, when the Gulf War took place, panics in the financial markets caused increases in interest rates and shortening of debt maturity. Reliance on short term cash from the Central Bank in order to keep interest rates from increasing caused the rise of

pressure on exchange rate. Agenor, McDermott and Ucer (1997)[43] state that while the government's reliance on net domestic financing has been increasing, it initially refrained from monetizing the deficits by issuing short term debt at high interest rates, however as domestic interest payments rose in 1993, the importance of short term advances from the Central Bank in financing the deficit increased.

Ozatay (1996)[44] compared the case of Turkey with funding crises in several European countries in the 1920s, and concluded that such crises were debt management policy, particularly by offering interest rates at less than market clearing levels. He attributed the timing of the Turkish crisis to the debt mismanagement of late 1993 to early 1994. Until the beginning of 1994, the government tried to control the interest rates on debt.

Thus, was the fiscal imbalance main reason of the 1994 Currency Crisis? In other words, did such a fiscal carelessness have to end up with a currency crisis? Eichgreen, Rose and Wyplozs (1995)[45] state that they do not detect any link between lack of fiscal discipline and exchange market turbulence. Sachs, Tornell

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[43] Agenor, P.R., McDermott C. J., Ucer M. E. (1997), *Fiscal Imbalances, Capital Infows and the Real Exchange Rate: The case of Turkey*, IMF Working Paper, WP97/1.

[44] Ozatay, F. (1996), *The Lessons From the 1994 Crisis in Turkey: Public Debt (Mis)Management and Confidence Crisis*, Yapi Kredi Economic Review, June, Vol:7: p.28.

[45] Eichengreen, B., Rose, A. K. and C. Wyplosz (1995*), Exchange Market Mayhem: The Antecedents and Aftermath of Speculative Attacks*, Economic Policy, 21: p. 278.

and Velasco (1996)[46] emphasize that countries with better fiscal performance had the chance to escape from any crisis. As one of the conceivable interpretations of their results, Eichgreen, Rose and Wyplozs (1995) argue that only money-financed deficits may matter.

Table 3.3 Consolidated Budget Balance (Percentage Share in GNP), Turkey, 1985-1995

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
EXPENDITURES	15.03	15.95	16.92	16.26	16.52	16.92	20.53	20.08	24.29	23.08	21.78
Current	5.93	5.96	6.47	6.09	7.73	8.93	10.38	11.28	11.09	9.49	8.20
Investment	2.91	3.17	2.64	2.10	1.68	1.72	1.85	1.72	1.83	1.30	1.17
Transfers	6.19	6.82	7.82	8.07	7.11	6.27	8.31	7.09	11.38	12.30	12.41
-Interest Pay.of which:	1.91	2.60	3.02	3.85	3.59	3.52	3.79	3.65	5.83	7.67	7.33
Domestic Borrowing	0.70	1.27	1.68	2.45	2.22	2.42	2.67	2.77	4.63	6.00	6.05
Foreign Borrowing	1.21	1.33	1.34	1.41	1.36	1.10	1.12	0.88	1.20	1.67	1.28
-Transfers To SEEs	0.51	0.27	0.64	0.78	0.53	0.32	1.92	0.74	1.29	0.54	0.58
-Tax Rebates	2.05	2.18	2.20	1.63	1.25	0.90	1.02	0.98	1.06	0.80	0.81
-Social Security	0.59	0.56	0.56	0.58	0.61	0.31	0.25	0.36	0.69	1.01	1.38
-Other Transfers	1.12	1.21	1.39	1.22	1.14	1.23	1.32	1.36	2.50	2.27	2.31
REVENUES	12.77	13.20	13.45	13.17	13.19	13.91	15.25	15.79	17.59	19.16	17.75

[46] Sachs, J., Tornell, A. and A. Velasco (1996), *Financial Crisis in Emerging Markets: The Lessons from 1995*, Brookings Papers on Economic Activity: p. 195-203.

General Budget Revenues	12.48	12.95	13.19	12.95	13.00	13.74	15.10	15.66	17.43	19.03	17.59
Annexed Budget Revenues	0.29	0.24	0.26	0.22	0.19	0.17	0.15	0.13	0.17	0.13	0.16
BUDGET BALANCE	-2.26	-2.76	-3.48	-3.09	-3.33	-3.01	-5.28	-4.30	-6.70	-3.91	-4.03
Deferred & Adv.Payments Net	-0.33	-0.38	0.04	-0.06	-0.28	-0.10	0.01	-1.09	0.39	0.01	0.28
CASH BALANCE	-2.59	-3.14	-3.43	-3.15	-3.61	-3.11	-5.27	-5.39	-6.31	-3.91	-3.75
FINANCING											
Foreign Borrowing (Net)	-0.64	-0.01	-0.35	0.24	-0.09	0.01	0.30	0.37	1.05	-1.73	-1.03
Domestic Borrowing (Net)	3.23	3.15	3.79	2.91	3.70	3.10	4.97	5.02	5.26	5.64	4.78

Source: State Planning Organization, Turkish Ministry of Finance

Table 3.4 shows the total imports and exports, import coverage of exports, foreign trade deficit as percentage of GNP and current account balance as percentage of GNP. Exports and imports continued to grow between 1980 and 1994, but imports surpassed the growth in exports due to the increased domestic demand for imports. Therefore, current account deficit deteriorated from 0.6% of GNP in 1992 to 3.5% of GNP in 1993, which was about six fold rise in one year time. In 1993 ratio of foreign trade deficit to GNP was the highest value through 1990s.

Table 3.4 Foreign Trade Deficit and Current Account Balance as percentage of GNP, Turkey, 1983-1995

	Total Exports (Millions of US$)	Total Imports (Millions of US$)	Import Coverage of Exports (%)	Foreign Trade Deficit/ GNP (%)	Current Account Balance/ GNP (%)
1983	5,728	9,235	62.0	4.8	3.1
1984	7,134	10,757	66.3	4.8	2.4
1985	7,958	11,343	70.2	4.4	1.5
1986	7,457	11,105	67.1	4.0	1.9
1987	10,190	14,158	72.0	3.7	0.9
1988	11,662	14,335	81.4	2.0	-1.8
1989	11,625	15,792	73.6	3.9	-0.9
1990	12,959	22,302	58.1	6.3	-1.7
1991	13,594	21,047	64.6	4.8	0.2
1992	14,715	22,871	64.3	5.1	-0.6
1993	15,345	29,428	52.1	7.8	-3.5
1994	18,106	23,270	77.8	3.2	2.0
1995	21,637	35,709	60.6	7.7	-1.4

Source: State Planning Organization, Turkish Statistical Institute

Treasury started to cancel the auctions of 3, 6 and 9 monthly maturities in the last quarter of 1993 in order to save on interest rates and raise the maturities. The amount of offers by the market participants was too low in the last quarter of 1993 comparing to the other quarters in 1993. In addition, accepted amount by Treasury was under 40%. In fact, the acceptance rate of 3, 6 and 9 month paper was zero in December 1993. There was not any borrowing from papers which had maturities less than one year. The domestic borrowing market would in fact disappear until May 1994, when the Treasury managed to borrow substantial amounts again, but at compounded annual rates around 400%.

Table 3.5 shows the maturity and average interest rates on domestic borrowing in 1993 and 1994. In 1993 the average simple and compound interest rates were about 80%. However, in 1994 interest rates started to increase and maturity started to decline. In May 1994 the maturity of domestic borrowing was 44 day with an average simple interest rate of 159% and with an average compound interest rate of 337%.

The essential part of capital inflow to Turkey was in the form of short-term borrowing. Many commercial banks held short positions in foreign exchange and lent them domestically at high interest rates. The large open positions of banks continued especially in 1993. The banks attacked to the foreign exchange market in order to close their positions in foreign exchange.

Table 3.5 Interest Rates and Maturity (day) on Domestic Borrowing, 1993-1993

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1 9 9 3 Maturity	127	200	264	221	330	218	269	275	290	336	356	365	257
Average Simple Interest Rates	75.1	72.8	77.2	75.3	83.3	76.4	80.7	82.0	80.9	84.2	87.2	89.2	79.3
Average Compound Interest Rates	95.8	84.7	84.6	85.7	85.8	87.3	87.9	89.1	86.3	86.2	87.9	89.2	87.6
1 9 9 4 Maturity	218	347	350	364	44	88	122	140	141	125	91	99	119
Average Simple Interest Rates	87.1	123.1	127.8	126.4	158.9	161.9	110.3	103.8	97.1	86.2	94.4	100.2	109.9
Average Compound Interest Rates	102.4	125.8	130.1	126.5	337.3	302.4	154.6	139.1	127.9	112.4	134.0	142.7	164.4

Source: The Undersecretariat of Treasury

At the same time, the Central Bank had been selling foreign currency at rates below the market rate to defend the parity. Thus, the Central Bank had lost more than half of its reserves during this time. Moreover, the fall in was coupled with the depreciation of the Lira. As shown in Table 3.6, in September 1993 the Central Bank had 7,001 million US$, on the other had the Central Bank had 3,206 million US$ in April 1994.

Table 3.6 Center Bank Reserves, Million US$, 1993-1994

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
1993	6,299	6,460	7,364	6,868	6,980	7,046	6,921	6,929	7,001	6,825	6,698	6,661
1994	5,747	4,783	4,288	3,206	3,275	3,881	4,927	6,070	6,367	6,848	6,760	7,302

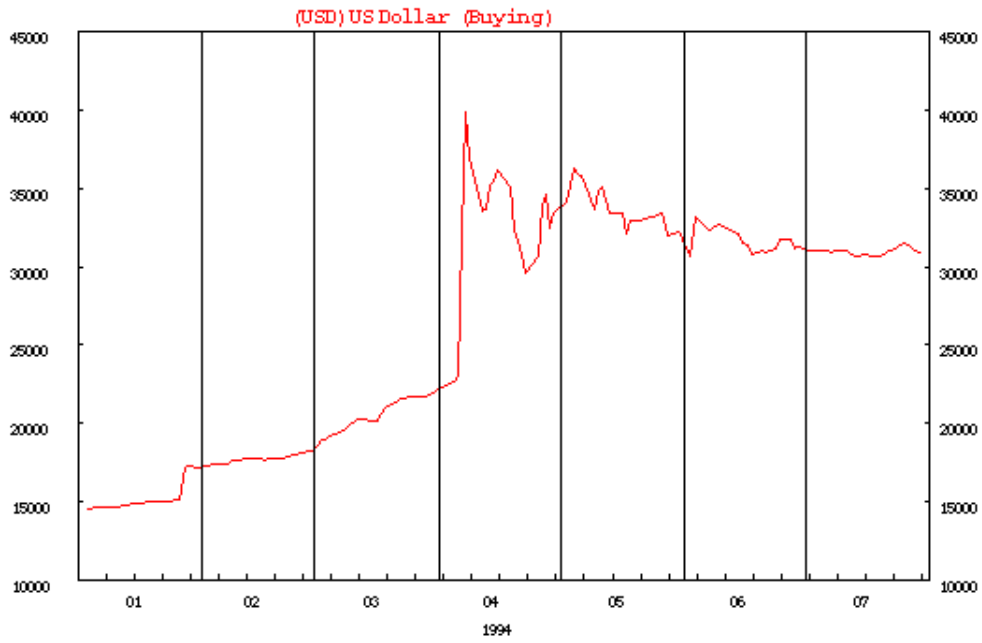
Source: Central Bank of Turkey

The Savings Deposit Insurance Fund (SDIF) took control over three small banks (Marmarabank, TYT Bank and Impexbank) in April 1994. To avoid bank run government declared a 100 percent guarantee on all domestic and foreign currency deposits.

Parallel to the loss of the Central Bank reserves, sharp depreciation of TL (Turkish Lira) occurred. As shown in Figure 3.1, the TL dropped from 14,500 in January 1st to 39,850 in April 7th against the US$, depreciating by more than 100%. The percentage depreciation of the TL was about 16, 6, 18, and 35 during the first 4 months of 1994 respectively. The TL dropped to 39,900 against the US$ on April 7, but recovered to 33,400 TL/US$ at the end of the month.

The pressure on the exchange rate market started to be declined starting in May as can be seen in Figure 3.1 by the appreciation of the exchange rate between May and July. In addition, the international reserves started to increase from May onwards, as can be seen in Table 3.6.

Figure 3.1 Exchange Rates (daily), US$, Jan.1994 – July 1994



Source: Central Bank of Turkey

In conclusion, Turkey experienced high level of budget deficits until 1994. Financing the fiscal imbalances was mostly based on domestic borrowing. The cost of domestic borrowing was rising, thus the Treasury cancelled various domestic debt auctions. Then, the Treasury started to rely upon Central Bank resources heavily. Ozatay (1996)[47] argues that the Turkish government had become unable to pay debt already by the end of 1992, and that the timing of the crisis specifically at the beginning of 1994 was due to the interventions in the domestic borrowing market.

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[47] Ozatay, F. (1996), *The Lessons From the 1994 Crisis in Turkey: Public Debt (Mis)Management and Confidence Crisis*, Yapi Kredi Economic Review, June, Vol:7: p.32.

The government announced a new stabilization package on the 5th of April 1994. This involved price increases of public goods, additional taxes (including one-time taxes on the net assets of firms, wealth and corporate taxes) and a reduction in public investment. In addition, reserve and liquidity requirement rules were revised in favor of holding TL relative to foreign currency. The financial crisis finished only after the Treasury was able to re-borrow from the domestic debt market at the end of May, after the stand-by agreement with the IMF.

3.4 The 2000 and 2001 Financial Crisis in Turkey

Turkish economy have had high and volatile inflation rates which has been the chronicle problem starting in the 1980s. Government tried to settle the inflation matter by various disinflation programs under the guidance of the International Monetary Fund (IMF). In December 1999 the Turkish government launched an exchange rate based stabilization program backed by the International Monetary Fund (IMF) in order to reduce inflation. The program was supported by the International Monetary Fund (IMF) with about US$4 billion over three years and was aimed at achieving single digit inflation by 2002. Fiscal adjustment and structural reform was carried out to supplement disinflation program. The main tool of the disinflation program was adoption of a crawling peg regime; i.e., the percent change in the Turkish lira value of a basket of foreign exchanges (1 US dollar plus 0.70 Euro) is fixed for a period of a year and a half.

After the letter of intent with the International Monetary Fund (IMF) and the Helsinki summit, Turkey is named as an official member considered for the enlargement of the European Union, initial indicators were encouraging. Inflationary expectations improved considerably. At these months Turkey was favorable for the international investors. Thus, Turkey attracted foreign investment after December 1999. As the capital inflow had continued, market liquidity increased and interest rates declined. In addition, some banks purchased huge amount of government securities, hence price of government securities increase and the interest rates decrease. In short, positioning of some banks in the expectations of falling interest rates led to quick decrease of interest rates.

Decrease in the interest rates caused rises in consumption and investment, leading to an increase in the growth of the economy. Also, the increase in accessibility to the credits led to high consumption and investment. Hence, high consumptions led to high tax revenue. As shown Table 3.7, after the stabilization program in December 1999 Turkish economy started to grow 5.6% in the first quarter of 2000, 6.9% in the second quarter of 2000, 7.8% in the third quarter of 2000, and 8.6% in the forth quarter of 2000. Turkish economy continued to grow with increasing growth rates in 2000. However, after the December 2000 crisis, Turkish economy started to contract by 2.1% in the first quarter of 2001.

Table 3.7 Growth Rate, Turkey, 1998-2001

Quarter	Growth Rate (%)

1998 Q1	9.2
1998 Q2	3.3
1998 Q3	2.7
1998 Q4	-1.2
1999 Q1	-8.2
1999 Q2	-2.2
1999 Q3	-6.3
1999 Q4	-2.1
2000 Q1	5.6
2000 Q2	6.9
2000 Q3	7.8
2000 Q4	8.6
2001 Q1	-2.1
2001 Q2	-8.9
2001 Q3	-7.1

Source: The Undersecretariat of Treasury

At the first months of stabilization program, there was a boom in imports and economic activity. These were financed by foreign borrowing. As a result of foreign borrowing, current account deficit became wide. Then, there were doubts in the financial markets about the sustainability of the stabilization program, leading to attacks against the Turkish Lira (TL).

At the beginning of stabilization program Consumer Price Index (CPI) was about 69%. In consequent months Consumer Price Index (CPI) declined to 39%. This ratio was over the target rate that was determined by the International Monetary Fund (IMF). Table 3.8 shows the monthly Consumer Price Index (CPI) between 1998 and 2001.

Table 3.8 Consumer Price Index (%), Monthly, Turkey, 1998-2001

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1998	102	99	97	94	91	91	85	81	80	77	73	70
1999	66	64	64	64	63	64	65	65	64	65	65	69
2000	69	70	68	64	63	59	56	53	49	44	44	39
2001	36	33	38	48	52	56	56	58	62	67	67	69

Source: Central Bank of Turkey

In 1999, Turkey had 26,588 million US$ total exports and 40,671 million US$ total imports. In 2000, the total exports were 27, 775 million US$ and the total imports were 54,503 million US$. Although the Turkish Lira (TL) depreciated, exports did not increase meaningfully. In 2000, exports increased by 4.5% according to previous year, however, imports increased by as much as 34%. The current account deficit which was 1.3$ billions in 1999, ejected to reach 9.8$ billions in 2000. The deficit in the current account reached to 4.9% as a ratio to the national product in 2000. Table 3.9 shows the total exports, total imports, the ratio of foreign trade deficit to the Gross National Product (GNP) and the ratio of current account balance to the Gross National Product (GNP).

Clearly, both the trade and the current account deficits deteriorated sharply throughout the stabilization program period and reached record levels by the end of 2000. In 2000 the current account balance showed a deficit of US$8.58 billion and a trade deficit of US$26.7 billion. Although exports had increased, increase in the imports, which was more than increase in exports, caused the deterioration in foreign trade. External factors such as increases in oil prices and

decline of Euro/Dollar parity played crucial roles in deterioration of foreign trade deficit. Increase in oil prices affected the deterioration in current account balance, but increase in oil prices were not the main reason of deterioration in current account balance. Decline of the Euro against the Dollar created difficulties for Turkish exports because essential share of Turkish exports had been on Euro zone.

Table 3.9 Exports, Imports, Foreign Trade Deficit and Current Account Balance/GNP, Turkey, 1998-2002

Year	Exports (Million US$)	Imports (Million US$)	Foreign Trade Deficit/ GNP (%)	Current Account Balance/ GNP (%)
1998	26,973	45,921	6.9	1.0
1999	26,588	40,671	5.6	-0.7
2000	27,775	54,503	11.1	-4.9
2001	31,334	40,410	3.1	2.3
2002	36,059	50,146	4.6	-0.8

Source: State Planning Organization

As shown in Table 3.10, between January 2000 and October 2000, the Turkish economy enjoyed a positive net capital flow of 12.4 billion US$. On the other hand, between November 2000 and September 2001 a negative net capital flow of 13.6 billion US$ had been occurred.

Table 3.10 Net Capital Flows, Turkey, 2000-2001, Million US$

	January-October 2000	November 2000-September 2001
Net Capital Inflows	15,179	-12,416
Net Capital Outflows	-2,707	-1,247
Total Net Capital Flows	12,472	-13,663

Source: Central Bank of Turkey

The Russian crisis in August 1998, the general elections in April 1999 and two devastating earthquakes in August and October 1999 caused the deterioration of the fiscal balance of the public sector. Weak fiscal position of Turkey was deepened by the record levels of interest payments on domestic borrowing. Interest payments of domestic borrowing reached 21.25% of GNP in 2001. A sharp increase in budget deficit can be seen in 2001 with 16.9% of GNP.

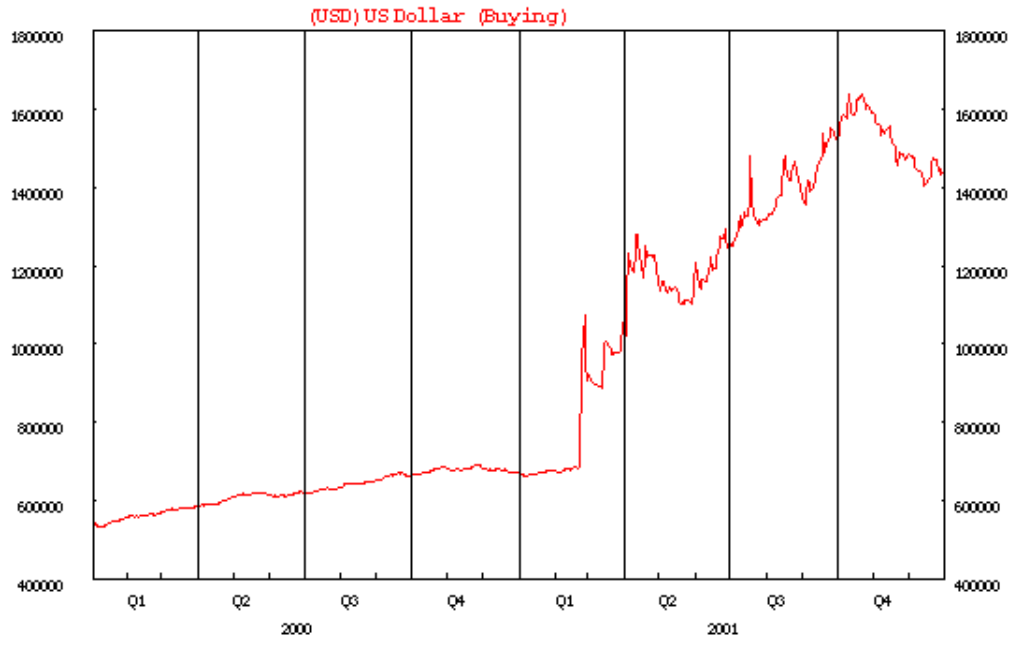
Table 3.11 Consolidated Budget Balance (Percentage Share in GNP), Turkey, 1999-2002

	1999	2000	2001	2002
EXPENDITURES	35.89	37.40	46.00	42.87
Current	11.70	10.82	11.56	11.18
Investment (*)	2.00	2.20	2.72	3.08
Transfers	22.18	24.37	31.72	28.60
-Interest Payments of which:	13.69	16.27	23.27	18.97
Domestic Borrowing	12.55	14.96	21.25	17.12
Foreign Borrowing	1.14	1.31	2.02	1.85
-Transfers To SEEs	0.53	0.71	0.63	0.79
-Tax Rebates	1.48	1.30	1.65	2.07
-Social Security	3.51	2.64	2.90	4.10
-Other Transfers	2.96	3.45	3.27	2.67
REVENUES	24.03	30.45	29.09	27.62
General Budget Revenues	23.78	30.21	28.74	27.26
Annexed Budget Revenues	0.25	0.24	0.35	0.36
BUDGET BALANCE	-11.86	-10.93	-16.91	-15.25
Deferred & Adv.Payments Net	-0.07	0.08	-2.01	1.72
CASH BALANCE	-11.90	-10.85	-18.92	-13.53
FINANCING				
Foreign Borrowing (Net)	0.76	2.43	-2.52	6.06
Domestic Borrowing (Net)	12.44	7.01	13.34	6.39

Source: State Planning Organization, Turkish Ministry of Finance

After the second quarter of 2001, the US$/TL nominal parity has increased by quarterly rates of 97%, 116%, and 114%, and stabilized only after November of 2001. As shown in Figure 3.2, US$/TL rate was 54,000 in the beginning of January 2000, however it was 1,636,942 in the end of October 2001. Figure 3.2 shows the US$/TL parity between January and December 2001.

Figure 3.2 Exchange Rates (daily), US$, Jan.2000 – Dec.2001

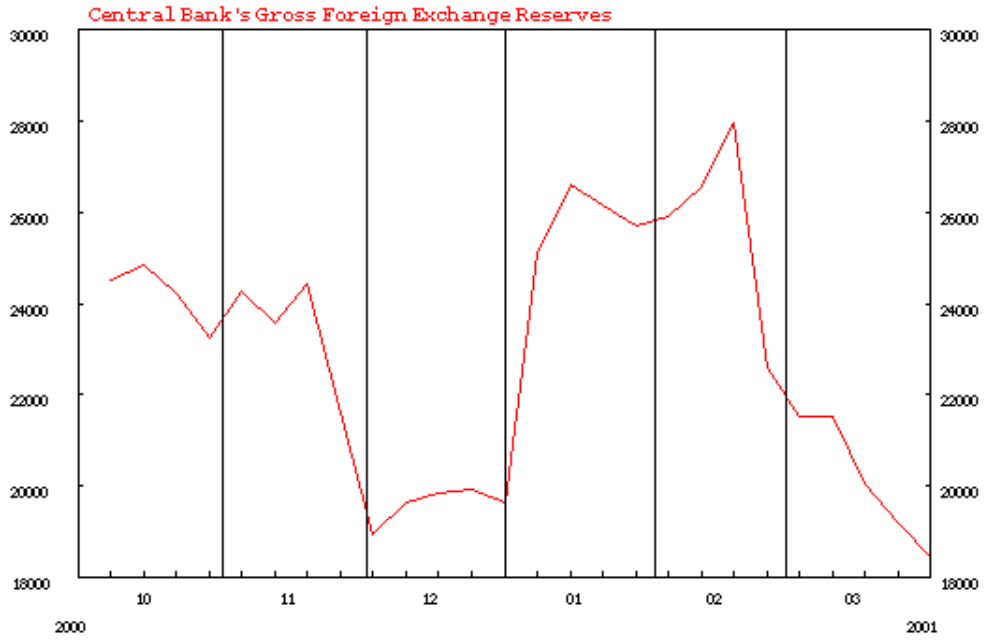


Source: Central Bank of Turkey

Central Bank used its foreign exchange reserves in order to interrupt the increase of exchange rates. As shown Figure 3.3, the Central Bank of Turkey had

about US$ 25 billion net international reserves at the beginning of October 2000. However at the end of November 2000, the Central Bank of Turkey had about US$ 18 billion net international reserves. The loss of Central Bank's reserves was about US$ 7 billion during this period. In addition the loss of the Central Bank was US$ 5 billion in the third week of February 2001.

Figure 3.3 Central Bank's Gross Foreign Exchange Reserves (weekly), Million US$, Oct.2000 – Mar.2001



Source: Central Bank of Turkey

The fragility of banking system must be taken into account during the 2000 and 2001 crises. The expectations of falling interest rates led to an aggressive positioning of some banks in Turkey after the stabilization program. With these expectations, huge amounts of government securities were purchased by banks, resulting in rise of the government securities' price and decline in interest rates. Also, interbank loans were important for the short-term financing needs of banks.

Price of government securities had declined as a result of the rise in the interest rates at the second half of November 2000. This situation increased the market risk in Turkey. Then some foreign banks shut credit lines to some Turkish banks because of market risk in Turkey. During this period, bankruptcy of some banks was a result of difficulties in funding. Banks in need of short-term funding started to sell government securities, therefore the price of government securities reduced and the interest rates increased. Interest rates were already on a rising path, which led the banks in difficulty to attempt to maintain liquidity by selling their holdings of government securities. In order to meet the need of banks' short-term funding, the Central Bank purchased the government securities and lent to banks at the interbank market. This injection of liquidity raised the demand for foreign exchange. Increased foreign exchange risk led to capital outflow and banks reducing their short foreign exchange position. As a result, reduction in foreign exchange reserves of the Central Bank was inevitable.

Table 3.12 shows the interbank overnight interest rates. A sharp rise can be seen in the months of November 2000, December 2000 and February 2001. In February 2001 the interbank overnight interest rates reached it top point with 4,018%.

Table 3.12 Interbank Overnight Interest Rates, %, Sep.1999-Mar.2001

	Minimum	Maximum	Average
1999 September	57	71	67
1999 October	65	70	69
1999 November	68	70	70
1999 December	69	70	70
2000 January	19	64	36
2000 February	26	83	49
2000 March	26	68	39
2000 April	19	46	36
2000 May	32	56	41
2000 June	26	76	42
2000 July	13	39	26
2000 August	22	93	35
2000 September	23	80	46
2000 October	25	71	38
2000 November	27	316	79
2000 December	61	873	199
2001 January	31	77	42
2001 February	36	4018	436
2001 March	80	96	82

Source: Central Bank of Turkey

News about a large emergency IMF package in the following week helped reduce the tension in the markets. However, the Turkish lira continued to be

overvalued as a result of the slow fall in inflation. Against this background, a public disagreement between the Prime Minister and the President was followed by a massive attack on the Turkish lira on the 21st of February 2001. The authorities decided to float the currency the following day with 28 per cent loss of value against the dollar. In the subsequent two months, the Turkish lira lost almost half of its value. The resulting output loss was substantial and the economy contracted by over nine per cent in 2001.

In consequence, sustainability of currency regime was not rationalized after the stabilization program with support of International Monetary Fund (IMF). Fischer (2001)[48] argue that the currency regimes based on soft-pegs (as had been the case for Turkey under the IMF program) were not sustainable, based on the experiences of the Turkish November 2000 and the Argentinean 2001 crises.

CHAPTER 4

RISK AND THE VALUE AT RISK IN RISK MEASUREMENT

4.1 Definition of Risk

When there are some alternatives and we have to choose one of them, our decision contains risk in some different degrees. For instance we can go the school by our car or by public transportation. These two different alternatives contain different degree of physical risk, thus we are exposed the risk of accident.

From the financial view, we may choose the best alternative under the three conditions. These are choosing the alternative under determined certain conditions, under the specific risk, and under the uncertain conditions. Under certain conditions, we know the results of alternatives. When we choose one of the alternatives, we know the outcome of the alternative. In brief the probability of alternatives' appearance is one hundred percent. Under the specific risk, we have the historical information of alternatives. In which conditions and with what probability the alternative may occur are known. That is to say, statistical data of alternatives exists under the risky conditions. In uncertainty, because we don't

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[48] Fischer, S. (2001), *Exchange Rate Regimes: Is the Bipolar View Correct?*, New Orleans, American Economic Association, January: p. 3-24

have any historical information of alternatives, we don't know the probability of alternatives' appearance.

Generally the concept of risk and uncertainty are confused. Knight (1921) made the summary of the difference between risk and uncertainty:

"Uncertainty must be taken in a sense radically distinct from the familiar notion of Risk, from which it has never been properly separated. The essential fact is that "risk" means in some cases a quantity susceptible of measurement, while at other times it is something distinctly not of this character; and there are far-reaching and crucial differences in the bearings of the phenomena depending on which of the two is really present and operating. It will appear that a measurable uncertainty, or "risk" proper, as we shall use the term, is so far different from an un-measurable one that it is not in effect an uncertainty at all."[49]

Holton (2004)[50] asserts that there are two ingredients that are needed for risk to exist. The first is uncertainty about the potential outcomes from an experiment and the other is that the outcomes have to matter in terms of providing utility. He notes, for instance, that a person jumping out of an airplane

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[49] Knight, F.H., 1921, Risk, Uncertainty and Profit, New York Hart, Schaffner and Marx.

[50] Holton, G.A. (2004), *Defining Risk*, Financial Analysts Journal, 60 (6): p. 19–21

without a parachute faces no risk since he is certain to die. There are not any uncertain conditions for the jumping person.

In this framework, financial investments occur under the conditions which have the probability distributions based on the past data. Thus we may define the risk as the deviation of actual return from the expected return. Actual return may be more or less than the expected return. In both cases we can mention about the risk. In conclusion, risk may be defined as the chance that an investment's actual return will be different than expected.

Definition of risk in statistical terms may be as follows with regarding the definitions of risk that are mentioned above:

$$E(R) = P_1 R_1 + P_2 R_2 + \ldots + P_n R_n \quad (4.1)$$ where

E(R) = expected return

Ri = the return of assets in time 'i'

Pi = the probability of returns

The square of differences between the actual returns and expected returns are called variance and symbolized as σ^2.

$$\sigma^2 = \sum_{i=1}^{n} P_i \left(R_i - E\left(R_i\right)\right)^2 \quad (4.2)$$

And standard deviation is equal to square root of variance which shows the deviations of return and is used to measure risk.[51]

4.2 Sources of Risk

There are some kinds of risk that can be controlled and a risk manager can take preventive measures to overcome risk. However, some kinds of risk can not be controlled and a risk manager can not adopt measures. According to the property of risk, sources of risk may be classified into two headlines. These are systematic risk and unsystematic risk.

4.2.1 Systematic Risk

Systematic risk influences a large number of assets. A significant political event, for example, could affect several of the assets in your portfolio. It is virtually impossible to protect yourself against this type of risk. In other words, systematic risk can not managed by the portfolio owner, manager or the any individual investor and it stems from the changes in economy and/or politics. Systematic risk influences all assets in the same direction but in different rates. That is to say, the prices of all assets may increase or decrease at the same time. The systematic risk levels differentiate according the type of assets.

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[51] Brealey R., Myers, A., Marcus, A., Maynes, E., and Devashis Mitra (2006), *Fundamentals of Corporate Finance*, McGraw-Hill Ryerson Higher Education: p. 43.

Systematic risk contains five sub-risks: Inflation rate risk, interest rate risk, market risk, political risk and exchange risk.

4.2.1.1 Inflation Rate Risk

Increase in the aggregate price level reduces the purchasing power of constant income. Inflation rate risk affects the prices of assets in the context of deterioration in purchasing power. Inflation rate risk is also called as purchasing power risk. In addition, since inflation rates influence the expected return, inflation rates must be taken into consideration in calculating reel return of investment. Especially in long run investments inflation rate risk becomes more important.

4.2.1.2 Interest Rate Risk

Interest rate risk is the risk that an investment's value will change as a result of a change in interest rates. In other words, the risk that an investment's value will change due to a change in the absolute level of interest rates, in the spread between two rates, in the shape of the yield curve or in any other interest rate relationship. Such changes usually affect securities inversely and can be reduced by diversifying or hedging.

Basel Committee on Banking Supervision (BCBS)[52] notes that interest rate risk can be separated into four parts: repricing risk, yield curve risk, basis risk, and optionality. Repricing risk refers to fluctuations in interest rate levels that have

differing impacts on bank assets and liabilities. Yield curve risk refers to changes in portfolio values caused by unanticipated shifts in the slope and shape of the yield curve. Basis risk refers to the imperfect correlation between index rates across different interest rate markets for similar maturities. Optionality refers to risks arising from interest rate options embedded in a bank assets, liabilities, and off-balance-sheet positions.

Increase in the interest rate volatility raised the interest rate risk. Thus, return of assets decreases with the increase in the interest rate volatility. Interest rate risk also affects stock market. When interest rate increases, the price of stocks declines because increase in interest rates makes the stock ownership less desirable.

4.2.1.3 Market Risk

Market risk is the risk which is common to an entire class of assets or liabilities. The value of investments may decrease over a given time period simply because of economic changes or other events that affect large portions of the market. Market risk generally seems on stock prices. Uncertainty in the market affects the stock markets more than the bond markets. Because the future values of bonds are more realistic than the future value of stock, stocks are exposed the more market risk.

4.2.1.4 Political Risk

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[52] Basel Committee on Banking Supervision (2004), *Principles for the Management and Supervision of*

Political risk is the risk which represents the financial risk that a country's government will suddenly change its policies. Political and economical crisis in the world, wars, domestic unrest and clash of economic interest are very effective in investors' decision. Thus, political risk is the reflection of national and international political conditions.

4.2.1.5 Exchange Rate Risk

Exchange rate risk is simply the risk to which investors are exposed because changes in exchange rates may have an effect on investments that they have made. When investing in foreign countries you must consider the fact that currency exchange rates can change the price of the asset as well. applies to all financial instruments that are in a currency other than your domestic currency. For instance, if you are a resident of Turkey and invest in some German stock in Euro, even if the share value appreciates, you may lose money if the Euro depreciates in relation to the Turkish Lira.

Investors in companies that have operations in another country are also exposed to exchange rate risk. A company with operations abroad will find the value in domestic currency of its overseas profits changes with exchange rates.

In a similar manner, an exporter is likely to find that an appreciation in its domestic currency will mean that either sales fall, because its prices rise in terms

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Interest Rate Risk, http://www.bis.org/publ/bcbs108.pdf

of its customer's currency, or that it's gross margin shrinks, or both. A depreciation of its domestic currency would have the opposite effect.

4.2.2 Unsystematic Risk

Unsystematic risk is the risk of price change due to the unique circumstances of a specific asset, as opposed to the overall market. Unsystematic risk sometimes referred to as "specific risk". This kind of risk affects a very small number of assets. For example, there is news of sudden strike by employees of a firm. This news will affect the firm's stock, not overall stock market. The unsystematic risk is unique to a company such as a strike, the outcome of unfavorable litigation, or a natural catastrophe. That is to say, Unsystematic risk only affects a specific stock. The unsystematic risk can be eliminated from a portfolio through diversification. Unsystematic risk may be classified into four categories. These are business risk, financial risk, management risk, and sector risk.

4.2.2.1 Business Risk

Business risk is the risk which is related to the firm's assets structure. Business risk increases as the ratio of fixed assets in total assets increases. Increased fixed assets lead to increase in the ratio of fixed costs to total costs, thus break-even point raises. In addition, when the productions and the sales are low, these fixed costs become problematic. Furthermore, fluctuations in sales results in high fluctuations in profit. Fluctuations in profit affect the return of firm's stock. The business risk can be reduced by diversification in incomes and productions.

4.2.2.2 Financial Risk

Fixed financial obligations, such as credits of banks and long run lease agreement are the source of financial risk. Financial risk is the additional risk a shareholder bears when a company uses debt in addition to equity financing. Companies that issue more debt instruments would have higher financial risk than companies financed mostly or entirely by equity. That is to say, financial risk is the risk that a company will not have adequate cash flow to meet financial obligations.

4.2.2.3 Management Risk

The risks associated with ineffective, destructive or underperforming management, which hurts shareholders and the company or fund being managed. This term refers to the risk of the situation in which the company and shareholders would have been better off without the choices made by management.

Management risk refers to the chance that company managers will put their own interests ahead of the interest of the company and shareholders. An example of this is the recent scandals with Enron and other large companies, whose managers acted in a manner that eventually bankrupted the companies and destroyed shareholder wealth. Management risk also applies to investment managers, whose decisions and actions may divert from the investors' wishes or reduce the value of an investment portfolio.

4.2.2.4 Sector Risk

Fluctuations in the incomes of a specific sector are the source of sector risk. Sector risk contains changes in consumer preferences, foreign competition, strikes in this sector, technological development and difficulties in supplying raw materials. This risk affects only the one sector. Other sectors can not be affected by the risk of other sectors.

4.3 Risk Measurement

The term risk plays a spreading role in the literature on economic, political, social and technological issues. There are several attempts to define and to characterize the risk for descriptive purposes. If we wish to understand and use the concepts of risk, we need to be able to measure these outcomes of risk. The risk can be regarded as the random gain or loss of a condition. The outcome of the risk may be positive, which means there is a gain, or negative which means there is a loss.

Table 4.1 Risk Measurement Tools

1938	Bond duration
1952	Markowitz mean-variance framework
1963	Sharpe's capital asset pricing model
1966	Multiple factor models

1973	Black-Scholes option pricing model
1979	Binomial option model
1983	RAROC, risk-adjusted return
1986	Limits on exposure by duration bucket
1988	Risk-weighted assets for banks
1992	Stress testing
1993	VaR (VaR)

The evolutions of risk measurement tools until the VaR are shown in Table 4.1. The literature of risk measurement may be divided into two parts. These are the pre-Markowitz era and the post-Markowitz era. Studies about the risk measurement before the publication of Harry Markowitz, "Portfolio Selection", were criticized that they assume that there is not any relations between the assets in terms of returns of assets and distribution of risk. Variance was first suggested by Markowitz to measure the risk connected with the return of assets. Markowitz (1952)[53] argues that the relations of assets are essential in measuring risk. The statistical term used to depict the interrelations of assets is covariance. Under these assumptions, the statistical definitions of expected return, variance and covariance are as below:

Depending on the past data, the expected return of an asset is the sum of the multiplications of actual returns and the probability of the event.

[53] Markowtiz, Harry (1952), *Portfolio Selection*, Journal of Finance, American Finance Association, Volume 7, Issue 1, 77-91.

$$E(r_i) = \sum_{i=1}^{n} P_i \times r_i \qquad (4.3)$$

where E(ri) = expected return of an asset

Pi = probability of the event

ri = actual return

The variance of an asset is the average of square of the difference between returns and the average return.

$$\sigma_i^{\,2} = \frac{1}{n} \sum_{i=1}^{n} \left[(r_i - \bar{r}_i) \right]^2 \qquad (4.4)$$

where, $\sigma_i^{\,2}$ = variance of an asset

n = number of observations

r_i = actual return and $\bar{r}_i$ = average return

Standard deviation is equal to the square root of the variance.

$$\sigma = \sqrt{\sigma^2} \qquad (4.5)$$

As we mentioned above, variance and standard deviation have been traditional risk measures in economics and finance since the pioneering work of

Markowitz. The two risk measures exhibit a number of nice technical properties. For example, the variance of a portfolio return is the sum of the variance and covariance of the individual returns.

In statistics, covariance is a measure of how much two variables change together. Variance is a special case of the covariance when the two variables are identical. If two variables tend to vary together (that is, when one of them is above its expected value, then the other variable tends to be above its expected value too), then the covariance between the two variables will be positive. On the other hand, if one of them tends to be above its expected value when the other variable is below its expected value, then the covariance between the two variables will be negative.

According to the Markowitz Model, when the risk of a portfolio is calculated, the relations between assets which compose the portfolio must be taken into consideration. One of the important statistical criterions that show the relationship of assets in a portfolio is covariance. Covariance of a portfolio is the average of multiplications of the difference between each asset's actual return and average return.

$$\sigma_{ij} = \frac{1}{n-1} \sum_{n=1}^{N} \left[\left(r_{i,n} - \bar{r}_i \right) \left(r_{j,n} - \bar{r}_j \right) \right] \qquad (4.6)$$

If the covariance based on the data belonging to future, the covariance the sum of the multiplications of the difference between each asset's actual return and expected return multiplied by the probability.

$$\sigma_{ij} = \sum_{n=1}^{N} P_i \left[\left(r_{i,n} - E(r_i) \right) \left(r_{j,n} - E(r_j) \right) \right] \qquad (4.7)$$

Exactly like this, the variance of a portfolio can be calculated as the formula 4.8.

$$\sigma_{r_p}{}^2 = \sum_{i=1}^{N} w_i^2 \sigma_i^2 + \sum_{i=1}^{N} \sum_{j=1, j \neq 1}^{N} w_i w_j \sigma_{ij} \qquad (4.8)$$

$$\sum_{i=1}^{N} \sum_{j=1, j \neq 1}^{N} w_i w_j \sigma_{ij} = 2 \sum_{i=1}^{N} \sum_{j<1}^{N} w_i w_j \sigma_{ij} \qquad (4.8.2)$$

$$\sigma_{r_p}{}^2 = \sum_{i=1}^{N} w_i^2 \sigma_i^2 + 2 \sum_{i=1}^{N} \sum_{j<1}^{N} w_i w_j \sigma_{ij} \qquad (4.8.3)$$

In addition to covariance, correlation is another statistical term to exhibit the relationship of assets. A correlation is a single number that describes the degree of relationship between two variables. The correlation is calculated by the

division of covariance of assets into the multiplication of assets' standard deviations.

$$\rho_{ij} = \frac{\sigma_{ij}}{\sigma_i \sigma_j} \qquad (4.9)$$

The main result of a correlation is called the correlation coefficient (or "ρ"). It ranges from -1.0 to +1.0. The closer ρ is to +1 or -1, the more closely the two variables are related. If ρ is close to 0, it means there is no relationship between the variables. If ρ is positive, it means that as one variable gets larger the other gets larger. If ρ is negative it means that as one gets larger, the other gets smaller.

4.4 The Value at Risk

The VaR (VaR) was appeared in 1993 in response to several financial disasters. The bankruptcies of global financial institutions, such as Barings Bank, Orange Country, Daiwa Bank, and Metallgeshellshaft, and the financial crisis in early 1990s showed that risk measurement techniques were inadequate to compute and manage the risk. These financial disasters reflected that there was a need for summary measure of market risk. The VaR was conceived as one of the strongest measures to satisfy this need.

The VaR is a method of estimating the risk. VaR provides a summary of risk that is calculated by using statistical techniques. The VaR is very popular and widespread because it aggregates the several components of risk at firm and

market levels into a single number. For instance, an investor can say that the VaR of his/her portfolio is $1 million at the 99% confidence level. That is to say, the probability of losing greater than $1 million is 1 percent. According to measurement the investor has an opportunity to decide whether this level of risk can be accepted or avoided. The probability of this loss is very small; however the VaR is essential because the VaR answers the questions of 'What current risk is'. That is to say, the VaR quantifies the current risk.

Definitions of the VaR by some of the researches are as follows: Jorion (2000) argues that the VaR measures the worst expected loss over a given horizon under normal market conditions at a given confidence level.[54] Linsmeier and Pearson (1996) argue that the VaR is measure of losses due to "normal" market movements and losses greater than the VaR are suffered only with a specified small probability.[55] Dowd (1997) argues that the VaR is the maximum loss in a given period at the given confidence level.[56] Schacter (1997) asserts that VaR is a forecast of a given percentile, usually in the lower tail, of the distribution of returns on a portfolio over some period; similar in principle to an estimate of the expected return on a portfolio, which is a forecast of the 50th percentile.[57]

In short, for a given time horizon and confidence level α the VaR is the loss in market value over the time horizon t that is exceeded with probability 1- α.

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[54] Jorion, P. (2001), *VaR: The New Benchmark for Managing Risk*, 2nd edition: McGraw-Hill: p. 201.
[55] Linsmeier, T.J., Pearson, D.N. (1996), *Risk Measurement: An Introduction to VaR*, University of Illinois at Urbana-Champaign: p.5.

According to the definitions of VaR, it can be formulated as follows: If V_t represents the value of a portfolio at the time *t*, with a $(1-\alpha)$ confidence level and the (*T-t*) desired time interval, it can be expressed as in equation 4.10.

$$P(V_T - V_t \leq -VaR) = \alpha \qquad (4.10)$$

The VaR should be used by any institutions that are exposed to financial risk. It is used as an internal risk management tool, and has also been chosen by the Basel Committee on Banking Supervision[58] as the international standard for external regulatory purpose in determining capital requirement. [59] In conclusion, the VaR is being adopted by institutions all over the world including financial institutions, regulators, non financial corporations, and the asset managers for risk measurement.

The VaR also has direct implications for the 1997 Asian crisis. According to most of economists, main cause of the Asian crisis was the poor risk management of financial institutions. At this point, the VaR would have helped to the risk management of financial institutions. Dornbusch (1998) asserted that

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[56] Dowd, K. (1998), *Beyond VaR: The New Science of Risk Management*, New York, NY: John Wiley & Sons, Inc: p. 47-51.

[57] Schacter, B. (1997), *An Irreverent Guide to VaR*, Financial Engineering News, vol.1 no.1.

[58] Basel Committee on Banking Supervision. Amendment to the capital accord to incorporate market risks. www.bis.org/publ/bcbs24.htm, January 1996, updated version of November 2005 http://www.bis.org/publ/bcbs119.htm

[59] The capital that a bank is required to hold against its market risk is based on VaR with a 10-day holding period at a 99% confidence level. Specifically, the ragulatory capital requirement for market risk is defined as $max(VaR_{t-1}\ k \times Avg\{VaR_{t-i} | i=1, ..., 60\})$. Here *k* is multiplication factor, which is set to between 3 and 4

"An effective supervisory system would, at the least, put in place a mandatory the VaR analysis not only for the individual financial institutions but in fact for the entire country." The VaR can help countries to reduce risk in hedging foreign currency liabilities, lengthening debt maturities.

In addition, during the risk measurement process financial institutions are forced to constitute independent risk management function supervising the front and back offices. Thus, as Jorion (2000) argued, the process of getting to the VaR may be as important as the number itself.[60]

There are some benefits of the VaR in risk measurement. These are: the VaR provides risk managers with a useful, albeit very imperfect, measure of financial risk, which can be used to considerable effect in risk management within the firm.[61] The VaR enables firms to determine the internal capital allocation and capital requirement. In addition, the VaR has a role in individual investment decisions. Thus, the more risky investment means more the VaR. The VaR enables investors to evaluate alternative investment in the respect of outcomes. Consequently, VaR is being used for just about every need; risk reporting, risk

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depending on previous backtest results, and VaR_t refers to a VaR estimate for day t based on a 10 day holding.

[60] Jorion, P. (2001), *VaR: The New Benchmark for Managing Risk,* 2nd edition: McGraw-Hill: p. 213-214.

[61] Woods, M., Dowd, K., Humphrey, C. (2008), *The Value of Risk Reporting: A Critical Analysis of VaR Disclosures in the Banking Sector*, International Journal of Financial Services Management, Vol.8 (1): p. 45-64. (Electronic copy available at: http://ssrn.com/abstract=1288204)

limits, regulatory capital, internal capital allocation, and performance measurement.

4.4.1 The Parameters in Measuring VaR

The parameters using in calculating VaR are holding period, confidence level, and sample period. In using VaR methods these parameters are essential. The selections of these parameters play an important role in measurement of VaR. Thereby; the selections of parameters affect the results of VaR methods. Basel Committee had decided four standards in measuring VaR:[62]

(a) "Value-at-risk" must be computed on a daily basis.

(b) In calculating the value-at-risk, a 99th percentile, one-tailed confidence level is to be used.

(c) In calculating value-at-risk, an instantaneous price shock equivalent to a 10 day movement in prices is to be used, i.e. the minimum "holding period" will be ten trading days. Banks may use value-at-risk numbers calculated according to shorter holding periods scaled up to ten days by the square root of time.

(d) The choice of historical observation period (sample period) for calculating value-at risk will be constrained to a minimum length of one year. For banks that use a weighting scheme or other methods for the historical observation period, the "effective" observation period must be at least one year (that is, the

[62] Basel Committee on Banking Supervision (2005), *Amendment to the Capital Accord to Incorporate Market Risks*. (Electronic copy available at: http://www.bis.org/publ/bcbs119.pdf?noframes=1

weighted average time lag of the individual observations cannot be less than 6 months).

On the other hand, certain financial institutions prefer to select other confidence levels and holding periods. Choundhry and Tanna (2006) argue that which level and holding period is being used are a function of asset types in the portfolio, quality of market data available and the accuracy of the model itself.[63] In conclusion, the choice of parameters is itself an important determinant of the VaR result. These parameters will be discussed in next section.

4.4.1.1 The Holding Period

Roughly, the holding period is the length of time an asset was held. The time is between the trade date of purchase and the trade date of the sale. In other words, a holding period is the length of time you keep an investment.

Although the holding period is typically a day, 10 days (for regulatory purposes, as seen in Basel Committee and Banking Regulation and Supervision Agency of Turkey), or a month, VaR calculations are always initially done on a holding period of 1 day, since this provides the maximum amount of historical information with which to estimate parameters.

[63] Choudhry, M. and Tanna, K. (2006), *An Introduction to VaR*, John Wiley & Sons Ltd, England: p.47

Choice of the holding period is depend on the liquidity of the asset. If the liquidity of the asset is high, holding period will be short. On the other hand, the less liquid the asset is, the longer the holding period is. Long holding period is often used for proprietary trading firms, institutional investors, and corporations. Challenges in the selection of the holding period are summarized by Beder (1996)[64]. These challenges are:

One challenge in the selection of the holding period is that while a model may produce adequate views of capital at risk on an overnight or weekly basis, it may produce inadequate risk views over time horizons of several months, a year, or longer. For example, the calculation of one-day or overnight VaR may be misleading for customized or exotic products that cannot be analyzed, action decided upon, and liquidated in such a time frame. The 1995 Basel Amendment suggests that firms employ a single time horizon of two weeks (10 business days) for VaR calculations. This may be short relative to the life of many asset classes and other exposures and potentially too long for highly liquid instruments.

A second challenge is that while longer time horizons may be preferred for instruments such as illiquid, path-dependent options, some mathematical functions are inaccurate beyond small market moves. For example, many

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[64] Beder, Tanya S. (1996), *Report Card on VaR: High potential but Slow Starter*, Bank Accounting and Finance: p.17-18.

mathematical models are incapable of handling discontinuities such as market gapping or require linearity to produce accurate information.

Finally, a third challenge is to compare and combine VaR calculated over alternate time frames and under different methods. The translation of long holding period VaRs into short holding period VaRs (and vice versa) typically assumes linearity, joint normal relationships (that is, that the square root of time is sufficient), or static relationships (that is, no drift), which may produce misleading results.

Because the VaR is basically a multiple of the portfolio standard deviation and the standard deviation of an asset's return increases in proportion to square root of holding period, 10-day VaR at 95% confidence level is the multiplication of 1-day VaR at 95% confidence level and the square root of 10.

For example, if an asset's 1-day VaR at 95% confidence level is US 1 million$, the 10-day VaR of this asset at 95% confidence level will be equal to the multiplication of US 1 million $ and square root of 10. Thus, the 10-day VaR of this asset at 95% confidence level is US 3.16 million $

$$1million \times \sqrt{10} = 3.16\,million \qquad (4.11)$$

4.4.1.2 The Confidence level

The confidence level defines the percentage of time that the asset can not lose more than the VaR amount. The level of confidence at which the VaR is calculated depends upon the nature of the asset and what the VaR measurement

is being used for. For instance, Basel Committee suggests that in calculating the value-at-risk, a 99th percentile, one-tailed confidence level is to be used. J.P. Morgan prefers the 95% confidence level in calculating VaR.

As done in holding period, different confidence level can be converted to each other in the same VaR methodology at the assumption of those factors are joint normally distributed. Therefore, the VaR amount at the 99% confidence level can be obtained from the VaR amount at the 95% confidence level. Assumption that factors are normally distributed shows that the VaR is equal to ($-\alpha\sigma$) and the value of α is 1.65 at the 95% confidence level. Thus,

$$VaR_{0.95} = -1.65 \times \sigma \qquad (4.12.1)$$

Standard deviation of the asset is equal to division of VaR at the 95% confidence level to the value of α which is equal to 1.65 at the 95% confidence level.

$$\sigma = \frac{VaR_{0.95}}{1.65} \qquad (4.12.2)$$

Similarly, at the 99% confidence level VaR is equal to the multiplication of standard deviation and the value of α is at the 99% confidence level. The value of α is 2.33 at the 99% confidence level. Then,

$$VaR_{0.99} = -2.33 \times \sigma \qquad (4.13.1)$$

Standard deviation of the asset is equal to division of VaR at the 99% confidence level to the value of α.

$$\sigma = \frac{VaR_{0.99}}{2.33} \tag{4.13.2}$$

By using equations 4.12.2 and 4.13.2,

$$\frac{VaR_{0.99}}{2.33} = \frac{VaR_{0.95}}{1.65} \tag{4.14.1}$$

$$VaR_{0.99} = (2.33/1.65)VaR_{0.95} \tag{4.14.2}$$

$$VaR_{0.99} = 1.41VaR_{0.95} \tag{4.14.3}$$

VaR at the 99% confidence level is equal to 1.41 fold of VaR at the 95% confidence level.

4.4.1.3 The Sample Period

The VaR is depend on the past data of the asset, thus the VaR is fairly data intensive. Historical data sets have become ordinary in VaR measurement, thereby driving the need for additional data decisions to be made.

Shorter sample period makes the VaR more sensitive to the changes in the market. On the other hand, longer sample period has a greater quality in return

distribution. Different sample periods give different VaR. In other words, various VaR views can be produced by alternative data sets.

Sample period differs from financial institutions to financial institutions in the respect of purposes of VaR measurement. Basel Committee suggests that the choice of historical observation period (sample period) for calculating VaR will be constrained to a minimum length of one year.

Exclusion of any extreme deviations from the mean of asset is essential in calculating VaR. For instance, when calculating the VaR of a portfolio, are the effects of Iraq War on portfolio excluded from the sample period? It could not be excluded because this event reflects the real history and this period is part of sample period. However, this event could be excluded because by inclusion of this event a different VaR is likely calculated.

4.4.2 The Methods of VaR Measurement

At this section it is worthwhile reminding ourselves what VaR is not. Tanna and Choudhry (2006) argue that VaR is not a unified method for measuring risk, as the different calculation methodologies each produce different VaR values. In addition, as it is a quantitative statistical technique, VaR only captures risk that can be quantified. Thus, VaR does not measure other risks that a bank or securities house will be exposed to, such as liquidity risk or operational risk.[65]

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[65] Choudhry, M. and Tanna, K. (2006), *An Introduction to VaR*, 4th edition, John Wiley & Sons Ltd, England: p.37

Guldimann (1995), who is one of the architects of RiskMetrics, states that "risk measurement and management continues to be as much a craft as it is a science and no amount of sophisticated analytics will replace experience and professional judgment in managing risks".[66]

We now turn to various methods of VaR measurement. Approaches to VaR basically can be classified into two groups.[67] These are local-valuation methods and full-valuation methods. Local-valuation methods values the assets at the initial position and use local derivatives to conclude the movement that might be suitable capable of happening. Variance/covariance method is the best example of local valuation methods. On the other hand, full-valuation methods redetermine the price of assets over different scenarios. Historical simulation method and the Monte Carlo simulation method are the best examples of full-valuation methods.

There are three basic methods of VaR measurement: Historical simulation, Variance/covariance and the Monte Carlo simulation. In following section, we describe and compare the three basic methods of VaR measurement.

4.4.2.1 Historical Simulation

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[66] Guldimann, T. (1995), *RiskMetrics-Technical Document*, Morgan Guaranty Trust Company: p. 13

[67] Jorion, P. (2001), *Value at Risk: The New Benchmark for Managing Risk,* 2nd edition: McGraw-Hill: p. 221

The historical simulation method provides a direct carrying out of full valuation. By full valuation, historical simulation method accounts all nonlinearities. In historical simulation method the distribution of the returns of the risk factors is determine by pulling samples from the historical data of returns. In other words, historical simulation method based on the time-series of historical asset returns. Also, historical simulation method is nonparametric since all dimensions of the actual distribution are captured.

Basically, VaR is the qth quantile of the sample distribution of the asset. The computations of VaR in the historical simulation method for a single asset include these steps: Obtaining the historical dataset of price, calculation of historic returns of each observation, [68] arrangement of historical returns in the ascending numeric order, determining the $q$thquantile which equals to $(1-\alpha)$, multiplying the historical return in the qth quantile by the monetary value of asset.

For instance we want to calculate the VaR at the 99% confidence level with 100 observations. Firstly we find the historical returns of assets, and then we arrange the historical returns in the ascending numeric order. The 5^{th} lowest observation value would be the one-day 99% confidence level VaR.

There are some advantages of historical simulation method. The historical simulation method is relatively easy to implement for assets whose data on the

past values of the market factors are available. Also, because historical simulation method performs with the historic data of assets, by changing the sample size and periods, different VaR measurements can be obtained.

There is not any need to estimate a covariance matrix in historical simulation method because it simplifies the computations in any cases of portfolios containing a huge number of assets and short sample periods. In addition, the historical simulation method's computations are performed quickly and it is very easy to explain to senior management.

The historical simulation method can consider fat tails and since it does not rely on valuation models it does not subject to model risk. This method is the most widely use method to measure VaR.

However, the historical simulation method has a number of disadvantage and difficulty. Assets with short histories or/and unrecorded data make the historical simulation method inefficient or impossible. In both cases, VaR may be either underestimated or overestimated. Also, it assumes that past reflects future. If the historical data includes the events that won't reappear in the future, the tails won't be well represented.

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[68] We can obtain the historical returns by dividing the change in price of asset into the previous day's price. Thus, $r = \frac{P_{i+1} - P_i}{P_i}$

Historical simulation method is not easy to implement "what if" analyses to check effects of alternative assumptions. In addition, if too many simplifications of market factors are done, it will fail to keep the benefits of full valuation.

4.4.2.2 Variance/Covariance Method

In this method, the VaR of an asset is a simple transformation of the estimated variance/covariance matrix. The variance/covariance method is based on the assumption that the market factors have a jointly Normal distribution with mean zero because the expected change in asset value over a short holding period is almost always close to zero.[69] Also, variance/covariance method assumes the serial independence. With the assumptions of normality and serial independence, all percentiles become the multiples of standard deviation. Therefore, the VaR measurement needs only an estimate of the standard deviation of the asset's change in value over the holding period.

For a single asset, the covariance is not taken into consideration in calculating the VaR; therefore it might be called variance methods. In this method the VaR can be calculated as follows:

$$VaR_t(\alpha) = \mu + z_\alpha \sigma_t \qquad (4.15)$$

[69] Linsmeier, T.J., Pearson, D.N. (1996), *Risk Measurement: An Introduction to VaR*, University of Illinois at Urbana-Champaign: p.47-48.

In other words, $VaR(\alpha) = -z_\alpha \sigma_t$ for a single asset, where z_α is the inverse of the cumulative normal distribution function. The calculations of sample mean and sample variance showed in section 4.3.

Assume that there are two assets in a portfolio. In this case, the sample variance is

$$\sigma_{r_p}^{\ 2} = \sum_{i=1}^{N} w_i^2 \sigma_i^2 + 2 \sum_{i=1}^{N} \sum_{j<1}^{N} w_i w_j \sigma_{ij} \qquad (4.16)$$

Thus, the calculation of VaR will be as follows:

$$VaR_t(\alpha) = z_\alpha \times \sqrt{w_i^{\ 2} \sigma_i^2 + w_j^2 \sigma_j^2 + 2\rho_{ij} w_i w_j \sigma_i \sigma_j} \qquad (4.17)$$

where, w_i : weight of asset i

w_j : weight of asset j

σ_i : standard deviation of asset i

σ_j : standard deviation of asset j

ρ_{ij} : correlation between asset i and asset j.

If there are more than two assets in a portfolio, we must use the variance-covariance matrix that is obtained by multiplying standard deviation matrix of assets with correlation matrix:

$$\Sigma = \begin{bmatrix} \sigma_1 & 0 & \cdots & 0 \\ 0 & \sigma_2 & 0 & \vdots \\ \vdots & 0 & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_N \end{bmatrix} \begin{bmatrix} 1 & \rho_{12} & \cdots & \rho_{1N} \\ \rho_{21} & 1 & \cdots & \rho_{2N} \\ \vdots & & \ddots & \vdots \\ \rho_{N1} & \rho_{N2} & \cdots & 1 \end{bmatrix} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{1N} \\ \sigma_{21} & \sigma_{22} & & \\ \vdots & & \ddots & \\ \sigma_{N1} & \sigma_{N2} & \cdots & \sigma_{NN} \end{bmatrix} \quad (4.19)$$

The VaR of a portfolio is a factor of portfolio's standard deviation at the given confidence level. Thus, the linear algebra implementation of the VaR is:

$$VaR_p(\alpha) = -z_\alpha \sqrt{w' \Sigma w} \quad (4.19)$$

where, w shows the portfolio's weightiness matrix, w' shows the vertical vector of portfolio's weightiness and z_α is the inverse of the cumulative normal distribution function.

Instead of the sample variance, the standard deviation in Equation (4.16) can be estimated by a statistical model. Since financial time series exhibit volatility clustering, RiskMetrics[70] model of JP Morgan (1995), the ARCH[71] (Engle, 1982), GARCH[72] (Bollerslev, 1986), TGARCH[73] (Glosten et al., 1993), and EGARCH[74] (Nelson, 1991) are popular models for volatility modeling.

[70] For more information about RiskMetrics, visit http://www.riskmetrics.com/
[71] ARCH refers to Autoregressive Conditional Heteroscedasticity.
[72] GARCH refers to Generalized Autoregressive Conditional Heteroscedasticity.
[73] TGARCH refers to Threshold Generalized Autoregressive Conditional Heteroscedasticity.
[74] EGARCH refers to Exponential Generalized Autoregressive Conditional Heteroscedasticity

Now we turn to the benefits and drawbacks of variance/covariance method. The variance/covariance approach requires mapping financial instruments into market factors that are contained in the matrix. To facilitate this process, entire instrument classes are often mapped into market indices. For example, all domestic stocks may be mapped into the ISE National 100. For some portfolios mapping an undiversified portfolio into an assumed diversified portfolio produced misleading results. The variance/covariance approach significantly understates risk for portfolios with options or financial instruments with nonlinear price functions, particularly during periods of large volatility or with large changes in the price of the underlying.[75]

The variance/covariance method is not able to capture the risks of portfolios that include options, except when calculated using a short holding period for portfolios with limited or moderate options content. [76]

On the other hand, the variance/covariance method is easy to compute the VaR because it contains a simple matrix multiplication. Also, when recent data is atypical, by using alternative correlations and standard deviations it prevents from producing misleading measurement.

4.4.2.3 The Monte Carlo Simulation

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[75] Beder, Tanya S. (1996), *Report Card on VaR: High potential but Slow Starter*, Bank Accounting and Finance: p. 14-16.

[76] Linsmeier, T.J., Pearson, D.N. (1996), *Risk Measurement: An Introduction to VaR*, University of Illinois at Urbana-Champaign: p. 13

In the Monte Carlo Simulation method, the VaR is calculated as shown in the Historical VaR method. However, the main difference of Monte Carlo Simulation method from Historical simulation method is that in the Monte Carlo simulation method random variables are generated. In other words, the Monte Carlo simulations include various numbers of possible values in assets. In this sense, like Historical simulation, the Monte Carlo simulation method is a full valuation method.

Parameters of variables such as correlations are computed from the historical data, and then, depending on these parameters imaginary price paths of all variables are simulated. In briefly, future values of assets are produced by using the historical values of assets.

The Monte Carlo simulation methodology has a number of similarities to historical simulation. One of the differences is that rather than carrying out the simulation using the observed changes in the market factors over the last N periods to generate N hypothetical portfolio profits or losses, one chooses a statistical distribution that is believed to adequately capture or approximate the possible changes in the market factors. Then, a pseudo-random number generator is used to generate thousands or perhaps tens of thousands of hypothetical changes in the market factors. These are then used to construct thousands of hypothetical portfolio profits and losses on the current portfolio,

and the distribution of possible portfolio profit or loss. Finally, the VaR is then determined from this distribution.[77]

The Monte Carlo simulation method enables researchers to select alternative distributions for the variables. Also, researchers can bring in subjective judgments to moderate these distributions.

The most important property of the Monte Carlo simulation method is its flexibility and power in computing VaR because it contains all non- linearities of the assets. Also, the Monte Carlo simulation method might be applied on longer holding period which is the case for the calculation of credit risk.

One of the drawbacks of the Monte Carlo simulation method is difficulties in calculation of VaR. For example, if 10,000 sample paths are produced with a portfolio of 100 assets, the total number of valuations will be 1 million. This is too long in the sense of computational time.

The Monte Carlo method is very exposed to model risk because it relies on specific stochastic processes. In addition, sample variation can be a problem because of limitations on the number of simulations.

The selection of simulation parameters is an important determinant of the VaR measurement. Therefore, the sensitivity of the VaR result to different sets of parameters should be tested in order to get the best VaR result.

[77] *Ibid.* p.15

In Conclusion, unlike the variance/covariance method, we do not have to assume that distribution of assets' return is a normal distribution. In contrast to the historical simulation method, we begin with historical data but we are free to bring in both subjective judgments and other information to improve forecasted probability distributions. Thus, Monte Carlo simulation can be used to estimate the VaR for any type of portfolio and it is flexible enough to cover options and option-like securities. That is to say, Monte Carlo simulation method is probably the most comprehensive method to calculate VaR.

4.4.2.4 Which Method is the Best?

Each of the three methods to calculate VaR has advantages and disadvantages. The methods are different in their ability to revalue the positions, capture the risks of options and option-like instruments, ease of implementation, ease of explanation to senior management, flexibility in analyzing the effect of changes in the assumptions, and reliability of the results.

Each method has different dimensions. The choice of method is related with which dimensions of a method are more important than the dimensions of other methods. Some various dimensions of three methods are summarized in Table 4.2.

Each method has a potential ability to calculate reliable VaR. However, reliabilities of methods depend on the selections of portfolio and parameters of methods. In short, the question of which VaR method is best may be answered by looking at the task at hand. For instance, historical simulation method can do

a good job in calculating VaR for a stable risk source with substantial historic data. The variance/covariance method can give reasonable and good results in computing VaR for portfolios over very short time periods. The Monte Carlo simulation method can give good results in calculating VaR for non-linear portfolios over longer periods.

Table 4.2 Comparison of VaR Methods[78]

Feature	Variance Covariance	Historical Simulation	Monte Carlo Simulation
Positions			
Valuation	Linear	Full	Full
Distribution			
Shape	Normal	Actual	General
Time-varying	Yes	Possible	Yes
Implied data	Possible	No	Possible
Extreme events	Low probability	In recent data	Possible
Use correlations	Yes	Yes	Yes

[78] Jorion, P. (2001), *Value at Risk: The New Benchmark for Managing Risk,* 2nd edition: McGraw-Hill: p. 230

VaR precision	Excellent	Poor with short window	Good with many iterations
Implementation			
Ease of Computation	Yes	Intermediate	No
Accuracy	Depends on portfolio	Yes	Yes
Communicability	Easy	Easy	Difficult
VaR analysis	Easy, analytical	More difficult	More difficult
Major pitfalls	Nonlinearities, fat tails	Time-variation in risk, unusual events	Model risk

CHAPTER 5
VALUE-AT-RISK COMPARISON OF SECTORS TRADED AT THE ISE

5.1 Purpose of the Applications and the Dataset

In this section, the ability of VaR to measure the risks of sectors will be evaluated. Firstly VaR of each sector will be computed, and then compared to the actual losses occurred. VaRs of the sectors are calculated at three different points of time by historical simulation, and variance/covariance method. Two of these points belong to the crises experienced by the Turkish economy and the third is when the Turkish economy is functioning well.

We assume that the exact day of crisis occurs when any specific non-ordinary political or/and financial changes are seen in the country. For the November 2000 crisis, on 20 November huge desertion from bond market and high increases in interest rates were occurred. Thus, we determine 20th day of November as the beginning day of crisis. For the February 2001 crisis, the controversy between prime minister and president during a quarrel in a National Security Council meeting on February 21 was happened. Thus, we determine the 21 February as the starting day of crisis. In conclusion, selected dates for the computing VaRs of sectors are: 20 November 2000 -2000 crisis- (Case A), 21 February 2001 -2001 crisis- (Case B), and 5 July 2006 (Case C). Case C is chosen randomly without loss of generation.

Although there are four main sectors with twenty subsectors in Istanbul Stock Exchange, we examine three main sectors with fifteen subsectors because of the unavailability of historical data of the rest sectors. Base data of the main sector 'Technology' and subsectors 'Sport, Information Technology, Real Estate Investment Trusts, Telecommunications, Defence' do not cover the 2000 and 2001 financial crisis in Turkey. Sectors are listed in Table 5.1. Henceforth, each sector will be named by its code.

Table 5.1 List of Sectors

CODE	**INDICES**
XUSIN	ISE NATIONAL INDUSTRIES
XGIDA	FOOD, BEVERAGE

XTEKS	TEXTILER, LEATHER
XKAGT	WOOD, PAPER, PRINTING
XKMYA	CHEMICAL, PETROLEUM PLASTIC
XTAST	NON-METAL MINERAL PRODUCTS
XMANA	BASIC METAL
XMESY	METAL PRODUCTS, MACHINERY
XUHIZ	ISE NATIONAL SERVICES
XELKT	ELECTRICITY
XULAS	TRANSPORTATION
XTRZM	TOURISM
XTCRT	WHOSALE AND RETAIL TRADE
XUMAL	ISE NATIONAL FINANCIALS
XBANK	BANKS
XSGRT	INSURANCE
XFINK	LEASING, FACTORING
XHOLD	HOLDING AND INVESTMENT

The closing price values of sectors in Istanbul Stock Exchange are provided from www.analiz.com by going free of charge. All price corrections are made with the same methods ISE used.

These parameters and assumptions are used to compute VaRs of sectors:

- 1-day holding period is used in computing VaR.
- Confidence levels are respectively 95% and 99%.
- Sample period is one year. This means that dates between 19.11.1999 and 17.11.2000 for the Case A; 18.02.2000 – 20.02.2001 for the Case

B; and 04.07.2005 – 05.07.2006 for the Case C are used as the time horizons.

- Returns of all sectors are normally distributed.
- Short selling is prevented

5.2 Descriptive Statistics of Sectors

Historic data of closing price of a sector is transferred to Excel Sheet. Returns are calculated as follows:

$$r = \frac{P_{1+i} - P_i}{P_i} \qquad (5.1)$$

Closing price of a sector in *(1+i)* time minus closing price of a sector in *i* time is divided by the closing price of a sector in *i* time.

Then, by the help of statistical software program SPSS 17.0[79], descriptive statistics of each sector are provided. Table 5.2 shows the descriptive statistics of sectors in ISE between the dates 19.11.1999 and 17.11.2000. XFINK has the best performance in the sense of average return with about 0.46%; on the other hand, XELKT has the worst performance with about -0.36%. That is to say, the smallest mean is -0.36% of XELKT and XFINK has the greatest mean with

[79] For more info visit *www.**spss**.com/statistics/*

0.46%. It is interesting to note that only the mean of XELKT is negative. In other words, only the daily average return of XELKT is less than 0 along one year. XTRZM has the greatest standard deviation with 0.047; however, XTAST has the lowest standard deviation with 0.028.

XBANK has the smallest minimum daily return with -12% and XTRZM has the greatest maximum daily return with 21%. The price of XBANK declined 12% in a day and the price of XTRZM increased 21% in a day along the researched period.

Table 5.2 Descriptive Statistics of Sectors (daily)
19.11.1999 - 17.11.2000

Code	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Skewness	Kurtosis
XBANK	249	0.28	-0.12	0.16	0.45	0.0018	0.0409	0.67	1.94
XELKT	249	0.29	-0.10	0.19	-0.76	-0.0036	0.0382	0.97	3.13
XFINK	249	0.21	-0.09	0.12	1.14	0.0046	0.0346	0.47	0.50
XGIDA	249	0.20	-0.08	0.12	0.86	0.0035	0.0332	0.45	0.34
XHOLD	249	0.23	-0.09	0.15	0.58	0.0023	0.0376	0.70	0.87
XKMYA	249	0.23	-0.08	0.15	0.31	0.0012	0.0330	0.80	1.87
XMAN	249	0.22	-0.10	0.12	0.43	0.0017	0.0348	0.55	1.03

XMESY	249	0.25	-0.09	0.16	0.81	0.0032	0.0358	0.71	1.89
XKAGT	249	0.26	-0.08	0.17	0.89	0.0036	0.0374	0.84	2.22
XSGRT	249	0.22	-0.09	0.13	0.92	0.0037	0.0372	0.28	0.55
XTAST	249	0.20	-0.07	0.13	0.52	0.0021	0.0283	0.73	1.98
XTEKS	249	0.21	-0.08	0.13	0.88	0.0035	0.0307	0.38	1.01
XTCRT	249	0.23	-0.09	0.15	0.32	0.0013	0.0341	0.89	2.11
XTRZM	249	0.32	-0.10	0.21	1.07	0.0043	0.0467	1.24	3.09
XULAS	249	0.25	-0.10	0.15	0.82	0.0033	0.0379	0.69	1.35

Table 5.3 shows the descriptive statistics of sectors in ISE between 18.02.2000 and 20.02.2001. XTRZM has the lowest average return and the highest standard deviation. XGIDA has the highest average return and XTAST has the lowest standard deviation.

Table 5.3 Descriptive Statistics of Sectors (daily)
18.02.2000 - 20.02.2001

Code	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Skewness	Kurtosis
XBANK	250	0.38	-0.191	0.188	-0.38	-0.0015	0.0424	0.38	4.05
XELKT	250	0.37	-0.156	0.215	-0.66	-0.0026	0.0455	0.91	5.06
XFINK	250	0.36	-0.168	0.187	-0.41	-0.0016	0.0393	0.02	4.26
XGIDA	250	0.38	-0.175	0.201	-0.12	-0.0005	0.0379	0.11	5.70
XHOLD	250	0.38	-0.183	0.197	-0.70	-0.0028	0.0429	0.51	4.47
XKMYA	250	0.38	-0.169	0.206	-0.55	-0.0022	0.0393	0.63	6.57
XMANA	250	0.41	-0.187	0.219	-0.83	-0.0033	0.0426	0.44	5.86
XMESY	250	0.36	-0.170	0.193	-0.58	-0.0023	0.0424	0.44	4.43
XKAGT	250	0.31	-0.152	0.153	-0.54	-0.0022	0.0394	0.04	3.09

XSGRT	250	0.37	-0.187	0.188	-0.36	-0.0014	0.0428	0.44	5.05
XTAST	250	0.35	-0.161	0.185	-0.76	-0.0030	0.0341	0.33	7.89
XTEKS	250	0.37	-0.176	0.195	-0.56	-0.0022	0.0387	0.23	6.98
XTCRT	250	0.38	-0.184	0.195	-0.85	-0.0034	0.0401	0.27	5.82
XTRZM	250	0.39	-0.177	0.213	-1.05	-0.0042	0.0460	0.48	4.33
XULAS	250	0.38	-0.167	0.208	-0.44	-0.0017	0.0424	0.68	4.68

The smallest mean is -0.42% of XTRZM and XGIDA has the greatest mean with -0.05%. It is interesting to note that the means of all sectors are negative. In order words, the daily average returns of all sectors are less than 0 along one year. XTRZM has the greatest standard deviation with 0.042; however, XTAST has the lowest standard deviation with 0.034.

XBANK has the smallest minimum daily return with -19% and XMANA has the greatest maximum daily return with 21%. The price of XBANK declined 19% in a day and the price of XMANA increased 21% in a day along the researched period.

Table 5.4 Descriptive Statistics of Sectors (daily)
04.07.2005 - 04.07.2006

Code	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Skewness	Kurtosis
XBANK	246	0.15	-0.08	0.07	0.38	0.0016	0.0210	-0.25	0.83
XELKT	246	0.19	-0.10	0.09	-0.13	-0.0005	0.0231	-0.41	3.31
XFINK	246	0.22	-0.11	0.10	0.41	0.0017	0.0250	0.44	4.12
XGIDA	246	0.21	-0.11	0.10	0.33	0.0013	0.0248	-0.42	3.65

XHOLD	246	0.15	-0.08	0.07	0.30	0.0012	0.0204	-0.40	1.20
XKMYA	246	0.16	-0.09	0.07	0.32	0.0013	0.0194	-0.38	2.59
XMANA	246	0.17	-0.09	0.08	0.30	0.0012	0.0219	-0.44	2.03
XMESY	246	0.15	-0.08	0.07	0.20	0.0008	0.0174	-0.66	3.29
XKAGT	246	0.15	-0.09	0.06	0.13	0.0005	0.0209	-0.56	1.79
XSGRT	246	0.20	-0.11	0.09	0.54	0.0022	0.0275	-0.35	2.12
XTAST	246	0.12	-0.08	0.05	0.48	0.0019	0.0171	-1.05	3.25
XTEKS	246	0.13	-0.08	0.05	0.15	0.0006	0.0170	-1.47	5.82
XTCRT	246	0.16	-0.09	0.07	0.53	0.0021	0.0165	-0.61	5.05
XTRZM	246	0.21	-0.11	0.10	0.34	0.0014	0.0309	-0.49	1.80
XULAS	246	0.16	-0.09	0.07	-0.05	-0.0002	0.0206	-0.41	1.77

Table 5.4 shows the descriptive statistics of sectors in ISE between 04.07.2005 and 04.07.2006. XELKT has the lowest average return and the XTRZM has the highest standard deviation, on the other hand, XSGRT has the highest average return and XTCRT has the lowest standard deviation.

5.3 Computing VaR by Historical Simulation

VaR is the qth quantile of the sample distribution of the asset. In calculations of VaR by historical simulation method, firstly, returns of each sector are determined as in the formula 5.1. And then, returns are descending sorted. Finally, VaR is obtained depending on the confidence level which coincides with the cumulative percent of descending data. Alternatively, VaR can be computed from the frequency graph. The VaR is equal to the point where normal distribution and return distribution coincide at the given confidence level.

5.3.1 Case A (November 2000 Crisis)

SPSS 17.0 is used to compute the historical simulation of VaR and the results for November 2000 crisis are shown in Table 5.5.

The VaRs of sectors at the 99% confidence level which are computed by historical simulation shows that XBANK has the greatest VaR with about 9.4%. This means that the maximum loss of XBANK at the 99% confidence level is about 9.4%. That is to say, the probability of losing greater than 9.4% is 1 percent. XTAST has the lowest VaR with approximately 6.2% at the 99% confidence level. In other words, the probability of losing greater than 6.2% is 1 percent.

According to 2000 Crisis VaR figures at the 99% confidence level, XBANK is the most risky sector followed by XSGRT, XULAS, XKAGT, XMANA, and XELKT. All sectors of industry, service, and finance have high risks and the daily risk is not below 6% even for the least risky sectors of XTAST and XTCRT. Similar comments can be applied for the 95% confidence level.

At the 95% confidence level, XELKT has the highest VaR with about 5.8% and XTAST has the lowest VaR with about 4.3%. It is important to note that XTAST has the lowest risk at the both 99% and 95% confidence levels; however, XBANK is the most risky sector at the 99% confidence level and XELKT is the most risky sector at the 95% confidence level.

Actual returns at the date 20/11/2000 are shown in Table 5.4. XTRZM has the greatest loss with about 10.2%. That is to say, the closing price of XTRZM had decreased 10.2% at the date 20/11/2000 compared the closing price at the date

17/11/2000. However, XTAST has the lowest actual return at the date 20/11/2000 with about 5.4%, that means closing price of XTAST had decreased 5.4%.

Table 5.5 also shows the comparison of VaRs, calculated by historical simulation, with actual returns. At the 99% confidence level, actual returns of XBANK, XFINK, XGIDA, XHOLD, XMANA, XMESY, XKAGT, ZSGRT, and XTAST don't exceed the VaRs. On the other hand, actual returns of XELKT, XKMYA, XTEKS, XTCRT, XTRZM, and XULAS in 20/11/2000 exceed the VaRs. Hence, actual returns of XELKT, XKMYA, XTEKS, XTCRT, XTRZM, and XULAS in 20/11/2000 are in the 1% area because maximum loss at the 99% confidence level is smaller than the actual returns.

Consequently, historical simulation at the 99% confidence level does not cover the actual returns of some sectors.

It is not surprising that the maximum loss at the 95% confidence level is smaller than the maximum loss at the 99% confidence level.

$$VaR_{95\%} < Var_{99\%} \tag{5.2}$$

Table 5.5 Value-at-Risk figures of sector returns over the November 2000 Crisis (Historical Simulation)

	99% confidence level	95% confidence level	Actual Returns
XBANK	-9.44%	-5.74%	-7.29%
XELKT	-8.20%	-5.82%	-8.21%

XFINK	-7.32%	-4.70%	-6.36%
XGIDA	-6.61%	-4.60%	-6.23%
XHOLD	-7.44%	-5.40%	-7.13%
XKAGT	-8.28%	-5.09%	-7.39%
XKMYA	-6.82%	-4.39%	-7.82%
XMANA	-8.28%	-4.53%	-7.92%
XMESY	-7.44%	-5.01%	-5.51%
XSGRT	-8.80%	-5.25%	-7.38%
XTAST	-6.23%	-4.38%	-5.39%
XTCRT	-6.43%	-4.80%	-6.61%
XTEKS	-6.57%	-4.43%	-8.26%
XTRZM	-7.86%	-5.74%	-10.28%
XULAS	-8.68%	-4.63%	-10.05%

Thus, we expect that the actual returns of XELKT, XKMYA, XTEKS, XTCRT, XTRZM, and XULAS are absolutely out of VaRs at the 95% confidence level because they have already been greater than VaRs at the 99% confidence level.

When the VaRs at the 95% confidence level are compared with the actual returns of sectors, it is shown that actual returns of all sectors exceed the maximum loss computed by historical simulation. Therefore, actual returns of all sectors for the 2000 Crisis are in the 5% area of the stock returns' histogram.

5.3.2 Case B (February 2001 Crisis)

SPSS 17.0 is used to compute the historical simulation of VaR and the results for February 2001 crisis are shown Table 5.6.

The VaRs of sectors at the 99% confidence level which are computed by historical simulation shows that XTRZM has the greatest VaR with about

13.9%. That means, the maximum loss of XTRZM at the 99% confidence level is about 13.9%. That is to say, the probability of losing greater than 13.9% is 1 percent. On the other hand, XBANK has the lowest VaR with approximately 9.3% at the 99% confidence level. In other words, the probability of losing greater than 9.3% is 1 percent.

At the 95% confidence level, XTRZM has the greatest VaR with about 7.4% and XGIDA has the lowest VaR with about 5%. It is important to note that XTRZM has the greatest VaRs at the both 99% and 95% confidence levels.

According to 2001 Crisis VaR figures at the 99% confidence level, XTRZM is the most risky sector followed by XFINK, XTEKS, XKAGT, XMANA, and XMESY. All sectors of industry, service, and finance have high risks and the daily risk is not below 9% even for the least risky sector of XBANK. Similar comments can be applied for the 95% confidence level.

All VaRs at the both 99% and 95% confidence levels in February 2001 crisis are higher than the VaRs at the both 99% and 95% confidence levels in November 2000 crisis, except XBANK's VaR at the 99% confidence level in November 2000 crisis is higher than the its VaR at the 99% confidence level in February 2001 crisis.

There are two remarkable points at this point: Firstly, because the time horizon of February 2001 crisis includes the November 2000 crisis, VaRs of all sectors in February 2001 crisis are higher than the VaRs in November 2000 crisis.

That is to say, sample period of February 2001 crisis contains an extreme event: The November 2000 crisis.

Secondly, XBANK's VaR at the 99% confidence level in November 2000 crisis is higher than the its VaR at the 99% confidence level in February 2001 crisis because November 2000 crisis had emerged as a result of bankruptcies of several banks in the banking system. Thus, there are a lot of desertions from the stocks of banks before November 2000 crisis.

Table 5.6 Value-at-Risk figures of sector returns over the February 2001 Crisis (Historical Simulation)

	99% Confidence Level	95% Confidence Level	Actual Returns
XBANK	-9.27%	-6.07%	-19.08%
XELKT	-11.97%	-6.07%	-15.56%
XFINK	-12.28%	-5.93%	-16.81%
XGIDA	-11.89%	-4.98%	-13.41%
XHOLD	-9.98%	-6.01%	-18.26%
XKMYA	-10.69%	-5.52%	-16.94%
XMANA	-12.05%	-5.52%	-18.74%
XMESY	-12.03%	-6.02%	-16.97%
XKAGT	-12.11%	-6.27%	-15.22%
XSGRT	-11.00%	-6.63%	-18.67%
XTAST	-11.05%	-5.05%	-16.11%
XTEKS	-12.13%	-5.75%	-17.59%
XTCRT	-10.31%	-5.83%	-18.43%
XTRZM	-13.86%	-7.37%	-17.71%
XULAS	-9.86%	-5.60%	-16.73%

Actual returns at the date 21/02/2001 are shown in Table 5.5. XBANK has the greatest loss with about 19.1%. That is to say, the closing price of XBANK had decreased 19.1% at the date 21/02/2001 compared to the closing price at the date 20/02/2001. However, XTAST has the lowest actual return at the date 21/02/2001 with about 13.4%, that means closing price of XGIDA had decreased 13.4%.

Table 5.6 also shows the comparison of VaRs, calculated by historical simulation, with actual returns. At the 99% confidence level, actual returns of all sectors exceed the VaRs. That means, actual returns are in the 1% area of stocks returns' histogram. If the VaRs at the 99% confidence level don't cover the actual returns, it won't be surprising that the VaRs at the 95% confidence level also can not cover the the actual returns as a matter of fact that the VaR at the 95% confidence level is smaller than the VaR at the 99% confidence level.

Both at the 99% confidence level and at the 95% confidence level, actual returns of all sectors don't exceed the VaRs. Hence, actual returns of all sectors at the date 21/02/2001 are in the 1% area because maximum loss at the 99% confidence level is smaller than the actual returns.

Consequently, historical simulation at the 99% confidence level does not cover the actual returns of all sectors.

5.3.3 Case C

The VaRs of sectors at the 99% confidence level which are computed by historical simulation shows that XTRZM has the greatest VaR with about 10.3%. The maximum loss of XTRZM at the 99% confidence level is about 10.3%. That is to say, the probability of losing greater than 13.9% is 1 percent. On the other hand, XTCRT has the lowest VaR with approximately 4.4% at the 99% confidence level.

According to Case C VaR figures at the 99% confidence level, as shown in Table 5.7, XTRZM is the most risky sector followed by XSGRT, XELKT, XGIDA, XTEKS, and XKAGT. The daily risk is 4.4% for the least risky sector of XTCRT. At the 95% confidence level, XTRZM is again the most risky sector followed by XSGRT, XGIDA, XELKT, XMANA, and XFINK. XTCRT is the least risky sector with the VaR of 2.4%.

Table 5.7 Value-at-Risk figures of sector returns over Case C (Historical Simulation)

	99% Confidence Level	95% Confidence Level	Actual Returns
XBANK	-4.74%	-3.61%	-3.27%
XELKT	-8.89%	-3.74%	-3.92%
XFINK	-6.40%	-3.65%	-1.35%
XGIDA	-8.65%	-4.07%	0.29%
XHOLD	-5.45%	-3.57%	-2.37%
XKMYA	-5.67%	-3.33%	-3.10%
XMANA	-6.52%	-3.70%	-4.05%
XMESY	-6.36%	-2.69%	-2.45%
XKAGT	-6.85%	-3.61%	-3.70%

XSGRT	-8.96%	-4.22%	-5.02%
XTAST	-6.47%	-2.84%	-3.11%
XTEKS	-7.52%	-2.47%	-4.85%
XTCRT	-4.42%	-2.37%	-3.00%
XTRZM	-10.37%	-5.69%	-5.59%
XULAS	-5.13%	-3.60%	-3.37%

Actual returns at the date 05/07/2006 are shown in Table 5.7. XTRZM has the greatest loss with about 5.6%. That is to say, the closing price of XBANK had decreased 5.6% at the date 05/07/2006 compared the closing price of previous day. However, XGIDA has positive actual return with about 0.3%. Closing price of XGIDA had increased 0.3%.

Table 5.7 also shows the comparison of VaRs, calculated by historical simulation, with actual returns. At the 99% confidence level, VaRs of all sectors cover the actual returns of all sectors. In other words, actual returns are not in the 1% area of stocks returns' histogram. At the 95 confidence level VaRs of XTRZM, XULAS, XBANK, XKMYA, XMESY, XHOLD, XFINK, and XGIDA cover the actual returns.

5.4 Computing VaR by Variance/Covariance Method

Calculation VaR of a sector can be considered as a single asset. For a single asset, the covariance is not taken into consideration in calculating the VaR; therefore it might be called variance methods. In this method the VaR can be calculated as follows:

$$VaR_t(\alpha) = \mu + z_\alpha \sigma_t \qquad (5.3)$$

In other words, $VaR(\alpha) = -z_{\alpha}\sigma_t$ for a single asset, where z_{α} is the inverse of the cumulative normal distribution function.

Firstly, the standard deviation of each sector is calculated, and then the standard deviation is multiplied by the inverse of the cumulative normal distribution function.

$$z_{0.95} = 1.65$$
$$z_{0.99} = 2.33 \qquad (5.4)$$

Alternatively, VaRs of the sectors can be calculated by the EXCEL. This is based on the assumption of normality and serial independence; hence, all percentiles become the multiples of standard deviation. The probability of being below the level of confidence level is computed as follows:

Mean	μ
Standard Deviation	δ
Confidence level	α
The probability of being below this level	VaR

VaR=NORMSINV ((1-confidence level), mean, standard deviation)

5.4.1 Case A (November 2000 Crisis)

Table 5.8 shows the VaRs of sectors computed by variance/covariance method. The VaRs of sectors at the 95% confidence level which are computed by variance/covariance method show that XTRZM has the highest VaR with

about 7.25%. This means, the maximum loss of XTRZM at the 95% confidence level is about 7.25%. That is to say, the probability of losing greater than 7.25% is 5 percent. In addition, XTAST has the lowest VaR with approximately 0.045 at the 95% confidence level. In other words, the probability of losing greater than 4.5% is 5 percent.

At the 99% confidence level, XTRZM has the highest VaR with about 10.44% and XTAST has the lowest VaR with about 6.38%. It is important to state that XTAST has the lowest VaR at the both 99% and 95% confidence levels and XTRZM has the highest VaR at the both 99% and 95% confidence levels.

Table 5.8 Value-at-Risk figures of sector returns over the November 2000 Crisis (Variance/Covariance Method)

Code	99% Confidence Level	95% Confidence Level	Actual Returns
XBANK	-9.32%	-6.54%	-7.29%
XELKT	-9.26%	-6.65%	-8.21%
XFINK	-7.59%	-5.23%	-6.36%
XGIDA	-7.37%	-5.11%	-6.23%
XHOLD	-8.51%	-5.95%	-7.13%
XKMYA	-7.56%	-5.31%	-7.82%
XMANA	-7.92%	-5.55%	-7.92%
XMESY	-8.01%	-5.57%	-5.51%
XKAGT	-8.34%	-5.79%	-7.39%
XSGRT	-8.29%	-5.75%	-7.38%
XTAST	-6.38%	-4.45%	-5.39%
XTEKS	-6.80%	-4.70%	-8.26%
XTCRT	-7.80%	-5.48%	-6.61%
XTRZM	-10.44%	-7.25%	-10.28%

XULAS	-8.50%	-5.91%	-10.05%

Actual returns at the date 20/11/2000 are shown in Table 5.8. At the 99% confidence level, VaRs of XTRZM, XELKT, XMAN, XKAGT, XSGRT, XBANK, XHOLD, XTCRT, XFINK, XGIDA, XMESY, and XTAST are not greater than the actual losses and VaRs of XULAS, XTEKS, and XKMYA are smaller than the actual losses.

At the 95% confidence level, the actual losses of all sectors, except XMESY, exceed the VaRs. Hence, actual return of XMESY in 20/11/2000 is not in the 5% area because maximum loss at the 95% confidence level is smaller than the actual loss. However, the actual returns of all sectors, except XMESY, are in the 5% area because maximum losses at the 95% confidence level are greater than the actual losses.

5.4.2 Case B (February 2001 Crisis)

Table 5.9 shows the VaRs of sectors at the both 99% and 95% confidence levels. At the 99% confidence level XTRZM is the most risky sector followed by XELKT, XHOLD, XMANA, SGRT, and XMESY. The least risky sector is XTAST whose VaR is not below than 8%.

VaR figures of sectors at the 95% confidence level shows that XTRZM is again the most risky sector and XTAST is again the least risky sector.

XBANK has the most actual loss in February 2001 Crisis with about 19%. Even the least actual loss is not smaller than 13%.

VaRs of sectors at the both 99% and 95% confidence levels don't cover the actual losses.

Table 5.9 Value-at-Risk figures of sector returns over the February 2001 Crisis (Variance/Covariance Method)

Code	99% Confidence Level	95% Confidence Level	Actual Returns
XBANK	-10.00%	-7.12%	-19.08%
XELKT	-10.86%	-7.76%	-15.56%
XFINK	-9.31%	-6.63%	-16.81%
XGIDA	-8.87%	-6.29%	-13.41%
XHOLD	-10.26%	-7.34%	-18.26%
XKMYA	-9.36%	-6.68%	-16.94%
XMANA	-10.23%	-7.33%	-18.74%
XMESY	-10.10%	-7.21%	-16.97%
XKAGT	-9.38%	-6.69%	-15.22%
XSGRT	-10.10%	-7.19%	-18.67%
XTAST	-8.25%	-5.92%	-16.11%
XTEKS	-9.22%	-6.59%	-17.59%
XTCRT	-9.66%	-6.93%	-18.43%
XTRZM	-11.13%	-7.99%	-17.71%

XULAS	-10.04%	-7.15%	-16.73%

5.4.3 Case C

Table 5.10 shows the VaRs of sectors at the both 99% and 95% confidence levels. At the 99% confidence level XTRZM is the most risky sector followed by XSGRT, XFINK, XGIDA, XELKT, and XMANA. The least risky sector is XTCRT whose VaR is not below than 3.6%. VaR figures of sectors at the 95% confidence level shows that XTRZM is again the most risky sector and XTCRT is again the least risky sector.

XTRZM has the most actual loss at the date 05.07.2006 with about 5.6%. Actual returns of sectors, except XGIDA, are negative.

VaR figures of sectors at the 99% confidence level shows that VaRs of sectors, except XTEKS, cover the actual returns. That is to say, only the VaR of XTEKS is greater than the actual loss. At the 95% confidence level VaRs of XBANK, XFINK, XGIDA, XHOLD, XMESY, and XULAS cover the actual losses.

Table 5.10 Value-at-Risk figures of sector returns over the Case C (Variance/Covariance Method)

Code	99% Confidence Level	95% Confidence Level	Actual Returns
XBANK	-4.73%	-3.30%	-3.27%
XELKT	-5.44%	-3.86%	-3.92%
XFINK	-5.65%	-3.95%	-1.35%
XGIDA	-5.63%	-3.94%	0.29%

XHOLD	-4.63%	-3.24%	-2.37%
XKMYA	-4.39%	-3.07%	-3.10%
XMANA	-4.98%	-3.49%	-4.05%
XMESY	-3.96%	-2.77%	-2.45%
XKAGT	-4.81%	-3.39%	-3.70%
XSGRT	-6.19%	-4.31%	-5.02%
XTAST	-3.78%	-2.61%	-3.11%
XTEKS	-3.90%	-2.74%	-4.85%
XTCRT	-3.63%	-2.50%	-3.00%
XTRZM	-7.05%	-4.94%	-5.59%
XULAS	-4.81%	-3.41%	-3.37%

5.5 Conclusion

We have used VaR estimates that are calculated from the historical data of the sector returns to compare the sectors traded at the ISE and to evaluate the comparison of historical simulation and variance/covariance method, especially at the times of crises. XTRZM appears to be the most risky sector at crisis times and randomly chosen date. XTAST and XTCRT appear to be least risky sectors. Table 5.11 shows the most and the least risky sectors.

Table 5.11 Comparison of Sector Risks

	Case A				Case B				Case C			
	Historical Simulation		Variance Covariance		Historical Simulation		Variance Covariance		Historical Simulation		Variance Covariance	
	99%	95%	99%	95%	99%	95%	99%	95%	99%	95%	99%	95%
Most	XBANK	XELKT	XTRZM	XTRZM	XTRZM	XTRZM	XTRZM	XTRZM	XTRZM	XTRZM	XTRZM	XTRZM
Least	XTAST	XTAST	XTAST	XTAST	XBANK	XGIDA	XTAST	XTAST	XTCRT	XTCRT	XTCRT	XTCRT

Performances of historical simulation and the variance covariance method are showed in Table 5.12. At crisis times both the historical simulation and the variance covariance method fail to compute the maximum loss of each sector at the 95% confidence level. Especially in the February 2001 Crisis, both the historical simulation and the variance covariance method fail to compute the risks of all sectors. In addition, at the 99% confidence level the historical simulation and the variance covariance method display similar performances.

Table 5.12 Performance of Value-at-Risk[80]

	Case A				Case B				Case C			
	Historical Simulation		Variance Covariance		Historical Simulation		Variance Covariance		Historical Simulation		Variance Covariance	
Code	99%	95%	99%	95%	99%	95%	99%	95%	99%	95%	99%	95%
XBANK	+	--	+	--	--	--	--	--	+	+	+	+
XELKT	--	--	+	--	--	--	--	--	+	--	+	--
XFINK	+	--	+	--	--	--	--	--	+	+	+	+
XGIDA	+	--	+	--	--	--	--	--	+	+	+	+
XHOLD	+	--	+	--	--	--	--	--	+	+	+	+
XKMYA	--	--	--	--	--	--	--	--	+	+	+	--
XMANA	+	--	+	--	--	--	--	--	+	--	+	--
XMESY	+	--	+	+	--	--	--	--	+	+	+	+
XKAGT	+	--	+	--	--	--	--	--	+	--	+	--
XSGRT	+	--	+	--	--	--	--	--	+	--	+	--
XTAST	+	--	+	--	--	--	--	--	+	--	+	--
XTEKS	--	--	--	--	--	--	--	--	+	--	--	--
XTCRT	--	--	+	--	--	--	--	--	+	--	+	--
XTRZM	--	--	+	--	--	--	--	--	+	--	+	--

[80] '+' denotes that VaR covers the actual loss, '—' denotes that VaR does not cover the actual loss.

XULAS	--	--	--	--	--	--	--	--	+	+	+	+

VaR appears as a good measure to evaluate risk when the economy is functioning smoothly and the confidence level is 99%. On the other hand, VaR starts failing at the times of crisis. The two cases of crises we included in our analysis reveal that risks computed by VaR are not good measures of true losses incurred. It is not to argue that VaR method is unsuccessful.

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