

AN ANALYSIS OF GEOGRAPHIC AND SECTORAL DIVERSIFICATION
USING CITY AND SECTOR INDICES OF TURKEY

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ABSTRACT

AN ANALYSIS OF GEOGRAPHIC AND SECTORAL DIVERSIFICATION USING CITY AND SECTOR INDICES OF TURKEY

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This thesis examines the potentials of geographic and sectoral diversification in Turkey. A Causality in variance test suggested by Hafner and Herwartz is conducted in a pairwise fashion among city indices and among sector indices, separately, to explore the existence of diversification potential. All data are 5-day week daily time series and sourced from Borsa Istanbul. City index data covers the period January 2, 2009 between November 24, 2014, whereas sectoral index data covers the period April 1, 2004 and December 12, 2014. Empirical results show that there is no risk spillover across city and sector indices, which suggests that sectoral and geographic diversification is both beneficial for minimizing the risk. In order to compare the effects of geographic and sectoral diversification, risks of minimum variance portfolios are calculated. To see the effect of geographic and sectoral concentration on risk, Herfindahl–Hirschman Index (HHI) concentration ratios and diversifiable risks are compared. Similar to the previous findings in the literature, the results of HHI ratios and risks of minimum variance portfolios indicate that both diversification strategies are beneficial in reducing risk but geographic diversification is superior to sectoral diversification in Turkey based on the index returns.

Keywords: Geographic diversification, Sectoral diversification, Volatility spillover
City indices, Causality-in-variance

Öz

TÜRKİYE ŞEHİR VE SEKTÖR ENDEKSLERİYLE ÇEŞİTLENDİRME DE SEKTÖREL VE BÖLGESEL ETKİLERİN BİR ANALİZİ

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Bu tezde Türkiye'deki bölgesel ve sektörel çeşitlendirme potansiyelleri incelenmektedir. Hafner ve Herwartz tarafından önerilen varyansta nedensellik testi çeşitlendirme potansiyelinin var olup olmadığını öğrenmek için, şehir ve sektör endekslerinin kendi aralarında olmak üzere, her bir çift sektör ve şehir endeksi için uygulanmıştır. Çalışmada Borsa İstanbul'dan alınan günlük veriler kullanılmıştır. Şehir endeksi verileri 2 Ocak 2009 ve 24 Kasım 2014 arasındaki dönemi, Sektör endeksi verileri ise 1 Nisan 2004 ve 12 Aralık 2014 arasındaki dönemi kapsamaktadır. Ampirik bulgular herhangi iki sektör ya da herhangi iki şehir endeksi arasında oynaklık yayılımı bulunmadığını göstermektedir. Bu sonuçlar riski en aza indirmede bölgesel ve sektörel çeşitlendirmenin etkili olduğunu ifade etmektedir. Bölgesel ve sektörel çeşitlendirmenin etkilerinin karşılaştırılması için minimum varyans portföylerinin riskleri hesaplanmıştır. Bölgesel ve sektörel yoğunlaşmanın risk üzerindeki etkilerinin gözlenmesi amacıyla Herfindahl–Hirschman Endeksi yoğunlaşma rasyoları ve dağıtılabilir riskler karşılaştırılmıştır. Daha önce yapılan çalışmaların bulgularına benzer şekilde, sonuçlar, riski azaltmada bölgesel ve sektörel çeşitlendirmenin yararlı olduğunu ancak bölgesel çeşitlendirmenin, sektörel çeşitlendirmeye göre daha etkili olduğunu göstermektedir.

Anahtar Kelimeler: Bölgesel çeşitlendirme, Sektörel çeşitlendirme, Oynaklık
Yayımlı, Şehir Endeksleri, Varyansta nedensellik

To My Wife

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TABLE OF CONTENTS

PLAGIARISM	iii
ABSTRACT	iv
ÖZ	vi
DEDICATION	viii
ACKNOWLEDGEMENTS	ix
LIST OF TABLES	xii
LIST OF ABBREVIATIONS	xiii
CHAPTER	
1.INTRODUCTION	1
2.ISTANBUL STOCK EXCHANGE AND THE INDICES.....	5
2.1 Borsa Istanbul (BIST)	5
2.2 Stock Indices and General Rules	5
2.3 Calculation Method and Adjustment.....	6
2.4 City and Sector Indices.....	7
3.LITERATURE REVIEW.....	15
3.1 Spillover Across Developed Countries	15
3.2 Spillover Among Developed and Emerging Countries	17
3.3 Spillover Across Emerging Countries	20
3.4 Spillover Among Sectoral Equity Indices	22
3.5 Geographic versus Sectoral Diversification	25
4.DATA CHARACTERISTICS	32
5.METHODOLOGY	38
5.1 Causality-in-Variance.....	38
5.2 Minimum Variance Portfolio	43
5.3 Sharpe Ratio	44
5.4 Herfindahl-Hirschman Index.....	44
5.5 The Index Model and Diversifiable Risk	45

6.EMPIRICAL RESULTS	47
6.1 ARMA-GARCH Estimations	47
6.2 Volatility Spillover	52
6.3 Minimum Variance Portfolios (MVP)	56
6.4 HHI Concentration Ratios and Diversifiable Risks	60
7.CONCLUSION	62
REFERENCES.....	65
APPENDICES	
APPENDIX A: HIGHER ORDER GARCH SELECTION	71
APPENDIX B: CAUSALITY-IN-VARIANCE TEST USING HIGHER ORDER GARCH MODELS	74
APPENDIX C: TURKISH SUMMARY	77
APPENDIX D: TEZ FOTOKOPİSİ İZİN FORMU	89

LIST OF TABLES

TABLES

Table 2.1 The Number of Firms Included in City and Sector Indices	10
Table 2.2 The Number of Common Firms Included in City and Sector Indices	11
Table 2.3 Market Capitalization Based Percentage Dispersion Rates of City Indices Across Sectors	12
Table 2.4a Market Capitalization Based Percentage Dispersion Rates of Sector Indices Across Cities: Geographically Less Dispersed Sectors	13
Table 2.4b Market Capitalization Based Percentage Dispersion Rates of Sector Indices Across Cities: Geographically More Dispersed Sectors.....	14
Table 4.1 Indices of cities and sectors in the study	32
Table 4.2a Descriptive Statistics: City Price Indices	33
Table 4.2b Descriptive Statistics: City Return Indices	33
Table 4.3a Descriptive Statistics: Sector Price Indices	34
Table 4.3b Descriptive Statistics: Sector Return Indices	34
Table 4.4 Unit Root Tests: Price Index	36
Table 4.5 Unit Root Tests: Return Index	37
Table 6.1 ARMA Models.....	48
Table 6.2 GARCH (1,1) Results	49
Table 6.3 ARCH-LM Test P-Values.....	51
Table 6.4 T-Statistics of LM Test For Causality in Variance: City Indices	53
Table 6.5 T-Statistics of LM Test For Causality in Variance : Sector Return Indices	54
Table 6.6 T-Statistics of LM Test For Causality in Variance : Sector Price Indices .	55
Table 6.7 Minimum Variance Portfolios	58
Table 6.8 Minimum Variance Portfolio Weights of Hypothetical Index Funds.....	59
Table 6.9 HHI Concentration Ratios and Diversifiable Risks	61

LIST OF ABBREVIATIONS

FOOD	FOOD, BEVERAGE
TEXT	TEXTILE
PAPER	PAPER, FOREST
CHM	CHEMISTRY, OIL, PLASTICS
STONE	STONE, SOIL
METAL	METAL
MCHN	MACHINERY
ELECTR	ELECTRICITY
TRANS	TRANSPORTATION
TRSM	TOURISM
CMRC	COMMERCE
COMN	COMMUNICATION
SPORT	SPORT
BANK	BANK
INSR	INSURANCE
LEAS	LEASING, FACTORING
HOLD	HOLDING, INVESTMENT
REAL	REAL ESTATE INVESTMENT TRUST
IT	IT INDUSTRY
MIN	MINING
CONSTR	CONSTRUCTION
TECH	TECHNOLOGY
ADN	ADANA
ANK	ANKARA
ANT	ANTALYA
BUR	BURSA
IST	İSTANBUL
IZM	İZMİR
KAY	KAYSERİ
KOC	KOCAELİ
TKR	TEKİRDAĞ

CHAPTER 1

INTRODUCTION

Borsa Istanbul introduced city indices in 2009, as first of its kind, with the purpose of providing benchmarks for future index funds, as a new passive investment opportunity for investors seeking to easily invest in one single city. Istanbul Stock Exchange (name of the Turkish organized stock market before it has changed its name to Borsa Istanbul in 2013) has been using broad market indices as well as sector indices for more than 20 years. In the past few years it has added even more industry indexes in addition to the city indices.

Known and used by finance professionals and academicians, equity indices as well as fixed income, and other asset related indices are simply the statistical measures of changes in a group of individual data points. They can be broad or specific according to the purpose. They are used as benchmarks against which investors and money managers can measure their own investment performance. The rapid growth of exchange traded funds in the late 1990's made stock indices even more important. The ETF industry has also caused the development of many new stock market indices to diversify the passively managed investment opportunities.

The purpose of this thesis is to discover and compare the potentials of geographic and sectoral diversification using the sector and city indices in Turkey, which is an emerging market that attracts global investors. In the BIST, the share of foreign holdings is approximately 65%. The results of this study will have important implications for both local and global investors, as well as scholars.

In the literature, there are many studies seeking to discover and compare the contributions of geographic and sectoral diversification based on sectoral and

regional index returns or individual security returns globally. However, to the extent of our knowledge, there are not many studies making such comparison within the same country. Using the data of one single country makes the comparison more robust as opposed to that of multi-national studies because the stocks are not cross-listed, synchronously traded (located in the same time zones) and exposed to the same macroeconomic and political effects. In that respect, a major contribution of this thesis is that, to the extent of our knowledge, comparison of geographic and sectoral diversification has not been conducted within the same country on a “city basis”. Turkey is an important case, since first there are city indices developed for this purpose.

In order to discover the sectoral and regional diversification potentials, causality-in-variance tests are widely used in the literature to investigate whether there are volatility spillover between index returns because understanding volatility spillovers are critical for pricing securities, global hedging strategies and asset allocation decisions (Ng, 2000; Bekaert and Harvey, 1997). The diversification potential will be higher if there is no information transmission. In our study, causality-in-variance approach is adopted following the literature. However, we use a newly developed methodology which is described in detail in the methodology part of the thesis.

On the other hand, Sharpe ratios, introduced by Sharpe (1966), of minimum variance portfolios constructed of purely sector or regional indices are used in the literature to compare the contributions of sectoral and geographic indices to diversification. Moreover, efficient frontiers (Markowitz, 1952) are drawn for those portfolios to see generated returns according to risks by using different proportions of stock market indices. These methods are also used in our study to compare the potentials of geographic and sectoral diversification in Turkey.

In addition to the methodologies used in the literature, a simple approach is suggested to discover and compare the sectoral and geographic diversification

potentials in the study. The approach involves calculating concentration ratios according to the famous Herfindahl–Hirschman Index (HHI) and diversifiable risks of each city and sector index. Lower concentration suggests higher diversification potential and it is expected that the degree of concentration is positively correlated with diversifiable risks.

In the literature, the general conclusion about the volatility spillover is that volatility is generally transmitted from developed or large markets to the less developed or small markets. (Hamao, Masulis and Ng, 1990; Booth, Martikainen and Tse, 1997). The degree of developedness or maturity in financial sectors can be referred to free float rate of the stocks, the size of trade volume, market capitalization of the stockmarkets, high levels of liquidity, financial deregulation and free flow of capital (Beck et al., 2000 and 2010). As to the comparison of sectoral and geographic diversification potentials, the superiority of geographic diversification over sectoral diversification is observed in the literature (Heston and Rouwenhorst, 1994; Griffin and Karolyi, 1998; Brooks and Del Negro, 2004) although there are some exceptions (Adjaouté and Danthine, 2001; Wang, Lee, and Huang, 2003; Flavin, 2004).

We find that there is no risk spillover across city and sector indices, which suggests that sectoral and geographic diversification is both beneficial for minimizing the risk. The results of HHI ratios, efficient frontiers and Sharpe ratios also confirm the benefits of both diversification strategies. Similar to the results provided in the literature, we find that geographic diversification is superior to sectoral diversification in Turkey based on the index returns.

The rest of the thesis is organized as follows; Next section gives general information about Istanbul Stock Exchange and calculation of the indices. Third section provides a body of literature which discuss volatility spillovers among equity indices of developed and emerging countries and comparison of geographic diversification and sectoral diversification. The fourth section gives information and descriptive

statistics of the data. Fifth section presents the methodology and procedure to conduct the analysis. Sixth and seventh sections provide the empirical results and conclusion.

CHAPTER 2

ISTANBUL STOCK EXCHANGE AND THE INDICES

2.1 Borsa Istanbul (BIST)

The Istanbul Stock Exchange (ISE or IMKB in Turkish) is the only organization in Turkey for securities exchange established as an autonomous, professional organization in 1986. A major change has been made recently in the regulation of Turkish capital markets to complete the integration process of the Turkish capital markets with the EU regulations, global markets and improve competitiveness. The new regulation involves bringing about liberalization of the organized market activities and re-structuring and re-branding of IMKB as Borsa İstanbul (Borsa İstanbul, 2013).

Istanbul Stock Exchange (ISE), the Istanbul Gold Exchange and the Derivatives Exchange of Turkey (VIOB), which was originally established in Izmir in 2005, operate under the roof of Borsa İstanbul. Shareholders of Borsa İstanbul are: 49% Turkish Government, 41% IMKB, 5% VOB, 4% IMKB members, 1% IMKB brokers. There are 350 companies quoted in Borsa İstanbul and their total market capitalization value is approximately 297 billion dollars as of May 5, 2015 (Borsa İstanbul, 2013).

2.2 Stock Indices and General Rules

BIST Stock Indices have been created to measure the joint performances of group of stocks traded on Borsa İstanbul. They are calculated both in terms of price and return. Price and return indices differ only in inclusion of dividend payments made in cash. Dividends are excluded in calculation of Price Indices. Stocks traded on the

Free Trade Platform and the Watchlist Companies Market are not included in any of BIST Stock Indices. Stocks included in lists C and D and traded on the Emerging Companies Market are not included in any of BIST Stock Indices except BIST SME Industrial index. In order to launch a new index, the number of constituents should reach to 5. The only exception is the indices in which certain companies are fixed permanently. If the number of companies in an index falls below 2, the index is no longer calculated permanently beginning from the next business day. Calculated Indices are; BIST 100 Index, BIST 30 Index, BIST 10 Bank Index, BIST 100-30 Index, BIST Corporate Governance Index, BIST All Index, BIST All-100 Index, BIST Sector Indices and Sub-Sector Indices, BIST National Index, BIST Second National Index, BIST Investment Trusts Index, BIST City Indices, BIST Dividend Index, BIST Dividend 25 Index, BIST IPO Index and BIST SME Industrial Index (Borsa Istanbul, 2013).

2.3 Calculation Method and Adjustment

BIST Indices are calculated as free float market capitalization weighted and latest price data are used in the index calculations. The formula used in the calculation of indices is;

$$E_t = \frac{\sum_{i=1}^n F_{it} N_{it} H_{it} K_{it}}{B_t} \quad (1)$$

E_t = Value of the index at time t

n = Number of constituent stocks

F_{it} = Price of the stock "i" at time t

N_{it} = Total number of shares of stock "i" at time t

H_{it} = Free float ratio used in index calculation of the stock "i" at time t

K_{it} = Coefficient of the stock "i" at time t

B_t = Divisor of the index at time t

In case the numerator is changed because of some events, the divisor of the index is adjusted accordingly for the continuity in value of the index. The adjustment calculation is made using this formula;

$$B_{t+1} = \left(1 + \frac{\Delta PD}{PD_t} \right) B_t \quad (2)$$

B_{t+1} = Adjusted divisor to be used on day t+1

ΔPD = Change in the total Weighted Free Float market value of the stocks

PD_t = Total Weighted Free Float market value of the stocks on day "t"

B_t = Divisor of the index at time t

Adjustment is made following these events; cash dividend payment, capital increase in cash, inclusion or exclusion of new stocks in indices, change in free float ratio, company mergers, company spin-off, the sale of shares held ready to sell in public offerings and share transformation of companies with multiple groups of stock altering the number of shares in different groups.

2.4 City and Sector Indices

The Sector indices include the stocks of companies quoted on Borsa İstanbul, with the exception of Investment Trusts. They have no specific selection criteria other than general rules stated in the previous section.

As a new example of regional segmentation, in Turkey, as of January 2009, Borsa Istanbul (IMKB at the time) has started to calculate city indices for the first time in the world. The indices include the stocks of companies quoted on Borsa İstanbul but there are some specific criteria in classification of companies by cities. If the company is a production company and more than 50 % of its production takes place in one city then it is included in the index of that city. If the company is a services company and more than 50 % of its operating income originates from one city then it is included in the index of that city. If the company is not either of them then the location of its registered office is taken into account. The last criterion is valid for communication, construction companies and holdings. Financial and retail sector companies are excluded from the city indices except the holdings. If there is no index being currently calculated for a city then it is irrelevant for the eligible company to be included in an index (Borsa Istanbul, 2013).

The purpose of calculating the city indices is stated as follows: The performance of the stocks of the firm in cities will be revealed and the opportunity of investing in a city will be provided to investors seeking to invest in a certain city with a single financial instrument by forming city index funds (Borsa Istanbul, 2013).

The lists and number of companies included in indices are provided below in Table 2.1. In total, city indices include 192 firms, while sector indices include 303. There are 172 companies covered by both a city and a sector index. However, some indices are omitted from the data sample (mining, construction, technology, Konya, Balıkesir and Denizli) to achieve the longest possible sample period. These indices are relatively new and are updated in two or three years. Also, technology index includes all firms covered by IT index plus one company. That's why to avoid repetition, we assume that index has one company located in Ankara.

After excluding the last three indices in both kind from the study, there are now 180 firms in city indices, while 289 firms in sector indices. The number of common firms

is 160 after the omission. Table 2.2 shows the number of common firms by each index. As seen in the table, some sectors are concentrated in certain cities and some cities are concentrated in certain sectors. However, making such an inference based on the number of companies can be misleading because there are big differences between the values of the companies. Market Capitalization based concentration, as displayed in Table 2.3, 2.4a and 2.4b, is a more robust approach because in calculating the indices and constructing portfolios, value-based weighted average returns and risks are used rather than using simply average returns and risks generated through dividing the figures by number of the firms. For example, there is only one food and beverage company in Ankara, while there are 7 companies in İzmir from the same sector. If we calculated the distribution of the sector across cities based on number of the companies, İzmir's share in the sector would be seven times bigger than that of Ankara. However, the size of the company in Ankara almost doubles the total size of 7 companies in İzmir.

Market Capitalization based concentration rates are displayed in Table 2.3, 2.4a and 2.4b below. Table 2.3 shows the value based distributions of city indices across sectors. For example, in the interception of Ankara and food and beverage sector, we see the figure of 29.47. This figure represents that food and beverage companies (or company) located in Ankara have the 29.47 % share in total market capitalization value of all companies included in Ankara city index. Table 2.4a and 2.4b show the value based distributions of sector indices across cities. Likewise, in the interception of Ankara and food and beverage sector, we see the figure of 24.50. However, this time the figure states that food and beverage companies (or company) located in Ankara have 24.50 % share in total market capitalization value of all companies included in food and beverage sector index. Concentration rates in Table 2.3, 2.4a and 2.4b are calculated using closing market capitalization values of companies on March 26, 2015.

Table 2.1 The Number of Firms Included in City and Sector Indices

Sectoral Indices				City Indices			
Code	Index Name	Abbr.	# of Firms	Code	Index Name	Abbr.	# of Firms
XGIDA	FOOD, BEVERAGE	FOOD	20	XSADA	ADANA	ADN	6
XTEKS	TEXTILE	TEXT	16	XSANK	ANKARA	ANK	15
XKAGT	PAPER, FOREST	PAPER	14	XSANT	ANTALYA	ANT	4
XKMYA	CHEMISTRY, OIL, PLASTICS	CHM	25	XSBUR	BURSA	BUR	15
XTAST	STONE, SOIL	STONE	26	XSIST	ISTANBUL	IST	88
XMANA	METAL	METAL	15	XSIZM	IZMIR	IZM	25
XMESY	MACHINERY	MCHN	28	XSKAY	KAYSERI	KAY	3
XELKT	ELECTRICITY	ELCTR	6	XSKOC	KOCAELI	KOC	19
XULAS	TRANSPORTATION	TRANS	6	XSTKR	TEKİRDAĞ	TKR	5
XTRZM	TOURISM	CMRC	5	XSKON	KONYA	KON	5
XTCRT	COMMERCE	TRSM	22	XSBAL	BALIKESIR	BAL	3
XILTM	COMMUNICATION	COMN	2	XSDNZ	DENIZLI	DNZ	4
XSPOR	SPORT	SPORT	4				
XBANK	BANK	INSRN	12				
XSGRT	INSURANCE	BANK	5				
XFINK	LEASING, FACTORING	LEAS	4				
XHOLD	HOLDING, INVESTMENT	HOLD	39				
XGMYO	REAL ESTATE INV. TRUST	REAL	28				
XBLSM	IT INDUSTRY	IT	12				
XMADN	MINING	MIN	5				
XINSA	CONSTRUCTION	CONSTR	8				
XTEK	TECHNOLOGY	TECH	1				

Table 2.2 The Number of Common Firms Included in City and Sector Indices

	ADN	ANK	ANT	BUR	IST	IZM	KAY	KOC	TKR	KON	BAL	DNZ	Common firms
FOOD		1		4	2	7				1	2	1	18
TEXT	2				3		1	1	2			1	10
PAPER		1			5	4		1	3				14
CHM	1				6	2		7			1	1	18
STONE	3			1	3	4		2		1		1	15
METAL				3	2	1	1	2					9
MCHN		3		4	5	2		4		1			19
ELECTR				1	2		1						4
TRANS					5								5
TRSM			4		1								5
CMRC				1	5	1							7
COMN		1			1								2
SPORT					3								3
BANK													0
INSR													0
LEAS													0
HOLD		2			26			1		2			31
REAL													0
IT		2			9			1					12
MIN		2				2							4
CONSTR					7								7
TECH		1											1
Common firms	6	10	4	14	78	21	3	19	5	5	3	4	172

Table 2.3 Market Capitalization Based Percentage Dispersion Rates of City Indices Across Sectors

	ADN	ANK	ANT	BUR	IST	IZM	KAY	KOC	TKR	KON	BAL	DNZ
FOOD		29.47		8.81	11.11	17.36				1.83	21.64	25.28
TEXT	4.70				0.06		16.12	0.64	36.08		48.49	
PAPER		0.18			0.27	2.66		1.51				
CHM	33.57				2.59	31.36	6.41	71.22	63.92		11.78	74.72
STONE	61.72			4.42	2.13	5.98		2.12		34.65	18.09	
METAL				3.30	0.30	3.39	54.28	2.38				
MCHN		12.44		77.23	4.47	7.69		20.18		26.78		
ELECTR				4.69	0.90		23.18					
TRANS					11.68							
TRSM			100.0		0.17							
CMRC				1.22	1.78	0.35						
COMN		36.70			17.13							
SPORT					0.94							
BANK												
INSR												
LEAS												
HOLD		3.86			41.26			0.41		36.74		
REAL												
IT		0.70			0.85			1.55				
MIN		6.09				30.21						
CONSTR					4.07							
TECH		9.94										
Common firms	100.0	99.4	100.0	99.7	99.7	99.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2.4a Market Capitalization Based Percentage Dispersion Rates of Sector Indices Across Cities: Geographically Less Dispersed Sectors

	ELCTR	TRANS	CMRC	COMN	TRSM	SPORT	REAL	IT	MIN
ANKARA				23.61			10.63	8.19	27.75
ANTALYA					50.56				
BURSA	15.72		0.32						
ISTANBUL	62.05	93.62	9.54	76.39	49.44	90.19	89.37	69.12	
IZMIR			0.12						63.94
KAYSERI	5.18								
KOCAELI								22.69	
KONYA									
SIİRT									8.30
ISPARTA	4.52								
Ş.URFA	12.53								
FOREIGN		6.38							
TRABZON						9.81			
Coverage Ratio	100.0	100.0	10.0	100.0	100.0	100.0	100.0	100.0	100.0
	INSRN	BANK	LEAS	HOLD	CONSTR	TECH			
ANKARA				1.30		100.0			
ANTALYA									
BURSA									
ISTANBUL	100.0	100.0	100.0	97.71	100.0				
IZMIR									
KAYSERI									
KOCAELI				0.17					
KONYA				0.82					
SIİRT									
ISPARTA									
Ş.URFA									
FOREIGN									
TRABZON									
Coverage Ratio	100.0	100.0	100.0	100.0	100.0	100.0			

Table 2.4b Market Capitalization Based Percentage Dispersion Rates of Sector Indices Across Cities: Geographically More Dispersed Sectors

	FOOD	TEXT	PAPER	CHM	STONE	METAL	MCHN
ADANA		6.70		1.86	9.21		
ANKARA	24.50		2.94	0.27	3.83		10.71
BURSA	2.48				3.32	1.04	22.52
ISTANBUL	64.06	7.67	30.59	12.48	27.79	1.96	26.83
IZMIR	6.70		20.25	10.12	5.19	1.46	3.07
KAYSERI		6.50		0.10	3.83	1.14	
KOCAELI		14.30	30.91	62.05	5.66	2.98	21.77
TEKIRDAG	0.22	13.19		0.91			
KONYA	0.10			0.27	4.30		1.53
DENIZLI	0.30	14.42		0.14	0.56		
BALIKESIR	1.10			2.71			
ZONGULDAK						72.13	0.14
AFYON				0.27	3.25		
AYDIN		5.30			0.52		0.38
BURDUR					0.52		
ESKİŞEHİR					4.33		
MERSİN				3.55	4.33		
BOLU			10.63		4.25		
NİĞDE		5.21			3.83		0.18
ISPARTA					6.00		
KÜTAHYA				0.10	0.56		
MARDİN					5.16		
UŞAK					0.93		
ORDU					1.04		
KARABÜK						18.94	
KIRŞEHİR						0.34	
SAKARYA							6.11
MANİSA							6.45
AMASYA							0.16
BİLECİK					0.19		0.15
DÜZCE			2.35				
ÇANAKKALE			2.35				
YALOVA				5.16			
KIRKLARELİ		4.31					
K.MARAŞ		10.95					
HATAY		2.54					
G.ANTEP		8.91					
SİNOP	0.31						
SAMSUN	0.22						
Coverage	100.00	100.00	100.00	100.00	98.59	100.00	100.00

CHAPTER 3

LITERATURE REVIEW

There is a large body of literature on cross-country volatility spillovers that are mainly examined across developed countries, across emerging markets, and a combination of developed and emerging markets. However, the literature on spillover effects using sectoral equity indices is quite sparse. In this section we firstly review the literature on regional or geographic volatility spillovers between indices in three parts as developed, emerging, and developed to emerging. After giving few examples of sectoral volatility spillovers in the fourth part, we discuss examples of research in literature on comparison of geographic and sectoral diversification as the fifth.

3.1 Spillover Across Developed Countries

There exist a large number of studies on developed markets. Hamao, Masulis and Ng (1990) examine the short-run interdependence of price and price volatility spillovers across New York, London and Tokyo by using opening and closing prices of S&P 500, FTSE 100 and Nikkei 225 indices, respectively. Their analysis includes a family of ARCH models to examine the price relationships. According to test results they find that GARCH (1,1)-M should be used to approximate the price relationships. Evidence of price volatility spillovers from New York to London, New York to Tokyo and London to Tokyo is observed. These spillovers are unidirectional for the period between April 1, 1985 and March 31, 1988. Shimada, Tsukuda and Miyakoshi (2009) provide evidence on this asymmetric volatility spillover examining stock indices of S&P 500 and TOPIX for the period between 1991 and 1993 by using EGARCH and SV models. Their conclusion is consistent with the results of Hamao,

Masulis and Ng (1990) and suggests that there is volatility spillover from US to Japan but not vice versa. Similar results can be found in the analysis of Datar, So and Tse (2008) for the Standard & Poor's Depository Receipts (SPY) and the iShares Morgan Stanley Capital International Inc.'s Japan Index Fund (EWJ). They employed a pair-wise Granger-causality test and unidirectional mean and volatility spillovers from SPY to EWJ are observed for the data covering the period between January 2, 2002 and December 31, 2004.

Baele (2005) investigates the magnitude and time-varying nature of volatility spillovers from the aggregate European (EU) and U.S. market to 13 local European equity markets. He finds that EU and US spillover intensity had increased substantially over 1980s and 1990s, while the increase is more evident for EU spillovers and also provides evidence for contagion from the U.S. market to many local equity markets in Europe during periods when high volatility is observed in world markets. He states that growing trade integration, equity market development and low inflation figures have roles in increased intensity in EU spillover. According to the author, results also suggest that potential for international diversification has reduced during 1980s and 1990s.

Studies on developed markets are not limited to US versus others. For example, Booth, Martikainen and Tse (1997) analyze the mean and volatility spillovers between Scandinavian stock markets using multivariate EGARCH model. The study includes stockmarkets of Denmark, Sweden, Norway and Finland. They report bidirectional volatility spillover between Sweden and Finland for the period between May 2, 1988 and June 30, 1994 and stated that these volatility spillovers may well reflect the longstanding cultural and economic ties between the countries. For the same region, however, Koulakiotis, Dasilas and Papasyriopoulos (2009) find that the Finnish and Danish portfolios of cross-listed equities are those that transmit volatility to the Swedish portfolios of cross-listed equities.

Koulakiotis, Dasilas and Papasyriopoulos (2009) examine the volatility transmissions between the portfolios of cross-listed equities the Germanic (Austria, Switzerland and Germany) and the French area (Brussels, France, Italy, Netherlands and Spain) besides the Scandinavian area. In the study, a multivariate GARCH-BEKK model is used for the period between 1997 and 2006. They report that in the Germanic stockmarket area, Swiss portfolio of cross-listed equities is the major exporter of volatility and error to the other portfolios of cross-listed equities, while in French stock market area, Paris, Amsterdam and Brussels stock exchanges are the major exporters of volatility and error to the portfolios of cross-listed equities traded on the Milan and Madrid stock exchanges. Likewise the evidence on Scandinavian area, the former evidence is also not consistent with those provided in the literature. They point out that volatility spillovers are not necessarily exported by the leader or the biggest stock exchanges. They also state conflicting results may arise from the difference that they use cross-listed equities, while Booth, Martikainen and Tse (1997) use stock market indices in the analysis.

We observe in the literature that volatility is generally transmitted from more developed markets to less developed ones. The degree of developedness in financial sectors can be explained by the rate of floating stocks, free flow of capital, the liquidity level, the size of trade volume and market capitalization of the stockmarkets. It is also argued that cross listed securities may be confounding the results. In our study this will not be a problem since there is no cross listing issue.

3.2 Spillover Among Developed and Emerging Countries

In the literature, there are many empirical studies supporting the intuition by that direction of the spillovers is usually towards emerging equity markets from developed equity markets.

Ng (2000) examines the degree and changing nature of the volatility spillovers from Japan and the US to equity markets of six Pasific-Basin countries such as Hong Kong, Korea, Malaysia, Singapore, Taiwan, and Thailand. The study aims to investigate the fundamenal forces driving the return volatility in these emerging markets. She uses bivariate GARCH (1,1), ADC and BEKK models and weekly returns, to avoid the day-of-the-week effects, from S&P 500, Tokyo Stock Price Index, Kuala Lumpur Stock Price Composite Index, Singapure All Share Index, Taiwan Weighted Price Index, Korean Composite Index, Thailand Stock Exchange Index and Hang Seng Index of Hong Kong. She reports that both regional and world factors are important for market volatility in the Pasific-Basin region but influence of world market is more dominant. The relative importance of the regional and global factors can be linked to developments in liberalization such as changes in foreign direct investment restrictions, close-end country fund premium.

Bhar and Nikolova (2007) examine the BRIC countries' regional and global integration level. The data samples, forming the basis for analysis of the study, are the daily closing stock market indices for Brazil (Bovespa), Russia (AKMI Composite), India (Sensex), China (Shanghai Composite), Morgan Stanley's All Countries World Index, Financial Times All Countries Europe Index, Financial Times All Countries Asia-Pacific Index and Financial Times All Countries Americas Index, for the period between January 1995 and December 2004. ARMA(1,1)-GARCH(1,1)-in Mean and/or MA(1) processes were modelled for the BRIC equity index returns. The study provides evidence for a high level of integration between the BRIC countries. They also find that regional trends have greater influence than world trends for the case of BRIC countries. This is contrary to Ng (2000) who finds global factors to be more influential than regional factors.

Lee (2004) conducts an analysis of volatility spillover between US and Korean stock markets. They use daily data from the Dow Jones Industrial Average and Korea

Composite Stock Price Index over the period January 1995- August 2000 by estimating GARCH and VAR models. They report that price as well as volatility spillover effects from the US stock markets to the Korean counterparts are observed but not vice versa, which supports the prevailing intuition that volatility spills over from mature markets to emerging counterparts.

Beirne et al. (2008) examine volatility spillovers from mature to emerging stock markets and tests for changes in the transmission mechanism—contagion—during turbulences in mature markets. They use a trivariate GARCH-BEKK model for the time period between September 1993 and March 2008. In the study, data is taken from stock indices of 41 emerging countries in four geographic regions as Asia, Latin America, Europe (which includes Turkey) and Middle East and 6 developed countries as France, Germany, Italy, Japan, UK and US. They report that volatility of emerging market returns are strongly influenced by the volatility of mature market returns and this volatility spillover increases in turbulent times.

Hu et al. (1997) investigate the spillover effects of volatility among two developed markets (US and Japan) and four emerging markets in South China Growth Triangular (Hong Kong, Taiwan, Shanghai and Shenzhen) by using the causality-invariance test developed by Cheung and Ng (1996). Their findings can be summarized as follows. The volatility of Shanghai and Shenzhen markets are less correlated with Hong Kong and Taiwan than with US and Japan. Developed markets have less impact on volatility persistence on the Hong Kong market than they have on the other three markets although Hong Kong is the most liberalized market among others. They state that there is an inverse relationship between market openness and volatility persistence and geographical proximity does not necessarily create strong causal relationship in return volatility across equity markets.

Bekaert and Harvey (1997) report similar evidence on the inverse relationship between liberalization and volatility that Brazil, Mexico, Taiwan and Portugal experience decrease in conditional volatility after liberalization.

Wei et al. (1995) analyze the intuition that short-term volatility and price changes spill over from developed to emerging markets and how degree of market openness affects return and volatility spillovers. In study, daily open and close data from five stock indices is used over the period August 1, 1991 to December 31, 1992. S&P 500, FTSE 100, NIKKEI 225, Taiwan Market Index and Hang Seng Index are chosen as representative of stock markets of New York, London, Tokyo, Taiwan, and Hong Kong, respectively. They employ MA (1)-GARCH (1,1)-M model to estimate the volatility spillover across the indices. They found that volatility spillover effects are observed from New York to Tokyo and Hong Kong, and from Tokyo to London and New York and also New York market has more influence than the Tokyo market on the Taiwanese and Hong Kong markets.

This line of literature shows that there is information and risk transmission from developed to emerging markets. Furthermore, although there are studies that find the opposite, generally regional dynamics appear to be more important than world trends. As a result emerging markets appear to attract a lot of attention from scholars and global investors.

3.3 Spillover Across Emerging Countries

Studies on emerging markets seem to have increased recently. Diebold and Yilmaz (2009b) provide an empirical analysis of return and volatility spillovers among five equity markets in the Americas: Argentina, Brazil, Chile, Mexico and the U.S. and comparison with ten East Asian countries: Hong Kong, Japan, Australia, Singapore,

Indonesia, Korea, Malaysia, Philippines, Taiwan and Thailand. They describe a spillover index proposed recently by Diebold and Yilmaz (2009a) over the period January 1992 through 10 October 2008. They conclude based on return spillover patterns that South American stock markets are not as well integrated as East Asia's. They also state that the presence of the major Japanese stock market and Hong Kong's role as hub facility may cause spillovers and improve financial integration. They believe as many others that hub markets has critical role in exporting volatility and shocks, and there is no hub in South America like Hong Kong.

Johansson and Ljungwall (2008) examine the spillover effects among the stockmarkets in the greater China region (China, Hong Kong and Taiwan). They adopted the vector-autoregressivemultivariate exponential GARCH (VAR-MVEGARCH) model to investigate the volatility spillovers among the regions and use weekly returns on price indices of Hang Seng Index (Hong Kong), the Dow Jones China (Mainland China, an index that covers the major stocks listed on the Shanghai and Shenzhen stock exchanges), and the Taiwan Weighted Index to avoid the day-of-the week effects and non-synchronous trading. The data sample covers the period between January 5,1994 to December 31, 2005. The empirical evidence of the study shows that China and Hong Kong are both affected by mean spillover effects from Taiwan. Volatility in the Hong Kong is transmitted into Taiwan whereby the volatility is spilled over to the Mainland China market. This means that the mainland China market is related to other markets. Overall, the study shows that these three markets are significantly interdependent to one other. They conclude that the results are in line with the previous research and increased integration level of markets is strongly related to the degree of financial developedness which has been recently improved by high levels of liquidity and extremely large turnover in the domestic market.

Deehani and Moosa (2006) investigate the volatility spillovers among the stock markets of Saudi Arabia, Kuwait and Bahrain by the help of stochastic volatility concept and structural time-series modeling. They use the stock prices of companies from three regions and the data sample includes the period from January 1, 2000 to April 15, 2003. The results show that Kuwait market acts as a hub in exporting volatility spillovers. They explain the case of Kuwait market as; it is the most liquid, oldest and active market among the others and more organized than the Saudi market, which still remains an over-the-counter market. Finally, it is the most internationally recognized market.

We observe in this part of literature that most financially integrated markets, which can be defined as internationally recognized, more liquid and deregulated, are the major volatility exporters among emerging countries. Generally there is one big stockmarket, operating as hub facility, influence the volatility of the other stockmarkets. In this respect, the cities of Turkey have a similar structure that Istanbul city index solely constitutes the 30 % of the total market capitalization of the city indices. However, in other factors affecting the financial development, city indices do not differentiate much from each other because the stocks included in the indices are subject to the same regulations, same policies and quoted in the same stock exchange and same denomination.

3.4 Spillover Among Sectoral Equity Indices

In addition to international diversification, sectoral diversification is also of interest to investors. In that respect, several studies examine the risk transfer dynamics between sectoral indices. Ewing (2002), for example, examines five major S&P stock indices- capital goods (LNCAP), financials (LNFI), industrials (LNIN), transportation (LNTR), and utilities (LNUT)- to determine their interdependencies to one another in volatility transmission by using generalized forecast error variance

decomposition method. The sample includes the monthly returns on the price indices of these five sectors between the period January 1988 and July 1997. He finds that shocks to one index explain movements in other indices in different percentages. Variability in Utilities sectors are mainly effected by financials and industrials shocks at 28.4 % and 26 % levels, respectively. Transportation are effected mostly by capitals, while industrials are effected by transportation and financials. In explaining the variability of financials, industrials dominates any of the other three indices regardless of horizon. Finally, variability of capitals are explained mostly by industrials.

Hassan and Malik (2006) investigate transmission of shocks and volatility among Dow Jones's sectoral indices; financial, industrial, consumer (services), health, energy (oil and gas), and technology. They employ GARCH-BEKK model by using the daily returns of these indices between January 1, 1992 to June 6, 2005. In line with Ewing (2002) results, they observe that consumer sector is significantly affected by news from the financial sector, while financial sector is affected by news from the consumer and technology sectors in an indirect fashion. As to the technology sector, it is affected both directly and indirectly by news from the financial sector. They finally state that volatility of the technology sector is affected by volatility from all sectors including its past volatility in both direct and indirect manner.

Hammoudeh et al. (2009) examine volatility spillovers in three major sectors, namely, Service, Banking and Industrial/or Insurance, in four Gulf Cooperation Council (GCC)'s economies (Kuwait, Qatar, Saudi Arabia and UAE) by using a multivariate VAR(1)-GARCH(1,1) model. They find that there are volatility spillovers between the sectors of a country in moderate level, except UAE and the spillover from industrials to services is more pronounced than the reverse. Industrial sector of Qatar, an exporter country of natural gas and oil, exports the volatility to the other two sectors. Unlike the findings of Hassan and Malik (2006), financial sector in

GCC countries are not exporter of volatility but its volatility is significantly effected by services and industrial sectors.

Using a GARCH (1,1) model by following Bekaert and Harvey (1997), Ng (2000), and Bekaert et al. (2005), Balli et al. (2013) investigate the integration of the Euro- and US-wide sector equity indices by examining the local and global return, volatility, and trend spillover effects. The data set includes weekly stock returns for 17 leading sectors and over 300 initial public offerings (IPOs) of stocks for the European and the US markets for the period from 1992 to 2009. 17 sectors can be categorized under four main headings; Production and industry sectors, consumer goods and services sectors, financial sectors and TMT (Technology, Media, Telecommunication) sectors. They observe that the production, industry, consumer goods and services and TMT sectors equally respond to local shocks, but the financial sector is the most responsive one among all sectors.

Duran and Şahin (2006) and Tokat (2010) examine the volatility spillovers among the services, financial, industrial and technology indices of Borsa Istanbul as we did partially in our study. While the former uses EGARCH and VAR models for daily returns from July 2000 to April 2004, the former adopts the GARCH-BEKK model for the daily returns from June 30, 2000 to August 27, 2009. Tokat (2010) finds that while volatility of financial sector is indirectly effected by the volatility of services sector, services sector is effected by financial and technology sectors in the same way. Similar to Tokat (2010), Duran and Şahin (2006) find that services sector is effected by technology sector at 5 % significance level. However, they also state that financial and industrial indices are effected by technology sector at 1 % significance level.

From the literature on the subject, a general conclusion on the volatility spillover pattern among the sector indices can not be drawn, except that financial sector

appears to be a transmission node regardless of the direction of spillover. In this study we examine both sectoral and regional spillovers using a more recent volatility spillover test developed by Hafner and Herwartz (2006). Unlike Duran and Şahin (2006) and Tokat (2010), we can not find any volatility spillover among the sector indices in Borsa Istanbul. The conflicting results may arise due to methodological differences, different GARCH specifications or sample periods.

3.5 Geographic versus Sectoral Diversification

There is a vast literature on the gains resulting from adopting country vs. sectoral portfolio diversification strategy. In this section, we discuss the evidence on the subject and different methodologies used in the literature. The main conclusion on diversification gains is that investing in assets from different countries resulted in larger gains than investing in a variety of sectors within the same country.

The most dominant methodology in this subject is the one suggested by Heston and Rouwenhorst (1994). Using monthly individual stock returns, they run cross-sectional regressions on country and industry dummies to separate, quantify and compare country specific and industry-specific components of stock returns. Their data sample includes monthly total returns from 1978 to 1992 for 829 firms in the 12 European countries across the 7 different sectors in these countries. They find that diversification across countries within an industry is a much more effective tool for risk reduction than industry diversification within a country.

Griffin and Karolyi (1998) adopt the extended version of Heston and Rouwenhorst (1994)'s dummy variable regression framework, using a new database, the Dow Jones World Stock Index, with coverage in 25 countries and over 66 industry classifications over a recent period (1992-1995). They confirm the previous evidence

suggested by Heston and Rouwenhorst (1994) that country effects are more dominant than sector effects.

Following the methods of Heston and Rouwenhorst (1994), as extended by Griffin and Karolyi (1998), Baca, et al. (2000) suggest that because of increasing integration in capital markets in the world, the impact of industrial sector effects is almost the same as that of country effects. Their sample consists of U.S. dollar-denominated total monthly returns from March 31, 1979, to March 31, 1999 of 10 sector indices within each of the seven largest countries (France, Germany, Japan, Netherlands, Switzerland, UK and US). By using the same methodology, Cavaglia et al. (2000) find similar results that country and sector effects are equal. Their sample includes 36 industries in 21 developed countries for 1986-1999.

Also using the same method, Wang, Lee, and Huang (2003) investigate the country vs. sector effects on diversification in major Asian markets (Hong Kong, Japan, Korea, Malaysia, Singapore and Taiwan) and the U.S. across 22 sectors. Their data sample covers monthly returns of indices for 1990-2001. They find that sector effects have significantly dominated country effects in Asian markets since 1999. Employing the same method, Flavin (2004) confirms the results suggested by Wang, Lee, and Huang (2003) for 11 original member countries of the Euro Zone. The data sample includes monthly returns of 1193 companies for the period from January 1995 to December 2002. Wang, Lee, and Huang (2003) state that sector effects has become dominant over country effects after the Asian crisis of 1997, while Flavin (2004) observes the same event in Euro Zone after the introduction of euro as a single currency in 2001.

Brooks and Del Negro (2004), by following the extended methods of Heston and Rouwenhorst (1994) by Griffin and Karolyi (1998), observe that the rise in industry effects is a temporary event which is related to the TMT (telecommunications,

media, technology) bubble. By excluding the TMT sectors from the sample, they observe that diversifying across countries or regions rather than sectors is more efficient in minimizing portfolio risk. The data covers monthly total US dollar-denominated stock returns and market capitalizations from January 1985 to February 2002 for 9679 companies in 42 developed and emerging countries.

Following the methods of Heston and Rouwenhorst (1994) and also analyzing the volatility spillovers patterns, Soriano and Climent (2006) conduct an analysis to compare the regional and industry effects in stock returns. They use a multivariate GARCH-BEKK model. The dataset consists of daily price indices in U.S. dollars for 10 industries in three regions (North America, Europe, and Asia) and 10 economic Industries according to Level 3 of the FTSE Actuaries classification for the period January 1995-December 2004. The results suggest that the overall dominance of country effects over sector effects in the sample period still continues but because of the TMT crisis, effects of industry have increased. In the analysis volatility spillover, the results show that the significance of spillovers in an industry across international regions depends on the industry itself. The industries which are more interacted between their variance equations (GARCH) are basic industries and general industrials.

Adjaouté and Danthine (2001) use the notion of cross-sectional dispersion introduced by Roulet and Solnik (2000) to compare possible gains of cross-country and cross-sector diversification by measuring the dispersion of sector and country indices. High dispersion means lower correlation and high diversification and vice versa. Their sample consists of weekly index returns from October 7, 1988 to March 30, 2001 of ten original member countries of Euro Zone and 86 sectors in these countries. They state that due to economic and monetary integration, diversification opportunities in the Euro-zone have been permanently decreased and traditional country diversification approach is no longer superior to the sectoral diversification strategy.

In another study of the authors, Adjaouté and Danthine (2002), Heston and Rouwenhorst (1994)'s methodology is criticized as being too restrictive. They state that this methodology forces all companies to be included in one industry and one country and it could be misleading especially for the multinational companies. A similar argument is put forward by Moerman (2008).

Moerman (2008) uses mean-variance analysis to compare the possible gains of cross-country and cross-sector diversification as we did in our study. They explain the superiority of this method over that of Heston and Rouwenhorst (1994) as; it improves the analysis by examining the consequences of changes in the market for the portfolios of investors in a direct manner. They construct efficient frontiers for the index based portfolios and use spanning tests introduced by Huberman and Kandel (1997) to interpret the differences between the efficient frontiers. Their sample consists of monthly returns of industry and country indices within the entire euro area countries (except Luxembourg) from January 1995 till December 2004. Their results indicate that the efficient frontier of countries lies higher than that of the industries before the introduction of the euro as single currency, which confirms the dominance of cross-country diversification over cross-sector diversification. However, after the euro, the results suggest the opposite.

Gerard et al (2002) provide empirical evidence on the comparison of the performances of industry and country portfolios via Jensen measure, which is helpful to see if industry or country portfolios sufficiently offer diversification benefits. They suggest a new test to compare the Sharpe ratios of portfolios constructed by using pure sector or country indices and use this test to compare the efficiencies of diversification strategies based on pure sector or country indices. The data sample includes monthly returns of equity market indices of the G7 countries and ten major industry sectors within each country for the period December 1973 until November 1998. They suggest that the contribution cross-country

diversification is much bigger than that of cross-sector diversification in international diversification gains.

Emiris (2004) investigates the advantage of country diversification relative to sector diversification after European monetary and financial integration process. They adopt the ADCC (Asymmetric Dynamic Conditional Correlation) model developed by Cappiello et al (2003), which is the asymmetric version of the DCC (Dynamic Conditional Correlation) model suggested by Engle (2002). By the help of the model, they estimate the conditional correlation and volatility of weekly returns on indices of 24 countries and 10 sectors within each country for 1990-2003. They criticize a body of literature because of the two mismeasurement problems; they do not take into account the time-variation in conditional correlations and the influence of the downside risk. A comparison of alternative strategies is made via Sharpe ratios and expected maximum utilities of the portfolios constructed. They conclude that while cross-country diversification is still the superior strategy for world's portfolios, cross-sector diversification is superior for euro zone portfolios.

Balli et al. (2014) examine the effects of local and global shocks on the sector indices and national returns of the Association of Southeast Asian Nations (ASEAN) by using the univariate AR-GARCH model. They use the weekly data from ASEAN national equity return indices (Indonesia, Malaysia, the Philippines, Singapore, Thailand, Vietnam and China), global equity indices (US, Europe, Japan) and ASEAN-wide sectoral equity indices (production and industry, consumer goods and services, financial sectors and TMT). The data spans the period between 1990 and 2013. According to the results, the volatility spillover effects of local and global shocks on almost all ASEAN sectors' equity returns have been decreasing, while the effects on the production and industries group sectors and the food and beverage sector have been increasing. Comparing the variance ratios of ASEAN sectoral and national returns, they find that the percentage of national equity returns belonging to

their own shocks is higher than that of sectoral returns, indicating that investors might be better off diversifying their assets across countries rather than sectors in ASEAN area. They state that this finding is consistent with the results of the mean–variance frontiers, as the portfolio composed purely of ASEAN national returns has a stronger efficiency frontier than a portfolio of all ASEAN-wide sector equity returns. By using the spanning and intersection tests suggested by Huberman and Kandel (1997), the paper also indicates that adding ASEAN national equity returns might improve the efficiency frontiers of investors' holding portfolios.

Qiao et al. (2010) investigate the volatility behaviour and spillovers among the four major segmented Chinese stock markets. Weekly data is taken from indices of the A-type market, on which only domestic citizens can trade, and B-type market, which are traded in other locations, in foreign currencies and considerably affected by different kind of investors and market conditions, in Shenzhen and Shanghai stock markets for the period between January 1995 and March 2003. The price indices of SZA and SZB, A and B type shares in Shenzhen, SHA and SHB, A and B type shares in Shanghai, are used in the study. SWARCH-L, TGARCH and GARCH models are employed to estimate regime switching in conditional volatility and the volatility spillovers. The results show that while volatility of the SHA spills over to the SZB market, it is transmitted from the SZA to the SHB and SZB markets. On the other hand, there is no volatility transmission from B-type to A-type markets. This study is probably the only study that looks into regional diversification within a country. However, the diversification is at regional not city level, and non-citizens are not allowed to trade in A-type market, hence global investors do not have the opportunity to invest into this market.

In this part of literature, two main methods are suggested to compare the two investment strategies; dummy variable regression framework to decompose the sectoral and geographic factors and mean variance portfolio risks together with the

Sharpe ratios. We adopt the latter approach following Gerard et al (2002), Moerman (2008) and Balli et al. (2014) because it is more parsimonious and not restrictive as suggested by Moerman (2008). Also co-movement in variance and mean between sectoral and country indices are investigated via univariate or multivariate GARCH models and correlation matrices to determine whether diversification potential in both direction exists or not. We adopt the newly developed Hafner and Herwartz (2006) approach to examine the causality in variance. The superiority of the approach over other methods is discussed and tested in Hafner and Herwartz (2006). We provide detailed information in the methodology part of our study. In addition to the suggested methods, considering that city and sector indices are portfolios diversified over sectors and cities, respectively, we calculate the market capitalization based concentration ratios of city and sector indices to see if they are related with the diversifiable risks of the returns on the indices.

By using various methods, the main conclusion in the literature is that diversification across regions or countries are more efficient relative to the sectoral diversification in the same country but the level of efficiency has decreased in recent years due to the increasing financial and economic integration. Indeed, it has been observed that the incremental gain of country diversification in Europe has disappeared after the financial integration process of the euro area countries. Moreover, sectoral diversification becomes more efficient than country diversification in times of financial crisis because of the increased co-movement between the countries. As a contribution to the existing literature on the subject, we are able to measure the effect of geographic diversification in one single country by the help of city indices introduced by Borsa Istanbul. We believe that measuring the potentials of two investment strategies in the same country makes the comparison more solid because sector and city indices are exposed to the same country specific effects.

CHAPTER 4

DATA CHARACTERISTICS

In order to examine the volatility spillover discussed in the literature, price and return series of indices given in Table 4.1 are used in this study. Because their data ranges do not match those of the majority, some of the indices are omitted from the analysis. All data are 5-day week daily time series and sourced from Borsa Istanbul. City index data covers the period January 2, 2009 between November 24, 2014, whereas sectoral index data covers the period April 1, 2004 and December 12, 2014. For all series, log returns are calculated and used in each analysis in the study.

Table 4.1 Indices of cities and sectors in the study

Sector Indices		City Indices	
Index Code	SECTOR	Index Code	CITY
XGIDA	FOOD, BEVERAGE	XSADA	ADANA
XTEKS	TEXTILE	XSANK	ANKARA
XKAGT	PAPER, FOREST	XSANT	ANTALYA
XKMYA	CHEMISTRY, OIL, PLASTICS	XSBUR	BURSA
XTAST	STONE, SOIL	XSIST	İSTANBUL
XMANA	METAL	XSIZM	İZMİR
XMESY	MACHINERY	XSKAY	KAYSERİ
XELKT	ELECTRICITY	XSKOC	KOCAELİ
XULAS	TRANSPORTATION	XSTKR	TEKİRDAĞ
XTRZM	TOURISM		
XTCRT	COMMERCE		
XILTM	COMMUNICATION		
XSPOR	SPORT		
XBANK	BANK		
XSGRT	INSURANCE		
XFINK	LEASING, FACTORING		
XHOLD	HOLDING, INVESTMENT		
XGMYO	REAL ESTATE INV. TRUST		
XBLSM	IT INDUSTRY		

Table 4.2a Descriptive Statistics: City Price Indices

	ADN	ANK	ANT	BUR	IST	IZM	KAY	KOC	TKR
Mean	0.0005	0.0008	0.0002	0.001	0.0008	0.0007	0.0009	0.0009	0.0011
Median	0.0012	0.0012	0.0002	0.0015	0.0015	0.0014	0.0017	0.0015	0.0003
St. Dev.	0.0153	0.0153	0.0203	0.0184	0.0135	0.0149	0.0171	0.0177	0.0241
S. Var.	0.0002	0.0002	0.0004	0.0003	0.0002	0.0002	0.0003	0.0003	0.0006
Kurtosis	7.033	4.411	5.724	7.324	4.962	4.07	5.148	3.488	13.12
Skewness	-0.964	-0.494	-0.618	-0.695	-0.732	-0.624	-0.795	-0.637	0.823
Obs.	1467	1467	1467	1467	1467	1467	1467	1467	1467

Table 4.2b Descriptive Statistics: City Return Indices

	ADN	ANK	ANT	BUR	IST	IZM	KAY	KOC	TKR
Mean	0.0007	0.001	0.0002	0.0011	0.0009	0.0008	0.001	0.0012	0.0012
Median	0.0012	0.0013	0.0002	0.0015	0.0015	0.0014	0.0017	0.0016	0.0003
St. Dev.	0.0149	0.015	0.0203	0.0183	0.0135	0.0149	0.017	0.0173	0.0242
S. Var.	0.0002	0.0002	0.0004	0.0003	0.0002	0.0002	0.0003	0.0003	0.0006
Kurtosis	6.814	4.15	5.725	7.464	4.971	4.089	5.291	2.83	13.156
Skewness	-0.845	-0.35	-0.62	-0.695	-0.737	-0.632	-0.795	-0.468	0.842
Obs.	1467	1467	1467	1467	1467	1467	1467	1467	1467

As seen in Table 4.2a and 4.2b price and return indices of cities are observed to be fairly close to each other while those of sector indices, as displayed in Table 4.3a and 4.3b are quite different. The longer the period covered in series are extended, the bigger the difference between the price and return indices get because of the dividend effect. That's why the gap in price and return sector indices are so wide. Volatility in return sector indices are higher than those of price indices. Tekirdağ, among the city indices, has the highest kurtosis and standard deviation figures. As far as kurtosis and skewness are concerned, all data shows the existence of non-normality. Moreover, all data shows positive extreme kurtosis, which means all data is leptocurtic, as it is the case in most of the financial data.

Table 4.3a Descriptive Statistics: Sector Price Indices

	FOOD	TEXT	PAPER	CHM	STONE	METAL	MCHN	ELECTR	TRANS	TRSM
Mean	0.0003	0.0002	0.0001	0.0002	0.0002	0.0003	0.0002	0.0001	0.0004	0.0001
Median	0.0004	0.0005	0.0004	0.0004	0.0006	0.0006	0.0004	0.0000	0.0005	0.0000
St. Dev.	0.0079	0.0069	0.0080	0.0077	0.0061	0.0092	0.0077	0.0094	0.0099	0.0099
S. Var.	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001
Kurtosis	4.368	8.519	3.564	3.937	5.089	4.734	5.148	5.761	3.349	4.982
Skewness	-0.467	-1.258	-0.544	-0.452	-0.884	-0.125	-0.596	-0.360	-0.039	-0.456
Obs.	2662	2662	2662	2662	2662	2662	2662	2662	2662	2662

	CMRC	COMN	SPORT	BANK	INSR	LEAS	HOLD	REAL	IT
Mean	0.0004	0.0002	0.0001	0.0003	0.0003	0.0002	0.0002	0.0001	0.0001
Median	0.0004	0.0000	0.0001	0.0004	0.0005	0.0001	0.0004	0.0005	0.0003
St. Dev.	0.0077	0.0092	0.0092	0.0099	0.0091	0.0097	0.0083	0.0079	0.0083
S. Var.	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Kurtosis	7.608	3.377	11.022	2.666	3.875	6.573	3.565	3.131	4.596
Skewness	-0.176	0.001	-0.262	-0.025	-0.409	0.145	-0.295	-0.590	-0.429
Obs.	2662	2662	2662	2662	2662	2662	2662	2662	2662

Table 4.3b Descriptive Statistics: Sector Return Indices

	FOOD	TEXT	PAPER	CHM	STONE	METAL	MCHN	ELECTR	TRANS	TRSM
Mean	0.0007	0.0005	0.0003	0.0008	0.0007	0.0009	0.0006	0.0001	0.0010	0.0001
Median	0.0010	0.0012	0.0009	0.0012	0.0014	0.0014	0.0012	0.0000	0.0011	0.0000
St. Dev.	0.0182	0.0159	0.0185	0.0176	0.0140	0.0211	0.0177	0.0216	0.0228	0.0229
S. Var.	0.0003	0.0003	0.0003	0.0003	0.0002	0.0005	0.0003	0.0005	0.0005	0.0005
Kurtosis	4.381	8.562	3.583	3.886	5.222	4.778	5.152	5.754	3.377	4.982
Skewness	-0.461	-1.258	-0.547	-0.385	-0.896	-0.117	-0.594	-0.358	-0.032	-0.456
Obs.	2662	2662	2662	2662	2662	2662	2662	2662	2662	2662

In theory, if a time series fluctuates around a constant mean, indicating that the series have a finite variance, then it is said that the series is stationary. On the other hand, if there is unit root in a time series, this suggests that the process is non-stationary. In order to make robust estimation, the stationarity of the series must be satisfied.

Table 4.3b Descriptive Statistics: Sector Return Indices (continued)

	CMRC	COMN	SPORT	BANK	INSR	LEAS	HOLD	REAL	IT
Mean	0.0009	0.0006	0.0005	0.0007	0.0007	0.0005	0.0004	0.0004	0.0003
Median	0.0011	0.0000	0.0002	0.0010	0.0011	0.0002	0.0010	0.0012	0.0008
St. Dev.	0.0176	0.0211	0.0210	0.0227	0.0210	0.0222	0.0192	0.0182	0.0192
S. Var.	0.0003	0.0004	0.0004	0.0005	0.0004	0.0005	0.0004	0.0003	0.0004
Kurtosis	7.596	3.402	11.280	2.663	3.882	6.572	3.569	3.172	4.658
Skewness	-0.183	0.003	-0.239	-0.026	-0.410	0.141	-0.294	-0.578	-0.432
Obs.	2662	2662	2662	2662	2662	2662	2662	2662	2662

There are various unit root tests to determine stationarity in the data. Because these test can give conflicting results, two test are jointly conducted to check reliability. These tests are augmented Dickey-Fuller (1976) and Dickey-Fuller generalized least squares detrended (DF-GLS) test of Elliott et al. (1996). The null hypothesis of the each unit root test is that the series in concern has a unit root.

As Table 4.4 and 4.5 illustrate, ADF test statistics suggest that all series in level are integrated of order 1 except xiltm series. According to DF-GLS, together with xiltm and xbank in both, xkmya series in price index and xkoc series in return index are stationary in levels. For both return and price indices, ADF statistics unanimously suggest that at 1% significance level, first differenced series are stationary. In DF GLS test, non-stationarity is rejected for almost all the first differenced series at 1% level.

Non-stationarity for three series each in price and return indices are rejected at either 5% or 10% significance levels. However, for xsank log return series in both kind of indices, the null hypothesis that series has a unit root can not be rejected. According to DF-GLS, xsank first differenced series is not stationary. Next chapter describes the methodologies we use in the study.

Table 4.4 Unit Root Tests: Price Index

	Level		First Differenced	
	ADF	DF-GLS	ADF	DF-GLS
ADN	-2.095	-0.996	-37.323***	-4.580***
ANK	-2.564	-1.798	-39.741***	-1.926
ANT	-2.442	-0.660	-37.441***	-37.101***
BUR	-2.796	-1.999	-38.693***	-37.714***
IST	-2.608	-2.047	-38.571***	-3.030**
IZM	-1.623	-1.192	-38.189***	-37.992***
KAY	-2.313	-1.164	-35.369***	-2.604*
KOC	-2.771	-2.211	-36.097***	-3.590***
TKR	-2.490	-1.101	-28.230***	-10.920***
BANK	-2.831	-2.622*	-50.218***	-49.277***
IT	-2.054	-1.666	-47.830***	-3.942***
ELECTR	-1.986	-1.987	-47.523***	-10.577***
LEAS	-2.368	-2.204	-46.986***	-46.455***
FOOD	-2.843	-2.233	-39.819***	-50.811***
REAL	-2.222	-2.017	-47.172***	-6.185***
HOLD	-2.152	-2.184	-48.588***	-48.569***
COMN	-4.326***	-3.814***	-51.985***	-4.378***
PAPER	-2.129	-2.098	-48.639***	-10.489***
CHM	-2.684	-2.689*	-48.603***	-30.952***
METAL	-0.942	-1.285	-48.064***	-46.738***
MCHN	-1.125	-0.787	-47.391***	-5.081***
INSR	-2.397	-2.234	-46.683***	-45.018***
SPORT	-1.646	-1.547	-45.048***	-10.361***
STONE	-1.919	-1.544	-47.009***	-6.126***
CMRC	-2.794*	-1.858	-51.160***	-50.743***
TEXT	-1.949	-1.517	-49.097***	-5.579***
TRSM	-2.303	-1.530	-49.021***	-3.913***
TRANS	-0.811	-0.633	-48.094***	-7.316***

Superscripts *, **, *** represent significance at the 10, 5, and 1% respectively. Lag Lengths are determined via SIC

Table 4.5 Unit Root Tests: Return Index

	Level		First Differenced	
	ADF	DF-GLS	ADF	DF-GLS
ADN	-2.074	-0.995	-37.656***	-4.649***
ANK	-2.633	-2.143	-39.950***	-1.907
ANT	-2.444	-0.656	-37.410***	-37.068***
BUR	-2.489	-2.066	-38.675***	-37.717***
IST	-2.627	-2.135	-38.521***	-3.037**
IZM	-1.758	-1.386	-38.226***	-38.034***
KAY	-2.258	-1.192	-35.444***	-2.601*
KOC	-3.048	-2.720*	-36.082***	-3.559***
TKR	-2.470	-1.099	-28.180***	-10.910***
BANK	-2.586	-1.791	-38.829***	-3.160**
IT	-2.883	-2.772*	-39.832***	-50.790***
ELECTR	-2.022	-1.578	-47.246***	-6.223***
LEAS	-1.952	-1.955	-48.615***	-48.598***
FOOD	-2.341	-2.252	-51.941***	-4.385***
REAL	-2.401	-1.765	-48.562***	-10.568***
HOLD	-2.254	-2.186	-48.413***	-30.917***
COMN	-2.085	-2.108	-47.972***	-46.690***
PAPER	-4.648***	-4.575***	-47.273***	-5.127***
CHM	-2.164	-2.141	-46.627***	-44.999***
METAL	-2.493	-2.252	-45.154***	-12.185***
MCHN	-0.269	-0.734	-47.034***	-5.550***
INSR	-0.763	-0.437	-51.142***	-50.741***
SPORT	-2.279	-2.254	-49.137***	-5.593***
STONE	-1.546	-1.470	-49.022***	-3.914***
CMRC	-1.785	-1.697	-47.971***	-7.340***
TEXT	-2.599	-1.624	-50.176***	-47.960***
TRSM	-1.958	-1.528	-47.766***	-3.950***
TRANS	-2.305	-1.534	-47.487***	-6.064***

Superscripts *, **, *** represent significance at the 10, 5, and 1% respectively. Lag Lengths are determined via SIC

CHAPTER 5

METHODOLOGY

5.1 Causality-in-Variance

We first check the stationarity of the series via augmented Dickey-Fuller (1976) and Elliott et al.'s (1996) Dickey-Fuller generalized least squares (GLS) detrended (DF-GLS) tests. Then in order to determine the existence and direction of volatility spillover of city and sector indices with respect to each other, this study uses Granger causality-in-variance test suggested by Hafner and Herwartz (2006). There are also earlier studies to investigate volatility spillover between two series, such as Cheung and Ng (1996) and Hong (2001) which suggest causality tests based on CCF (cross-correlation functions) of residuals generated from univariate GARCH models.

Hafner and Herwartz (2006) use an Lagrange Multiplier (LM) statistic calculated also using univariate GARCH estimations. They state that using univariate GARCH estimations is simpler than multivariate versions because it is sufficient to deal with the dimensionality problem. In the study, authors conduct a Monte Carlo simulation study to evaluate the empirical power of the LM statistic and its relative performance over CCF based testing. They conclude that the LM approach has superior empirical power comparing to the CCF statistic and performance of the CCF test is adversely affected by choice of an inappropriate order. Due to factors stated above, the latter procedure is preferred in this study.

The estimation of univariate ARMA (p,q)-GARCH (1,1) is necessary for Hafner and Herwartz (2006) approach of causality in variance testing. While ARMA (p,q) part of the model is called as mean equation, GARCH (1,1) part is called as variance equation. ARMA (p,q) model means that contemporaneous terms of a series y

depends linearly on its lagged values besides current and lagged values of a white noise error term. It can be denoted as;

$$y_t = \mu + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \dots + \phi_p y_{t-p} + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \dots + \theta_q \varepsilon_{t-q} + \varepsilon_t \quad (1)$$

with $E(\varepsilon_t) = 0$; $E(\varepsilon_t^2) = \sigma^2$; $E(\varepsilon_t \varepsilon_s) = 0, t \neq s$

We follow Box and Jenkins (1976) because they were the first to approach the task of estimating an ARMA model in a systematic manner, although ARMA models exist before them. The approach involves three steps: Identification, estimation and diagnostic checking.

Identification of an ARMA involves determining the order of AR and MA terms, which are p and q respectively, to capture the dynamic features of the data. To select the appropriate model, Information criteria can be used. The object of the approach is determining the number of parameters so that the value of the information criteria can be minimized (Brooks, 2008).

The three most popular information criteria are Akaike's (1974) information criterion (AIC), Schwarz's (1978) Bayesian information criterion (SBIC) and Hannan-Quinn information criterion (HQ) (Hannan and Quinn, 1979). These are expressed as;

$$AIC = \ln(\hat{\sigma}^2) + \frac{2k}{T} \quad (2)$$

$$SBIC = \ln(\hat{\sigma}^2) + \frac{k}{T} \ln T \quad (3)$$

$$HQIC = \ln(\hat{\sigma}^2) + \frac{2k}{T} \ln(\ln(T)) \quad (4)$$

where is $\hat{\sigma}^2$ the residual variance (also equivalent to the residual sum of squares divided by the number of observations, T), $k = p + q + 1$ is the total number of parameters estimated and T is the sample size. In this study, we use SBIC criterion in general because AIC generally selects a larger model than needed even for the data of big sample size (Brooks, 2008).

ARMA models are estimated by Maximum Likelihood method but if the process is an AR(p) process then OLS can be employed.

An ARMA process should be stable, stationary and invertible. Stationarity must be satisfied for a series because in a model of a non-stationary series, lagged values of residuals do not decline as time progresses. This is against the intuition and dubious in an empirical sense.

The invertibility is the same as the stationarity in mathematical sense but it refers to the MA process. They can be expressed as follows. If we rewrite Equation (5) in lag operator notation as;

$$\phi(L)y_t = \theta(L)\varepsilon_t \tag{5}$$

with $\phi(L) = 1 - \phi_1L - \dots - \phi_pL^p$ and $\theta(L) = 1 - \theta_1L - \dots - \theta_pL^p$. The process is stable and stationary if $\phi(z) \neq 0$ for $|z| \leq 1$, and invertible if $\theta(z) \neq 0$ for $|z| \leq 1$.

In diagnostic checking, the adequacy of the model is evaluated. Overfitting and residual diagnostics can be used according to Box and Jenkins. The main objective here is to check whether there is autocorrelation left in residuals. If so, then the model is not appropriate because there is still some meaningful information not modeled. We add extra terms which is called overfitting to eliminate autocorrelation. It is critical to select the most parsimonious model which solves the autocorrelation

problem, because a model containing unnecessary lags leads to higher coefficient standart errors, which means that finding significant relationships get harder in the data (Brooks, 2008).

In order to detect the autocorrelation, one of the most popular test is the one suggested by Durbin-Watson test suggested by Durbin and Watson (1951). However, the test requires that there be no lags of dependent variable. Therefore, in the thesis we use **Breusch-Godfrey Serial Correlation LM Test**. In the test, firstly a linear regression is estimated using OLS and the residuals \hat{u}_t are obtained. The residuals are then regressed on all the regressors of the first equation and the lags of the obtained residuals up to r th order. Second regression can be written as;

$$\hat{u}_t = \gamma_0 + \gamma_1 x_{1t} + \gamma_2 x_{2t} + \gamma_3 x_{3t} + \rho_1 \hat{u}_{t-1} + \rho_2 \hat{u}_{t-2} + \rho_3 \hat{u}_{t-3} + \dots + \rho_r \hat{u}_{t-r} + \nu_t \quad (6)$$

with $\nu_t \sim N(0, \sigma_\nu^2)$, Letting T denote the number of observations and obtaining R^2 from the (6), test statistic is given by;

$$(T - R^2) \sim \chi^2$$

The null and alternative hypothesis are;

$$H_0 : \rho_1 = 0 \text{ and } \rho_2 = 0 \text{ and } \dots \text{ and } \rho_r = 0$$

$$H_0 : \rho_1 \neq 0 \text{ or } \rho_2 \neq 0 \text{ or } \dots \text{ or } \rho_r \neq 0$$

The null hypothesis involves that there is no relationship between current error and and its r previous values. Test statistic then asymptotically follows a chi-square distribution with r degrees of freedom. If the model is statistically adequate, no evidence of autocorrelation should be found in the residuals whatever value of r is

chosen. The Hafner and Herwartz (2006) approach requires estimating an ARMA (p,q) model where the difference from the classical model is that error terms do not have constant variance, which means they are heteroscedastic. It can be denoted as;

$$y_t = \mu + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \dots + \phi_p y_{t-p} + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \dots + \theta_q \varepsilon_{t-q} + \varepsilon_t \quad (7)$$

where $\varepsilon_t \sim N(0, \sigma_t^2)$, then to estimate this heteroscedasticity we can now build a GARCH model. Following Hafner and Herwartz (2006), we employ the GARCH (1,1) model as in Equation (8):

$$\sigma_{it}^2 = \omega_i + \alpha_i \varepsilon_{it-1}^2 + \beta_i \sigma_{it-1}^2 \quad (8)$$

We want to test the following null hypothesis for given $i, j = 1, \dots, N, i \neq j$,

$$H_0 : \text{Var}(\varepsilon_{it} | F_{t-1}^{(j)}) = \text{Var}(\varepsilon_{it} | F_{t-1}) \quad (9)$$

where $F_t^{(j)} = F_t \setminus \sigma(\varepsilon_{it}, \tau \leq t)$, and ε_{it} are the residuals from the univariate model.

Following model is considered to test the H_0 :

$$\varepsilon_{it} = \xi_{it} \sqrt{\sigma_{it}^2} g_t, \quad g_t = 1 + z'_{jt} z_{jt} = (\varepsilon_{jt-1}, \sigma_{jt-1}^2)', \quad (10)$$

In Equation (10) a sufficient condition for Equation (9), granger non-causality in variance, is $\pi = 0$. The score of the Gaussian log-likelihood function of ε_{it} is given by $x_{it}(\xi_{it}^2 - 1)/2$, where $x_{it} = \sigma_{it}^{-2} (\partial \sigma_{it}^2 / \partial \theta_i)$, $\theta_i = (\omega_i, \alpha_i, \beta_i)'$. They propose the following test statistic:

$$\lambda_{LM} = \frac{1}{4T} \left(\sum_{t=1}^T (\xi_{it}^2 - 1) z'_{jt} \right) V(\theta_i)^{-1} \left(\sum_{t=1}^T (\xi_{it}^2 - 1) z_{jt} \right) \xrightarrow{d} \chi^2(2), \quad (11)$$

where

$$V(\theta_i) = \frac{\kappa}{4T} \left(\sum_{t=1}^T z_{jt} z'_{jt} - \sum_{t=1}^T z_{jt} x'_{it} \left(\sum_{t=1}^T x_{it} x'_{it} \right)^{-1} \sum_{t=1}^T x_{it} z'_{jt} \right), \kappa = \frac{1}{T} \sum_{t=1}^T (\xi_{it}^2 - 1)^2.$$

The asymptotic distribution of λ_{LM} will depend on the number of misspecification indicators in z_{jt} . Because there are two indicators in our case, The λ_{LM} statistic then asymptotically follows a χ^2 distribution with two degrees of freedom.

5.2 Minimum Variance Portfolio

The portfolio optimization for the purpose of minimizing the risk, has been firstly proposed by Markowitz (1952). Using the mean returns, historical average returns, and the covariance matrix of both the city and the sector indices, risk of minimum variance portfolios can be calculated easily. The standard Markowitz (1952) approach follow this optimization problem;

$$\min_w \frac{1}{2} w' \Sigma w \tag{18}$$

$$\text{s.t. } w' \mu = R,$$

$$w' l = 1$$

where w indicates the percentage weight invested in each index, μ is the mean return, Σ represents the corresponding covariance matrix and l is a vector with all elements equal to one. The risk of the portfolio is minimized as measured by the portfolio variance given a certain demanded return R and subject to the budget restriction that all weights should sum up to one. Solution of this minimization problem gives the weights of indices in the minimum variance portfolio and the minimum risk.

5.3 Sharpe Ratio

The Sharpe Ratio is the measure for comparing the performances of multiple portfolios and also known as reward-to-variability ratio. It was firstly introduced by Sharpe (1966). The Sharpe ratio is the average return minus the risk-free rate per unit of standart deviation or total risk.

$$\text{Sharpe Ratio} = \frac{R_p - R_f}{\sigma_p}$$

where R_p is the expected portfolio return, R_f is the risk free rate and σ_p is the portfolio standard deviation. We use the Sharpe Ratio to compare performances of the minimum variance portfolios constructed by city and sector indices separately.

5.4 Herfindahl-Hirschman Index

The Herfindahl-Hirschman index (HHI), is a measure of concentration. The index was introduced independently by Hirschman (1945) and Herfindahl (1950). The HHI is used in various areas and contexts such as calculating concentration in the household income, determining the market concentration which is very critical for avoid monopolistic mergers and acquisitions and restore competition in the markets.

We use the index to measure the concentration of the city and sector indices across sectors and cities, respectively. Higher concentration suggests lower diversification of the indices across cities or sectors. We calculated the shares of cities or sectors on total market capitalization values of each index, as displayed in Chapter 2, to generate the concentration ratios suggested by the HHI index. The specification of the index is quite simple;

$$\text{HHI} = \sum_{i=1}^n (\text{MC}_i)^2$$

where MC is the percentage share of the cities or sectors on total market capitalization values of the index and n is the number of cities or sectors included in the index. Detailed information on the background of HHI is provided by Hirschman (1964).

5.5 The Index Model and Diversifiable Risk

There is a portion of risk that can not be eliminated through diversification according to the financial theory (Sharpe, 1963). That risk is called market risk and it refers to external factors such as the political or macroeconomic risks. It can be also called as systematic or nondiversifiable risk. The remaining portion of the risk can be decreased or even reduced to zero by diversification. It has many names such as diversifiable risk, non-systematic risk or firm-specific risk. In this respect, we need to decompose diversifiable risks of the indices from total risks to clearly see the power of diversification in sector and city indices. The index model, first suggested by Sharpe (1963), enables us to make such a decomposition. It is stated in the Sharpe (1963) that the rate of return on a broad index of securities such as the S&P 500 is a valid proxy for the common macroeconomic factor. The counterpart of the S&P 500 index in Turkey can be XTUM (BIST-ALL) index. The specification of the model is;

$$R_i(t) = \alpha_i + \beta_i R_M(t) + e_i(t) \quad e_i \sim N(0, \sigma^2) \quad (19)$$

where R_i is the return of the index, R_M is the return of the index used as a proxy for the common factor, α_i is the intercept of this equation and indicates expected excess return of index when the market excess return is zero. β_i is the beta. Beta is the measure of index's sensitivity to the market index: e_i ; the residual is firm-specific

surprise, which is assumed to have zero mean. Considering that total risk is composed of systematic and unsystematic (diversifiable) risks, the following equation can be specified by the help of the equation (19);

$$\sigma_i^2 = \beta_i^2 \sigma_i^2 + \sigma^2(e_i) \quad (20)$$

where $\beta_i^2 \sigma_i^2$ denotes systematic variance (square of the risk), $\sigma^2(e_i)$ is the unsystematic variance. As it can be clearly seen that σ_i^2 is the variance of the security returns and $\sigma^2(e_i)$ is the variance of the residuals (also called firm specific variance). $\sigma(e_i)$, unsystematic or diversifiable risk, is simply the standard error of the regression equation (19). We run the regression equation (19) for each city and sector index, by using BIST-ALL index as the proxy of the common market factor, to generate the diversifiable risks and compare them with the HHI concentration ratios.

CHAPTER 6

EMPIRICAL RESULTS

6.1 ARMA-GARCH Estimations

In ARMA estimations following Box and Jenkins (1976), firstly we select the appropriate model which minimizes the information criteria. However, in some models, either invertibility or stationarity condition is not satisfied. There are also models which do not satisfy both conditions. We tried different models for each series to find the best parsimonious model. In case there is still autocorrelation in the model, we use overfitting until the autocorrelation disappears. Estimated ARMA models are given in Table 6.1 below.

In GARCH estimations, firstly we use the GARCH (1,1) as suggested by Hafner and Herwartz (2006) to examine the volatility spillover. In the specification of GARCH (1,1) model as equation (8), it is assumed that the stability conditions are satisfied; the intercept $\omega \geq 0$, the ARCH parameter $\alpha \geq 0$, the GARCH parameter $\beta \geq 0$, and $\alpha + \beta < 1$. In Table 6.2, we report the results from the GARCH estimations. Before making some inferences, we should see if the stability and homoscedasticity conditions are satisfied. The results in Table 6.2 support the validity of the stability conditions for the estimated GARCH models and estimated coefficients are highly significant. However according to the ARCH-LM p-values showed in Table 6.3, homoscedasticity is rejected for the models of price and return index series of food, transportation and communication at different significance levels. It means that GARCH (1,1) is insufficient for these series to model the heteroscedasticity. In this case, one should fit larger models to capture the dynamics of the data. However, in Hafner and Herwartz, there is no empirical evidence on the robustness of this approach. That's why these series are excluded from the volatility spillover analysis. Higher order GARCH estimations take place in Appendix A section of the study.

Table 6.1 ARMA Models

Sector Indices ARMA Models			City Indices ARMA Models		
Index Name	Price Indices	Return Indices	Index Name	Price Indices	Return Indices
FOOD, BEVERAGE	ARMA(1,2)	ARMA(1,2)	ADANA	ARMA(0,0)	ARMA(0,0)
TEXTILE	ARMA(1,0)	ARMA(0,1)	ANKARA	ARMA(0,0)	ARMA(0,0)
PAPER, FOREST	ARMA(1,0)	ARMA(0,1)	ANTALYA	ARMA(0,0)	ARMA(0,0)
CHEMISTRY, OIL, PLASTICS	ARMA(1,2)	ARMA(2,0)	BURSA	ARMA(0,0)	ARMA(0,0)
STONE, SOIL	ARMA(1,0)	ARMA(1,0)	ISTANBUL	ARMA(0,0)	ARMA(0,0)
METAL	ARMA(0,1)	ARMA(0,1)	IZMIR	ARMA(0,0)	ARMA(0,0)
MACHINERY	ARMA(0,1)	ARMA(1,0)	KAYSERI	ARMA(2,2)	ARMA(2,2)
ELECTRICITY	ARMA(1,1)	ARMA(1,1)	KOCAELI	ARMA(0,1)	ARMA(0,1)
TRANSPORTATION	ARMA(1,0)	ARMA(1,0)	TEKİRDAĞ	ARMA(2,2)	ARMA(2,2)
TOURISM	ARMA(1,0)	ARMA(1,0)			
COMMERCE	ARMA(0,0)	ARMA(0,0)			
COMMUNICATION	ARMA(0,0)	ARMA(0,0)			
SPORT	ARMA(1,0)	ARMA(1,0)			
BANK	ARMA(0,0)	ARMA(0,0)			
INSURANCE	ARMA(1,0)	ARMA(0,1)			
LEASING, FACTORING	ARMA(1,0)	ARMA(1,0)			
HOLDING, INVESTMENT	ARMA(0,1)	ARMA(0,1)			
REAL ESTATE INV. TRUST	ARMA(1,0)	ARMA(1,0)			
IT INDUSTRY	ARMA(0,1)	ARMA(1,0)			

We can start to make some inferences from the variance equations displayed in Table 6.2. As seen in the Table 6.2, all coefficients of the estimated model are statistically significant at 1% level. The positive coefficients in the variance equations indicates the importance of the conditional variance (volatility) process of the variables. Large values of the ARCH and GARCH parameters has an influence on the conditional volatility in various fashions. A large ARCH parameter means that the shock has a greater effects in the next period. On the contrary, a high GARCH parameter indicates that the shock has more persistent effects (Enders, 2014). Therefore a high ARCH and GARCH parameters are the indicator of high volatility in the short and

long run, respectively. The results of the GARCH models suggest that the GARCH effect is more dominant in the volatility processes of the sector and city index returns. We conclude that the conditional variance exhibits more autoregressive persistence which means high volatility of returns in the long run.

Table 6.2 GARCH (1,1) Results

Price Indices GARCH(1,1) coefficients

	ADN		ANK		ANT		BUR		İST	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	2.2E-05	0.0000	1.4E-05	0.0000	6.6E-05	0.0000	3.6E-05	0.0000	1.2E-05	0.0000
α	0.2596	0.0000	0.1334	0.0000	0.2287	0.0000	0.2002	0.0000	0.1634	0.0000
β	0.6681	0.0000	0.8072	0.0000	0.6257	0.0000	0.7096	0.0000	0.7766	0.0000
	İZM		KAY		KOC		TKR			
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value		
ω	1.5E-05	0.0000	6.1E-05	0.0000	4.0E-05	0.0000	4.3E-05	0.0000		
α	0.0867	0.0000	0.2351	0.0000	0.1308	0.0000	0.2280	0.0000		
β	0.8438	0.0000	0.5554	0.0000	0.7437	0.0000	0.6979	0.0000		
	BANK		IT		ELCTR		LEAS		FOOD	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	1.5E-05	0.0000	3.7E-05	0.0000	3.8E-05	0.0000	3.5E-05	0.0000	1.6E-05	0.0000
α	0.0784	0.0000	0.2266	0.0000	0.2167	0.0000	0.2373	0.0000	0.1200	0.0000
β	0.8914	0.0000	0.6898	0.0000	0.7126	0.0000	0.7105	0.0000	0.8344	0.0000

Table 6.2 GARCH (1,1) Results (continued)

	METAL		MCHN		INSR		SPORT		STONE	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	1.8E-05	0.0000	2.0E-05	0.0000	8.4E-06	0.0000	3.4E-05	0.0000	2.1E-05	0.0000
α	0.1290	0.0000	0.1792	0.0000	0.1346	0.0000	0.3193	0.0000	0.2571	0.0000
β	0.8333	0.0000	0.7646	0.0000	0.8532	0.0000	0.6665	0.0000	0.6487	0.0000

	REAL		HOLD		COMN		PAPER		CHM	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	3.0E-05	0.0000	1.5E-05	0.0000	4.7E-06	0.0000	3.2E-05	0.0000	2.2E-05	0.0000
α	0.1539	0.0000	0.1194	0.0000	0.0573	0.0000	0.2394	0.0000	0.1423	0.0000
β	0.7555	0.0000	0.8397	0.0000	0.9323	0.0000	0.6826	0.0000	0.7889	0.0000

	CMRC		TEXT		TRSM		TRANS	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	2.5E-05	0.0000	2.9E-05	0.0000	2.8E-05	0.0000	2.8E-05	0.0000
α	0.1308	0.0000	0.2686	0.0000	0.1785	0.0000	0.0931	0.0000
β	0.7832	0.0000	0.6340	0.0000	0.7814	0.0000	0.8536	0.0000

Return Indices GARCH(1,1) coefficients

	ADN		ANK		ANT		BUR		İST	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	1.6E-05	0.0000	1.2E-05	0.0000	6.6E-05	0.0000	3.1E-05	0.0000	1.2E-05	0.0000
α	0.2182	0.0000	0.1246	0.0000	0.2288	0.0000	0.2094	0.0000	0.1615	0.0000
β	0.7248	0.0000	0.8214	0.0000	0.6257	0.0000	0.7164	0.0000	0.7775	0.0000

	İZM		KAY		KOC		TKR	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	1.4E-05	0.0000	6.1E-05	0.0000	2.4E-05	0.0000	4.4E-05	0.0000
α	0.0828	0.0000	0.2358	0.0000	0.1151	0.0000	0.2319	0.0000
β	0.8505	0.0000	0.5498	0.0000	0.8028	0.0000	0.6912	0.0000

	BANK		IT		ELCTR		LEAS		FOOD	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	1.5E-05	0.0000	3.8E-05	0.0000	3.8E-05	0.0000	3.3E-05	0.0000	1.5E-05	0.0000
α	0.0781	0.0000	0.2239	0.0000	0.2167	0.0000	0.2198	0.0000	0.1205	0.0000
β	0.8921	0.0000	0.6878	0.0000	0.7134	0.0000	0.7273	0.0000	0.8361	0.0000

Table 6.2 GARCH (1,1) Results (continued)

	METAL		MCHN		INSR		SPORT		STONE	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	1.8E-05	0.0000	2.0E-05	0.0000	8.6E-06	0.0000	2.7E-05	0.0000	2.2E-05	0.0000
α	0.1353	0.0000	0.1786	0.0000	0.1386	0.0000	0.3276	0.0000	0.2552	0.0000
β	0.8282	0.0000	0.7652	0.0000	0.8493	0.0000	0.6785	0.0000	0.6476	0.0000

	REAL		HOLD		COMN		PAPER		CHM	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	2.9E-05	0.0000	1.5E-05	0.0000	5.1E-06	0.0000	3.3E-05	0.0000	1.8E-05	0.0000
α	0.1528	0.0000	0.1168	0.0000	0.0641	0.0000	0.2427	0.0000	0.1351	0.0000
β	0.7600	0.0000	0.8424	0.0000	0.9252	0.0000	0.6767	0.0000	0.8088	0.0000

	CMRC		TEXT		TRSM		TRANS	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
ω	2.6E-05	0.0000	2.9E-05	0.0000	2.8E-05	0.0000	2.9E-05	0.0000
α	0.1336	0.0000	0.2697	0.0000	0.1785	0.0000	0.0939	0.0000
β	0.7785	0.0000	0.6329	0.0000	0.7815	0.0000	0.8517	0.0000

Table 6.3 ARCH-LM Test P-Values

	Price Ind.	Return Ind.		Price Ind.	Return Ind.
FOOD, BEVERAGE	0.0988	0.0927	ADANA	0.5947	0.8216
TEXTILE	0.3012	0.3048	ANKARA	0.3296	0.2255
PAPER, FOREST	0.4690	0.5294	ANTALYA	0.8845	0.8859
CHEMISTRY, OIL, PLASTICS	0.8106	0.7496	BURSA	0.8798	0.8432
STONE, SOIL	0.5474	0.8328	ISTANBUL	0.2822	0.3173
METAL	0.7766	0.7994	IZMIR	0.6607	0.6865
MACHINERY	0.8912	0.8539	KAYSERI	0.9645	0.9926
ELECTRICITY	0.9583	0.9584	KOCAELI	0.8378	0.6637
TRANSPORTATION	0.0365	0.0482	TEKİRDAĞ	0.5608	0.6322
TOURISM	0.5487	0.5482			
COMMERCE	0.7515	0.7743			
COMMUNICATION	0.0017	0.0010			
SPORT	0.6824	0.7626			
BANK	0.1732	0.1799			
INSURANCE	0.3222	0.3475			
LEASING, FACTORING	0.6404	0.7297			
HOLDING, INVESTMENT	0.9187	0.9149			
REAL ESTATE INV. TRUST	0.9934	0.9844			
IT INDUSTRY	0.8228	0.8541			

6.2 Volatility Spillover

In this study, we test the existence of volatility risk spillovers across the sector indices and city indices, separately. As mentioned in the Methodology section, to run the tests, this study adopts newly developed Hafner and Herwartz (2006) approach which uses LM principles by the help of univariate GARCH models. In order to test causality-in-variance (or volatility spillover) between indices, individual regression models are tested for each and every indices of sectors and cities. These models are tested in pair-wise fashion and both ways. For example, the volatility spillover from Istanbul to Ankara is tested separately than the volatility spillover from the Ankara to Istanbul. As seen in Table 6.5, results show that there is no volatility spillover or risk transmission between any pair of city indices. Similarly, results of sector indices displayed in Table 6.6 and 6.7 indicate that volatility does not spillover between the sector indices. Volatility Spillover tests of excluded series, as explained in the previous section, are reported in Appendix B section of the study.

Our results can be interpreted as follows. The diversification potential across sectors or cities is very high because their volatility is not effected form each other. Also as suggested by Booth, Martikainen and Tse (1997), we may conclude that the economic and financial integration between cities in Turkey is not yet at the level of developed and certain emerging countries which exports volatility spillovers. The reason of the weak integration level could be linked to the financial immaturity (Beirne et al., 2008; Balakrishnan et al., 2009; Psalido and Sun, 2009) which can be defined as underdevelopedness of the financial market in the sense of trade volume, size of the market capitalization, free float ratio, free flow of capital. Except the last one, all features of financial immaturity are valid for city and sector indices. Capital is freely circulated through cities in Turkey.

Table 6.4 T-Statistics of LM Test For Causality in Variance: City Indices

		CITY RETURN INDICES								
		DEPENDENT VARIABLES								
		Adana	Ankara	Antalya	Bursa	İstanbul	İzmir	Kayseri	Kocaeli	Tekirdağ
INDEPENDENT VARIABLES	Adana		1.5956	0.5544	0.5927	1.3155	0.8800	0.4561	1.1043	0.6881
	Ankara	0.4473		0.4554	0.6103	1.1898	0.7018	0.2082	0.9641	0.6810
	Antalya	0.4936	1.6979		0.4564	1.1911	0.5825	0.2366	0.8200	0.6883
	Bursa	0.4804	1.3738	0.4103		1.194	0.7138	0.2348	0.8087	0.6900
	İstanbul	0.3754	1.3834	0.3982	0.4354		0.676	0.1932	0.9988	0.6838
	İzmir	0.3397	1.3866	0.4048	0.3685	1.2018		0.1171	0.7117	0.6770
	Kayseri	0.4136	1.4248	0.4728	0.4002	1.1809	0.7375		0.7300	0.6916
	Kocaeli	0.3557	1.3867	0.4300	0.3407	1.1920	0.5938	0.1558		0.6788
	Tekirdağ	0.4499	1.3835	0.3496	0.3906	1.1840	0.5348	0.0977	0.6393	
			CITY PRICE INDICES							
		DEPENDENT VARIABLES								
		Adana	Ankara	Antalya	Bursa	İstanbul	İzmir	Kayseri	Kocaeli	Tekirdağ
INDEPENDENT VARIABLES	Adana		1.1918	0.8270	0.2899	1.7330	1.4024	0.6699	1.3313	0.8204
	Ankara	0.8994		0.5301	0.5291	1.2870	0.8332	0.3397	1.0957	0.7865
	Antalya	0.7521	1.2247		0.8355	1.2591	0.6302	0.327	0.7245	0.7845
	Bursa	0.7651	1.1479	0.4118		1.2607	0.7685	0.3135	0.7013	0.7870
	İstanbul	0.6683	1.1178	0.4033	0.8281		0.731	0.2736	0.9125	0.7799
	İzmir	0.6374	1.1666	0.4081	0.8952	1.2786		0.2085	0.6208	0.7733
	Kayseri	0.6680	1.1451	0.5138	0.8522	1.2539	0.8358		0.6181	0.7845
	Kocaeli	0.6491	1.1372	0.4453	0.9189	1.2759	0.6222	0.2435		0.7805
	Tekirdağ	0.7539	1.1372	0.3507	0.8922	1.2580	0.5688	0.1939	0.4297	

Table 6.5 T-Statistics of LM Test For Causality in Variance : Sector Return Indices

	DEPENDENT VARIABLES							
	TEXT	PAPER	CHM. OIL	STONE	METAL	MCHNRY	ELCTR	TRSM
FOOD, BEVERAGE	1.3231	0.9793	0.5298	0.5616	0.6423	0.4205	0.472	0.8333
TEXTILE		1.0403	0.7203	0.6333	0.9528	0.4549	0.543	0.8221
PAPER, FOREST	1.1883		0.5173	0.4197	0.6257	0.3918	0.3252	0.8607
CHEMISTRY	1.3377	0.8727		0.4511	0.5272	0.3961	0.448	0.7845
STONE, SOIL	1.2455	0.9959	0.561		0.7698	0.4252	0.4435	0.7883
METAL	1.2812	0.9354	0.5218	0.4702		0.3938	0.6028	0.846
MACHINERY	1.2865	0.9113	0.5318	0.4934	0.7135		0.5695	0.792
ELECTRICITY	1.3024	0.8166	0.5181	0.4367	0.5925	0.3915		0.859
TRANSPORTATION	1.1263	0.7246	0.5732	0.4044	0.4898	0.3954	0.3415	0.7321
TOURISM	1.3276	1.0746	0.5229	0.4826	0.764	0.3933	0.5201	
COMMERCE	1.1984	0.7972	0.5242	0.4193	0.4993	0.3917	0.2433	0.8034
COMMUNICATION	1.2805	1.0011	0.5173	0.4525	0.5182	0.3936	0.3533	0.8733
SPORT	1.2188	0.8462	0.5528	0.4529	0.4769	0.3914	0.2607	0.8119
BANK	1.3111	0.8732	0.5143	0.4702	0.5596	0.4039	0.6048	0.8003
INSURANCE	1.4289	1.0167	0.5141	0.5249	0.5273	0.3934	0.5294	0.8773
LEASING	1.2289	0.8903	0.5228	0.4174	0.5591	0.4018	0.2646	0.8822
HOLDING	1.3219	0.9338	0.5149	0.4434	0.5358	0.3932	0.6046	0.8137
REAL ESTATE	1.2828	1.0847	0.5252	0.4999	0.6518	0.403	0.4255	0.8417
IT INDUSTRY	1.1924	0.8375	0.5532	0.4019	0.5127	0.4196	0.245	0.7704

	DEPENDENT VARIABLES							
	CMMRC	SPORT	INSRN	BANK	LEAS	HOLD	REAL	IT
FOOD, BEVERAGE	0.7336	0.5211	1.3405	1.0726	0.6424	0.2786	0.1602	0.4654
TEXTILE	1.4689	0.6817	1.6727	0.9693	0.5864	0.5769	0.2865	0.5026
PAPER, FOREST	1.338	0.7516	1.4002	1.0407	0.5173	0.2856	0.1659	0.4528
CHEMISTRY	0.8377	0.609	1.4392	1.0966	0.5447	0.2808	0.144	0.4761
STONE, SOIL	1.4804	0.7431	1.4364	1.0042	0.5524	0.4441	0.2575	0.4871
METAL	0.8446	0.6944	1.3584	1.0986	0.5993	0.2797	0.1401	0.4397
MACHINERY	1.3902	0.6784	1.361	1.0759	0.5367	0.3008	0.214	0.4317
ELECTRICITY	1.1253	0.4322	1.3618	1.0569	0.5496	0.2772	0.1951	0.3978
TRANSPORTATION	0.85	0.6313	1.4576	1.1014	0.5646	0.3163	0.1351	0.3331
TOURISM	0.7018	0.5252	1.3468	1.0117	0.6679	0.3271	0.1862	0.4159
COMMERCE		0.5262	1.4545	1.0986	0.551	0.2804	0.1359	0.4103
COMMUNICATION	0.5025	0.5321	1.4683	1.0878	0.6779	0.2689	0.1351	0.4021
SPORT	0.4904		1.4684	1.0913	0.5345	0.2881	0.1355	0.4254
BANK	0.8134	0.6536		1.1214	0.5755	0.2703	0.1341	0.4332
INSURANCE	0.8327	0.6059	1.3992		0.6477	0.266	0.1428	0.4853
LEASING	0.5184	0.6826	1.413	1.0418		0.2772	0.1347	0.4045
HOLDING	0.9132	0.6547	1.4071	1.1225	0.5796		0.1402	0.4194
REAL ESTATE	1.0019	0.6599	1.4183	1.0229	0.607	0.3377		0.5848
IT INDUSTRY	0.67	0.582	1.3854	1.0744	0.5275	0.2842	0.153	

Table 6.6 T-Statistics of LM Test For Causality in Variance : Sector Price Indices

	DEPENDENT VARIABLES								
	TEXT	PAPER	CHM. OIL	STONE	METAL	MCHNRY	ELCTR	TRSM	
FOOD, BEVERAGE	1.3206	1.0328	0.5967	0.9386	0.6718	0.3445	0.4699	0.8323	
TEXTILE		1.0939	0.803	0.9591	1.0125	0.3743	0.5631	0.8232	
PAPER, FOREST	1.1919		0.5396	0.7878	0.6554	0.3349	0.3337	0.8614	
CHEMISTRY	1.3428	0.9404		0.8545	0.5838	0.3333	0.4559	0.7882	
STONE, SOIL	1.2768	1.1049	0.723		0.902	0.3807	0.5081	0.7942	
METAL	1.2765	0.9765	0.5858	0.8773		0.3324	0.5946	0.8417	
MACHINERY	1.2907	0.9817	0.6943	0.876	0.7742		0.5909	0.7914	
ELECTRICITY	1.3002	0.878	0.5166	0.8304	0.6239	0.332		0.8573	
TRANSPORTATION	1.1291	0.7886	0.4429	0.7983	0.5196	0.3473	0.3534	0.7335	
TOURISM	1.322	1.1206	0.6235	0.8701	0.7903	0.3311	0.5251		
COMMERCE	1.2024	0.8568	0.4931	0.7963	0.5311	0.3324	0.2444	0.8023	
COMMUNICATION	1.2924	1.0529	0.4918	0.8683	0.5527	0.3342	0.361	0.8798	
SPORT	1.2221	0.9061	0.4491	0.8393	0.5091	0.3318	0.2683	0.8117	
BANK	1.3172	0.9259	0.5518	0.8604	0.596	0.3375	0.6094	0.7999	
INSURANCE	1.4285	1.0632	0.5706	0.9613	0.5569	0.3326	0.5279	0.8768	
LEASING	1.2301	0.9491	0.4904	0.8028	0.5887	0.3361	0.2663	0.8814	
HOLDING	1.3267	0.9864	0.5561	0.8412	0.5743	0.3325	0.6153	0.8142	
REAL ESTATE	1.3144	1.1524	0.6096	0.9453	0.7093	0.3419	0.4414	0.8533	
IT INDUSTRY	1.1979	0.9072	0.4503	0.7993	0.5494	0.3681	0.251	0.7702	

	DEPENDENT VARIABLES								
	CMMRC	SPORT	INSRN	BANK	LEAS	HOLD	REAL	IT	
FOOD, BEVERAGE	0.7717	0.6248	1.3696	1.1025	0.7651	0.2726	0.1325	0.5131	
TEXTILE	1.5021	0.8465	1.721	0.9714	0.6928	0.5329	0.2666	0.5353	
PAPER, FOREST	1.3598	0.9547	1.441	1.0561	0.6134	0.2793	0.1306	0.4973	
CHEMISTRY	0.8668	0.7448	1.4483	1.1009	0.6458	0.2738	0.1193	0.6173	
STONE, SOIL	1.5936	0.9473	1.4901	1.004	0.6793	0.4572	0.2396	0.5746	
METAL	0.8711	0.8211	1.3823	1.1289	0.7172	0.271	0.1073	0.4863	
MACHINERY	1.5218	0.8575	1.375	1.0913	0.6423	0.2881	0.2014	0.4752	
ELECTRICITY	1.1741	0.5503	1.3892	1.0799	0.6607	0.2699	0.1721	0.4439	
TRANSPORTATION	0.908	0.7994	1.4847	1.1374	0.6886	0.3146	0.0945	0.3792	
TOURISM	0.7386	0.6507	1.3758	1.0257	0.7862	0.3157	0.1567	0.4576	
COMMERCE		0.6327	1.4707	1.1281	0.6638	0.2746	0.1001	0.4605	
COMMUNICATION	0.5374	0.6383	1.4822	1.1117	0.8297	0.2648	0.0938	0.4575	
SPORT	0.5238		1.4939	1.1288	0.6446	0.2809	0.0969	0.4755	
BANK	0.8548	0.7944		1.1558	0.6911	0.2655	0.0998	0.4821	
INSURANCE	0.8722	0.7286	1.4416		0.7761	0.2669	0.1114	0.5319	
LEASING	0.5514	0.8217	1.4358	1.0539		0.2717	0.0966	0.4544	
HOLDING	0.9663	0.8044	1.4194	1.1512	0.699		0.1094	0.4698	
REAL ESTATE	1.0684	0.8059	1.4591	1.0321	0.7282	0.3388		0.658	
IT INDUSTRY	0.7149	0.7452	1.3837	1.0924	0.6312	0.2693	0.1223		

6.3 Minimum Variance Portfolios (MVP)

The spillover analysis has shown that geographic or sectoral diversification could be beneficial in reducing risk of the portfolios. Applying the optimization method put forward by Markowitz (1952), we are able to distinguish between the contributions of geographic or sectoral diversification in Turkey by using the index returns. As shown in Table 6.7, we calculate the risks and returns of minimum variance portfolios created using only city indices or only sector indices. It should be stated that there is not yet any index fund using these city or sector indices as underlying. In this part of the study MVPs are prepared as if there were real investable index funds. The results indicate that risks of MVPs constructed of purely city indices are lower than that of sector indices. When we look at the sharpe ratios we observe that city index portfolio has higher sharpe ratios than sector index portfolio except the portfolio constructed using the daily returns. According to the results, we conclude that in minimizing the risk, portfolios diversified across cities perform better than the portfolios diversified across sectors in each of daily, weekly and monthly return categories. It is also interesting that by including 180 firms, portfolios of cities have lower risk although portfolios of sectors cover 289 firms. The results suggest that geographic diversification is more efficient than sectoral diversification in minimizing the risk. In Table 6.8, we present the weights of hypothetical index funds in MVP's. In order to show their relative contributions, we allow the short sell otherwise we would not see the exact ranking because some of the indices do not have shares in MVP. As we see in Table 6.8, stone, soil index has the highest share. When we look at the Table 2.4 in Chapter 2, we observe that this index is well diversified across cities. We can observe this connection in many indices. For example, Antalya and Bursa Indices have the lowest shares in MVP, which are mostly concentrated in Tourism and Machinery sectors, respectively. Although sport index is concentrated in Istanbul at 90 % level, it constitutes approximately 15% of the MVP. This can be referred to its low correlation with the other sectors. These results also confirm the findings stated in the volatility spillover section. Diversification across sectors or cities are very efficient in minimizing the portfolio

risk. Price indices are excluded in this part of this study because they ignore the dividend payments made by the companies. This causes overrating of returns on the stocks of non-dividend paying companies. In order make a robust comparison, we include weekly and monthly returns in this section. Annualization of the returns are made via calculating the daily, weekly or monthly compounded annual returns. When we annualize the risks, we simply multiply them with the square root of the number of periods in a year. We assume that there are 252 business days, 52 weeks and 12 months in a year.

Table 6.7 Minimum Variance Portfolios

Daily Returns

City Indices	MVP
Risk	19.57%
Return	24.20%
Sharpe Ratio	0.85

Sector Indices	MVP
Risk	19.83%
Return	32.37%
Sharpe Ratio	1.25

Weekly Returns

City Indices	MVP
Risk	16.22%
Return	25.79%
Sharpe Ratio	1.12

Sector Indices	MVP
Risk	19.31%
Return	17.50%
Sharpe Ratio	0.51

Monthly Returns

City Indices	MVP
Risk	18.09%
Return	25.33%
Sharpe Ratio	0.98

Sector Indices	MVP
Risk	18.18%
Return	17.77%
Sharpe Ratio	0.56

Table 6.8 Minimum Variance Portfolio Weights of Hypothetical Index Funds

Portfolios of Sector Indices					
Daily Return		Weekly Return		Monthly Return	
STONE	49.17%	STONE	55.43%	STONE	48.11%
CMRC	18.82%	CMRC	28.16%	FOOD	35.37%
TEXT	16.55%	FOOD	20.09%	CMRC	32.70%
FOOD	16.26%	TEXT	18.25%	COMN	25.08%
SPORT	15.39%	COMN	18.15%	TEXT	16.83%
COMN	11.95%	SPORT	9.19%	SPORT	14.33%
CHM	9.71%	IT	4.87%	CHM	13.40%
REAL	4.30%	ELECTR	3.42%	PAPER	6.95%
PAPER	2.49%	METAL	3.03%	METAL	3.45%
IT	1.57%	TRANS	2.43%	ELECTR	2.46%
METAL	1.28%	LEAS	0.84%	BANK	-3.66%
LEAS	0.99%	PAPER	0.55%	IT	-5.19%
TRANS	0.46%	REAL	-2.34%	MCHN	-5.46%
MCHN	-2.23%	CHM	-2.50%	TRSM	-6.45%
ELECTR	-2.26%	MCHN	-4.41%	TRANS	-7.61%
HOLD	-7.34%	TRSM	-9.51%	INSR	-7.61%
TRSM	-7.72%	HOLD	-12.90%	LEAS	-10.69%
INSR	-8.14%	BANK	-14.24%	REAL	-17.08%
BANK	-21.25%	INSR	-18.50%	HOLD	-34.93%

Portfolios of City Indices					
Daily Return		Weekly Return		Monthly Return	
ISTANBUL	31.27%	ANKARA	33.17%	ISTANBUL	48.22%
ADANA	25.38%	ISTANBUL	30.13%	ADANA	34.81%
ANKARA	23.42%	IZMİR	29.45%	ANKARA	31.22%
IZMİR	20.96%	KAYSERİ	16.51%	IZMİR	26.43%
KAYSERİ	8.93%	ADANA	12.47%	KOCAELİ	3.06%
TEKİRDAĞ	4.42%	TEKİRDAĞ	4.51%	TEKİRDAĞ	1.44%
KOCAELİ	1.75%	ANTALYA	-4.64%	KAYSERİ	-1.02%
ANTALYA	-7.56%	BURSA	-9.31%	ANTALYA	-11.84%
BURSA	-8.57%	KOCAELİ	-12.28%	BURSA	-32.31%

6.4 HHI Concentration Ratios and Diversifiable Risks

Previous results show that diversification across sectors or cities is useful in reducing the risk and geographic diversification is more efficient than sectoral diversification based on return indices of Turkey. In this section, we analyze the relationship between geographic or sectoral concentration (or dispersion) and diversifiable risks. We assume that city indices are sectorally diversified portfolios, while sector indices are geographically diversified portfolios where weights of the individual stocks are determined by relative values of market capitalizations. Using the dispersion rates of each indices across sectors or cities in Table 2.3, 2.4a and 2.4b, we calculate the HHI concentration ratios of each index. HHI ratios of sector indices show the degree of geographic concentration, while those of city indices measure the sectoral concentration. Lower ratios suggest lower concentrations and higher degree of diversification. As explained in methodology chapter, we know that one can decrease only firm specific risks by diversifying the portfolio. Market risk remains constant because all the assets in the portfolio are exposed to effects of the same macroeconomic or market specific variables. That's why we calculated the index specific risks by using the equations (19) and (20) to clearly see the effect of diversification. In Table 6.9 below, we present the HHI concentration ratios and index specific (diversifiable)risks of each indices. As seen in the table, HHI ratios of some sector indices are missing such as bank, commerce, holding, leasing and insurance. It is almost impossible to calculate the concentration ratios of bank, commerce, leasing and insurance indices because the companies included in the indices have branches almost all over the country. Also, the holding index acts like a city index because it represents the returns of holding companies that are mostly headquartered in Istanbul and have branches or affiliates in a variety of sectors. That's why it would not be appropriate to involve this index in sector indices. We also can not include that index in city index category because it is already covered by the index of Istanbul. We should also state that the companies included in financial indices (bank,commerce and leasing) are also headquartered in Istanbul but are excluded from the index of Istanbul.

When looking at the positive correlation between concentration and diversifiable risk, we conclude that risk reduction is strongly and positively related to dispersion or diversification in both ways. This finding supports the results of volatility spillover tests. However, the degree of correlation between the HHI ratios of sector indices, which show the degree of geographic diversification, and the diversifiable risks are quite higher than the correlation between the HHI ratios of city indices, measuring sectoral diversification, and diversifiable risks. It may suggest that reducing the portfolio risk is more related to geographic dispersion comparing to sectoral dispersion. As supported MVP analysis, we can conclude that geographic diversification is more efficient than sectoral diversification in minimizing the risk in Turkey.

Table 6.9 HHI Concentration Ratios and Diversifiable Risks

SECTOR	HHI	RISK	CITY	HHI	RISK
FOOD	0.47564	1.481%	ADANA	0.496	1.102%
TEXT	0.10120	1.114%	ANKARA	0.252	1.020%
PAPER	0.24354	1.235%	ANTALYA	1.000	1.599%
CHM	0.41596	1.026%	BURSA	0.610	1.272%
STONE	0.11214	0.816%	ISTANBUL	0.231	0.477%
METAL	0.55786	1.406%	IZMIR	0.231	1.047%
MCHN	0.19070	1.009%	KAYSERI	0.379	1.287%
ELECTR	0.43013	1.648%	KOCAELI	0.549	1.173%
TRANS	0.88046	1.725%	TEKIRDAG	0.539	2.199%
TRSM	0.50006	1.733%			
COMN	0.63925	1.586%	CORRELATION	0.571	
SPORT	0.82307	1.984%			
IT	0.53596	1.398%			
CORRELATION	0.843				

CHAPTER 7

CONCLUSION

In recent years, the number and diversity of the stock indices have increased rapidly because of increased demand on the passively managed portfolios where transactions costs are considerably low. In that respect, in addition to sector indices, which have been calculated for 20 years, city indices have been introduced by Borsa Istanbul in 2009 as the first time in the world to provide benchmarks for future index funds which will increase the variety of passive investment opportunities in the country.

This thesis aims at describing and comparing the geographic and sectoral diversification potentials in Turkey using the sector and city indices. It is important to note that this research has the characteristic of being first by comparing the geographic and sectoral diversification within the same country on a “city basis”. Although there are many studies comparing the risk reduction potentials of geographic and sectoral diversification based on sectoral and national index returns, to the extent of our knowledge, this is a first using the data from a single country. We believe that the results have important implications for both local and global investors, as well as academicians.

In order to examine whether sectoral and geographic diversification potentials exist, we calculate the probability of the volatility and risk transmission among city and among sector indices, separately. Based on the literature, understanding volatility spillovers are critical for pricing securities, global hedging strategies and asset allocation decisions (Ng, 2000; Bekaert and Harvey, 1997). Most frequently used methods for this analysis are those suggested by Cheung and Ng (1996) and Hong (2001) who developed a causality-in-variance test based on cross-correlation functions (CCF). In the thesis, a newly developed approach suggested by Hafner and Herwartz (2006) is used because in their article they provide empirical evidence on

the superiority of their approach over Cheung and Ng (1996)'s and Hong (2001)'s. According to Hafner and Herwartz (2006), an Lagrange Multiplier (LM) statistic is constructed by means of estimated univariate GARCH processes to test the volatility spillovers. In the thesis, LM tests for causality-in-variance are conducted in a pairwise fashion. The results in literature indicate that volatility is generally transmitted from large or developed markets to the small or less developed ones. In that respect, our results contradict with the previous results because we find that there is no risk spillover between any two of the city indices or between any two of the sector indices, which suggests that diversification of both kind is beneficial for reducing the risk.

In the second part, in order to distinguish between the sectoral and geographic diversification potentials, following the approach suggested by Gerard et al (2002), Moerman (2008) and Balli et al. (2014), we construct minimum variance portfolios that include purely city indices versus purely sector indices to compare the efficiency of geographic and sectoral diversification. In general, superiority of portfolios constructed of geographic indices over portfolios constructed of sectoral indices has been observed in the literature. In line with the results of the existing literature, we find that Sharpe ratios of city index portfolios are generally higher than those of sector index portfolios for daily, weekly and monthly return series. The findings suggest that geographic diversification is superior to sectoral diversification in Turkey based on the index returns. To the extent of our knowledge this is the first study to demonstrate superiority of geographic diversification within a country.

The third part in the study involves both purposes stated in the first and second parts but uses a different methodology. We introduce a quite simple and new approach to investigate the existence of geographic and sectoral diversification potentials and distinguish between them. Firstly we assume that city indices are sectorally diversified portfolios, while sector indices are geographically diversified portfolios where weights of the individual stocks are determined by relative values of market capitalizations. Then, we calculate the amount of diversifiable risk and concentration

ratios suggested by Hirschman (1945) and Herfindahl (1950) for each index to see the degree of the relationship between market capitalization based sectoral or geographic concentration and diversifiable risks. Lower concentrations suggest higher diversification and vice versa. We find that diversifiable risks are positively correlated with geographic and sectoral concentration to a great extent, but the degree of this relationship is much higher in the case of the former. This finding can be interpreted as sectoral or geographic diversification in Turkey are both being efficient in risk reduction, but geographic diversification being relatively more efficient. This result supports the findings of earlier parts of our analysis and also the results of the existing literature.

As for the limitations of the study, first, as explained in previous sections, we had to omit some of the indices to achieve the longest possible sample period. Second, because some sector indices require higher order GARCH models for causality-invariance tests and there is no evidence of such practice in Hafner and Herwartz (2006), we do not use them in second part of our analysis. We also excluded some of the sector indices from the third part of the study, as otherwise would have been misleading to calculate concentration ratios for them. Third, we use market capitalization values for a specific day to calculate the concentrations ratios. Fourth, we do not use the famous methodology of Heston and Rouwenhorst (1994) because it requires using the individual stock returns. As we conducted the causality-invariance tests by using index returns, we proceed with same data in later parts to sustain integrity in the study.

For further research examining the subject, it may be more fruitful to calculate the concentration ratios for each time period and to compare them with the volatility figures of the periods. Also Heston and Rouwenhorst (1994)'s dummy variable framework by using individual stock returns may provide better results to decompose the effects of sectoral and geographic diversification. Moreover, new techniques such as spatial econometrics could be useful to generate extra information about the interaction between the regions of Turkey.

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APPENDICES

APPENDIX A: HIGHER ORDER GARCH SELECTION

As displayed in Tables, we add extra ARCH and GARCH terms to the model to find the adequate model. By adding one extra ARCH or GARCH term, we solve the problem of autocorrelation in food and transportation models. Because $\alpha + \beta$ is very close to 1 in GARCH (1,2) models, we prefer GARCH (2,1) model for these series. For communication series, $\alpha + \beta$ is very close to 1 in GARCH (1,2) and there is still autocorrelation in the residuals of GARCH (2,1) model so, we prefer GARCH (3,1) model for that series. In Hafner and Herwartz (2006) approach, the model is tested for only GARCH (1,1) model.

Sector Price Indices GARCH Selection

	FOOD, BEVERAGE					
	GARCH(1,1)		GARCH(1,2)		GARCH(2,1)	
	Coef.	P values	Coef.	P values	Coef.	P values
Arch-Lm t-stat	1.8213	0.0988	1.5596	0.1681	1.3922	0.2239
ω	1.6E-05	0.0000	1.1E-05	0.0000	2.1E-05	0.0000
α_1	0.1200	0.0000	0.1871	0.0000	0.1540	0.0000
α_2	-	-	-0.1050	0.0000	-	-
β_1	0.8345	0.0000	0.8878	0.0000	0.3540	0.0004
β_2	-	-	-	-	0.4314	0.0000
$\Sigma\alpha + \Sigma\beta$	0.9545		0.9700		0.9395	

TRANSPORTATION

	GARCH(1,1)		GARCH(1,2)		GARCH(2,1)	
	Coef.	P values	Coef.	P values	Coef.	P values
Arch-Lm t-stat	2.3798	0.0365	0.7729	0.5691	0.6545	0.658
ω	2.8E-05	0.0000	1.3E-05	0.0000	4.0E-05	0.0000
α_1	0.0932	0.0000	0.1731	0.0000	0.1525	0.0000
α_2	-	-	-0.1179	0.0000	-	-
β_1	0.8537	0.0000	0.9203	0.0000	0.1594	0.0001
β_2	-	-	-	-	0.6159	0.0000
$\Sigma\alpha + \Sigma\beta$	0.9469		0.9756		0.9279	

COMMUNICATION

	GARCH(1,1)		GARCH(1,2)		GARCH(2,1)		GARCH(3,1)	
	Coef.	P values	Coef.	P values	Coef.	P values	Coef.	P values
Arch-Lm t-stat	3.8697	0.0017	0.6028	0.6978	2.3388	0.0395	1.2057	0.3038
ω	0.0000	0.0000	1.8E-06	0.0001	6.5E-06	0.0000	7.7E-06	0.0000
α_1	0.0573	0.0000	0.1646	0.0000	0.0819	0.0000	0.0980	0.0000
α_2	-	-	-0.1335	0.0000	-	-	-	-
β_1	0.9323	0.0000	0.9645	0.0000	0.4321	0.0068	0.7817	0.0000
β_2	-	-	-	-	0.4716	0.0019	-0.5393	0.0000
β_3	-	-	-	-	-	-	0.6427	0.0000
$\Sigma\alpha + \Sigma\beta$	0.9897		0.9957		0.9856		0.9832	

Sector Return Indices GARCH Selection

FOOD, BEVERAGE

	GARCH(1,1)		GARCH(1,2)		GARCH(2,1)	
	Coef.	P values	Coef.	P values	Coef.	P values
Arch-Lm t-stat	1.8905	0.0927	1.5674	0.1659	1.4041	0.2195
ω	1.5E-05	0.0000	1.0E-05	0.0000	2.0E-05	0.0000
α_1	0.1206	0.0000	0.1872	0.0000	0.1554	0.0000
α_2	-	-	-0.10356	0.0000	-	-
β_1	0.8362	0.0000	0.8870	0.0000	0.3534	0.0003
β_2	-	-	-	-	0.4330	0.0000
$\Sigma\alpha + \Sigma\beta$	0.9568		0.9706		0.9418	

TRANSPORTATION

	GARCH(1,1)		GARCH(1,2)		GARCH(2,1)	
	Coef.	P values	Coef.	P values	Coef.	P values
Arch-Lm t-stat	2.2367	0.0482	0.7737	0.5685	0.5854	0.7112
ω	2.9E-05	0.0000	1.4E-05	0.0000	4.1E-05	0.0000
α_1	0.0939	0.0000	0.1740	0.0000	0.1581	0.0000
α_2	-	-	-0.1179	0.0000	-	-
β_1	0.8517	0.0000	0.9188	0.0000	0.1365	0.0001
β_2	-	-	-	-	0.6320	0.0000
$\Sigma\alpha + \Sigma\beta$	0.9457		0.9749		0.9264	

COMMUNICATION

	GARCH(1,1)		GARCH(1,2)		GARCH(2,1)		GARCH(3,1)	
	Coef.	P values	Coef.	P values	Coef.	P values	Coef.	P values
Arch-Lm t-stat	4.1400	0.0010	0.6875	0.6329	2.5277	0.0273	1.2218	0.2961
ω	0.0000	0.0000	2.0E-06	0.0000	6.7E-06	0.0000	7.5E-06	0.0000
α_1	0.0641	0.0000	0.1690	0.0000	0.0898	0.0000	0.1036	0.0000
α_2	-	-	-0.13426	0.0000	-	-	-	-
β_1	0.9252	0.0000	0.9606	0.0000	0.4264	0.0043	0.7245	0.0000
β_2	-	-	-	-	0.4694	0.0009	-0.4450	0.0000
β_3	-	-	-	-	-	-	0.6007	0.0000
$\Sigma\alpha + \Sigma\beta$	0.9893		0.9954		0.9856		0.9838	

APPENDIX B: CAUSALITY-IN-VARIANCE TEST USING HIGHER ORDER

GARCH MODELS

Results of food, communication and transportation indices are provided separately in Table below to compare test statistics generated through different GARCH models. By using GARCH (1,1) model, results suggest that there is significant unidirectional volatility spillover from almost all the sector indices towards food, communication and transportation indices. When we run causality in variance test for higher order GARCH models, we observe that volatility spillovers disappear from the series. In the previous section, we show that GARCH (1,1) model is insufficient to capture the dynamics of these series because there is still autocorrelation in the residuals of the GARCH models. It is obvious that this phenomenon is the reason behind the spurious volatility spillovers. However, in Hafner and Herwartz (2006), the model is tested only for GARCH (1,1) model. The robustness of the Hafner and Herwartz (2006) approach by using higher order GARCH model can be tested via bootstrapping or simulations for adequacy of the probability distributions and test statistics but this quantitative work is beyond the scope of this study. We conclude that there are no risk transmissions towards these three indices. The results of the section about minimum variance portfolios also confirm our conclusion. We show that food and communication indices have a considerable percentage share in minimum variance portfolios, they constitute half of the portfolio with monthly returns, which indicates the efficiency of these indices in risk reduction. If there were volatility spillovers from all sector indices to these indices, they should not appear in the minimum variance portfolios.

SECTOR RETURN INDICES

DEPENDENT VARIABLES

INDEPENDENT VARIABLES	FOOD		TRANS		CMMCN	
	(1,1)	(2,1)	(1,1)	(2,1)	(1,1)	(3,1)
	GARCH					
FOOD, BEVERAGE			2.1820*	0.572	3.6184***	0.8711
TEXTILE	2.0637*	1.5622	2.2144*	0.8688	2.9000**	0.7962
PAPER, FOREST	1.8745*	1.3781	2.2335**	0.7794	3.1418***	0.7487
CHEMISTRY	2.0989*	1.5741	2.1622*	0.552	3.7176***	0.9497
STONE, SOIL	1.9974*	1.5073	2.2609**	0.7807	2.8959**	0.7092
METAL	1.9992*	1.4832	2.1896*	0.5619	3.7843***	0.9718
MACHINERY	1.9728*	1.4621	2.1866*	0.6477	3.5422***	0.877
ELECTRICITY	1.9372*	1.4206	2.1279*	0.543	3.4730***	0.8724
TRANSPORTATION	1.9348*	1.4059			3.9727***	1.0556
TOURISM	1.9820*	1.4738	2.1417*	0.5513	3.1707***	0.7491
COMMERCE	1.9506*	1.4449	2.1813*	0.5607	4.1070***	1.1836
COMMUNICATION	1.9667*	1.49	2.2318**	0.5802		
SPORT	1.8462	1.3662	2.1928*	0.5543	4.0737***	1.176
BANK	1.9692*	1.465	2.1841*	0.5731	3.9673***	1.0768
INSURANCE	2.0215*	1.5032	2.1593*	0.5402	3.7520***	0.9567
LEASING	1.9232*	1.4251	2.1369*	0.5373	3.8674***	1.0287
HOLDING	2.0123*	1.5106	2.1601*	0.5589	3.7393***	0.9451
REAL ESTATE	2.0402*	1.5202	2.1500*	0.633	3.2118***	0.7706
IT INDUSTRY	1.8672*	1.3691	2.1140*	0.5335	3.3561***	0.7924

Superscripts *, **, *** represent significance at the 10, 5, and 1% respectively.

SECTOR PRICE INDICES

DEPENDENT VARIABLES

	FOOD		TRANS		CMMCN	
	(1,1)	(2,1)	(1,1)	(2,1)	(1,1)	(3,1)
	GARCH					
FOOD, BEVERAGE			2.3252**	0.6363	3.3206***	0.884
TEXTILE	2.0285*	1.5533	2.3410**	0.9379	2.6301**	0.8425
PAPER, FOREST	1.8432	1.3777	2.3869**	0.8741	2.8673**	0.7955
CHEMISTRY	2.0562*	1.5612	2.2989**	0.6224	3.3293***	0.911
STONE, SOIL	1.9711*	1.5073	2.4409**	0.911	2.6061**	0.7637
METAL	1.9639*	1.4789	2.3364**	0.637	3.5208***	0.9819
MACHINERY	1.9552*	1.4734	2.3375**	0.7376	3.2246***	0.8861
ELECTRICITY	1.9022*	1.417	2.2716**	0.6151	3.1840***	0.8912
TRANSPORTATION	1.8894*	1.3962			3.7053***	1.0657
TOURISM	1.9525*	1.4736	2.2858**	0.6254	2.8922**	0.7783
COMMERCE	1.9074*	1.4347	2.3278**	0.6323	3.8389***	1.1736
COMMUNICATION	1.9360*	1.4913	2.3750**	0.6518		
SPORT	1.7997	1.355	2.3374**	0.6251	3.7755***	1.1595
BANK	1.9403*	1.4665	2.3299**	0.6473	3.6624***	1.0564
INSURANCE	2.0016*	1.5112	2.3103**	0.6166	3.4629***	0.9542
LEASING	1.8804*	1.4146	2.2674**	0.6033	3.5668***	1.0182
HOLDING	1.9872*	1.5156	2.3016**	0.632	3.4188***	0.9361
REAL ESTATE	2.0487*	1.5537	2.2930**	0.7129	2.8567**	0.7926
IT INDUSTRY	1.8312	1.3641	2.2506**	0.6041	3.0637***	0.8139

Superscripts *, **, *** represent significance at the 10, 5, and 1% respectively.

APPENDIX C: TURKISH SUMMARY

Endeksler bir grup deęişkenin toplu olarak deęişimlerini gösteren istatistiki ölçümlerdir. Amacına göre geniş veya dar olabilirler. Yatırımcılar tarafından yatırımın performansını ölçmede referans olarak da kullanılabilirler. Borsa yatırım fonlarının 1990'ların sonunda hızlı bir şekilde artmasıyla endekslerin önemi de artmıştır. Ayrıca bu yatırım fonlarının sayılarının artması pasif yatırım fırsatlarının çeşitlendirilmesi amacıyla birçok yeni endeks türünün ortaya çıkmasına sebep olmuştur.

Türkiye'de yukarıda belirtilen amaçlarla ileride borsa yatırım fonlarına referans teşkil etmesi amacıyla 20 yıldır sektör endeksleri hesaplanmaktadır. Sektör endekslerine ilaveten, 2009 yılında Borsa İstanbul tarafından Dünya'da türünün ilk örnekleri olarak şehir endeksleri hesaplanmaya başlanmıştır. Bu endekslerin çıkarılış amacı, şehirlerin performansını ortaya koymak ve ileride çıkarılacak borsa yatırım fonlarına referans teşkil ederek pasif yatırım imkanları arayan yatırımcıların bu fonlar aracılığıyla şehirlere yatırım yapabilmesine imkan sağlamaktır.

Bu tezin amacı, Türkiye'deki şehir ve sektör endeks verilerini kullanarak ülkedeki bölgesel ve sektörel çeşitlendirme potansiyelinin varlığını araştırmak ve bu iki çeşitlendirme biçimini performans bakımından karşılaştırmaktır. Türkiye uluslararası yatırımcıların ilgisini çeken bir ülke olup Borsa İstanbul'daki hisselerin % 65'ini yabancılar ellerinde tutmaktadır. Bu yüzden bu tezin akademisyenler kadar yatırımcılar için de önemli sonuçları olacaktır.

Literatürde bölgesel ve sektörel çeşitlendirmenin etkilerini uluslararası düzeyde endeks getirilerini yada firma getirilerini kullanarak inceleyen birçok çalışma bulunmaktadır. Ancak bildiğimiz kadarıyla bunu bir ülke içerisinde yapan bir çalışma bulunmamaktadır. Bir ülkenin verilerini kullanarak yapılacak bir çalışma, daha iyi bir karşılaştırma imkanı sağlayacaktır, çünkü bir ülke içerisindeki firmalar

aynı makroekonomik ve politik etkilere maruz kalıp aynı borsada aynı zaman kuşağında işlem görmekte ve aynı para birimde ticarete konu olmaktadır. Bu bağlamda bu tezin en büyük katkısı şudur ki; bölgesel ve sektörel çeşitlendirmenin karşılaştırılması incelemesi ilk defa bir ülkenin verileriyle şehir bazında yapılmaktadır. Türkiye ise bu bağlamda şehir endekslerinin çıkarılması ile inceleme açısından büyük önem arz etmektedir.

Çalışmanın taslağı genel olarak şöyledir: Borsa İstanbul hakkında genel bilgi veren bir bölümden sonra literatürde konuyla ilgili yapılan bazı çalışmalara yer verilmiştir. Kullanılan verilerin bir incelemesi yapılmakta ve çalışmada izlenen metodoloji tanıtılmaktadır. Yapılan analizlerin sonuçları anlatıldıktan ve yorumlandıktan sonra ise genel sonuçlar ve yorumlar sunulmaktadır.

Borsa İstanbul, eski adıyla İstanbul Menkul Kıymetler Borsası (İMKB), Türkiye’de menkul kıymet ticareti yapmakla yetkili tek kurumdur. Bağımsız bir kurum olarak 1986 yılında kurulmuştur. Sermaye piyasalarının Avrupa Birliği müktesabı ve uluslararası sermaye piyasaları ile uyumlulaştırılması amacıyla sermaye piyasaları ile ilgili bir dizi hukuki düzenleme yapılmıştır. İMKB’nin Borsa İstanbul olarak yeniden markalaştırılması da bu süreç içerisinde gerçekleştirilmiştir. Borsa İstanbul bugün itibarıyla, İstanbul Altın Borsası, Vadeli İşlemler ve Opsiyon Borsası’nı bünyesinde barındırmaktadır. Yaklaşık olarak 350 firma Borsa İstanbul’da işlem görmekte olup borsada ki hisselerin toplam değeri 297 milyar dolardır.

Borsa İstanbul tarafından birçok endeks hesaplanmakta olup bunların amacı genel olarak performans ölçümleri için referans sağlamaktadır. Piyasaların genel performansının ölçülmesi yatırımcılar için büyük önem taşımaktadır. Her bir sektör şehir veya piyasa için endeksler fiyat ve getiri endeksleri olmak üzere iki çeşittir. Fiyat ve getiri endekslerinin tek farkı, fiyat endeksinde temettü ödemeleri hesaba katılmazken, getiri endeklerinde bunların hesaba katılmasıdır.

Sektör endeksleri Borsa İstanbul'a kote olan şirketlerin sektörlerine göre kategorize edilmesiyle oluşturulmaktadır. Genel seçim kriterlerinden farklı bir seçim kriteri bu endeksler için bulunmamaktadır. 2009 yılında Dünya'da ilk defa hesaplanmaya başlayan şehir endeksleri için bazı özel seçim kriterleri bulunmaktadır. Firmalar şehirlere göre kategorize edilirken temel olarak hizmet verdiği yada üretim yaptığı şehir dikkate alınmaktadır. Eğer bir üretim firmasının % 50'den fazla üretimi bir şehirde gerçekleşiyorsa ya da bir hizmet firmasının % 50'den fazla faaliyet kârı bir şehirde gerçekleşiyorsa, firma o şehrin endeksine dahil edilmektedir. Eğer böyle bir durum yoksa o zaman firmanın genel merkezinin bulunduğu şehir dikkate alınmaktadır. Finansal sektör (banka, finansal kiralama, faktoring) şirketleri şehir endekslerine dahil edilmemektedir.

Sektör Endeksleri			Şehir Endeksleri		
Kod	İsim	Firma Sayısı	Kod	İsim	Firma Sayısı
XGIDA	GIDA,İÇECEK	20	XSADA	ADANA	6
XTEKS	TEKSTİL	16	XSANK	ANKARA	15
XKAGT	KAĞIT, ORMAN	14	XSANT	ANTALYA	4
XKMYA	KİMYA, PETROL, PLASTİK	25	XSBUR	BURSA	15
XTAST	TAŞ, TOPRAK	26	XSIST	İSTANBUL	88
XMANA	METAL	15	XSIZM	İZMİR	25
XMESY	MAKİNE	28	XSKAY	KAYSERİ	3
XELKT	ELEKTRİK	6	XSKOC	KOCAELİ	19
XULAS	ULAŞIM	6	XSTKR	TEKİRDAĞ	5
XTRZM	TURİZM	5	XSKON	KONYA	5
XCRT	TİCARET	22	XSBAL	BALIKESİR	3
XILTM	İLETİŞİM	2	XSDNZ	DENİZLİ	4
XSPOR	SPOR	4			
XBANK	BANKA	12			
XSGRT	SİGORTA	5			
XFINK	LEASING, FAKTORİNG	4			
XHOLD	HOLDİNG	39			
XGMYO	GAYRİ MENKUL YATIRIM ORT	28			
XBLSM	BİLİŞİM	12			
XMADN	MADEN	5			
XINSA	İNŞAAT	8			
XTEK	TEKNOLOJİ	1			

Yukarıdaki tabloda endekslerin isimleri ve bu endekslerdeki firma sayıları yer almaktadır. Şehir endekslerinde 192 firma varken sektör endekslerinde 303 firma bulunmaktadır. 172 firma hem bir şehir hem de bir sektör endeksine dahildir. Bazı endeksler çalışmanın kapsamı dışında tutulmuştur, çünkü bu endeksler son birkaç bir ya da iki yıldır hesaplanmaktadır. Mümkün olan en uzun örneklem periyodunun yakalanması için bu endeksler analizlerde yer almamaktadır.

	ADN	ANK	ANT	BUR	IST	IZM	KAY	KOC	TKR	KON	BAL	DNZ	Ortak Firma Sayısı
GIDA,İÇECEK		1		4	2	7				1	2	1	18
TEKSTİL	2				3		1	1	2			1	10
KAĞIT, ORMAN		1			5	4		1	3				14
KİMYA, PETROL, PLASTİK	1				6	2		7			1	1	18
TAŞ, TOPRAK	3			1	3	4		2		1		1	15
METAL				3	2	1	1	2					9
MAKİNE		3		4	5	2		4		1			19
ELEKTRİK				1	2		1						4
ULAŞIM					5								5
TURİZM			4		1								5
TİCARET				1	5	1							7
İLETİŞİM		1			1								2
SPOR					3								3
BANKA													0
SİGORTA													0
LEASING, FAKTORİNG													0
HOLDİNG		2			26			1		2			31
GAYRİ MENKUL YATIRIM ORT													0
BİLİŞİM		2			9			1					12
MADEN		2				2							4
İNŞAAT					7								7
TEKNOLOJİ		1											1
Ortak Firma sayısı	6	10	4	14	78	21	3	19	5	5	3	4	172

Çalışmada ayrıca şirketlerin borsadaki değerlerine dayalı olarak şehir endekslerinin sektörlere ve sektör endekslerinin de şehirlere dağılımını gösteren tablolara yer verilmiştir. Sadece firma sayısına bağlı dağılım yanlış çıkarımlara sebep olabileceğinden böyle bir yöntem benimsenmiştir. Örneğin yukarıdaki tabloya göre turizm sektörünün İstanbul'da bir Antalya'da da 4 firması bulunmaktadır. Buna göre diyebiliriz ki turizm sektörünün % 80'i Antalya'da yer alırken, % 20'si İstanbul'da yer almaktadır. Ancak değere dayalı yaklaşıma baktığımızda turizm sektörünün % 50'si Antalya'da diğer % 50'si ise İstanbul'da yer almaktadır. Değere dayalı dağılım bazı sektör endekslerinin bazı şehirlerde ya da bazı şehir endekslerinin ise bazı sektörlerde yoğunlaştığını göstermektedir. Bu yoğunlaşmanın risklerle ilgili olup olmadığının incelenmesi amacıyla çalışmanın ilerleyen kısımlarında bazı analizler yapılmıştır.

Çalışmada Borsa İstanbul' dan alınan günlük veriler kullanılmıştır. Şehir endeksi verileri 2 Ocak 2009 ve 24 Kasım 2014 arasındaki dönemi, Sektör endeksi verileri ise 1 Nisan 2004 ve 12 Aralık 2014 arasındaki dönemi kapsamaktadır. Serilerin tanımlayıcı istatistikleri hesaplanmış ve birim kök testleri yapılmıştır. Birim kök testleri gecikme değişkeniyle yapılan regresyon çalışmalar için büyük önem arz etmektedir. Eğer seride birim kök varsa gecikme değişkenleri üstel ifadeler nedeniyle geçmişe doğru gittikçe patlama etkisi meydana getirmektedir. Bu durum da regresyonun güvenilirliğine zarar vermektedir.

Çalışmada ilk olarak sektörel ve bölgesel çeşitlendirme potansiyelinin var olup olmadığının incelenmesi amacıyla literatürde sıkça kullanılan varyansta nedensellik testi yapılmıştır. Tezde Hafner ve Herwartz (2006) tarafından önerilen varyansta nedensellik testi benimsenmiştir. İlgili makalede kendi testlerinin tahmin kabiliyetinin önceki testlere göre üstünlüğünü ortaya koyan bir Monte Carlo Simulasyon çalışması yapılmıştır. Bu sebeple tezde bu yöntem kullanılmıştır. Test her iki sektör ya da her iki şehir endeksi arasında oynaklık yayılımı olup olmadığını ortaya çıkarmaktadır. Çalışma hem fiyat hem de getiri endeksleri ayrı ayrı yapılmış olup 800'ün üzerinde test yapılmıştır. Oynaklık yayılımı olmaması çeşitlendirmenin

riski azaltmada etkili olacağı anlamına gelmektedir. Test için öncelikle tek değişkenli GARCH (1,1) modellemesi yapılması gerekmektedir. GARCH modellemesi için ise ARMA modellerinin tahmin edilmesi gerekmektedir. Aşağıdaki tabloda tahmin edilen ARMA modelleri yer almaktadır.

Sektör Endeksleri			Şehir Endeksleri		
İsim	Fiyat Endeksi	Getiri Endeksi	İsim	Fiyat Endeksi	Getiri Endeksi
GIDA,İÇECEK	ARMA(1,2)	ARMA(1,2)	ADANA	ARMA(0,0)	ARMA(0,0)
TEKSTİL	ARMA(1,0)	ARMA(0,1)	ANKARA	ARMA(0,0)	ARMA(0,0)
KAĞIT, ORMAN	ARMA(1,0)	ARMA(0,1)	ANTALYA	ARMA(0,0)	ARMA(0,0)
KİMYA, PETROL, PLASTİK	ARMA(1,2)	ARMA(2,0)	BURSA	ARMA(0,0)	ARMA(0,0)
TAŞ, TOPRAK	ARMA(1,0)	ARMA(1,0)	İSTANBUL	ARMA(0,0)	ARMA(0,0)
METAL	ARMA(0,1)	ARMA(0,1)	İZMİR	ARMA(0,0)	ARMA(0,0)
MAKİNE	ARMA(0,1)	ARMA(1,0)	KAYSERİ	ARMA(2,2)	ARMA(2,2)
ELEKTRİK	ARMA(1,1)	ARMA(1,1)	KOCAELİ	ARMA(0,1)	ARMA(0,1)
ULAŞIM	ARMA(1,0)	ARMA(1,0)	TEKİRDAĞ	ARMA(2,2)	ARMA(2,2)
TURİZM	ARMA(1,0)	ARMA(1,0)			
TİCARET	ARMA(0,0)	ARMA(0,0)			
İLETİŞİM	ARMA(0,0)	ARMA(0,0)			
SPOR	ARMA(1,0)	ARMA(1,0)			
BANKA	ARMA(0,0)	ARMA(0,0)			
SİGORTA	ARMA(1,0)	ARMA(0,1)			
LEASING, FAKTORİNG	ARMA(1,0)	ARMA(1,0)			
HOLDİNG	ARMA(0,1)	ARMA(0,1)			
GAYRİ MENKUL YATIRIM ORT	ARMA(1,0)	ARMA(1,0)			
BİLİŞİM	ARMA(0,1)	ARMA(1,0)			

Tahmin edilen ARMA modelinin kalıntı serisi alınıp GARCH edilmekte, ardından bu GARCH modelinin türev serisi, kalıntı serisi ve oynaklık süreci serisi alınmaktadır. Kalıntı serisinin karesinin bir eksiği bağımlı, türev serisi ve diğer endeksin oynaklık süreci serisi bağımsız olmak üzere bir regresyon tahmin edilerek bu regresyonda otokorelasyon testi yapılmaktadır. Otokorelasyon olmadığını öneren sıfır hipotezi reddedilemez ise iki endeks arasında oynaklı yayılımı olduğu sonucuna varılmaktadır.

	FiyatEndeksi	Getiri Endeksi		FiyatEndeksi	Getiri Endeksi
GIDA,İÇECEK	0.0988	0.0927	ADANA	0.5947	0.8216
TEKSTİL	0.3012	0.3048	ANKARA	0.3296	0.2255
KAĞIT, ORMAN	0.469	0.5294	ANTALYA	0.8845	0.8859
KİMYA, PETROL, PLASTİK	0.8106	0.7496	BURSA	0.8798	0.8432
TAŞ, TOPRAK	0.5474	0.8328	İSTANBUL	0.2822	0.3173
METAL	0.7766	0.7994	İZMİR	0.6607	0.6865
MAKİNE	0.8912	0.8539	KAYSERİ	0.9645	0.9926
ELEKTRİK	0.9583	0.9584	KOCAELİ	0.8378	0.6637
ULAŞIM	0.0365	0.0482	TEKİRDAĞ	0.5608	0.6322
TURİZM	0.5487	0.5482			
TİCARET	0.7515	0.7743			
İLETİŞİM	0.0017	0.001			
SPOR	0.6824	0.7626			
BANKA	0.1732	0.1799			
SİGORTA	0.3222	0.3475			
LEASING, FAKTORİNG	0.6404	0.7297			
HOLDİNG	0.9187	0.9149			
GAYRİ MENKUL YATIRIM ORT	0.9934	0.9844			
BİLİŞİM	0.8228	0.8541			

Yukarıdaki tablo ilk aşamadaki GARCH (1,1) modellerinin otokorelasyon test sonuçları göstermektedir. Bazı sektör endeksleri bu sonuçlara göre daha yüksek dereceli GARCH modellerine ihtiyaç duymaktadır. Hafner ve Herwartz (2006) tarafından yazılan makalede daha yüksek dereceli GARCH modelleriyle varyansta nedensellik testi yapıp yapılmayacağına dair kanıt sunulmadığından bu modeller bu aşamada analizden çıkarılmıştır. Ancak bu seriler için yüksek dereceli GARCH modelleri tahmin edilip varyansta nedensellik testi yapılmıştır. Ancak yapılan testlerin doğruluğunun ispat edilmesi bu çalışmanın kapsamı dışındadır. Bu konunun incelenmesi istatistik konusunda ileride yapılacak çalışmalara bırakılmaktadır. Aşağıdaki tablolarda oynaklık yayılımı testlerinin sonuçlarına yer verilmektedir. Buna göre hiçbir endeks ikilisi arasında oynaklık yayılımı gözlenmemektedir. Bu sonuçlar Türkiye’de endeks verilerine göre sektörel ve bölgesel çeşitlendirme potansiyelinin var olduğunu göstermektedir.

ŞEHİR GETİRİ ENDEKSLERİ

BAĞIMLI DEĞİŞKENLER

	Adana	Ankara	Antalya	Bursa	İstanbul	İzmir	Kayseri	Kocaeli	Tekirdağ
BAĞIMSIZ DEĞİŞKENLER	Adana	1.5956	0.5544	0.5927	1.3155	0.88	0.4561	1.1043	0.6881
Ankara	0.4473		0.4554	0.6103	1.1898	0.7018	0.2082	0.9641	0.681
Antalya	0.4936	1.6979		0.4564	1.1911	0.5825	0.2366	0.82	0.6883
Bursa	0.4804	1.3738	0.4103		1.194	0.7138	0.2348	0.8087	0.69
İstanbul	0.3754	1.3834	0.3982	0.4354		0.676	0.1932	0.9988	0.6838
İzmir	0.3397	1.3866	0.4048	0.3685	1.2018		0.1171	0.7117	0.677
Kayseri	0.4136	1.4248	0.4728	0.4002	1.1809	0.7375		0.73	0.6916
Kocaeli	0.3557	1.3867	0.43	0.3407	1.192	0.5938	0.1558		0.6788
Tekirdağ	0.4499	1.3835	0.3496	0.3906	1.184	0.5348	0.0977	0.6393	

ŞEHİR FİYAT ENDEKSLERİ

BAĞIMLI DEĞİŞKENLER

	Adana	Ankara	Antalya	Bursa	İstanbul	İzmir	Kayseri	Kocaeli	Tekirdağ
BAĞIMSIZ DEĞİŞKENLER	Adana	1.1918	0.827	0.2899	1.733	1.4024	0.6699	1.3313	0.8204
Ankara	0.8994		0.5301	0.5291	1.287	0.8332	0.3397	1.0957	0.7865
Antalya	0.7521	1.2247		0.8355	1.2591	0.6302	0.327	0.7245	0.7845
Bursa	0.7651	1.1479	0.4118		1.2607	0.7685	0.3135	0.7013	0.787
İstanbul	0.6683	1.1178	0.4033	0.8281		0.731	0.2736	0.9125	0.7799
İzmir	0.6374	1.1666	0.4081	0.8952	1.2786		0.2085	0.6208	0.7733
Kayseri	0.668	1.1451	0.5138	0.8522	1.2539	0.8358		0.6181	0.7845
Kocaeli	0.6491	1.1372	0.4453	0.9189	1.2759	0.6222	0.2435		0.7805
Tekirdağ	0.7539	1.1372	0.3507	0.8922	1.258	0.5688	0.1939	0.4297	

Konuyla ilgili literatürdeki sonuçlar incelendiğinde oynaklığın genelde büyük piyasalarda ya da gelişmiş ülkelerden küçük piyasalara ya da daha az gelişmiş ülkelere doğru yayıldığını gözlemlenmektedir. Bu bulguların aksine, bizim sonuçlarımıza göre görece büyük olan şehirler diğer şehirlere oynaklık yaymamaktadır.

SEKTÖR GETİRİ ENDEKSLERİ BAĞIMLI DEĞİŞKENLER

	TEKS	KAĞIT	KİMYA	TAŞ	METAL	MAKİNA	ELEK	TRZM
GIDA,İÇECEK	1.3231	0.9793	0.5298	0.5616	0.6423	0.4205	0.472	0.8333
TEKSTİL		1.0403	0.7203	0.6333	0.9528	0.4549	0.543	0.8221
KAĞIT, ORMAN	1.1883		0.5173	0.4197	0.6257	0.3918	0.3252	0.8607
KİMYA, PETROL	1.3377	0.8727		0.4511	0.5272	0.3961	0.448	0.7845
TAŞ, TOPRAK	1.2455	0.9959	0.561		0.7698	0.4252	0.4435	0.7883
METAL	1.2812	0.9354	0.5218	0.4702		0.3938	0.6028	0.846
MAKİNE	1.2865	0.9113	0.5318	0.4934	0.7135		0.5695	0.792
ELEKTRİK	1.3024	0.8166	0.5181	0.4367	0.5925	0.3915		0.859
ULAŞIM	1.1263	0.7246	0.5732	0.4044	0.4898	0.3954	0.3415	0.7321
TURİZM	1.3276	1.0746	0.5229	0.4826	0.764	0.3933	0.5201	
TİCARET	1.1984	0.7972	0.5242	0.4193	0.4993	0.3917	0.2433	0.8034
İLETİŞİM	1.2805	1.0011	0.5173	0.4525	0.5182	0.3936	0.3533	0.8733
SPOR	1.2188	0.8462	0.5528	0.4529	0.4769	0.3914	0.2607	0.8119
BANKA	1.3111	0.8732	0.5143	0.4702	0.5596	0.4039	0.6048	0.8003
SİGORTA	1.4289	1.0167	0.5141	0.5249	0.5273	0.3934	0.5294	0.8773
LEASING, FAKTORİNG	1.2289	0.8903	0.5228	0.4174	0.5591	0.4018	0.2646	0.8822
HOLDİNG	1.3219	0.9338	0.5149	0.4434	0.5358	0.3932	0.6046	0.8137
GAYRİ MENKUL YAT	1.2828	1.0847	0.5252	0.4999	0.6518	0.403	0.4255	0.8417
BİLİŞİM	1.1924	0.8375	0.5532	0.4019	0.5127	0.4196	0.245	0.7704

SEKTÖR GETİRİ ENDEKSLERİ BAĞIMLI DEĞİŞKENLER

	TİCARET	SPOR	SGRT	BANKA	FINK	HOLD	GMYO	BLSM
GIDA,İÇECEK	0.7336	0.5211	1.3405	1.0726	0.6424	0.2786	0.1602	0.4654
TEKSTİL	1.4689	0.6817	1.6727	0.9693	0.5864	0.5769	0.2865	0.5026
KAĞIT, ORMAN	1.338	0.7516	1.4002	1.0407	0.5173	0.2856	0.1659	0.4528
KİMYA, PETROL	0.8377	0.609	1.4392	1.0966	0.5447	0.2808	0.144	0.4761
TAŞ, TOPRAK	1.4804	0.7431	1.4364	1.0042	0.5524	0.4441	0.2575	0.4871
METAL	0.8446	0.6944	1.3584	1.0986	0.5993	0.2797	0.1401	0.4397
MAKİNE	1.3902	0.6784	1.361	1.0759	0.5367	0.3008	0.214	0.4317
ELEKTRİK	1.1253	0.4322	1.3618	1.0569	0.5496	0.2772	0.1951	0.3978
ULAŞIM	0.85	0.6313	1.4576	1.1014	0.5646	0.3163	0.1351	0.3331
TURİZM	0.7018	0.5252	1.3468	1.0117	0.6679	0.3271	0.1862	0.4159
TİCARET		0.5262	1.4545	1.0986	0.551	0.2804	0.1359	0.4103
İLETİŞİM	0.5025	0.5321	1.4683	1.0878	0.6779	0.2689	0.1351	0.4021
SPOR	0.4904		1.4684	1.0913	0.5345	0.2881	0.1355	0.4254
BANKA	0.8134	0.6536		1.1214	0.5755	0.2703	0.1341	0.4332
SİGORTA	0.8327	0.6059	1.3992		0.6477	0.266	0.1428	0.4853
LEASING, FAKTORİNG	0.5184	0.6826	1.413	1.0418		0.2772	0.1347	0.4045
HOLDİNG	0.9132	0.6547	1.4071	1.1225	0.5796		0.1402	0.4194
GAYRİ MENKUL YAT	1.0019	0.6599	1.4183	1.0229	0.607	0.3377		0.5848
BİLİŞİM	0.67	0.582	1.3854	1.0744	0.5275	0.2842	0.153	

SEKTÖR GETİRİ ENDEKSLERİ BAĞIMLI DEĞİŞKENLER

	TEKS	KAĞIT	KİMYA	TAŞ	METAL	MAKİNA	ELEK	TRZM
GIDA,İÇECEK	1.3206	1.0328	0.5967	0.9386	0.6718	0.3445	0.4699	0.8323
TEKSTİL		1.0939	0.803	0.9591	1.0125	0.3743	0.5631	0.8232
KAĞIT, ORMAN	1.1919		0.5396	0.7878	0.6554	0.3349	0.3337	0.8614
KİMYA, PETROL	1.3428	0.9404		0.8545	0.5838	0.3333	0.4559	0.7882
TAŞ, TOPRAK	1.2768	1.1049	0.723		0.902	0.3807	0.5081	0.7942
METAL	1.2765	0.9765	0.5858	0.8773		0.3324	0.5946	0.8417
MAKİNE	1.2907	0.9817	0.6943	0.876	0.7742		0.5909	0.7914
ELEKTRİK	1.3002	0.878	0.5166	0.8304	0.6239	0.332		0.8573
ULAŞIM	1.1291	0.7886	0.4429	0.7983	0.5196	0.3473	0.3534	0.7335
TURİZM	1.322	1.1206	0.6235	0.8701	0.7903	0.3311	0.5251	
TİCARET	1.2024	0.8568	0.4931	0.7963	0.5311	0.3324	0.2444	0.8023
İLETİŞİM	1.2924	1.0529	0.4918	0.8683	0.5527	0.3342	0.361	0.8798
SPOR	1.2221	0.9061	0.4491	0.8393	0.5091	0.3318	0.2683	0.8117
BANKA	1.3172	0.9259	0.5518	0.8604	0.596	0.3375	0.6094	0.7999
SİGORTA	1.4285	1.0632	0.5706	0.9613	0.5569	0.3326	0.5279	0.8768
LEASING, FAKTORİNG	1.2301	0.9491	0.4904	0.8028	0.5887	0.3361	0.2663	0.8814
HOLDİNG	1.3267	0.9864	0.5561	0.8412	0.5743	0.3325	0.6153	0.8142
GAYRİ MENKUL YAT	1.3144	1.1524	0.6096	0.9453	0.7093	0.3419	0.4414	0.8533
BİLİŞİM	1.1979	0.9072	0.4503	0.7993	0.5494	0.3681	0.251	0.7702

SEKTÖR GETİRİ ENDEKSLERİ BAĞIMLI DEĞİŞKENLER

	TİCARET	SPOR	SGRT	BANKA	FİNK	HOLD	GMYO	BLSM
GIDA,İÇECEK	0.7717	0.6248	1.3696	1.1025	0.7651	0.2726	0.1325	0.5131
TEKSTİL	1.5021	0.8465	1.721	0.9714	0.6928	0.5329	0.2666	0.5353
KAĞIT, ORMAN	1.3598	0.9547	1.441	1.0561	0.6134	0.2793	0.1306	0.4973
KİMYA, PETROL	0.8668	0.7448	1.4483	1.1009	0.6458	0.2738	0.1193	0.6173
TAŞ, TOPRAK	1.5936	0.9473	1.4901	1.004	0.6793	0.4572	0.2396	0.5746
METAL	0.8711	0.8211	1.3823	1.1289	0.7172	0.271	0.1073	0.4863
MAKİNE	1.5218	0.8575	1.375	1.0913	0.6423	0.2881	0.2014	0.4752
ELEKTRİK	1.1741	0.5503	1.3892	1.0799	0.6607	0.2699	0.1721	0.4439
ULAŞIM	0.908	0.7994	1.4847	1.1374	0.6886	0.3146	0.0945	0.3792
TURİZM	0.7386	0.6507	1.3758	1.0257	0.7862	0.3157	0.1567	0.4576
TİCARET		0.6327	1.4707	1.1281	0.6638	0.2746	0.1001	0.4605
İLETİŞİM	0.5374	0.6383	1.4822	1.1117	0.8297	0.2648	0.0938	0.4575
SPOR	0.5238		1.4939	1.1288	0.6446	0.2809	0.0969	0.4755
BANKA	0.8548	0.7944		1.1558	0.6911	0.2655	0.0998	0.4821
SİGORTA	0.8722	0.7286	1.4416		0.7761	0.2669	0.1114	0.5319
LEASING, FAKTORİNG	0.5514	0.8217	1.4358	1.0539		0.2717	0.0966	0.4544
HOLDİNG	0.9663	0.8044	1.4194	1.1512	0.699		0.1094	0.4698
GAYRİ MENKUL YAT	1.0684	0.8059	1.4591	1.0321	0.7282	0.3388		0.658
BİLİŞİM	0.7149	0.7452	1.3837	1.0924	0.6312	0.2693	0.1223	

Analizlerin ikinci kısmında ise sektörel ve bölgesel çeşitlendirmeden hangisinin riski azaltmada daha etkili olduğu incelenmiştir. Karşılaştırma yapmak için Markowitz (1952) tarafından önerilen minimum varyans portföyü yöntemi kullanılmıştır. Şehir endekslerinden oluşan minimum varyans portföyünün riski sektör endeksleri için hesaplanan riskle karşılaştırılarak riski azaltmada sektörel ve bölgesel çeşitlendirmeden hangisinin daha başarılı olduğu anlaşılmaya çalışılmıştır. Minimum varyans portföyü yöntemi endeks serilerinin ortalama getirileri ve riskleri ayrıca kovaryans matrisleri kullanılarak yapılan bir optimizasyon sürecidir. Sonuçlara göre bölgesel çeşitlendirme, sektörel çeşitlendirmeye göre riski azaltmada daha etkilidir.

Üçüncü analiz olarak, çalışmada yeni, basit bir yöntem önerilmektedir. Bu yöntem şöyle özetlenebilir; İlk olarak şehir endekslerinin sektörel olarak çeşitlendirilmiş, sektör endekslerinin ise bölgesel olarak çeşitlendirilmiş portföyler olduğu varsayılarak, bu çeşitlendirmeler yani dağılımlar sayısal olarak ölçülmeye çalışılmıştır. Bunun için Herfindahl–Hirschman endeksi yoğunlaşma rasyosu kullanılmıştır. Bu rasyo ABD’de tek el önleyici yasa içerisinde yer almakta ve şirket birleşme devralmalarında olası tekelleri önlemek amacıyla referans olarak kullanılmaktadır. Bu rasyo yoğunlaşmayı ölçmektedir. Kısaca yüzde payların karesi alınarak toplanmaktadır. Her bir şehir endeksinin sektörlere göre yüzde payları piyasa değeri yöntemine göre hesaplanıp karesi alınıp toplanmıştır. Her bir sektör endeksi için de aynı prosedür uygulanarak yoğunlaşma rasyoları hesaplanmıştır. Yüksek derecede yoğunlaşma düşük derecede çeşitlendirme anlamına gelmektedir. Daha sonra bu rasyolar endeks getirilerinin dağıtılabılır riskleri ile karşılaştırılmıştır. Dağıtılabılır risklerle karşılaştırmanın amacı ise şöyle açıklanabilir; Çeşitlendirme ile finans teorisine göre sadece riskin bir kısmı azaltılabilmektedir. Riskin azaltılamayan kısmına piyasa riski denilmekte olup, bu risk, firmanın özel durumuyla ilgisi olmayan ülke riski, makroekonomik riskler gibi dışsal faktörlerden kaynaklanmaktadır. Yoğunlaşma rasyolarını toplam riskle karşılaştırmak yanıltıcı olacağından dağıtılabılır riskler hesaplanmıştır. Bu hesaplamalar için öncelikle her bir endeks piyasa getirisini temsil eden BIST-TUM endeksi ile regrese edilmiştir. Bu regresyonun kalıntıları bize firmanın piyasa getirisi haricindeki sürpriz getirisini

vermektedir. Teorik olarak bu kalıntılar çeşitlendirme ile yok edilebileceğinden, çeşitlendirme ile bunların riskleri yani standart sapmaları da yok edilebilir. Yani regresyonun standart hatası bize tam olarak endeks getirilerinin dağıtılabilir risklerini vermektedir. Aşağıdaki tabloda sektör endeksleriyle bölgesel, şehir endeksleriyle sektörel yoğunlaşma ölçülmüş, bu ölçümlerin risklerle olan korelasyon ilişkisi hesaplanmıştır. Aşağıdaki sonuçlara göre her iki yoğunlaşma türünde rasyo arttıkça risk de artmaktadır. Bu, çeşitlendirmenin riskle negatif ilişkili olduğu anlamına gelmektedir. Ancak bölgesel çeşitlendirme ile riskin daha ilişkili olduğu görülmektedir. Buna göre literatürde yapılan çalışmaların çoğunluğunun bulunduğu sonuca benzer olarak riski azaltmada bölgesel ve sektörel çeşitlendirme yararlıdır ancak bölgesel çeşitlendirme sektörel çeşitlendirmeye göre daha etkilidir sonucuna ulaşabiliriz.

SEKTÖR	Yoğ. Rasyosu	Dağ. Risk	ŞEHİR	Yoğ. Rasyosu	Dağ. Risk
GIDA	0.47564	1.48%	ADANA	0.496	1.10%
TEKSTİL	0.1012	1.11%	ANKARA	0.252	1.02%
KAĞIT	0.24354	1.24%	ANTALYA	1.000	1.60%
KİMYA	0.41596	1.03%	BURSA	0.61	1.27%
TAŞ, TOPRAK	0.11214	0.82%	ISTANBUL	0.231	0.48%
METAL	0.55786	1.41%	IZMIR	0.231	1.05%
MAKİNA	0.1907	1.01%	KAYSERİ	0.379	1.29%
ELEKTRİK	0.43013	1.65%	KOCAELİ	0.549	1.17%
ULAŞIM	0.88046	1.73%	TEKIRDAG	0.539	2.20%
TURİZM	0.50006	1.73%			
İLETİŞİM	0.63925	1.59%	KORELASYON	0.571	
SPOR	0.82307	1.98%			
BİLİŞİM	0.53596	1.40%			
KORELASYON	0.843				

APPENDIX D: TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü

Sosyal Bilimler Enstitüsü

Uygulamalı Matematik Enstitüsü

Enformatik Enstitüsü

Deniz Bilimleri Enstitüsü

YAZARIN

Soyadı : Hamdi

Adı : AYAN

Bölümü : İşletme

TEZİN ADI (İngilizce) : AN ANALYSIS OF GEOGRAPHIC AND SECTORAL DIVERSIFICATION USING CITY AND SECTOR INDICES OF TURKEY

TEZİN TÜRÜ : Yüksek Lisans

Doktora

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir.

2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir.

3. Tezimden bir bir (1) yıl süreyle fotokopi alınmaz.

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: