ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY

EFFECTS OF MACROECONOMIC VARIABLES ON STOCK EXCHANGE TRADING VOLUME

Ph.D. THESIS

Mümine Banu YOBAŞ

Department of Management Engineering

Management Engineering Programme

Thesis Advisor: Prof. Dr. Burç ÜLENGİN

JUNE 2014

ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY

EFFECTS OF MACROECONOMIC VARIABLES ON STOCK EXCHANGE TRADING VOLUME

Ph.D. THESIS

Mümine Banu YOBAŞ
(507092011)

Department of Management Engineering

Management Engineering Programme

Thesis Advisor: Prof. Dr. Burç ÜLENGİN

JUNE 2014

İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

MAKROEKONOMİK DEĞİŞKENLERİN BORSA İŞLEM HACİMLERİ ÜZERİNDEKİ ETKİSİ

DOKTORA TEZİ

Mümine Banu YOBAŞ
(507092011)

İşletme Mühendisliği Anabilim Dalı

İşletme Mühendisliği Programı

Tez Danışmanı: Prof. Dr. Burç ÜLENGİN

HAZİRAN 2014

Mümine Banu YOBAŞ, **a Ph.D.** student of ITU **Graduate School of Science, Engineering And Technology / Management Engineering** student ID **507092011**, successfully defended the **thesis** entitled "**EFFECTS OF MACROECONOMIC VARIABLES ON STOCK EXCHANGE TRADING VOLUME**", which she prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

Thesis Advisor :	**Prof. Dr. Burç ÜLENGİN** Istanbul Technical University	.....
Jury Members :	**Prof. Dr. Mehmet BOLAK** Galatasaray University	.....
	Prof. Dr. Oktay TAŞ Istanbul Technical University	.....
	Prof. Dr. Belkıs SEVAL Istanbul University	.....
	Doç. Dr. Raziye SELİM Istanbul Technical University	.....

Date of Submission : 24 March 2014
Date of Defense : 13 June 2014

To my mother

and in the memory of my father,

FOREWORD

First and foremost, I would like to express my sincere gratitude to my advisor Prof. Dr. Burç Ülengin for his excellent teaching, patience, encouragement and immense knowledge. He was more than a PhD supervisor for me in these past years: he became my mentor in all aspects of my life during my PhD journey. Whenever I had problems, whether be it PhD related or not, he was always there to listen to me patiently and share his thoughts frankly. Every time, particularly during tough periods, I used to leave his room rejuvenated by his enthusiasm for research. Besides, he kept a sense of humour when I had lost mine. During all these years, what affected me the most is the way he wraps up his perfectionism with his positive and encouraging attitude. I have learned so many things from him.

I am thankful to the members of my PhD committee, Prof. Dr. Mehmet Bolak and Prof. Dr. Oktay Taş for their helpful suggestions. Prof Dr. Mehmet Bolak generously spared his limited time to share his valuable comments and broaden my horizon by the questions he asked during our discussions.

I wish to express my gratitude to Prof. Dr. Ümit Şenesen, not only for his excellent teaching and scientific advice, but also for many insightful discussions we made throughout these years. He is one of those rare people who enjoy sharing all sorts of knowledge modestly. He encouraged and supported my interest in writing as much, if not more than my academic research.

I owe a big thank you to Prof. Dr. Güler Aras, without her encouragement I wouldn't think of starting a PhD. During numerous chats we had, she consistently kept track of my progress with her endless energy and encouraged me to widen my perspective.

There are definitely many academicians and friends who helped me one way or the other during these years. Starting with my primary school teacher all the way through my professors in BSc and MSc. even though it is rather impossible to name everyone, I hope by now they already know how much I appreciated their help and support. Thank you.

Lastly, I believe in life there are things which cannot be really thanked for, but one can only be grateful for, because it is something valuable and it is given just like a gift. For me, it is my family and the faith my parents have in me. Both of my parents had an unfulfilled longing for attending a university, which lasted a lifetime, and resulted in a lifelong struggle to provide me the opportunities they had never been given. I am grateful to them for teaching me the joy of learning and the value of knowledge.

March 2014

M. Banu YOBAŞ
(MSc. Computer Engineer)

TABLE OF CONTENTS

Page

ABBREVIATIONS

ADF : Augmented Dickey-Fuller Unit Root Test
AIC : Akaike Information Criteria
aka : also known as
App : Appendix
ARCH : Autoregressive Conditional Heteroskedasticity
ARMA : Autoregressive Moving Average Models
ARIMA : Autoregressive integrated Moving Average Models
ASX : The Australian Securities Exchange
BSE : Bombay Stock Exchange
CBOT : The Chicago Board of Trade
CC : The Competition Commission
CFTC TAC : US Commodity Futures Trading Commission**,** Technology Advisory Committee
CME : Chicago Merchantile Exchange
CPI : Consumer Price Index
DF : Dickey-Fuller Unit Root Test
DS : Difference Stationary
DW : Durbin-Watson Statistic
ECM : Error Correction Model
ECT : Error Correction Term
ECN : Electronic Communication Networks
ESS : Error sum-of-squares
FDI : Foreign Direct Investment
FIIs : Foreign Institutional Investors
FPI : Foreign Portfolio Investment
GDP : Gross Domestic Product
GMM : Generalised Method of Moments
GNP : Gross National Product
HFT : High-frequency trading
HQC : HannanQuinn Criterion
ICRG : The International Risk Guide
IPS : Im, Pesaran, and Shin
ISE : International Securities Exchange
IT : Information Technology
KPSS : Kwiatkowski, Phillips, Schmidt, and Shin
LLC : Levin, Lin and Chu
LSE : London Stock Exchange
NMS : National Market System
NYSE : New York Stock Exchange
OECD : The Organisation for Economic Co-operation and Development
OLS : Ordinary Least Squares
SEC : The US Securities and Exchange Commission

SIC **:** Schwarz Information Criterion
TRF **:** Trade Reporting Facility
TS **:** Trend Stationary
TSLS **:** Two Step Least Squares
UAE **:** United Arab Emirates
UK **:** United Kingdom
UR **:** Unit Root
VAR **:** Vector Autoregressive Model
WFE **:** World Federation of Exchanges
2SLS **:** Two Step Least Squares

LIST OF TABLES

Page

LIST OF FIGURES

Page

EFFECTS OF MACROECONOMIC VARIABLES ON STOCK EXCHANGE TRADING VOLUME

SUMMARY

The securities markets throughout the world have been undergoing a radical transition. This transition period resulted in radical and permanent footprints of irrevocable changes in the way business is done in securities markets. This large scale transition in the stock exchanges had its consequences. However, it has become a subject worth investing only after some of the impacts became visible. This landscape change in securities markets has been very influential since those effects were not bounded by country borders, but spread to a much greater area. It is possible to say that the effects of this scale were not really anticipated by many in the securities market arena by comparing the studies conducted in the early 90s and ever since. Trading activity, more specifically trading volume inherit important knowledge of stock exchanges yet little is known about how the macroeconomic time series affect trading volume. The main purpose of this study is to investgate the effects of macroeconomic variables on aggregate trading volume of equity stock exchanges.

This study focuses on the stock exchanges and differs from the many studies conducted until now in three ways; firstly, it investigates the stock exchange itself, not a specific stock or a group of stocks traded within. Additionally, the focus of most of the studies in securities markets has been prices or returns, whereas studies focusing on trading volume have been very limited.

Secondly, this study provides a different view for the relation between economic growth and financial system debate by sitting on the fence, equally distant from both sides of the debate. Macroeconomic variables are used to measure the trends and overall state of the economy, based on this they are utilized extensively by economic growth analysis. There have been studies investigating the relationship between macroeconomic variables and stock exchanges; however most of them were limited to a single country in their analysis. Until now, as to my knowledge, this is the first study to investigate the relationship among the economy and aggregate trading volume of stock markets in several countries. The previous studies were either for a single exchange in a country, or for multiple exchanges but not on their relation with macroeconomic variables, or even for multiple countries macroeconomic variables but not for stock exchanges as a whole.

Thirdly, the aggregate trading volume of an equity stock exchange has recently been capturing more information than three decades ago. Moreover, today the information may play a crucial role, in terms of survival of the stock exchanges, since there is a fierce competition in securities markets. This study considers stock exchanges as any other publicly listed company. In fact this is what has been to exchanges: they are transformed to publicly listed companies. Nevertheless they cannot be handled in the same way since exchanges are listed on themselves. Macroeconomic variables affect any company in the economy however stock exchanges are affected two fold; both directly and indirectly. Directly affected just like any other company, because their focus is making profit in the current economy. Indirectly affected; through the actions of the companies listed and decisions of the investors.

Since 1980s exchanges have been going through a significant transformation all around the world. Financial liberalization, structural changes and technological advances are the forces behind this transformation. There were several outcomes; firstly, stock exchanges demutualized and became publicly listed companies on themselves. Secondly, competition was an unfamiliar concept within securities markets until 1990s, mainly due to the perception of the exchanges. The capital movement was not a big issue for securities markets. However, the financial liberalization and technological advances eased capital movement. Competition started initially among domestic exchanges, and then expanded over the boarders. The fierce competition in the international arena necessitated tremendous technology investments. Moreover, by the technological advances new trading venues emerged introducing market fragmentation. Competition and high investment costs together triggered the merger and acquisitions among stock exchanges, because the only way to make the investment feasible and to survive the fierce competition was to increase the trading volume. All these events in the last three decades changed the securities markets landscape dramatically.

Increasing trading volume of an exchange is more important today than it was three decades ago. Today exchanges must generate profit like any other publicly listed company, so they must increase their revenues and reduce their costs. The main revenue sources of exchanges can be grouped into 4 categories; transaction fees, listing fees, membership fees and sales of information services (e.g. market data). Due to the increased competition in the securities markets industry, exchanges were forced to reduce the listing fees. Meanwhile, as a consequence of demutualization membership fees are also expected to fall because trading on multiple exchanges or trading platforms became the norm rather than traders committing to a single venue. Aggarwal (2002) propose that the trading commissions will be the only source of revenue. He has foreseen that the success of an exchange in generating commissions depends on its ability to generate trading volume which is indeed true. Despite all those changes in the securities landscape, the number one revenue item for equity stock exchanges is still the transaction fees. Thus, trading volume is directly related to the profitability of a stock exchange. Today, how to increase trading volume is of great importance as the answer may hold the key to survival.

Industrial production, long term government bond yield, and inflation had all significant effects on trading volume not only in the long term, but also in the short term. On the other hand, unemployment had only long term effect on trading volume whereas market index affected only in the short term. In the long term both industrial production and long term government bond yield had a positive effect, whereas inflation and unemployment had a negative effect. In terms of drifts from the long term, industrial production responded such drifts negatively which is consistent with its short and long term effects. Regarding the variance of trading volume none of the macroeconomic variables seemed to play a significant role.

Financial markets and regulation could all be improved by knowledge of the macroeconomic factors that influence trading volume. A better understanding of these determinants also promises taking a step further towards establishing sustainable markets. These are of direct importance to policy makers and exchange officials attempting to identify conditions likely to disturb trading activity by guiding them to take the precautionary steps where possible.

The introductory section explains the main theme of the thesis. In the second section, the information trading volume possesses is explained and the importance of this information from various aspects of securities markets are discussed. The focus of the third section is panel data methods. In this section the stationary properties of series, cointegrated relationships and econometric modelling methodology are explained. There are several unit root tests and cointegration tests available. These tests are introduced and comparatively explained including the interpretation of the results. Advantages and disadvantage of panel data methods from similar methods are also underlined. The fourth section of this study involves the analysis carried out. It starts with an introduction of the panel dataset and variables used. Then, the methodology applied is explained and the results are presented. In the final section, the general findings of the analysis of the study are discussed. The limitations of the study and areas for futher research are pointed out. In the appendices, the results of tests conducted are presented in detail.

I propose liquidity, technology and economy form the three pillars of trading volume. Unless all three are combined properly, even if there is an increase in trading volume it will not be sustainable and would require a close monitoring.

MAKROEKONOMİK DEĞİŞKENLERİN BORSA İŞLEM HACİMLERİ ÜZERİNDEKİ ETKİSİ

ÖZET

Sermaye piyasalarında uzun yıllar ağırlıklı olarak fiyat ve getiri odaklı araştırmalar yapılmıştır. İşlem hacmini temel alan az sayıdaki çalışmada ise işlem hacminin yoğun olarak kullanıldığı iki alan öne çıkmaktadır: likidite ve fiyat oynaklığının (genellikle hisse senedi bazında) incelenmesi. Literatürde sıklıkla işlem hacmi ve türevlerinin (işlem hacminin, halka açık hisse senetleri toplamına oranı gibi) likidite için yaklaşık bir ölçü olarak kullanılmasının yanında işlem hacmi, piyasalara bilginin akışı ve etkileri incelenirken simetrik olmayan bilginin yatırımcılar tarafından ne derece farklı yorumlandığının bir ölçütü olarak da değerlendirilmektedir. İşlem hacmi ve hisse senedi-fiyat hareketliliğini inceleyen teorik modeller, piyasaya gelen bilginin farklı yorumlanmasının alım-satım işlemlerini tetiklediğini belirtirken, simetrik olmayan bilgiden kaynaklanan fikir ayrılığının boyutunu ise işlem hacmine atfeder. 1987'de Karpoff'un yayınladığı makalede ele aldığı gibi işlem hacmi ile fiyat ve getiri arasındaki ilişki de yoğun olarak incelenen konulardan biri olmuştur. 1990'ların sonlarından itibaren işlem hacmi ile fiyat oynaklığı ilişkisi de incelenmeye başlamıştır.

Geçtiğimiz 30 yılda, sermaye piyasalarının tarihlerindeki en büyük ve etkili değişikliklere, kalıcı sonuçlar yaratan dönüşümlere sahne olduğu söylenebilir. Bu değişimleri tetikleyen üç ana unsur vardır: finansal liberalizasyon, teknolojik gelişmeler ve yapısal değişiklikler. Finansal liberalizasyon, sermayenin ülke sınırlarına takılmaksızın kolaylıkla hareket edebilmesini sağlarken, teknolojik gelişmeler ise bunu hem mümkün kılmış hem de kolaylaştırıcı rol oynamıştır. Teknolojik gelişmelerin diğer iki faktörle etkileşimi de bu süreçte art arda yeni gelişmelere imkân vermiştir. Borsaların organizasyon yapılarındaki değişimler önce üyelik yapısından şirketleşmeye geçiş olarak kendini göstermiştir. Bunu, şirketleşme sürecini başarıyla tamamlayan borsaların halka açılmaları izlemiştir. Borsalar tarihte ilk kez kendileri işlem görmek üzere halka açılmıştır.

Borsa organizasyon yapılarındaki büyük çaplı değişiklik ve dönüşümler sermaye piyasalarında pek çok değişikliği de tetikleyen bir unsur olmuştur. Bu süreçte sermaye piyasaları için bir başka önemli değişim ise rekabet konusunda yaşanmıştır. Kârlılık amacı gütmeyen borsalar yıllar boyunca üyelik yapısıyla, ülkelerin korumasında rekabetten muaf ulusal kurumlar olarak görev yapmıştır. Teknolojik gelişmeler alım-satımları fiziksel salonlardan çıkartmış, bilgisayar ağları üzerinden herkesin erişimine açmıştır.

Piyasalardaki iş süreçlerinde son 30 yılda yaşanan köklü değişikliklerin temelinde teknolojik gelişmelerin büyük etkisi vardır. Bu döneme kadar rekabetin olmadığı sermaye piyasaları önce yerel zamanla uluslararası rekabete sahne olmuştur. Tüm bu değişim ve dönüşümler son 30 yılda kademeli olarak tüm dünya sermaye piyasalarında yaşanırken, küreselleşme ve liberalizasyon nedeniyle aynı bölgede yer almayan ve sürecin başlamadığı borsalarda bile etkiler hissedilmiştir. Son 30 yılda sermaye piyasalarında yaşanan değişimleri dört kelimeyle özetlemek mümkündür; dönüşüm, rekabet, şirketleşme ve küreselleşme (Gorham & Singh, 2009).

Doğrudan borsaları konu alan incelemelerin ilk olarak 1980'lerdeki şirketleşme ve bunu takip eden halka açılma süreçleriyle beraber başladığı söylenebilir. Organizasyon yapılarını konu alan bu incelemelerin haricinde, bu süreçte yaşanan rekabet, birleşme ve satın almaların nedenlerini ve etkilerini araştıran çalışmalar da borsaları bir bütün olarak ele almıştır. Her ne kadar borsayı bir bütün olarak ele alsalar da bu çalışmaların hiç birinde araştırma konusu işlem hacmi olmamıştır. Öte yandan literatürde işlem hacminin yoğun olarak kullanıldığı likidite ve oynaklık konularında yapılan çalışmaların tamamına yakınında incelemelerin bir ya da bir grup hisse senediyle sınırlı kaldığı görülmekte, borsanın bütünündeki işlem hacmini konu alan çalışmaların eksikliği kendini göstermektedir. Borsaların derinlik ve likidite açısından değerlendirilmesinde fiyatın değil işlem hacminin dikkate alınması, birleşme ve satın almalarda borsaların kârlılık ve potansiyelinin belirlenmesinde başvurulan temel göstergenin borsanın endeks bilgisinden ziyade toplam işlem hacmi olması da doğrudan işlem hacminin incelenmesinin önemine işaret etmektedir.

Bu çalışmada hisse senedi borsalarının toplam işlem hacmi üzerinde makroekonomik değişkenlerin etkileri incelenmektedir. İşlem hacmini inceleyen bu çalışmayı diğerlerinden ayıran en önemli noktalardan biri odak noktasında işlem gören bir ya da bir grup hisse senetlerine ait işlem hacminden ziyade bizzat borsaların toplam işlem hacminin yer almasıdır. Borsayı bir bütün olarak ele almasıyla, işlem hacmi konusunda yapılan fiyat ya da getiriye odaklı diğer çalışmalardan ayrılırken, borsayı bir bütün olarak ele alan incelemenin odağında doğrudan işlem hacminin yer almasıyla da organizasyon ve rekabet konusunda yapılan çalışmalardan ayrılmaktadır.

İkinci olarak, bu çalışma işlem hacmi üzerinde makroekonomik değişkenlerin etkilerini incelerken, ekonomik gelişme ve borsaların gelişmişliği ilişkisini konu alan çalışmalardan farklı bir bakış açısı sunmaktadır. Çalışmada ekonominin genel gidişatının göstergeleri olan makroekonomik değişkenler ile borsaların gelirleri işlem hacmi üzerinden ele alınmıştır. Kâr edemeyen borsaların günümüzde sermaye piyasalarından hızla silindikleri dikkate alındığında konunun bu yönünün de özellikle gelişmekte olan sermaye piyasalarına sahip ülkelerde önem arz ettiği görülmektedir.

Üçüncü olarak, günümüzde bir borsanın toplam işlem hacminin taşıdığı bilgi 30 yıl öncesiyle kıyas kabul etmez. Borsaların özel konumu onların halka açık diğer şirketlerle her konuda bir tutulmasına engel olsa da, günümüzde halka açık şirketler olarak borsaların da birincil önceliği kâr etmektir. Makroekonomik değişkenlerin etkileri özel konumları nedeniyle, borsalarda doğrudan ve dolaylı olmak üzere iki dalga halinde hissedilir. Öncelikle, halka açık her şirket gibi borsalar da ekonominin iyi işaretler verdiği dönemlerde yeni ürünlerini piyasaya sunar, yeni projelere başlarlar. Ekonomideki canlılık halka açık şirketlerin de yeni projeler, yatırımlar yapmasını teşvik eder, bunu yatırımcıların bu tür yatırımlar nedeniyle borsaya ilgilerinin artması izler. Dolayısıyla, bu dönemler hem ikincil hem de birincil halka arzlar için caziptir, yeni yatırımlara bağlı olarak yatırımcıların piyasadaki varlığının artmasıyla işlem hacimlerinde artışlar gözlenir. Hem şirketler hem de yatırımcılar tarafındaki bu hareketlilik, borsalarda ikincil etkiyi yaratır. İşlem hacminin artması borsanın gelirinin artmasını doğrudan etkilediğinden her şey aynı kaldığında işlem hacmi artışı borsanın kârlılığını artırır.

Bu çalışmada kullanılan panel veri setinde 17 ülkede yer alan 22 hisse senedi borsasına ait işlem hacmi ve makroekonomik veriler yatay kesiti oluştururken, Ocak 1999 ile Haziran 2010 dönemindeki 138 aylık veri de zaman kesitini

oluşturmaktadır. Bu tez kapsamında yapılan araştırmada verileri kullanılan ülkeler; Avusturya, Belçika, Kanada, Danimarka, Finlandiya, Fransa, Almanya, İtalya, Japonya, Kore, Lüksemburg, Meksika, Hollanda, Polonya, İspanya, Birleşik Krallık ve Birleşik Amerika'dır. Birleşik Amerika, NYSE ve Nasdaq ile iki borsayla, İspanya ise dört yerel borsayla çalışmaya dâhil edilmiştir, bu borsalara ek olarak, incelenen dönemde, 2000-2002 yılları arasında dört Avrupa borsasının birleşmesiyle oluşan ve 2007'de NYSE tarafından satın alınan Euronext de incelemede yer almıştır. Çalışmada yer alan borsalar FTSE küresel hisse senedi borsa endeksinde "gelişmiş" ve "gelişmekte olan öncü" kategorilerinde yer almaktadır.

Sermaye piyasaları ekonomideki beklentilere karşı duyarlıdır. Araştırmada kullanılan makroekonomik veriler: Gayri safi yurtiçi hasıla (GSYH), işsizlik oranı, tüketici fiyat endeksi (enflasyon), para arzı (dar ve geniş olarak M1 ve M3) ve 10 yıllık devlet tahvili getirisidir. Bunlara ek olarak borsanın dinamiğini yansıtması açısından her borsanın temel endeksinin aylık değerleri de çalışmaya dâhil edilmiştir. Bilindiği gibi makroekonomik değişkenlerdeki değişimin önemi, düzeyin öneminden önce gelmektedir. İşsizlik oranı ve enflasyon oranı dışında kalan değişkenler doğal logaritmaları alınarak kullanılmış, adı geçen iki değişken ise oransal bilgi içermesi nedeniyle logaritması alınmadan olduğu haliyle kullanılmıştır.

Zaman serilerinin ekonometrik analizlerinde karşılaşılan en büyük sorun incelenen serilerin durağan olmamasından kaynaklanır, çünkü durağan olmayan serinin bir dönemdeki davranışı diğer dönemlere genellenemez, dolayısıyla geleceği tahmin etmede yararlanılamaz. Bunun yanında, zamana bağlı seriler arasında bir ilişkinin varlığı incelenirken, şayet seriler durağan değilse *sahte (spurious) regresyon* sorunu ortaya çıkmaktadır. Bu sorun zaman serilerinin güçlü genel eğilimler (trend) taşımasından kaynaklanır. Bir zaman serisinin *durağan* (stationary) olarak tanımlanması, serinin ortalama ve varyansının zaman içinde sabit olduğunu ifade eder. Bunun yanında durağan seriye ait iki nokta arasındaki fark noktaların zamansal değerlerine (t_1, t_2) bağlı değildir; yalnızca noktalar arasındaki zaman aralığına (t_2 - t_1) bağlıdır; dolayısıyla serinin ortalaması zamana bağlı olarak değişmemektedir. Bir başka deyişle, bir zaman serisinin ortalaması, varyansı ve kovaryansı zaman içinde sabit kalıyorsa, serinin durağan olduğu söylenebilir. Durağan olmayan seriler farkları alınarak durağan serilere dönüştürülebilirler. Bir serinin durağan hale gelmesi için *n* kez farkının alınması gerekiyorsa seri *n.* dereceden bütünleşik olarak tanımlanır ve teknik olarak *I(n)* gösterimi kullanılır. Örneğin, birinci farkları durağan olan seriler 1. dereceden bütünleşiktir ve I(1) terimiyle gösterilirken durağan seriler I(0) terimiyle gösterilir. R*assal yürüyüş* (random walk) ekonometride durağan olmayan serilerin en klasik örneğidir. Durağan süreçlere örnek vermek istenirse *saf rassal* (pure random) ve *beyaz gürültü* (white noise) sayılabilir.

Sahte regresyon sorunu, incelenen seriler arasında gerçek bir ilişki var olmadığı halde yüksek R^2 değeri bulunmasıyla kendini gösterir; özellikle R^2 değeri Durbin-Watson istatistiğinden büyükse sahte regresyondan şüphelenmek gerekir. Durağan olmayan serilerin incelemesinde, bulunduğu sanılan ilişki tamamıyla serilerdeki zaman boyutundan kaynaklanabilir ve yanıltıcıdır. Bu sorunla karşılaşmamak için incelemede ilk olarak serilerin durağanlık seviyesi tespit edilir. Serilerin durağan olmadığı tespit edilirse öncelikle seriler uygun yöntemle durağan hale getirilir.

Literatürde finansal verilerin özellikle makroekonomik değişkenlerin durağan olmadıklarını gösteren pek çok çalışma bulunmaktadır. Dolayısıyla, makroekonomik değişkenlerin işlem hacmi üzerindeki kısa ve uzun vadeli etkilerinin incelenmesi için

öncelikle kullanılan verinin durağanlık özelliklerinin belirlenmesi gerekir. Bu amaçla altı tane birim-kök testi uygulanmıştır; genişletilmiş Dickey-Fuller (ADF), Im, Pesaran, and Shin (IPS), Levin, Lin and Chu (LLC), Phillips Perron (PP), Hadri, and Breitung. Genişletilmiş Dickey-Fuller testi literatürde en yaygın olarak kullanılan birim-kök testidir. Hadri dışındaki diğer beş testin hepsinde sıfır hipotezi seride birim-kök bulunduğunu ifade eder. Hadri'nin varsayılan hipotezi ise diğerlerinin tersine serinin durağan olduğu şeklindedir. Birden çok birim-kök testinin kullanılmasında, literatürde de sıklıkla rastlanan testlerden çelişkili sonuçların alınması etkili olmuştur. Testlerin sonuçları incelendiğinde sadece işsizlik oranı değişkeninin düzey durağan olduğu diğer tüm değişkenlerin düzeyde durağan olmadıkları, ancak birinci farklarının alınmasıyla oluşan serilerin durağan olduğu görülmüştür. Buna dayanarak işsizlik oranı dışındaki serilerin birinci dereceden bütünleşik I(1) olduğu sonucuna varılmıştır.

Durağan olmayan serilerin analizinde hangi yöntemin kullanılacağı, değişkenlerin arasında uzun dönemli bir ilişkinin varlığına bağlıdır. Bu nedenle ikinci aşama durağan olmadığı tespit edilen seriler arasında uzun dönemli bir ilişki olup olmadığının belirlenmesidir. Eşbütünleme, durağan olmayan serilerin doğrusal bileşimlerinin durağan olduğunu ve bunlar arasında uzun dönemli bir denge ilişkisinin varlığını gösterir. Seriler durağan olmasa da, eğer aynı dereceden bütünleşik iseler aralarında eşbütünleme olabilir ki, bu durumda aralarındaki ilişki sahte değil gerçektir.

Çalışmada ikinci olarak, durağan olmadığı belirlenen seriler eşbütünleme testleri kullanılarak incelenmiştir. Eşbütünleme analizinde Pedroni'nin 11 testi, Kao ve Fisher testleri kullanılmıştır. Bu testler gecikme dönem sayısının önceden belirlenmiş olmasını gerektirdiği için her test için (uygulanabilir olması şartıyla) altı farklı bilgi ölçütü kullanılmıştır. Kullanılan bilgi ölçütleri; Akaike, Schwarz ve Hannan Quinn ile her birinin düzeltilmiş olarak bilinen türevleridir. Test sonuçları seriler arasında uzun vadeli bir ilişki olduğuna işaret etmektedir. Serilerin eşbütünleme özelliğine sahip olmaları uzun dönemde birlikte hareket etme eğiliminde olduklarını göstermektedir

Durağan olmayan ancak aralarında uzun dönemli ilişki bulunduğu belirlenen verilerin incelenmesinde uzun dönemli ilişkinin yönünü ve kısa dönemdeki etkileri görebilmek için Vektör Hata Düzeltme (VHD) Modeli kullanılmıştır. Şayet seriler arasında eşbütünleme ilişkisi olmasaydı klasik Granger nedenselliği analizi ve standart bir VAR modeli uygulanacaktı. VHD modeli kurulduktan sonraki aşamada değişkenler arasındaki dinamik ilişkiler etki-tepki fonksiyonu ve varyans ayrıştırma aracılığıyla incelenmiştir. Öncelikle etki-tepki fonksiyonu ile ilgili değişken üzerinde en fazla etkisi olan değişkenin politika aracı olarak kullanılıp kullanılamayacağı incelenmiş, ardından bir değişken üzerinde en çok etki yaratan değişken(ler)in belirlenmesi amacıyla varyans ayrıştırması yapılmıştır.

Yapılan analiz sonucunda GSYH, uzun dönemli devlet tahvili getirisi ve enflasyonun işlem hacmi üzerinde hem kısa hem de uzun dönemde etkili olduğu görülmüştür. İşsizlik oranının yalnızca uzun dönemli etkisi görülürken, borsa endeksinin etkisinin ise yalnızca kısa dönemli olduğu görülmüştür. Para arzının kısa ya da uzun dönemde işlem hacmini etkilediğini gösteren bir bulguya rastlanmamıştır. Etkiler beklendiği ve fiyat-getiri odaklı çalışmaların sonuçlarını destekler şekilde GSYH'da ve uzun dönemli devlet tahvillerinde pozitif, enflasyon ve işsizlik oranında ise negatif yöndedir. Uzun dönemli devlet tahvillerinin getirilerindeki artışın (azalışın)

yatırımcıların portföylerindeki hisse senedi-tahvil oranını değiştirme yönünde bir etki yaratarak işlem hacminin artmasına neden olduğu düşünülmektedir.

Etki-tepki analizi sonuçları, değişkenlerde bir standart sapma şok yaratıldığında, bir istisna dışında, bu şokun işlem hacmi üzerindeki etkilerinin kalıcı olduğunu göstermektedir. Öte yandan varyans ayrıştırması sonuçları ise makroekonomik değişkenlerin hiçbirinin işlem hacmi varyansı üzerinde kayda değer bir rol oynamadığına işaret etmektedir.

Literatürde makroekonomik değişkenlerin yoğun olarak borsalardaki fiyat ve getiri üzerindeki etkilerinin incelenmesi nedeniyle oluşan kimi beklentiler, bu çalışmada aynı unsurların işlem hacmi üzerindeki etkilerine ilişkin varılan sonuçların ve etkilerin yorumlanmasında dikkatli olmayı gerektirmektedir. Bu noktada borsa işlem hacmindeki artış/azalışların nedenlerinin fiyatlardaki yükseliş/düşüşlerin nedenlerinden farklı olduğunu tekrarlamakta fayda var. İlk olarak Karpoff'un dikkat çektiği gibi fiyatların yükseldiği dönemlerde olduğu kadar düştüğü dönemlerde de işlem hacminde artışlar gözlenir, dolayısıyla fiyatlarda düşüş etkisi yaratan bazı faktörlerin işlem hacminde artış yaratması normal karşılanır. Uzun dönemli devlet tahvillerinin getirisindeki artışların hisse senedi fiyatlarını düşürücü etkisine rağmen, portföylerdeki hisse senedi ve devlet tahvillerinin ağırlıklarının yeniden belirlenmesine bağlı olarak işlem hacimlerinde artışa neden olması bu duruma güzel bir örnek teşkil eder. Sonuç olarak, bazı makroekonomik değişkenlerin işlem hacmi üzerindeki etkilerinin fiyatlar üzerindeki etkileriyle paralel olmasının, bu çalışmanın literatüre katkısını gölgelememesi için bulguların değerlendirilmesinde işlem hacmi ile fiyat üzerindeki etkilerin farklı yorumlanması gerektiği kadar çalışmanın odağında ilk kez borsaların toplam işlem hacminin yer aldığının da dikkate alınması yerinde olacaktır.

Bulgular ışığında makroekonomik değişkenlerin işlem hacmi üzerinde etkili oldukları görülmekle birlikte, bu etki, makroekonomik değişkenlerin doğası gereği belirli bir bant içinde kalmaktadır. Dolayısıyla, işlem hacminin artırılmasında başka yöntemlerden de faydalanılması gerektiği ortaya çıkmaktadır. İşlem hacmini artırmak için sunulan öneriler aynı zamanda ileride bu konuda yapılacak çalışmalarda araştırılabilecek konulara da ışık tutmaktadır. Likiditenin artırılmasına yönelik çalışmalar, gelişen teknolojiye yapılacak yatırımlar ve ekonominin sağlıklı olması birlikte sağlanabildiği ölçüde işlem hacminde sürdürülebilir artışlar görülmesi mümkün olacaktır. Piyasa derinliğinin artırılması ve piyasa kalitesinin iyileştirilmesinin işlem hacmi üzerindeki etkileri de incelenmeye değer bir konudur. İşlem maliyetlerinin işlem hacmi üzerindeki etkilerinin ölçülmesi ikisi arasındaki ilişkinin yanında sırasıyla Bölüm 2.2 ve 2.7.3'de değinilen parçalanmış piyasalar ve ağ dışsallığı muamması konularına da ışık tutacaktır. Borsalar arası birleşme ve satın almaların, işlem hacmi üzerindeki etkileri de bu çalışma kapsamında incelenmiş ve kimi birleşmelerin işlem hacmini artırıcı etkisi olduğu görülmüştü. Makroekonomik değişkenlerin etkilerinin incelenmesi, bu ilk çalışmada önceliğin gelişmiş ekonomiler ve borsalarına verilmesine neden olmuştur. Gelişmekte olan ülkelerdeki makroekonomik değişkenlerin borsa işlem hacmi üzerindeki etkilerinin incelenmesinde doğrudan yabancı yatırım gibi kimi unsurların da dikkate alınması ihtiyacına bağlı olarak bu tür borsaların izleyen çalışmalarda ele alınması planlanmıştır. Makroekonomik değişkenlerin etkilerinin incelendiği veri kümesinin alt veri kümelerine ayrılarak çalışmanın tekrarlanması, gelişmiş ve gelişmekte olan ülkelere dair benzerlikler ve farklar konusunda daha detaylı bilgi edinmeyi sağlayacaktır.

1. INTRODUCTION

Societies are complex and diversified in their resources and requirements, therefore increasing the welfare of societies as a whole, is an important problem. Securities markets can make a significant contribution to the solution of this problem by pointing to ways to deepen our understanding of economy as well as society and human behaviour and by addressing general practical policy-making issues and propounding reference frameworks.

Financial systems, either the banking system or the securities markets, are expected to play a prominent role in improving resource allocation (in terms of efficiency) and enabling risk diversification. Financial markets failing to meet these expectations would not be able to promote a long run economic development.

Macroeconomic variables are used to comprehend the economic climate, if not to measure the overall performance of the economy. The relationship between stock exchanges and macroeconomic variables has always been an attractive subject. Despite the fact that stock prices and trading volume are jointly determined by the same market dynamics, in existing literature most of the studies related to securities markets investigate prices or returns, whereas studies focusing on trading volume are very limited. Even in those limited number of studies, volume has rarely been the focus, but mostly regarded as an explanatory variable.

The main purpose of this study is to investigate the effects of macroeconomic variables on aggregate trading volume of equity stock exchanges. In doing so, this study focuses on the stock exchanges and differs from other studies conducted until now, in three ways: firstly, it investigates the stock exchange itself, not a specific stock or a group of stocks traded within. In literature, most of the analyses conducted focus on single stocks or at best on a group of stocks in a particular industry, rather than the exchange as a whole.

The first studies that focused on the stock exchanges were the ones that investigated the effects of changes in the organizational structures of exchanges. Later, competition issues arised within securities markets and many studies were conducted to investigate fragmentation, competition and network effects. The subject of most of these studies was the stock exchange itself. To my knowledge, none of the studies whose subject is exchange as an entity investigated the trading volume.

On the other hand, studies that utilized trading volume, investigated mainly liquidity and volatility of stocks. Trading volume was used as an explanatory variable; none of these studies investigated the aggregate trading volume of a stock exchange. So this study differs by examining the aggregate trading volume rather than utilizing it as an explanatory variable.

Secondly, this study provides a different view for the relation between economic growth and financial system debate by sitting on the fence, equally distant from both sides of the debate. Macroeconomic variables are used to measure the trends and the overall state of the economy as a whole. There have been studies investigating the relationship between macroeconomic variables and stock exchanges; however most of them were limited to a single country in their analysis. Until now, as to my knowledge, this is the first study to investigate the relationship among the economy and aggregate trading volume of stock markets in several countries. The previous studies were either for a single exchange in a country, or for multiple exchanges but not on their relation with macroeconomic variables, or even for multiple countries' macroeconomic variables but not for stock exchanges as a whole.

Thirdly, the aggregate trading volume of an exchange is capturing more information today than it was three decades ago. It will be clear, once we look at what has happened in securities markets in the last 30 years. First exchanges were transformed and demutualized. Competition within securities markets, that was unimaginable until 1980s, started. Exchanges competed not only with each other but also with new trading platforms and venues. In addition to trading and listing, they competed for price discovery, low price volatility, order flow, price dissemination fees, transparency (Cybo-Ottone, Di Noia, & Murgia, 2000; Domowitz, Glen, & Madhavan, 2001). Globalization and financial liberalization were the other two forces shaping the securities markets.

Competition in financial markets differs from other sectors. In terms of organizational structures there are two main reasons; firstly unlike other sectors, the microstructure of exchanges constitutes a part of their business models, so the business models are actually very homogenous. Secondly, financial markets differ from other sectors by the heterogeneity of trading motives and the way in which these markets create value (Cantillon & Yin, 2011). The value chain created by the equities exchanges and related services are summarized in Figure 1.1.

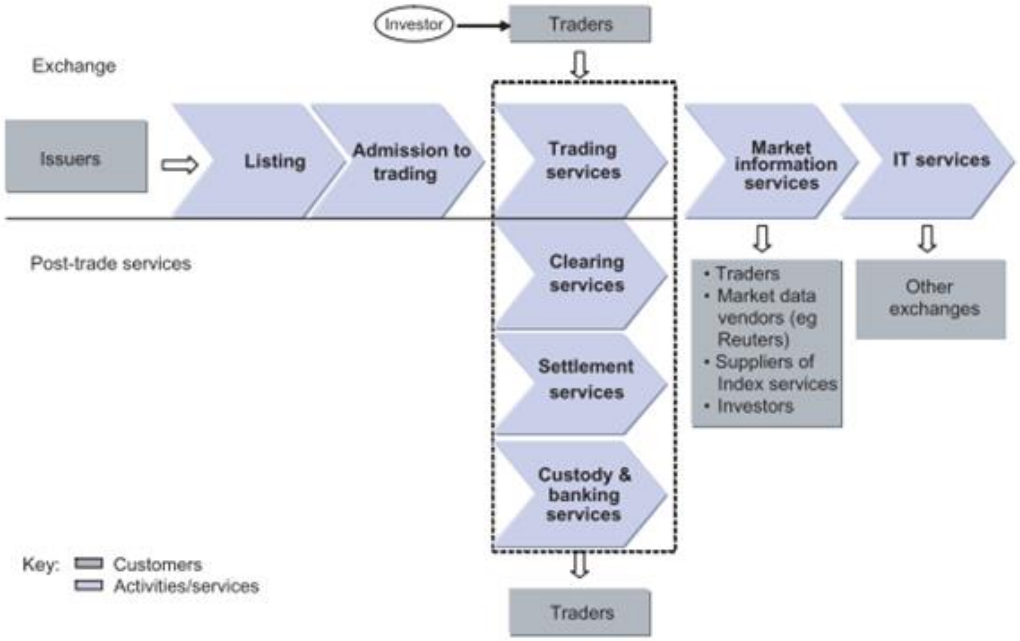

Figure 1.1 : Value chain for equities exchange and related services (Competition Commission, 2005).

Technology worked more often like a catalyst during the last three decades, but it was perhaps the most irresistible force driving the four: transformation, competition, demutualization and globalization (Gorham & Singh, 2009). Technological advances interacted with almost all forces. They created competitiors, but at the same time removed the physical limitations on trading volumes.

Trading volume and related subjects together with the relevant intersections within the scope of this thesis, are shown in Figure 1.2. To wrap up trading volume has a say in market structure, competition, liquidity, fragmentation, merger and acquisition, volatility, and economic growth. Yet, except for a handful of studies which will be disscussed in the following subsections, there has been no attempt to analyse differences in aggregate trading volumes and their determinants on a global basis.

Figure 1.2 : Trading Volume and related subjects

The remainder of the thesis is organized as follows. Section II discusses the literature on the determinants of trading volume in terms of liquidity, macroeconomic variables, the effects of market microstructures, and volatility. A brief explanation regarding the effects of economic growth on trading volume will be presented including the special case of emerging economies within the same section. In order to set the stage, challenges in securities markets affecting stock exchanges in terms of demutualization, structural changes, competition issues, merger and acquisitions, and technological advances are summarized.

Section III examines the econometric approach used for the dataset at hand from a theoretical perspective focusing on the spurious regression, stationarity of the series and unit root tests, cointegrated relations, and panel data modelling concepts. Section IV first presents the dataset, then provides an overview of the data with the indicators of macroeconomic determinants of aggregate trading volume of stock exchanges, and explains the methodology applied. Later in the same section the empirical findings are reported and summarized. Section V discusses the policy implications of inter-relationship of trading volume and macroeconomic variables, subsequently concludes and suggests the areas for further research. Three appendices are included.

2. LITERATURE SURVEY

The two broad components of financial system are financial intermediaries and markets. Financial intermediaries can be classified into credit institutions, other monetary financial institutions and other financial intermediaries. There are two main markets in a financial system; namely money markets and capital markets. The essential function of financial system is channelling funds from those who spend less than their income (net savers) to those who wish to spend or invest more than their income (net spenders). The most important lenders are normally households, but firms, the government and non-residents may also lend out excess funds. The principal borrowers are typically firms and the government, but households and non-residents also sometimes borrow to finance their purchases. Funds flow from lenders to borrowers via two routes as shown in Figure 2.1.

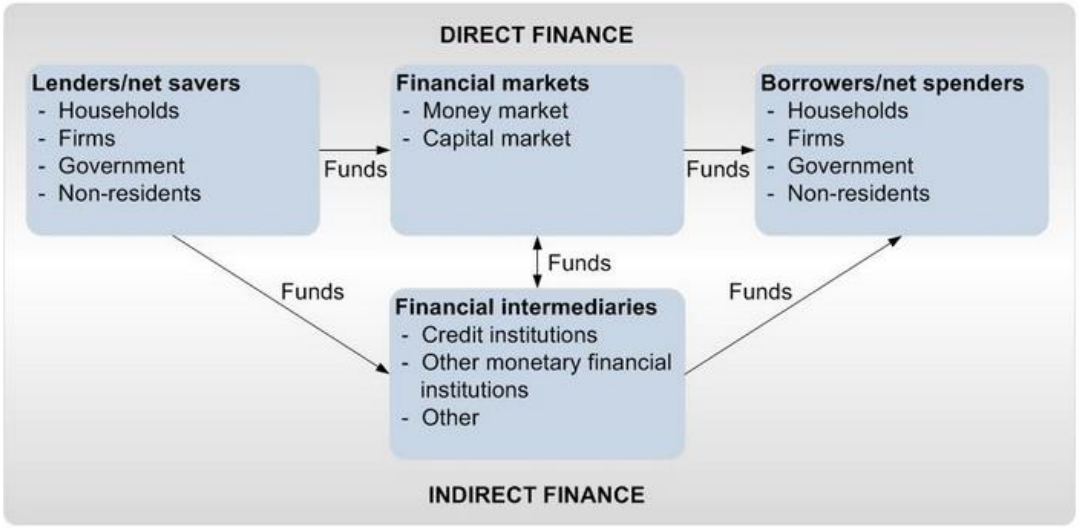

Figure 2.1 : Financial Markets and Intermediation (*Source : European Central Bank).*

In direct or market-based finance, debtors borrow funds directly from lenders in financial markets by selling them financial instruments, also called securities (such as debt securities and shares). If on the other hand, financial intermediaries play an additional role in the channelling of funds, the flow is called indirect finance. Most well-known financial intermediaries are banks, insurance companies, and pension

funds. One of the key features of a well-functioning financial system is its ability to foster an allocation of capital that is most beneficial to economic growth.

Exchanges (equity, futures, derivatives, etc.), regulatory bodies, post-trading institutions (including central counterparty, depository and settlement organizations), intermediaries, issuers and investors altogether form the securities markets (Figure 2.2).

Figure 2.2 : Fundamental Components of Securities Markets.

Financial intermediaries and markets play a crucial role in directing the economy's savings to productive investments. Additionally, the capital accumulation rate is a fundamental determinant of long-term growth; therefore an efficient financial system is essential for an economy (García & Liu, 1999). Emerging markets lack sufficient savings hence the importance of securities markets for emerging economies has been the subject of many studies. The relation between securities markets and economic growth regarding the role of securities markets in emerging markets will be discussed in detail later in Section 2.6.

The history of exchanges can be characterized by four words -- transformation, competition, demutualization and globalization (Gorham & Singh, 2009) . For the last two even three decades competition, globalization and technological advances changed the securities market landscape substantially (Easley & O'Hara, 2010). Recent advancements in securities markets influenced even the definition of a financial exchange. Consequently, the business models and governance structures of the securities market institutions including infrastructure institutions, but particularly exchanges have undergone significant changes. Now that most of the exchanges

themselves are listed companies, the primary objective of exchanges is generating profit. Meanwhile due to the increased competition and globalization all kinds of changes taking place in securities markets are watched closely by all the market participants. The relation between trading volume and microstructure will be discussed in Section 2.3. The challenges stock markets faced in the last three decades particularly demutualization and structural changes exchanges went through, effects of increased competition in securities markets, and M&As of stock exchanges will all be explained in Section 2.7

For many years stock exchanges' prime target has been to increase participation by firms and investors, because trade executions and listing fees generate revenue for exchanges, both of which are increased by greater participation. There is also an indirect channel as more volume causes lower spreads, this consequently lowers execution costs, which in turn induces more volume and generates more profits (see Figure 2.3). This cycle suggests that exchanges and investors both gain from greater participation and society as a whole may benefit from increased participation in stock markets if it lowers the equity premium (Easley & O'Hara, 2010). Today even though attracting new firms and investors is still a requirement it is no longer sufficient alone. Rules of the game have changed, hence new business models had to be adapted to stick to the new focus of generating profit.

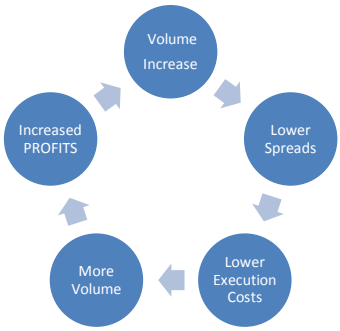

Figure 2.3 : Circular relationship of trading volume, spread, trading cost, and profit.

The increased competition in securities markets, particularly stock exchanges has been studied by many academics. In the 1980s and first half of 1990s competition among domestic exchanges was more common, whereas since the second half of 1990s competition is taking place between large consolidated groups operating in an internationalized financial market place. Today a number of stock exchanges in developed markets are providing multiple equities platforms for a sophisticated

equity trading worldwide. Competition among stock exchanges and its effects on trading volume will be discussed in Section 2.7.2.

Most of the studies on securities markets are concentrated in one of the following subjects; liquidity, volatility, market microstructure and price formation, or economic growth. Price-volume relation is by far the most investigated area of them all, even though all on its own deserves attention and offer very fruitful areas for understanding the securities markets better. Though each of these areas covers a wide scope, the interactions among them are even more appealing and provide generous investigation potentials. Nevertheless intersection areas are harder to examine.

Trading volume has an interaction with every one of these subjects, hence it is possible to say that trading volume has a central role; unfortunately it has long been undervalued. The focus of this study is the role of macroeconomic variables on trading volume of equity exchanges. Even though the subject is limited by the effects of macroeconomic variables, in order to fully understand and interpret the results of this analysis understanding the interactions of volume and the aforementioned subjects are a natural necessity (Figure 2.4).

Figure 2.4 : Trading volume and other concepts it interacts with

In the following sections the interaction of trading volume with liquidity, volatility, market microstructure and price formation, macroeconomic variables will be briefly explained and any related studies will be summarized to set the stage for the analysis of aggregate trading volume of stock exchanges.

As we will see some subjects do not only interact with trading volume, but with each other as well: inter-relations among trading volume, liquidity and competition in capital markets, particularly among stock exchanges is a good example (Figure 2.5). Apart from the relationship among three, there exists a relationship between liquidity and competition which is explained by the concept of network economy and will be addressed in Section 2.1.

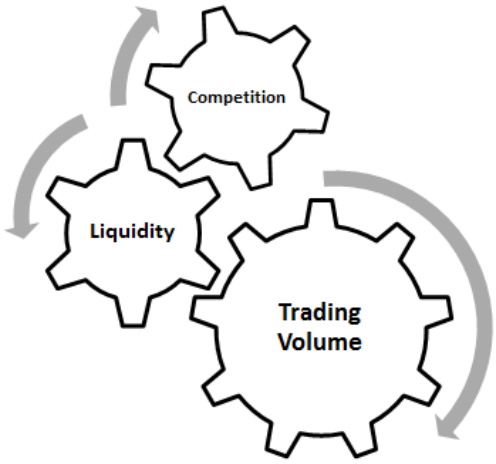

Figure 2.5 : Interactions among trading volume, liquidity and competition

A brief overview of how exchanges and market platforms work will be presented next. The focus of this study will be limited to the last three decades even though a historic view of exchanges including not only equity trading but also futures and options along with information on insider trading and manipulations goes back more than 300 years for some exchanges[1].

Financial and capital markets are essentially different from markets for ordinary goods and services. The central function of capital and financial markets includes information-gathering; in particular, assessing which projects and firms are most likely to yield the highest returns, and monitoring to ensure that the funds are used in the appropriate way. Additionally, markets for information are fundamentally different from "ordinary" markets as the impact of information imperfections on markets for information is noteworthy.

Capital markets are the markets where firms go to raise capital, hence their name. In these markets debt, equity and currencies are traded in regulated, non-regulated or

[1] For instance the Amsterdam Stock Exchange , reader may refer to De La Vega (1688). For a more recent history of several

private markets, or at exchanges. The alternatives offered by securities markets are as diverse as the financial needs of individuals such that each security has its "natural" traders. Even though it is beyond the scope of this study to provide information on each and every one of these alternatives, it must be noted that apart from the natural traders of securities, whose financial needs are directly addressed by a particular security, there are two other types of investors in every market. These investor types; namely speculators and arbitrageurs are more interested in the potential profit provided by this security rather than the security itself. Speculators take positions reflecting their provisions about future movements of prices whereas arbitrageurs hope to make profit by speculating on the price comovements of similar securities. Arbitrage opportunities coupled with technological advances are another source for creating trading volume and will be discussed later in Sections 2.7.4 and 2.7.5. For the purpose of this study the equity stock exchanges will be the focus and information on others will only be included to enhance the issues investigated or to make the points clearer. Nonetheless where possible, references to related publications will be provided inherently and conscientiously. For an overview of other types of securities market exchanges (e.g. derivatives) and products the reader may refer to Cantillon and Yin (2011).

An exchange has two direct customers: companies that apply to be listed and intermediaries that trade on the exchange. The main revenue of an exchange used to come from services provided to these two customers: namely listing and trading services. Increased trading volume not only increases exchange revenue but also attracts listing companies, hence more investors (Hasan, Heiko, & Song, 2010; Marsh & Rock, 1986).

Exchanges used to be a special kind of company for three reasons; firstly, unlike any other company the price information is the product of an exchange as it is produced during trading (Mulherin, Netter, & Overdahl, 1991). Secondly, the organizational structure of an exchange is different since some of its clients used to be also its owners. Thirdly, business models in stock exchanges used to be highly homogenous because they offer almost the same two services (Hasan et al., 2010). Until 1980s it was not possible to talk about competition among exchanges because they were often legal monopolists (Di Noia, 1998). The first two issues will be discussed in terms of market microstructure later in Section 2.4.

For many years trading volume and trading costs were thought of unrelated, therefore early researchers tried to capture transactions costs in terms of bid-ask spread. As a result, the focus was on how market makers set the spread, what determines the spread, how different market structures may affect the spread and the effect of spread on asset returns. See, for example, Demsetz (1969), Amihud and Mendelson (1986), Marsh and Rock (1986), (also Glosten and Milgrom (1985), Branch and Freed (1977), Easley and O'Hara (1987), Copeland and Galai (1983) as cited in Boulatov, Hatch, Johnson, & Lei, 2009; Madhavan, 2000). Then studies are conducted in which trading costs are measured by as a percentage of trading value, impling a close, even direct relationship between trading costs and trading volume (Demsetz & Villalonga, 2001).

As the securities markets landscape has been changing, all the institutions within securities industry are somehow affected. Post-trading institutions were not exempt from this change wave, but initially they acted a passive role. Lately their interaction with exchanges became another competition factor, therefore a brief explanation of this interaction will be provided postponing a detailed discussion to Section 2.7.2. The integration between exchanges and post-trading institutions varies in a wide range. Exchanges encapsulating post-trading activities are called to be vertically integrated. The degree of integration can be somewhere between no integration and full integration. Full integration also called as "*silo model*" indicates both clearing and settlement services are encapsulated by the exchange. An example of this model is Deutsche Börse. No integration exchanges have equal and non-exclusive access to the post-trading infrastructure: such exchanges are of "*horizontal model*".

Exchanges are industries that combine network effects, large fixed costs, switching costs, and differentiation. Thus, many of the same issues that arise in this type of industries can be expected: multiple equilibria, importance of beliefs and history, biased technological choices, and ambiguous welfare results. A few papers apply this approach to study the market structure in the exchange industry most well-known being Di Noia (1998).

A significant issue regarding the trading volume is the role of network externalities in stock exchanges. Exchanges can be considered as networks since both of the services they provide exhibit network characteristics: the listing service exhibit the direct-network effect while the trading service exhibits the cross-network effect

(Mulherin et al., 1991). Consequently, network externalities had a great impact on the structural transition of exhanges (Hasan, Malkamäki, & Schmiedel, 2003).

Domowitz and Steil (1999) discuss network effects, the demand-side economies of scale and scope, together with contestability issues. Models of network economies are used to investigate several dimensions thoroughly: comprising bid-ask spreads, market depth, informational efficiency and volatility. One of the findings indicate the contestability in trading services industry increased significantly. They concluded that cartels would dominate the industry and due to the network forces those cartels would even be socially desirable. In almost 20 years' time their predictions and conclusions are seen to be correct. However none of the studies to my knowledge, considered the effects of mergers and acquisitions on the aggregate trading volume of stock exchanges. M&As among stock exchanges were mainly seen as a reaction against the fierce competition. M&As and their impact on trading volume will be discussed in Section 2.7.3.

The influence of high volume trades on the market price is called *market impact*. Its relationship with both market fragmentation and switching costs makes market impact an important concept in securities markets (Figure 2.6).

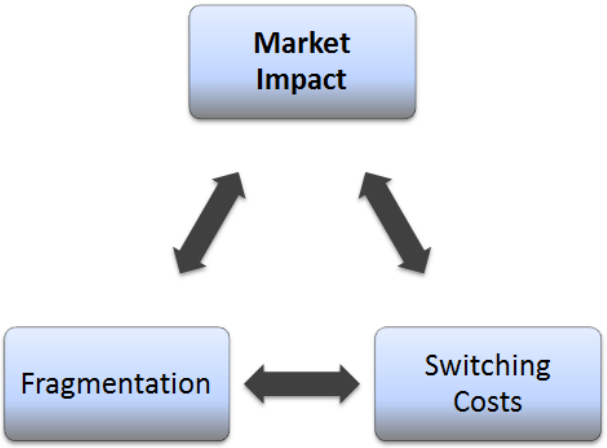

Figure 2.6 : Market impact, fragmentation and switching costs.

Ellison and Fudenberg propose that markets attract different types of traders and sometimes these traders prefer to be in a market with fewer traders of their types. Thus, such a situation conflicts with network effects, but is an indicator of an existing within-side competition among traders. As a consequence of this competition, these traders are scattered in different trading places forming equilibria.

These coexistence equilibria are stable, because each trader is strictly better off in its chosen market than switching to the other market (and moving prices adversely in that market as a result, an effect they call "*market impact*") (as cited in Cantillon & Yin, 2011). Fragmentation will be discussed in terms of liquidity and trading volume in Section 2.2.

Trading volume of a stock exchange is significant at macro level as an indicator of market depth and liquidity whereas it is also significant from the micro level perspective. Transaction commissions form an important part of exchange income and are directly linked to trading volume. Effects of the macroeconomic variables on trading volume in today's highly competitive climate of the capital markets are of great interest especially in an era of ever increasing competition.

Liquidity and trading activity attracted the attention of many scholars, hence many studies are conducted regarding these two properties of markets. However, until 1990s the literature on trading volume has been very limited compared to the vast literature on price or return, despite the valuable information trading volume possesses. The information captured by trading volume is largely undervalued: trading activity, more specifically trading volume inherit important knowledge of the stock exchanges yet little is known about the macroeconomic time series determinants of trading volume. Securities markets and regulation could all be improved by the knowledge of macroeconomic factors that influence trading volume. A better understanding of these determinants additionally promises taking a step further towards establishing sustainable markets. These are of direct importance to policy makers and exchange officials, particularly in emerging economies, attempting to identify conditions likely to disturb trading activity.

Most of the existing research in securities markets has been focused on either prices or returns. In addition, few studies conducted using trading volume have usually focused on the trading volume of individual securities. Karpoff's (1987) highly influential paper is one of the pioneers investigating the relation between trading volume and price. Even though questioning why aggregate market liquidity varies over time has been a fundamental issue, up till recently there are very few studies investigating this issue. This may be attributed to the lack of practical influential information exhibited by the total trading volume or liquidity of an exchange as a whole.

Aggregate volume was not a subject of interest for researches until recently. There are several reasons for that. First of all, aggregate trading volume of an exchange had no effect on the profitability of an exchange, which will be discussed in detail in Section 2.7.1. Secondly, only after late 1980s it was possible to talk about competition in the securities markets, which will be discussed in Section 2.7.2. Thirdly, technological investments causing the highest costs for exchanges, are also pointing out the importance of trading volume as there is no better justification for the high technological investments than increased trading volume. The relation between technological advances and trading volume regarding network economies and economies of scale will be discussed in Sections 2.1 and 2.7.4. Fourthly, the cost of transaction has only recently been related to trading volume. As we have seen, even though today several fundamental issues of stock markets have been affected by trading volume, thus virtually nothing is known about how macroeconomic variables affect the aggregate trading volumes of exchanges over time. In particular, some basic questions remain unanswered are:

- Which macroeconomic variables affect trading volume?
- Does the dynamic relationship between the macroeconomic variables and trading volume differ in the short and long run?
- Are there regularities in the time-series of trading volume and macroeconomic variables?

Satisfactory answers most likely depend on how well the dynamic relations can be modelled using a sample period long enough to subsume a variety of events, for only then could one be reasonably confident of the results.

Several studies documented commonality in the time series movements of liquidity, share turnover and macroeconomic variables (Chordia, Roll, & Subrahmanyam, 2000a; Hasbrouck & Seppi, 2001; Lo & Wang, 2010). However, authors do not analyse the behaviour of aggregate trading volume over time. These studies do, nevertheless, suggest a line of future research: identification of the factors causing the observed commonality in trading volume.

Thus, any profound study focusing on the aggregate trading volume of stock exchanges is bound to be selective and incomplete in its coverage. This study narrows the focus by investigating the macroeconomic determinants of the aggregate

trading volume of exchanges. The main motivation for studying trading volume is threefold. Firstly, it is an indicator of the overall market liquidity. Secondly, there is a direct relationship between trading volume and the profitability of an exchange. Thirdly, trading volume ultimately affects the cost of capital.

Trading volume forms the stock characteristics together with stock price, number of trades and return volatility. In order to develop a better understanding of the effects and importance of trading volume, one first needs to identify the relationships between trading volume and the other stock characteristics. Additionally, for a full understanding, the relationship between volume and market characteristics; namely market structure and competition need also be considered. Trading volume is also used as a measure of market depth and trading activity. Hence these relationships will be addressed in the following sections.

2.1 Trading Volume

The ability to generate trading volume will be a key factor in determining stock exchanges' future success, since transaction revenue is likely to become the most important source of income (Reena Aggarwal, 2002). Today, trading volume of a stock exchange is significant not only at macro level but also at micro level. At the macro level, trading volume has been serving as a fundamental indicator of market depth and liquidity.

Trading volume provides a valuable piece of information, neverthless it is not widely used by the researchers, but considered traditionally as valid data almost only by technicians. There has been little research both on investigating the role of volume and analysing the factors affecting volume. An analysis of the magnitude and determinants of aggregate trading volume of an exchange is valuable for many reasons.

The investigation of price-volume relationship of the stocks or indexes of the stock markets dates back to 1960s: the study of C. W. J. Granger and Morgenstern (1963) being one of the pioneers. Karpoff's (1987) survey on the price-volume relationship is widely recognized due to his excellent summary coupled with his critiques of the previous theoretical research done. Karpoff synthesized the conclusions of early research into four empirical propositions:

1- The correlation between volume and positive price changes is positive,

2- The correlation between volume and negative price changes is negative,

3- Tests using data on volume and the absolute value of price changes will yield positive correlations and heteroskedastic error terms,

4- Tests using data on volume and price changes per se will yield positive correlations.

More recently a survey by Hackard (2008) extended the survey of Karpoff (1987) including the most recent theoretical and empirical research in this area. Hackard focused on the trading volume and price changes in financial markets. A chapter by Lo and Wang (2010) provides one of the richest contents about trading volume.

Trading volume has been gaining more importance in terms of micro level, because even though the securities landscape around the world has changed substantially, the revenue items of stock exchanges stayed almost the same for all exchanges. Exchange revenues arise from multiple sources. These include regulatory fees, explicit execution fees, and tape revenue (income that arises from selling quote and trade data), which is often a substantial fraction of an exchange's overall revenue. These latter two sources of revenue are strictly increasing in volume, resulting in exchange profits being largely volume driven (Easley & O'Hara, 2010). The number one revenue item of the equity stock exchanges is still commission fees charged for transactions. The Cost and Revenue survey conducted by WFE in 2011 reports that trading and services remain the top contributors to total revenues by 84% of the total revenues (Devai & Naacke, 2012). Consequently, trading volume with its direct link to revenue is still the most important profitability indicator of an exchange.

In equities markets there are a couple of concepts closely related to the volume. These concepts are crucial in understanding the importance of volume, therefore in this section these concepts and terms will be explained briefly.

The total number of stocks that have risen or fallen during a specific period is an indicator of the direction of the market movement, hence called *the breadth of the market*. In equities the large number of shares being traded is a measure of breadth. In other words, breadth is the ability to trade across assets without affecting the price.

Quality of an exchange refers to the exchange's rules and practices covering which securities can be traded, who can participate, and what mechanism is used to match supply and demand and determine the transaction price, along with those concerning the required levels of disclosure, the transparency of the takeover rules, and other corporate practices (Cantillon & Yin, 2011; Kokkoris & Olivares-Caminal, 2008). Metrics for market quality are spreads, liquidity and volatility (Madhavan, 2000). FTSE Global Equity Index Series measures and scores the quality of market regarding the quality of regulation, the dealing landscape, custody and settlement procedures, and the presence of a derivatives market. Another concept related is the quality of trade execution, which comprises commissions charged by the exchanges, spreads, time to execution, in a broad sense market impacts (Cybo-Ottone et al., 2000). The components of market, exchange and trading quality is summarized in Figure 2.7.

The gap in the trading volume analysis lies mainly in the scope of the studies which are mostly limited to a certain stock or at best to a group of stocks representing an industry or a grouping. The aggregate trading volume was not an indicator of a popular concept. The trading volume of a single stock was considered to be important because of its relation with that particular stock's price and expected return. Expected returns have been in the centre of the popular area of research for many years.

On the other hand trading volume has strong influence on trading costs of a particular stock exchange. As demonstrated by Perold (1988), in the context of portfolio management, the cost due to manager's delay is simply the volume of the order multiplied by the change in the mid-offer price between the time when the portfolio manager decides on the transaction and the time when she passes the order to a trader.

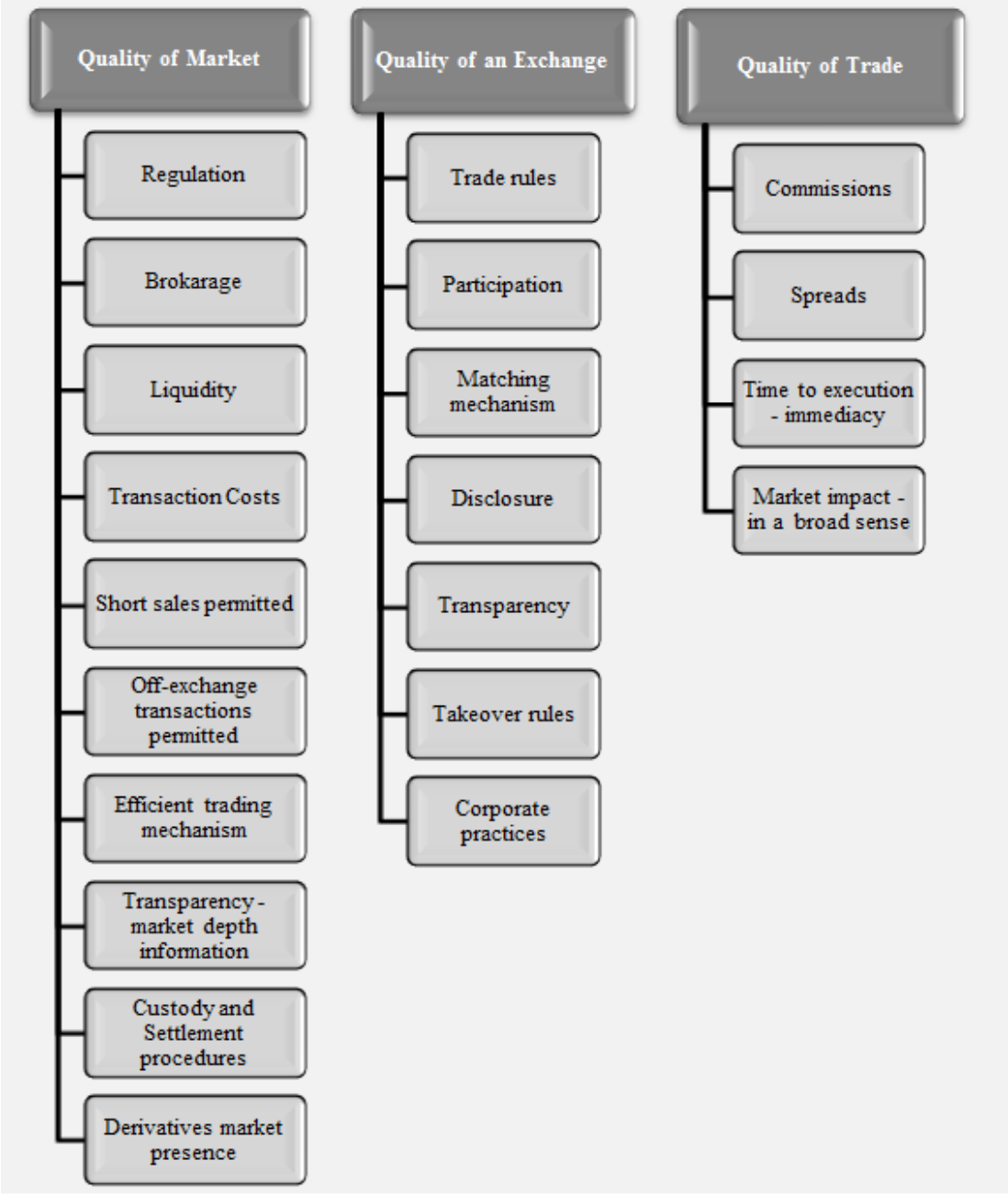

Figure 2.7 : Determinants of Quality of Market, Quality of Exchange and Quality of Trade.

When volume is high, the trading costs decrease causing the cost of capital decrease as well. The costs of trading can be grouped into two categories; explicit (direct) and implicit (indirect) costs (Table 2.1). Broker commissions, taxes, exchange and all other fees constitute direct costs and some of them are defined as a percentage of the trading volume. Costs attributed to the ability of trading without delay are considered as indirect costs. The major indirect cost is the price impact of the trade, hence market impact cost. In other words costs and risks associated with the immediacy fall

into indirect costs category. Effective spreads — i.e., the difference between the price of a trade and the midpoint of the best quoted bid and ask prices, just prior to the trade, are an example for indirect costs. Trading volume has a direct relation with the commission amounts. The higher the trading volume is, the higher the transaction commission will incur: either for a single stock or a group or this is even true for the aggregate trading volume of a stock exchange[2]. The same direct relation is valid between the investors and their investments. Fees investors pay for the investment or asset management advices are directly linked to the volume of the transactions and the size of the assets managed. Hence the fees on both the asset management side and the transaction side depend on the transactions, more precisely on trading volumes. Even though the transaction commissions were of highest importance for stock exchanges, their direct relation with trading volume has for long been underestimated. It was not considered to be a sufficiently interesting subject to investigate mostly because the profitability of exchanges was not a concern in the sector before 1980s.

Explicit (Direct) Costs	Implicit (Indirect) Costs
Broker comissions	Immediacy costs (bid-ask spreads)
Transaction commissions	Price impact costs
Taxes	Opportunity costs / implementation shortfall
Exchange fees	

Table 2.1 : Trading Costs.

In order to fully understand the radical transition the securities markets throughout the world have been undergoing, one needs to look at the reasons causing this transition and the way securities markets reacted to these changes. There has been an increasing number of studies analysing and investigating the reasons of this transition. Among them the most profound study was performed as a PhD thesis on this subject by Ramos. As Ramos (2003) stated three factors were driving this change: (1) liberalisation of economies; (2) changes in the market structure; (3) progress in communication systems.

[2] Except for upstairs trades: trades within a broker-dealer firm instead of at an exchange or between two broker-dealers in the over-the-counter (OTC) market. In an upstairs market transaction, the broker-dealer typically represents both parties (buyer and seller).

As such, De Gregorio and Guidotti (1995) interpreted the results of their joint impact of these three factors as difficult to predict, hard to control and not easy to understand (Figure 2.8). Moreoever, the interaction of technology, competition and regulation triggered new financial products, new investment styles and new quantitative trading techniques.

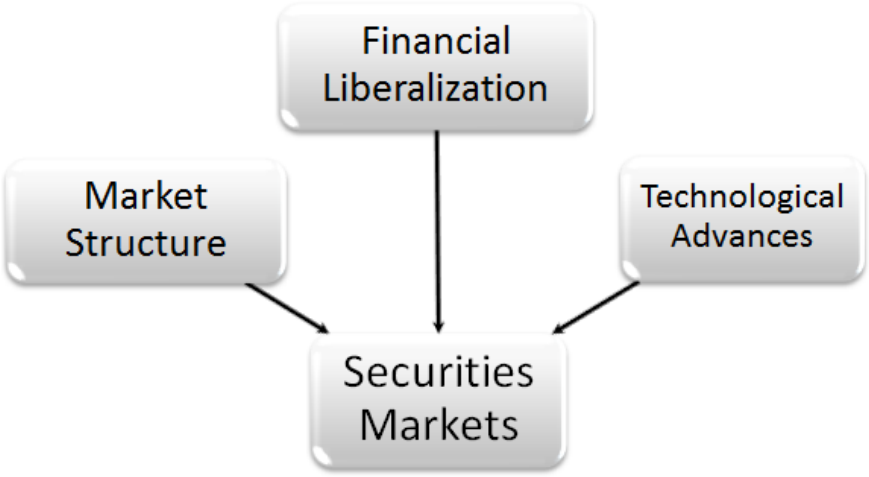

Figure 2.8 : Three drivers of transition.

Financial liberalization had a facilitating role for easier capital flow eliminating the limitation posed by country borders. The interaction between financial liberalization and stock market growth is a result of successive effects. Financial liberalisation policies remove financial market distortions and make domestic financial assets attractive, which in turn promotes stock market development. The relationship between financial liberalization and stock market development can be explained through the effects of liberalization on corporate governance in terms of transparency and accountability concepts. In stock markets increased transparency and accountability reduces adverse selection and related moral hazards, consequently reducing the cost of borrowing. This in turn triggers an increase in size and liquidity of stock exchanges.

Financial liberalization is identified as a key driver of emerging stock market growth by several including Levine and Zervos (1998), Andrianaivo and Yartey (2010), Lieberman and Kirkness, and Stulz (as cited in Yartey, 2010). Therefore, the domestic financial liberalization programmes of emerging markets mostly put stock market development to the central of the programmes. However, not everyone agrees with the role of financial liberalization in stock market growth (Stiglitz, 2003, 2011). Mishkin and Caldino et al. points out that financial liberalisation inducing

better corporate governance indirectly promotes the financial sector growth unless the regulatory and institutional support is lacking (as cited in El-Wassal, 2005).

Financial and capital market liberalization, if done perfunctorily, without first putting into place an effective regulatory framework, may cause adverse effects on markets. There is a debate on the arguments for and against capital market liberalization. Stiglitz (2003) explains the arguments for capital market liberalization, and identify their theoretical and empirical weaknesses with a focus on the intervention in short-term capital flows.

The stock exchange industry is a highly regulated industry and until recently strict regulation prevented exchanges from operating across country borders (Hasan et al., 2010). In the 1980s continental exchanges underwent a series of reforms affecting trading systems and regulations. These reforms had common features such as introducing continuous electronic order-driven systems, liberalizing access to their membership, and reducing transaction fees. For a more detailed description of the changes and reforms in the 1980s refer to Pagano (1989) and Ramos (2003). In Europe, such major elements as deregulation and economic and monetary convergence are also considered to be main reasons for the progress in the late 1990s (Ramos, 2003). Most stock market indicators are highly correlated with the financial intermediary development since countries with well-developed regulatory and institutional systems tend to have large, liquid stock markets (Demirgüç-Kunt & Levine, 1996). Whether liberalisation affected equity market negatively, leading to financial crises is out of the scope of this study yet for a discussion see El-Wassal (2005) and Stiglitz (2003).

Many stock exchanges all around the world went through significant structural changes particularly in the last three decades (Pirrong, 1999). Apart from the structural changes, business strategies of stock exchanges have also been changing due to the new deregulation, globalization of financial markets, and technological developments (Smith, 1991 as cited in Schmiedel, Malkamäki, & Tarkka, 2006), (Malkamäki and Topi, 1999, Hasan and Schmiedel 2004 as cited in Hasan et al., 2003) (Reena Aggarwal & Dahiya, 2006). The consequences of these changes in turn, affected other exchanges either directly or indirectly, due to the globalization of financial markets and the ever increasing (direct or indirect) competition among exchanges (Morsy & Rwegasira, 2010; O'Brien, 1992; Ramos, 2003).

The technological advances removed barriers to capital movements and together with financial liberalization greatly facilitated cross-border capital flows. Additionally, technological advances eliminated the physical limitations on trading volumes starting a new era in the capital markets (Ramos, 2003). Meanwhile, technology introduced and enabled dynamic trading strategies.

Not all parties forming the securities markets were affected from the technological advances by the same amount. Actually technology affected stock exchanges so significantly that for some time regulatory and other bodies were, if not reluctant, just too slow to determine how to respond. Investors and intermediaries were quick to react, simply because they had to act swiftly to survive. The slowness of the regulatory bodies can be attributable to most of them being governmental bodies and their lack of advanced technology usage. Regulations were issued only after the market has completed significant moves regarding for instance M&As, high frequency trading, or alternative trading platforms. No existing policies was in place for many structural changes or competition issues.

The impact of technological advances differs from the impacts of both financial liberalization and structural changes due to the fact that the interaction between technology and the others is bilateral. Technological advances removed not only the barriers to capital movements, but also the physical limitations on trading volumes. Consequently, technological advances altered the business rules both directly and indirectly. The interactions of financial liberalization, structural changes and technology will be examined in the following sections, and the role of technology will be examined in more detail in Section 2.8.7.

Exchanges reacted to these three factors differently; the competition among stock exchanges had an impact on both market structures and technology. The interaction among technology - market structure – competition ended up exchanges being a subject to M&As which has never been an issue before. Technology was a leading factor, paving the way to transition. In securities markets technology is both the advantage and the burden. It is essential to have the cutting edge technology in order to survive in the new landscape, at the same time the investment required in monetary terms is such a heavy burden that only few exchanges can carry it out on their own; hence causing M&As take place. Technology can be considered as a double-edged knife that must be used very carefully.

The effects of these three factors became visible in several ways; firstly, competition was introduced to securities markets. There was no such thing as competition among stock exchanges. This was due to the market conditions and policies. Because of the same reasons the capital flow among capital markets was not easy either. Competition in turn created its own solutions. Investing in technology became mandatory; consequently this investment imposed a financial burden to exchanges. In order to overcome this high financial investment costs, exchanges had to seek a solution which they found within the concepts of network economies and economies of scale. Actually high investment costs in information technology (IT) infrastructure and systems necessitated higher trading volumes so that the transaction costs would decrease. On the other hand, IT enabled new trading techniques and methods: high frequency trading and algorithmic trading being the most well-known two. Such new methods intrinsically created trading activity and increased trading volume. Again, it was these new techniques that made market depth, product variety, and market quality more important than ever. These techniques demanded deeper markets as well as more variety of products. Highly technology dependent techniques are fundamentally based on arbitrage, hence the requirement for deep markets.

Considering the overall picture of the securities market literature, there exists a gap in analysing stock exchange on its own. This study investigates the macroeconomic determinants of the stock exchange aggregate trading volume. There are of course reasons for academics to miss out exchanges (as an entity of their own) in investigations and analysis. Prior to the structural changes, exchanges were more a facilitator than a real player of the game. Now that exchanges became for profit entities, they are even listed on themselves so they are in the game, moreover this time they are positioned at both sides of the table.

All of the exchanges that went public are now responsible to their shareholders, employees and investors. They are obliged to make profit and at the same time operate as efficiently as possible in order to reduce the operating costs as much as possible. Even though exchanges have undergone significant structural changes and the business rules have radically changed, to the surprise of some, the number one revenue item has been unaffected: it is still the trading commissions. This forms a direct link between the trading volume of an exchange and its revenue. This is equally true for all regions throughout the world (derivatives exchanges may differ).

Among many macroeconomic variables used for evaluating the overall economic state a set of them is employed by studies much more frequently than others. These variables are: industrial production, unemployment rate, long-term interest rate, government bond yield, and inflation. There are many studies using these macroeconomic variables in securities markets (Apergis & Eleftheriou, 2002; Döpke, Hartmann, & Pierdzioch, 2005; García & Liu, 1999; Gay, 2011; Gregoriou & Kontonikas, 2010; Maysami, Howe, & Hamzah, 2004; Muradoglu, Taskin, & Bigan, 2000; Omran & Pointon, 2001). The relationship between financial growth, development and macroeconomic variables are investigated mainly for emerging economies. In some of these studies the role of stock exchanges are also included in the analysis.

Understanding the trading volume dynamics is important for a number of reasons. Karpoff (1987) proposed four reasons to explain the importance of the price-volume relationship:

1- It provides insight into the structure of financial markets,

2- Event studies that use a combination of price and volume data need to understand this relationship in order to draw inferences,

3- The empirical distribution of speculative prices cannot be explained adequately without this relation,

4- Price-volume relationships have significant implications for research into futures markets.

Defining the factors affecting trading volume of an exchange is becoming an increasingly important area of study, not only from an academical perspective but also for the securities markets industry. The information provided by trading volume of a stock exchange is at the heart of our understanding of securities markets. This is even more true today, than it was three decades ago. Understanding trading volume ground up includes information mainly about trades, investor and trader strategies, process of price formation, liquidity and volatility of the market, hence trading volume dynamics have important impacts in securities markets.

Understanding the macroeconomic determinants of trading volume across stock exchanges and over time is vital to many practical and academic questions.

One question that needs to be asked, however is what the factors affecting trading volume are. The answer may have important impacts, because trading volume affects among other things, the profitability of an exchange directly: it is the most significant revenue item of an equity exchange.

For the first time since 2001 revenues of exchanges decreased in 2013. Total revenues and costs of WFE member exchanges for the period 2004 to 2012 are shown in Figure 2.9. Trading revenues from cash markets decreased by 5% whereas revenues from derivatives increased 9% in 2011 for WFE members. Moreover, this decrease was significant and concerned all types of exchanges and all the regions. Even though there was a decrease in costs it was at a lesser extent. The decrease of revenues was less pronounced for listed exchanges (-6%) than for non-listed exchanges (-19%). This might be partly explained by the fact that revenues of listed exchanges tend to be more diversified (Devai & Naacke, 2012).

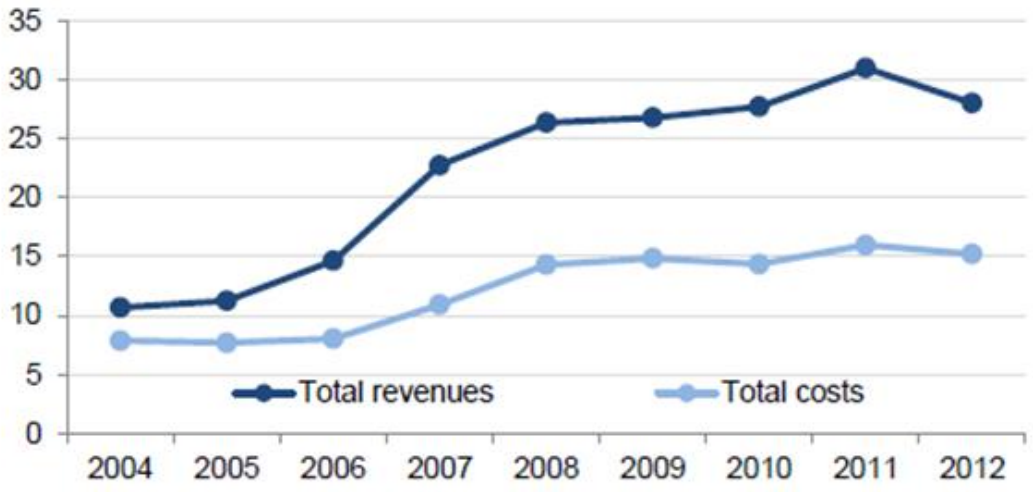

Figure 2.9 : 2004-2012 Revenues and Costs of the WFE members in the last decade (*Source : 2012 Cost and revenue survey report WFE pg.14).*

The products of "*goods*" exchanges sell can be structured in three parts: the traded object, the means of trading and price dissemination (Cybo-Ottone et al., 2000). In case of an equity stock exchange the traded object is issued by a company, for derivatives the issuer is the exchange itself. When the issuer is a company this service of listing a company is provided by the exchange, generally in return for a fee: hence the listing fee. Among the stock exchanges there is no standard or a general acceptance how these component parts shall be priced.

Stock exchanges have three sources of revenues: transaction fees, the listing fees charged to the companies whose stocks are traded on the exchange and trading data sales. The contribution of each source to the total revenue is different in every stock exchange depending on several factors like the economic characteristics of the market, target investor base etc. Prior to the structural changes fees collected from members or specialists used to be one of the main revenue sources as well.

Recent changes in the securities markets also affected the revenue items of stock exchanges by providing new sources. To name a few of the factors; vertical integrations (including post-trading) increased service revenues, the emergence of electronic trading increased the provision of technology services such as electronic trading platforms.

Recent trends and transitions of stock exchanges in securities markets have a potential to lead to a renewed interest in trading volume. Studies demonstrating commissions incurred on the transactions done, are still the No. 1 revenue item for a stock exchange: according to the figures reported by Cybo-Ottone et al. (2000), and cost and revenue surveys published by WFE in 2011 and 2012 (Devai & Naacke, 2011; Devai & Naacke, 2012).

Examining the costs of exchanges shows that apart from the costs contributing directly to the production of their three "main" goods sold, there are other costs such as: R&D costs, marketing costs, costs related to regulation and market efficiency. The latter two have more to do with the attractiveness of the exchange for issuers and intermediaries, hence affecting their entry decisions to the exchange (Cybo-Ottone et al., 2000). For a full list refer to WFE's cost and revenue surveys.

The following section draws the attention to the relationship between trading volume and liquidity.

2.2 Trading Volume and Liquidity

A considerable amount of literature has been published on several aspects of liquidity. Even though the definition of liquidity gained an overall acceptance, to date there has been little agreement on how to measure liquidity. It is not possible to measure liquidity directly, partly due to the complexity of the concept and partly to the large scope the definition covers. Despite the high number of research carried out

about the role of liquidity in equity markets, the basic question of how to measure liquidity remains unsolved and many approaches have been followed for measuring it (Chordia, Roll, & Subrahmanyam, 2000b).

The complexity of the liquidity concept is also reflected in its properties. Nevertheless, most of the properties of liquidity are well defined. Even though measuring liquidity is not straightforward, definitions of its properties suggest ways and dimensions for measurement (Karpoff, 1987).

Keynes defined an asset more liquid "*if it is more certainly realisable at short notice without loss*" (1930, Vol.II, p.67). This definition of asset liquidity actually considers two dimensions according to Pagano (1989). The first part "*more certainly realisable*" is about the riskiness of asset's final value. Pagano studied the risk related dimension of liquidity and showed that the riskiness of returns are inversely related to market size. The second part "*realisable at short notice without loss*" is about the market's capacity that can absorb the sale without adverse price changes occurring. The latter aspect of liquidity is related to the volume of trade. Transactions cause adverse changes in the market price unless the market is deep enough to handle the transaction. For the second part, liquidity as absorptive capacity of a market, Pagano investigated the relation between trading volume and asset liquidity and demonstrated that trades of large volume orders are exposed to price changes in thin markets (Pagano, 1989). This property of liquidity is also known as "*market depth*". According to his findings in these two studies, both dimensions of liquidity are actually positively related to market depth.

The four dimensions of liquidity are trading cost, trading quantity or volume, price impact, and trading speed (see Brown, Crocker, & Foerster, 2007) as shown in Figure 2.10. Studies focusing on one particular dimension of liquidity include but not limited to Amihud and Mendelson (1986) (used bid-ask spreads), Datar, Naik, and Radcliffe (1998) used turnover rate, Lee and Swaminathan (used trading volume), Chordia, Subrahmanyam, and Anshuman (used trading volume) (as cited in Brown et al., 2007). Johnson (2008) on the other hand, views liquidity as a property of equilibrium market demand, such that liquidity reflects the average risk-bearing capacity of the economy.

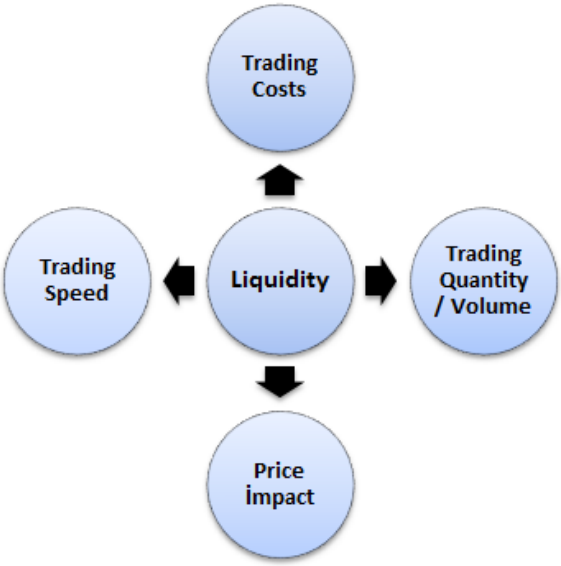

Figure 2.10 : Liquidity Dimensions

There is no single consensus on the measurement of the aggregate liquidity of a market. However, recent research has made several useful proxies available (Chai, Faff, & Gharghori, 2010). Depth is considered as one of basic liquidity measures, in a sense that it indicates how many more shares the market is capable of accommodating under current circumstances. There is a general acceptance for using trading volume and its variations (turnover etc.) as an indicator of liquidity.

There is a consensus among researchers about the definition of liquidity but not about which proxy best represents it. As a consequence several proxies have been used in different studies each proxy capturing one aspect of liquidity. This is also attributable to the fact that liquidity is a multifaceted concept and researchers pick the proxy best suiting their research subject. Every study used a proxy measuring the aspect of liquidity they are investigating.

Datar et al. (1998) used the turnover rate (number of shares traded as a fraction of the number of shares outstanding) as a proxy for liquidity. Domowitz et al. (2001) used turnover defined as total trading volume divided by average market capitalization. This proxy had two advantages over others. First advantage is about its theoretical appeal. Amihud and Mendelson (1986) proved that in equilibrium liquidity is correlated with trading frequency. So, if one cannot observe liquidity directly but can observe the turnover rate, then one can use the latter as a proxy for liquidity which is discussed in detail in their study. Second, the data on turnover rates is relatively easy

to obtain which enables to capture month by month variation in the liquidity of assets and allows the examination of liquidity effects across a large number of stocks over a long period of time.

In order to measure liquidity García and Liu (1999) used two separate proxies. First one is the ratio of total value traded to GDP. The second is frequently called the turnover ratio, and computed by the ratio of the total value traded divided by market capitalization. They measure the degree of trading in terms of the value of equity transactions, in comparison to the size of the economy and to the market respectively.

Liquidity is generally accepted as a desirable property of a market; in contrast, some economists regard liquidity as retarding growth by reducing uncertainty and consequently precautionary savings and by lowering investors' search incentives because it would be easier for them to get out fast. Additionally, liquidity would reduce shareholders incentives to control managers due to their short-run commitment to the corporation (García & Liu, 1999).

Dey (2005) investigated the determinants of turnover and also the relation between expected returns of stock exchange indexes and their corresponding turnover. Portfolio turnover ratio is used as a measurement of portfolio liquidity. Results suggest that turnover ratio affecting portfolio return positively is true only in emerging markets. However, a recent comparative study conducted by Chai et al. (2010) point out the liquidity turnover rate, when used as a measure for liquidity, shall be handled differently than other proxies of liquidity.

Chai et al. (2010) examined the degree of correlation among six different liquidity proxies in the Australian market using a monthly dataset for the period of January 1991 to September 2006. The proxies examined were namely stock turnover, Amihud illiquidity ratio, return reversal measure, proportional spread, zero return measure, and turnover-adjusted number of zero daily volumes. They used six different liquidity proxies to explain three of the stocks' trading characteristics; namely volume, variance and price. They found that volume is positively related to all liquidity proxies except for return reversal measure. Their findings are consistent with the literature, indicating trading characteristics are important determinants of liquidity. Their results suggest higher prices have higher turnover rates regardless of

the company size categories (small, medium, or large). However, it must be noted that the relationships with stock turnover is not found to be similar to other proxies examined and shall be handled accordingly.

The key problem researchers encounter when studying with liquidity, is picking the right proxy to use. Liquidity proxies used in the literature can be classified into four categories. The first one is pointed out by Black (1971), namely *immediacy*; time needed to execute an order. 14 years later Kyle (1985) drew our attention to the other classes; namely tightness, depth, and resiliency. *Tightness* is about the cost of transactions, such as the bid–ask spread. *Depth of a market* is defined by the quantity of a trade that can be executed without causing a large price movement. *Resiliency* is about the speed the prices return back to equilibrium after a large trade. Although these dimensions are to some degree overlapping, due to the relationship between the transactional properties of markets and liquidity proxies used to measure them, there is no single liquidity proxy that fully captures all dimensions.

Chordia et al. (2000b) find that except stock price, the influence of volume and volatility are consistent through different liquidity proxies.

Six proxies used by Chai et al. (2010) and the categories they belong to are displayed in Table 2.2. For a detailed discussion see Chai et al. (2010).

Proxies for Liquidity	Category
Stock turnover	Immediacy
The illiquidity ratio	depth/price impact
The return reversal measure	Resiliency
Proportional spread	Tightness
The zero return measure	Tightness
Turnover-adjusted number of zero daily volumes	Immediacy

Table 2.2 : Proxies used for liquidity by category.

Bid-ask spreads are used as a liquidity measure. One drawback of using the bid-ask spread to measure liquidity is that it does not reflect the impact market orders may have on prices. Another measure used is resiliency, which is measured by examining the variance of price changes from one period to the next, holding the equilibrium price constant. There are drawbacks of using resiliency; one is in reality equilibrium prices are not observed let alone being constant. Secondly “large” order is not easy to define accurately; it is relative and depends on the number of active traders in the

markets. Price volatility is an indicator of market liquidity but this indicator doesn't give information neither on the size of a transaction to be considered as "large" nor the immediacy of a trade (Massimb & Phelps, 1994).

Beginning with Demsetz (1968) the relationship between trading volume and spread is investigated and many researchers have argued that increased trading volume should reduce bid-ask spreads. The relationship between trading volume and spread affects the price as well. If trading volume of a particular stock is low, then the stock is harder to sell (e.g. in bear markets) and the bid-ask spread is typically high. This makes the stock less desirable, which is reflected in price. Amihud and Mendelson (1986) demonstrated that the most illiquid stocks could gain 50% in value if, all else equal, liquidity would be raised to the level of the most liquid stocks.

Some might argue that the volume of large trades is a better measure of liquidity than total volume. In a liquid market, dealers are willing to take large inventory positions because they can easily manage their inventory. As the markets become less liquid, dealers will charge a higher bid-ask spread for large trades because their inventory management becomes more costly. At some level of liquidity, investors would pay lower costs by breaking up a large order than submitting it all at once. Hence, the presence of a high volume of large trades indicates a liquid market. Whether volume is an appropriate proxy for liquidity, the correlation of volume from just large or small trades to the total volume is examined by analyzing the determinants of trading volume of high-yield corporate bonds (Bessembinder, Maxwell, & Venkataraman, 2006).

Technological advances have removed constraints on the volume of trading that is physically possible. As the trading volumes have grown, the investment in technology that allows such volume growth became essential. Exchanges had to invest significant capital in cutting-edge technology in their trading platforms for two reasons. Firstly, they had to meet the demands of sophisticated institutional investors. Secondly, they had to respond to threats of liquidity migration to electronic trading and matching platforms known as ECNs. High upfront costs changed the financial exchange business model, providing strong incentives for different exchanges to merge and migrate their combined trading onto a single trading system (Hasan & Malkamäki, 2000), (Reena Aggarwal & Dahiya, 2006). As we have seen exchanges are considered as networks and in network industries, making a major innovation is

the only way for a firm to defeat the advantage of the leader and become a leader (Evans & Schmalensee, 2002). Yet, the homogenous business models of exchanges make such innovations rather difficult. As Evans and Schmalensee (2002) pointed out in some cases, the only way to survive against such threats is merger. This may also explain the increased number of mergers among stock exchanges when the competition threatened their existence severely.

In the following part the relationship between trading volume and some of the concepts related to market liquidity will be briefly explained. These concepts are namely liquidity barriers, lock-in situations, liquidity switch or shift, liquidity inertia, and fragmentation. A lock-in situation happens when an investor is unwilling or unable to exit a position because of the regulations, taxes or penalties associated with doing so. Liquidity creates barriers to entry and may raise lock-in situations which are difficult to overcome. Network effects make a liquidity shift hard to achieve. Volume exhibits a similar behaviour to liquidity as it also tends to concentrate in one trading platform so liquidity switching conditions are equally valid for trading volume. Seven necessary conditions are identified for a liquidity switching to succeed (Competition Commission, 2005):

(1) the new entrant must provide lower pricing and better quality of services;

(2) the new services must be able to be delivered by the entrant at a low cost;

(3) the customers must be dissatisfied with the incumbent provider;

(4) there must be a powerful, concentrated customer group that has the

ability to switch its trading business from the existing venue to the new provider;

(5) this customer group must move in a coordinated fashion;

(6) there must be no regulatory or political barriers in place fettering the entrants; and

(7) there must be full access to existing clearing and settlement infrastructure.

Another issue for listed companies is the liquidity inertia created by switching costs. Switching costs can arise at the level of trading: these are the costs have to be borne to enable a trader to send her order easily to the competing trading venue. Switching costs can also arise at the level of post-trading if two competing exchanges use different clearing houses. Even though theoretically firms may move from one exchange to another freely, in practice it is almost impossible for firms to switch to

other venues not incurring additional costs, particularly to new entrants (new exchanges or new trading venues/platforms) due to this inertia. As Cantillon and Yin (2011) explain the switching costs arising at the post-trading stage are more important than the trading level. After all, switching costs create another competition issue to be considered.

The liquidity of an exchange has a significant impact on the listing decisions of a company. There is a relation between a company's choice of exchange to be listed on and the cost of capital to be raised. When there are several choices companies prefer the exchange that provides the capital required at the least cost which is generally provided only by the markets where the company has a strong market presence and a good reputation. This is generally the domestic market of the company, hence the relation is called home bias. Factors such as globalization, internationalization, integration, deregulation, technological advances, and legislative changes suggest to weaken the home bias, nonetheless empirical evidence reports the existence of home bias in equity portfolios (Kokkoris & Olivares-Caminal, 2008).

There are several studies on the fragmentation of trading volumes across venues and measuring the impact of this fragmentation on market performance. Fragmentation causes a coordination problem as well; traders with different timing needs go to different venues. It is unlikely that patient traders with hidden orders and impatient traders conducting searches choose the same venue as long as there is a market fragmentation (Hasbrouck & Saar, 2009). Pagano (1989) demonstrated that in a two-market case, fragmentation has a welfare-reducing effect. On the other hand when the same product is traded on several exchanges, this fragmentation generates arbitrage opportunities and thus may lead to an increase in trading volumes.

Despite strong arguments for consolidation, there are many fragmented markets and they remain fragmented for long periods of time. This bewildering phenomenon is known as *market externality puzzle*. Studies investigating the causes and impacts of market fragmentation produced mixed results. A detailed survey on market externality from microstructure point of view can be found in Section 4 of Madhavan (2000). About the measurement details of fragmentation refer to Cantillon and Yin (2011).

Regarding the fragmentation issue, Pagano (1989) demonstrated that there are two situations in which two markets may coexist assuming that the transaction costs of markets are different. In the first case, the volatility of the markets are different such that it balances the "*speculative value*" of the two markets justifying their existence. Pagano calls this "*a knife-edge equilibrium*" situation. The second one is an equilibrium situation in which one market has more traders, and also has a greater cross-sectional diversity. But its higher transaction costs are preventive for the other group of traders, therefore preclude concentration. More liquidity and a higher "*speculative value*" make the first market to be deeper, in return for more expensive trading. Unfortunately, not all investors can afford to trade there: the reason for the presence of the second market. The deeper market attracts the large traders and it has the higher volume. This outcome shows the link between the transaction costs, liquidity and trading volume in terms of fragmentation. Pagano and Roell (1990) questions whether it is possible to lead by concentrating the trade on a single market by means of policy actions. The answer is important because it means the welfare can be raised, provided that the concentration is performed with lower transaction costs. They demonstrate that the answer is generally positive pointing out the potential traders' preference of the trading venue determines the depth of the market. Traders' preferences depend not only on a personnel assessment but also the conjecture about the behaviour of the others. It is my belief that the conjecture is affected highly by the macroeconomic variables, among other things. The technological advances also played a significant role on fragmentation, which will be discussed in Section 2.7.5.

Liquidity is considered as an important concept for many areas of finance, though from very different views. The many faces of liquidity have as many different policy implications for financial market stability (O'Hara, 2004). Various policy prescriptions for market stability are outlined focusing on the two opposing views of liquidity. In the traditional economics view, liquidity is considered to be destabilizing whereas in the microstructure view, liquidity is seen as a positive attribute for both traders and markets. O'Hara (2004) adds a third view of liquidity depending on the uncertainty aversion.

The ongoing debate on liquidity is congregated mainly on its role and impact, indicating to a deeper disagreement as to whether liquidity is actually a positive

feature of markets. The answer to whether liquidity fosters or retards financial market stability is important because it will determine the role central banks should play in fostering or curtailing liquidity (O'Hara, 2004). The negative view considers liquidity as a destabilizing force by steering investors to trading alone rather than investing in the underlying economic process. The view also links liquidity to governance problems which is out of the scope of this study. O'Hara (2004) states that liquidity provision is enhanced when risk is perceived to be lower by the investors. For many assets, liquidity is determined, at least partially, by the characteristics of the asset and the market in which it trades, hence is endogenous. Disclosure rules, greater transparency, insider trading laws, lower transactions costs, all contribute to making markets more attractive to investors hence enhance market liquidity. For uncertainty aversion issues refer to O'Hara (2004). She is against the negative view of liquidity and believe the traditional approaches are misguided. She recommends employing appropriate policies to enhance liquidity and the free flow of capital to enhance market stability.

An increase in liquidity affects the market in two opposite ways; while promoting additional listings, these additional listings at the same time may reduce the average price of shares hence reducing the average value of companies (El-Wassal, 2005).

In order to measure the liquidity of an exchange Cybo-Ottone et al. (2000) suggest several alternatives stating their weaknesses. The volume traded is a commonly accepted measure, however it is prone to be biased by regulation and by home-country bias. Moreover exchanges can't control it directly when the liquidity providers are becoming its competitors. The number of listed companies is another measurement, its weakness depends on the relative industrial structure of firms (for instance being listed once or more depends on being a multidivisional firm, a multinational one or a holding). The total market value of all the firms listed in an exchange is another common indicator, sometimes used as scaled by the gross domestic product (GDP). The problem with this lies in the calculation of a firm's capital value particularly when the firm goes public for a small percentage of its total capital, say 10 per cent. The market value is calculated over its total capitalization rather than the floating capitalization (10 per cent).

Depending on the empirical evidence and contrary to the expectations Johnson (2008) argues that volume and liquidity are unrelated over time. But volume is

positively related to the variance of liquidity, or in other words the risk of liquidity. Johnson (2008) defines liquidity as a concept reflecting the average risk-bearing capacity of the economy. Volume reflects the changing contribution of individuals to that average risk-bearing capacity of the economy.

Findings of several recent studies investigating the relationship between volume and liquidity caused a controversy, stating that higher volume does not imply more liquid markets. Refer to Johnson (2008) for a detailed discussion of these studies. There are three paradigms pointing to the positive volume-liquidity relationship. The first one can be stated as markets with higher trading activity are usually more liquid based on the findings of Demsetz (1968), more frequently traded stocks have lower bid-ask spreads. The second paradigm is based on the asymmetric information models (with some exceptions) indicating higher volume may raise volatility which in turn reduces liquidity. The third trading paradigm based on search models asserts the positive relationship, measuring liquidity by the opportunity cost of the searching time. Johnson (2008) criticizes all the three paradigms for defining a static relationship and proposes that the relationship between trading volume and liquidity shall be dynamic. He asserts higher turnover may be associated with increased liquidity risk. He uses a frictionless model to examine his hypothesis using US government bond and stock markets data. The assumption of a frictionless model is not realistic given the fact that trading costs are very effective on the returns as pointed out by Domowitz et al. (2001) evidence shows that execution costs can be high particularly in an international context and shall not be ignored.

Volume responds symmetrically to arrivals and departures whereas liquidity responds antisymmetrically. Higher expected volume means higher liquidity risk. In Johnson's study the independent variable market volume is measured by turnover. His theory promotes the economic insight that large volume is necessary for large liquidity changes of either sign and that small volume is sufficient to ensure small liquidity changes. Although he thinks that liquidity is nonstationary, in the samples liquidity levels appear stationary and changes are negatively auto correlated, therefore why he didn't applied UR tests is to be questioned. He concludes that "higher levels of activity may not unambiguously indicate healthier markets accommodating greater risk transfer. In fact, such conditions may also be indicative of greater susceptibility to sudden changes in liquidity" (Johnson, 2008).

Transparency has gained an increased interest recently. It has a wide scope, in this study transparency in securities markets will be the focus. The user who wants to get more detailed information shall refer to the PhD thesis of Granados (2006) investigating the technology-driven changes in market transparency and its implications on firm strategies. There are case studies including financial securities industry in explaining why firms adopt transparent market mechanisms despite the consequent risk to their profit (Granados, 2006).

Granados (2006) defines market transparency as the ability of market participants to observe information about products and prices. Market transparency can be broken down depending on the type of information disclosed; product transparency and price transparency being the most well-known types. Price transparency contains the disclosed information regarding market prices and related information such as quotes and transaction prices. Accordingly most of the literature on price transparency appears in the context of financial markets. Research on transparency mainly questions its effect on increasing market efficiency and liquidity (Granados, 2006, p. 3).

Brown et al. (2007) examined the relationship between liquidity, measured by trading volume and stock performance at the individual stock level across different investment styles. Additionally, they created "*the trading volume factor*" a new measure in the same manner as the Fama-French factors and investigated its properties. Brown et al. (2007) used three liquidity measures: average daily trading volume measured on a 3-month basis, the dollar value of trading volume (i.e., the trading volume measure multiplied by the share price), and turnover as measured by the annualized trading volume as a percentage of shares outstanding. They applied regression analysis using monthly data over the period 1991 to 2006. Findings indicated that the more liquid stocks (based on trading volume and turnover) tend to have higher subsequent returns (1 through 12-month holding periods) than the less liquid stocks, although the reverse is true based on dollar volume. They conclude that trading volume embodies more information than an aspect of liquidity.

In the last decade there has been studies by Gervais et al. in 2001 and by Hou et al. in 2006 indicating that measures of trading volume may capture more than an aspect of liquidity (as cited in Brown et al., 2007). Studies on market-wide liquidity measures have been particularly engaged in incorporating liquidity into asset pricing models;

Chordia et al. (2000a) investigated commonality in liquidity across stocks, Pastor and Stambaugh in 2003 examined the price impact dimension of liquidity and created "*liquidity betas*" (as cited in Brown et al., 2007). In 2006, Liu developed a new measure of liquidity relating to price formation risks. He attempted to capture many dimensions of liquidity including trading speed, trading quantity, and trading cost. The measure he developed incorporates the number of zero daily volumes in the past months as well as a turnover measure (as cited in Brown et al., 2007).

Trading volume acting as a proxy for risk or reflecting information may have quite different if not opposite interpretations in terms of expected return. An investor may require an expected return premium for holding a stock that does not trade very frequently recently that's a stock with a low trading volume, on the other hand if a stock's recent trading volume is high it may reflect new information coming to the market and hence an investor may again expect a higher return.

Omran and Pointon (2001) used the value of trade, the volume of trade, the number of transactions, the number of traded companies and the value of new issues: as measures of stock market activity variables and the total value traded to market capitalization and the volume of shares traded to the volume of shares listed as a measure of market liquidity, to examine the relationship between inflation and market activity and liquidity.

2.3 Macroeconomic Variables

Today it is widely recognized that a well-functioning financial system is essential for economic growth, but there has been a long term debate on the relationship between financial development and economic growth dating back to 1955. Since then many studies have been conducted on different aspects of this relationship at both theoretical and empirical levels; the pioneering studies being conducted by Gurley and Shaw in 1955, 1960, and 1967, followed by McKinnon and Shaw in 1973 (as cited in García & Liu, 1999). Initially the role of banking sector in economic growth was investigated. Only recently the focus turned to how stock market development affects economic growth. As theoretical work showed, stock markets being a part of the financial system, play a significant role in economic growth; which is also

supported by empirical evidence see Demirgüç-Kunt and Levine (1996), Singh (1997) and Levine and Zervos (1998).

There is an interaction among stock markets, macroeconomic stability and economic growth as pointed out by Singh (1997) and Akyüz. They argue that unfavourable economic shocks produce macroeconomic instability through the interactions between stock markets and foreign exchange markets, which in turn affect economic growth adversely (as cited in Arestis, Demetriades, & Luintel, 2001; García & Liu, 1999).

The importance of dynamic linkages between stock markets and macroeconomic variables were stated by Muradoglu et al. (2000). The influence of economic policy on stock markets may be overwhelming particularly in emerging markets or when the trading volume is low. In emerging markets usually governments have a dominant influence in economic activity by means of macroeconomic policies. In any case the relationship between macroeconomic variables and stock returns is assumed to be unidirectional (Muradoglu et al., 2000).

The relationship between real economic activity, interest rates and stock returns has been analysed for the last three decades and even though there are ambiguities on the direction of causation, macroeconomic variables are considered important determinants of cash flows. In the decades during 1980s and 1990s, many researchers including Chen, Roll, and Ross (1986), Schwert (1990), and Geske and Roll, Kaul, Shah, Barro, Balvers et al., Fama, Cochrane, and Lee have shown there exists a relation between real economic activity, changes in industrial production growth, interest rates and stock returns (as cited in Nasseh & Strauss, 2000).

One of the pioneers to investigate how macroeconomic variables affected stock prices were Chen et al. (1986). Depending on the financial theory they analized the risk introduced by the changes in macroeconomic variables: namely the spread between long and short interest rates, expected and unexpected inflation, industrial production, and the spread between high- and low-grade bonds. Their findings indicate that these risks are significantly priced in the stock market.

Schwert (1990) and Fama (as cited in Nasseh & Strauss, 2000) propose three explanations for the strong link between stock prices and real economic activity:

> "First, information about future real activity may be reflected in stock prices well before it occurs—this is essentially the notion that stock prices are a leading indicator for the well-being of the economy. Second, changes in discount rates may affect stock prices and real investment similarly, but the output from real investment doesn't appear for some time after it is made. Third, changes in stock prices are changes in wealth, and this can affect the demand for consumption and investment goods" (Schwert, 1990, p. 1237).

Efficient financial systems increase capital productivity by increasing financial savings and improving their allocation across investments. This in turn improves economic growth. Determinants of stock market development are important because it is now widely recognized that stock market development is crucial to economic growth. Measuring stock market development is not straightforward since it is a multi-dimensional concept: usually stock market size, liquidity, volatility, concentration, integration with world capital markets, and the legal rule (regulation and supervision) in the market are used as a measure, all capturing an aspect of development.

The macroeconomic determinants of stock market development were investigated by García and Liu (1999). They compared the development of East Asian and Latin American stock markets using market capitalization as a proxy for stock market development. They examined the role of real income, saving rate, financial intermediary development, stock market liquidity, and macroeconomic stability on stock market capitalization for 15 countries. They also investigated the predictability role of these macroeconomic variables for future stock market development. García and Liu (1999) demonstrate that the real income level, saving rate, financial intermediary development, and stock market liquidity are important predictors of market capitalization, while macroeconomic stability does not prove to be significant. In the same study they also state the channels through which financial intermediaries and markets may affect economic growth. They make four conclusions; firstly, the economic development plays an important role in stock market development. Secondly, the saving rate also plays an important role in determining market capitalization and thirdly, stock market liquidity has a positive effect on market capitalization. The fourth one is that the stock market plays a complementary role rather than a substitute for the banking sector.

The changes in stock prices are attributed to the investor's expectations about values of certain economic variables which have a direct effect on the pricing of equities. This leads to the question of whether certain macroeconomic fundamentals are capable of driving the behaviour of financial aggregates.

The most comprehensive research conducted to investigate the relationship between stock prices and macroeconomic factors in emerging markets are the ones by Massimb and Phelps (1994), Muradoglu et al. (2000), Diacogiamnis, Tsiritakis, and Manolas (2001), Wongbangpo and Sharma (2002) and Mukhopadhyay and Sarkar (2003).

The relationships between various aspects of stock exchanges and economic indicators are analysed by many scholars. A majority of these studies focused on the relationships between stock prices or returns and economic indicators. In their models of stock returns, Fama and Schwert in 1977, 1988, 1989, Keim and Stambaugh in 1986, Campbell in 1987, Fama and Bliss in 1987, and Nai-fu Chen in 1991 all use the short-term interest rates as well as the yield spread between long-term and short-term rates (as cited in Nasseh & Strauss, 2000). Some of these studies applied factor analysis or similar methods to identify the set of economic variables, but the majority of the studies investigated a handful of macroeconomic variables: production data (mostly as GDP), short and long term interest rates, inflation, money supply, unemployment rate are among the most preferred. The interaction of these macroeconomic variables with stock returns is not straightforward, for instance even though the literature attributes a close relationship between inflation and nominal interest rates they don't necessarily affect returns in the same way, for a good discussion refer to Nasseh and Strauss (2000).

The existence of cointegration among stock market and macroeconomic activity has its roots in three fundamental premises of the stock market: (a) stock market activity explains future production; (b) stock markets possess higher volatility than underlying macroeconomic activities; (c) real activity explains more stock price variation over longer time horizons. In 1991, Cochrane demonstrated that consumption and production-based asset pricing models also provide a theoretical ground since they propose that stock prices at time *t* are related to the expected future production, due to the effects on the discounted value of changes in cash flows and dividend stream (as cited in Nasseh & Strauss, 2000). Stock returns lead and can

forecast future industrial production growth, since production is persistent and related to other macroeconomic variables. Cointegration between stock prices and macroeconomic activity also implies permanent increases in production will result in large increases in today's stock prices. In practice, macroeconomic innovations possess both permanent and temporary components; the stock price response to production innovations then depends on the expected persistence of the shock and will be greater if cointegration occurs. Cointegration between stock prices and economic variables, such as production, implies that their relationship becomes stronger over longer horizons (Nasseh & Strauss, 2000).

In an early study Cheng (1995) examined a set of economic variables that represent the UK economy by applying traditional factor analysis to estimate the number and loadings of the factors. The aim of the study was to analyse the relationships between security returns and economic indicators. His study was limited to UK only. He considered macroeconomic variables from major categories; namely stock market, money supply, industrial production, labour market, and international trade. The factors included among others are money supply (M1), unemployment rate, GDP average, industrial production (volume), and long term bond yield. Diacogiamnis et al. (2001) also focused on a single stock market. The relationship between the stock returns of Greek stock market and 18 macroeconomic variables were investigated.

Muradoglu et al. (2000) investigated the causality between market returns, exchange rates, interest rates, inflation, and industrial production. The data covered the period from 1976 to 1997 for 19 emerging economies. Their results revealed that the relationship between stock returns and macroeconomic variables were mainly due to the relative size of the respective stock market and their integration with world markets.

Nasseh and Strauss (2000) investigated the existence of a long-run relationship between stock prices and interest rates, consumer prices, real domestic macroeconomic innovations and international activity for the period 1962–1995 in six European economies: France, Germany, Italy, Netherlands, Switzerland and the U.K. The macroeconomic variables used were namely; industrial production, business surveys of manufacturing orders, short- and long-term interest rates as well as foreign stock prices, short-term interest rates and production as proxies for discounted cash flow.

Wongbangpo and Sharma (2002) investigated the relationship between stock index returns and five macroeconomic variables namely; gross national product (GNP), the consumer price index (CPI), the money supply, the interest rate, and exchange rate. The data was obtained from five countries; Indonesia, Malaysia, the Philippines, Singapore, and Thailand. The study considered both short and long run relationships and they found that in the long-run all five stock price indexes were positively related to growth in output and negatively to the aggregate price level. But a negative long-run relationship between stock prices and interest rates was noted for the Philippines, Singapore, and Thailand, and was found to be positive for Indonesia and Malaysia.

In another study the effect of monetary policy changes on asset prices in the foreign exchange and equity markets, in the financial markets of Brazil and Korea has been investigated (Goodhart, Mahadeva, & Spicer, 2003).

Maysami et al. (2004) investigated the cointegration between macroeconomic variables and stock market's sector indices rather than the composite index. They concluded that the Singapore's stock market and the property index form cointegrating relationship with changes in the short and long-term interest rates, industrial production, price levels, exchange rate and money supply.

Basher and Sadorsky (2006) investigated 21 emerging economies to find out the impact of oil price changes on the stock market returns. In most of the countries studied, they have found significant evidence that oil prices effected stock market returns positively.

In another study the relationship between stock prices and macroeconomic variables among BRIC[3] countries is examined in terms of stock prices, exchange rates and oil prices using time series of monthly data for the period 1999-2006. Box-Jenkins ARIMA model was used to examine the relationship between stock prices, exchange rates, and oil prices. Not being able to show a significant relationship between the current and past market returns and macroeconomic variables, they concluded that the BRIC markets exhibit weak form of market efficiency (Gay, 2011).

[3] Brazil, Russia, India and China

Another investigation regarding the relationship between stock prices, inflation and interest rates was conducted by Apergis and Eleftheriou (2002). They investigated the effects of inflation and nominal interest rates on stock prices ASE general index using consumer price index, industrial production and 3-month yields on treasury bills as explanatory variables. Apergis and Eleftheriou (2002) demonstrated empirically that stock prices in ASE index followed inflation rather than interest rates. In a more recent study Gregoriou and Kontonikas (2010) used average monthly inflation rates to investigate the existence of a long-run relation between stock prices and goods prices.

The relationship between macroeconomic variables and stock prices implies the possibility to achieve impressive gains both in economy and securities markets by proper government economic or financial policies (Wongbangpo & Sharma, 2002). Mukhopadhyay and Sarkar (2003) conducted a systematic analysis of the Indian stock market returns prior to and after market liberalization and the influence of macroeconomic factors on returns. Specifically for the post-liberalization period (since 1995), real economic activity, inflation, money supply growth, FDI, and the NASDAQ-index were significant in explaining variations in Indian stock return. Nominal exchange rate, while significant during the pre-liberalization period (1989-1995), was found not to be significant after liberalization.

The size of the stock market has been found to be highly correlated with real income. According to demand driven hypothesis, economic growth will create new demand for financial services. Larger and more sophisticated financial institutions will be established to satisfy the new demand for their services. The GDP per capita is generally used to measure the income level (Yartey, 2010). The ratio of total value traded to GDP is used as a measure for market liquidity (Yartey, 2010). The rationale for using the ratio of total value traded or its ratio to GDP is the assumption that the more liquid the stock market, the larger the amount of savings that are channelled through the stock market. Capitalization ratio is defined as the value of domestic equities traded on the stock market relative to GDP, and used as an indicator of stock market development (Yartey, 2010). The rationale is overall market size being positively correlated with the ability to mobilize capital and diversify risk on an economy-wide basis.

Some other explanatory variables used in literature are as follows: banking sector development measured by the value of domestic credit provided by the banking system to the private sector relative to GDP, savings and investment measured by either gross domestic savings as a percentage of GDP or/and gross domestic investment as a percentage of GDP, private capital flows measured by either foreign direct investment as a percentage of GDP or/and net private capital flows as a percentage of GDP, institutional quality is measured by a composite index from the International Country Risk Guide (ICRG) (Yartey, 2010).

Among the few studies focused on the effects of inflation on market activity and liquidity, rather than returns and prices, Omran and Pointon (2001) examined the impact of the inflation rate on the performance of the Egyptian stock market in terms of market activity and market liquidity.

The empirical efforts that examine the relationship between macroeconomic variables and stock prices theoretically depend on either financial or economic theory. Economic theory proposes forces which tend to keep some of the economic variables together. For instance short and long term interest rates, or household income and expenditures, prices of the same commodity in different markets are among such variables.

In financial theory how interest rates and inflation affect the behaviour of financial aggregates has been argued with different arguments in the direction of their impacts on, for instance stock prices. According to economic theory nominal interest rates closely track inflation changes, so should be positively related to inflation (due to Fisher effect a.k.a the Fisherian hypothesis) but not the other way round. The rationale behind this one-way relationship can be explained as nominal interest rates are supposed to compensate lenders for changes in the real value of nominal interest rate payments; nonetheless the relationship is not a one to one response because nominal interest rates reflect not only the current inflation, but also expectations of future inflation. As both Fama and Schwert note interest rates are forward looking and tend to proxy for future economic activity (as cited in Nasseh & Strauss, 2000).

There is an ongoing debate whether interest rates affect stock prices positively or negatively. Asprem argued that the effect depends on the liquidity and the size of the market. In a small illiquid market the effect will be positive. Barsky on the other

hand, attributes the positive relationship to the risk factor indicated by the interest rate; for instance increased risk or/and precautionary savings may cause a drop in interest rates and in turn cause investments move from stocks to less risky assets (as cited in Apergis, Dincer, & Payne, 2012). Nonetheless inflation lowers the price stability also known as the Friedman effect, has a reducing effect on investments, economic growth and future earnings; hence the relationship between inflation and stock prices is negative. In 1990 McCarthy et al. suggested a negative relationship between stock returns and inflation (as cited in Yartey, 2010). For a detailed discussion including studies on both positive and negative relationship between inflation and stock prices or returns see Omran and Pointon (2001).

While the debate on whether inflation affects stock prices positively or negatively is continued there is another debate on the relationship of inflation and stocks in a broader sense; whether stocks play a hedging role against inflation is questioned and investigated. In a recent study Gregoriou and Kontonikas (2010) conducted an analysis to determine whether stocks market investment can provide a hedge against inflation by examining the existence of a long-run relationship between stock prices and goods prices. The role of different inflation regimes has also been examined by means of sub-sample regressions. They report strong evidence in favour of a positive long-run relationship between goods prices and stock prices with long-run causality running from the former to the latter. Consequently, their findings support the generalized Fisher hypothesis and are consistent with the view that stocks hedge against inflation in the long-run.

Inflation is also used in order to measure the macroeconomic stability. García and Liu (1999) used three proxies; inflation rate, inflation change, and the standard deviation of inflation rate to measure the macroeconomic stability.

Macroeconomic stability is an important factor affecting markets in terms of capitalization, trading activity and so on. Two measures are used; real interest rate and current inflation. The relationship of stock prices and nominal interest rates indicates the motivation of an investor to restructure her portfolio between stocks and bonds, hence create trading volume. There are many studies carried on regarding the effects of inflation but hardly any concerning the effects on the trading volume rather than stock prices (see the literature provided by Apergis & Eleftheriou, 2002).

García and Liu (1999) in their influential paper demonstrated that income level, domestic investment and financial intermediary sector development were the main macroeconomic determinants of stock market development. García and Liu (1999) used two empirical indicators to measure the financial intermediary development: domestic credit given to the private sector divided by GDP and the ratio of broad money supply M3 to GDP. They used real GDP in U.S. dollars to measure the income level. They paved the way for other studies based on the results of this study: for instance El-Wassal (2005) and Yartey (2010). El-Wassal (2005) used trading value over GDP as an indicator for stock market growth for the dependent variable.

Calderon-Russell analysed the stock market growth in terms of economic growth and additional liquidity as major determinants. In his model stock market capitalisation is used as an indicator of market growth. Economic growth is measured by the GNP per capita growth rate whereas for additional stock market liquidity the increase in turnover ratio is used. In his model, economic growth and liquidity affect market capitalization through the combined effect of stock prices and number of listings (as cited by both El-Wassal, 2005; Yartey, 2010). Although the effects are acknowledged, this model lacks to include the effects of financial and economic policies and risk factors.

Cavenaile, Gengenbach, and Palm (2013) used the following three measures as indicators of stock market development: the stock market capitalization over GDP, the stock market turnover ratio and the stock market value traded over GDP. The stock market capitalization over GDP is a measure of the size of the financial markets relative to the GDP. The turnover ratio and value traded over GDP are used as measures of the liquidity of the markets such that turnover is the liquidity with respect to the size of the financial markets whereas value traded over GDP is on an economy wide basis.

As we have seen, the previous literature has not explicitly accounted for the impact of macroeconomic variables on the aggregate trading volume of stock exchanges.

2.4 Market Microstructure

Market microstructure studies the process and outcomes of exchanging assets under a specific set of rules, while microstructure theory addresses how specific trading

mechanisms affect the price formation process (O'Hara, 2001). For any market, price is the outcome or the real product (Figure 2.11).

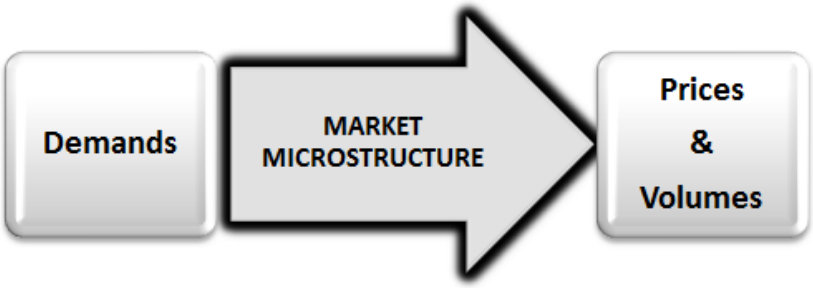

Figure 2.11 : Market microstructure theory

The performance of market structures are evaluated by two measures; the operational efficiency and the liquidity of the markets. An investigation on liquidity of an exchange is missing important parts if market microstructure is not taken into account. Intrinsically the same applies to trading volume not only because trading volume is used as a proxy for liquidity, but also because market microstructure is, by definition, closely related to structural issues affecting volume and price simultaneously. Therefore any analysis of trading volume is considered to be incomplete unless fundamentals of the market structures are taken into account. O'Hara (2004) comprehensively analysed market changes and their impact on exchanges. The role of market structure in the provision of liquidity has been questioned (O'Hara, 2001). In this respect, influential studies on market microstructure will be summarized as they will help to reach a healthy assessment of trading volume and its role.

Equity markets vary in all design dimensions; namely market transparency, price discovery and trading protocols (Madhavan, 2000). In terms of trading mechanisms depending on whether buyers and sellers interact indirectly or directly there are two broad categories of trading mechanisms: quote driven and order driven respectively. At quote-driven markets, the market maker gives the quotations for buyers and sellers, such that the difference of bid price for buyers and ask price for sellers makes the market maker's profit. Market maker has to include the compensation, for the risk of holding inventories of the stocks being traded, in the prices as well. Order-driven markets enable the direct interaction of buyers and sellers.

Regardless of the trading mechanism of the market, there are different types of order executions traders can choose from. Market orders and limit orders are the most widely used types of orders, some others being: stop orders, fleeting order, fill or kill order, hidden orders, immediate or cancel order, iceberg orders, post no preference order, adding liquidity only order etc. for more refer to (Hasbrouck & Saar, 2009; URL-3). Market orders are executed at the best current available price, whereas limit orders have price conditions (an upper limit for a sell order and a lower limit for a buy order) such that the order is executed only if the price satisfies the conditions, if not order is kept waiting until conditions are satisfied or until the order is cancelled. In 2009, Hasbrouck coined a new type of order: "*fleeting order*" that appeared as a recent phenomenon (Hasbrouck & Saar, 2009). Fleeting order is actually an example of how technology affected business rules. Fleeting orders are a new type of order standing in between limit order and market order such that they are cancelled within two seconds of submission. Three hypotheses is proposed to explain the emergence of fleeting orders: the chasing hypothesis, the cost-of-immediacy hypothesis and the search hypothesis (Hasbrouck & Saar, 2009). They use "*latent*" liquidity in the context of limit orders which are available for execution, but are not displayed; hence hidden. They demonstrate that a trader submits a fleeting order to demand immediacy. This contrasts with the traditional view of limit order traders as patient providers of liquidity. They argue that a "*new equilibrium*" has arisen driven by improved technology and the emergence of an active trading culture increasing market fragmentation. Technology affected trading culture profoundly, hence these effects will be addressed in Sections 2.7.4 and 2.7.5.

Market structure has been studied by a group of researchers from different aspects; a brief explanation of market architecture including definitions and a taxonomy of market types are presented by Madhavan (2000). For more on market order types and limit order refer to Hasbrouck and Saar (2009), for a good summary of order-driven markets, characteristics of open outcry and electronic matching systems refer to Massimb and Phelps (1994), for a survey of literature regarding market structure see O'Hara (1995) and Madhavan (2000). The survey conducted by Madhavan (2000) grouped these studies under four categories; namely price formation and price discovery, market structure and design issues, information and disclosure

informational issues arising from the interface of market microstructure with other areas of finance including corporate finance, asset pricing, and international finance.

Trading microstructure theory is about the effects of trading mechanisms on the price formation process. The classic theory of finance propounding that prices reflect information perfectly without any need for trading volume has no suggesting real life evidence or empirical literature. In a recent paper Cochrane (2013) highlights the fact that "*price discovery*" process by which the information is reflected in the prices actually uses a lot of trading volume, besides a lot of time, effort and resources. He reminds the vast literature for investigating the relationship between volatility and trading volume in the period following new announcements. Even though the information announced becomes public, high volatility and trading volume observed at these periods are attributed to the process of digesting this information and deciding what the new value of the stock index should be. Obviously, it requires actual stocks to be traded. He questions the conformity of common model of information to real life, deducing that we do not yet fully understand the size, function, and operation of trading volume.

Inventory models treat the trading process as a matching in which price is used to balance supply and demand across time. An alternative approach for modelling is based on the effects of asymmetric information, hence known as information-based models. This approach highlights the role of the market size. There has been quite a progress in understanding the trading process. There is no doubt that at the end of the day prices will converge to their true values (a.k.a resiliency). Markets with greater volume adjust faster (in clock time) to information (O'Hara, 2001). Despite the vast research, what determines volume is today still one of the puzzling issues. Even though a strong link has been identified by the empirical research between volume and price movements, the cause of this link has not been uncovered, yet. Volume may be emanating from trading process naturally, hence may have no effect on the prices; however it is the individual trades that cause the price changes. On the other hand, O'Hara (2001) considers it more likely that volume possesses underlying information and thus takes part in the learning process by revealing this information. Many studies are conducted to examine the role of information: some of them are given in O'Hara (2001, p. 2).

Another aspect of information dissemination is related to transparency, as demonstrated by an extensive body of research, transparency affects the creation of liquidity. Besides it plays a crucial role when markets compete for trading volume. For a comparative study of open outcry markets with electronic matching systems in terms of dissemination of market information: disclosure of transaction details, dissemination of the order book, timely availability of news, access to trading support transparency of open outcry markets refer to Massimb and Phelps (1994). Disclosure of "*order book*" is a feature putting electronic matching systems a step ahead of open outcry systems. The relationship between market quality and transparency is also investigated (Bessembinder et al., 2006). They examined whether increased transparency can affect trade execution costs in bond markets.

The literature on competition among stock exchanges from microstructure point of view include, but is not limited to Parlour and Seppi (2003), Foucault and Parlour (2004), and Chemmanur, He, and Fulghieri (2008). Competition issues in terms of trading volume will be addressed in Section 2.7.2

2.5 Volatility

In order to explore the relationship between volume and stock-price dynamics many theoretical models have been developed. In those models the asymmetric information (or differences in opinion) entails trading, whereas the extent of disagreement among traders about a security's value is reflected by the size of the trades (volume). As a consequence, these models inherently assume a positive relation between volume and absolute price changes (Jones, Kaul, & Lipson, 1994).

Empirical studies conducted by Schwert in 1989 and Gallant, Rossi, and Tauchen in 1992 demonstrated the existence of a positive relationship between stock return, volatility and volume (as cited in Jones et al., 1994). Volatility is measured as absolute or squared price changes and volume of an individual stock or a portfolio is used in these analyses. However, Jones et al. (1994) reported some intriguing results by demonstrating that the positive relationship is actually between volatility and the number of transactions rather than volume. They analysed the effects of volume on volatility and results indicated that the transactions per se, not their size, generates volatility. Their investigation based on the daily data of 853 securities of NASDAQ-NMS, grouped into five portfolios based on market value, over the period of 1986-

1991. They used average trade size as the measure of "volume" depending on the fact that share volume is simply the product of average trade size and number of transactions. They noted that alternative measures like dollar volume, number of shares traded or turnover yield to identical inferences. Depending on the reported correlations between average trade size, number of transactions, and share volume, Jones et al. (1994) have concluded that the two components of volume contain different information about share volume, since the components are not strongly correlated to each other although both are strongly positively correlated with share volume. They applied two step regressions on both the whole dataset and also after dividing the daraset into two sub periods. Their findings are contrary to the old Wall Street adage that "it takes volume to move prices". They claimed that unless we are able to distinguish between the size of trades (volume) and frequency of trades, it is not possible to come up with a clear explanation for their evidence of why the size of trades doesn't exhibit any additional information content to that of the number of transactions.

The joint analysis of liquidity, volatility and transaction costs is also of interest. From the risk premium perspective, risk premium has to compensate for transaction costs and illiquidity as well. An increase in volatility has a reducing effect on expected return. Further, turnover is inversely related to trading costs, so according to Domowitz et al. (2001) a possible explanation of increased turnover lies in the inverse relation between turnover and trading costs. Domowitz et al. (2001) analysed not only the interaction between trading costs, liquidity and volatility, but also their determinants. Additionally, the impact of these variables on equity returns was investigated in the same study. Trading costs are measured as a percentage of trade value.

Trading costs are considered to play an important role in the competition for order flow. Particularly, differences in trading costs and liquidity across markets may result in a move from emerging markets to more developed ones. For instance, corporations in emerging markets may choose to cross-list their stocks in more liquid, more developed markets, thus carrying the trading volume with. Costs also play a leading role in technology: cost considerations are often cited to be behind many technological innovations. Findings of Domowitz et al. (2001) demonstrate that the explicit costs constitute almost two-thirds of total costs. They used an

emerging market dummy to capture its effects. The results show that turnover is less sensitive to cost in emerging markets compared to more developed economies. A possible explanation may be that volumes in emerging markets are likely to be driven more by politically exogenous factors such as privatizations and are less sensitive to costs. Other factors identified are the increased competition pressure from new trading systems and regulatory authorities to reduce costs.

According to a 20 February 2014 dated report, trading costs are trending up (Mackintosh & Baudewyn, 2014). The comparison of the Transaction Cost Indexes[4] across the globe – looking at changes to costs in Asia, Europe and the US since 2006 indicates that costs fell the most in the US and the least in Asia in the 6 years before 2012. However, for the last two years costs seem to be trending up. Aligning these results with changes to market structure in each region seems to indicate that competition in the market, between investor types and across venues, is good for investors as it reduces costs. The results clearly indicate that trading costs have not decreased at the same rate (or times) in different regions around the world. The differences may be due to the market structure, timing and type of new rules across regions. The report concludes that fragmentation and competition are good for transaction costs.

2.6 Economic Growth and Emerging Markets

Financial system shall support growth not only through the selection of the productive investments, but also by ensuring the efficient allocation of resources via credits to such investments. Bagehot, Goldsmith and Schumpeter were considered to conduct the first prominent studies addressing the relation between financial development and economic growth by highlighting the way a well-functioning financial system should promote economic growth back in 1873, 1969 and 1972 respectively (as cited by El-Wassal, 2013). Since then, the relation between economic growth and financial structures has been investigated by many researches. Some studies document that financial development results in economic growth: accepting the long-run correlation between the level of financial development and

[4] In 2013 Credit Suisse announced Transaction Cost Index, which was designed to show how efficiently markets were absorbing trade flows by measuring investors transaction costs adjusted for different volatility regimes.

economic performance (Arestis et al., 2001; Beck, Demirgüç-Kunt, & Levine, 2000; Beck & Levine, 2004; Cavenaile et al., 2013; King & Levine, 1993; Levine, Loayza, & Beck, 2000; Levine & Zervos, 1998), but others do not (Atje & Jovanovic, 1993; De Gregorio & Guidotti, 1995; Ram, 1999).

The way of the causality, on the other hand, is not very clear. Theoretically, financial development improves efficiency of resource allocation, leading to increased total productivity, hence higher economic growth. Greenwood and Jovanovic (1990) demonstrate that there is a positive two-way causality between financial development and economic growth. For a good discussion about the direction of causality between financial development and economic growth see García and Liu (1999).

Both the banking sector and the securities markets have varying levels of effect on the economy, accordingly their role in economic growth is also varying. The role of securities markets in economic growth has been examined by some authors on its own and by others together with banking sector, as a comparative examination. With respect to the linkage between equity markets and growth, some studies support the positive role of equity markets on economic growth (Atje & Jovanovic, 1993; Beck & Levine, 2004; Levine & Zervos, 1998). Others find a weak relationship between stock markets and economic development (Arestis et al., 2001; Harris, 1997). In one of the recent studies investigating the relationship between the development of banks and stock markets and economic growth Cavenaile et al. (2013) test the direction of potential causality between financial and economic development. Results indicate the direction of the causation from financial development to economic development for the five developing countries analysed. The reported mixed results encourage further study for examining the relation between stock markets and economic growth.

The theoretical explanation for the relationship of stock markets and economic growth is based on the fundamental functions stock markets provide for risk reduction. Stock exchanges are considered to provide better opportunities for spreading and pooling risk compared to other alternatives. In addition formal markets support firms disclose more information about not only their financials, but also their investment projects to investors. These in turn enable more efficient resource allocation, hence raising the marginal product of capital. Stock market development affects growth both at the individual firm level and at the aggregate level by functioning as a complementary to the other parts of the financial system and to other

forms of finance (Claessens, Klingebiel, & Schmukler, 2002). El-Wassal (2005) criticizes this view stating that financial growth alone cannot provide a satisfactory explanation of the persistence of different stock markets after the initial stages of development or the different levels of stock market success. On the other hand, the growth in economy increases per capita income, consequently generating a growing demand for more efficient and broader financial intermediation by the investor side. Therefore, the causation is also possible the other way round, economic growth causing financial growth.

The expansion of the emerging stock markets' growth was a noteworthy international financial development during the last three decades. Market capitalisation increase in developed markets and the world during 1980 to 2000 were 11 and 12 times respectively. For the same period market capitalisation of emerging markets has increased 32 times, indicating to a phenomenal growth. The growth in stock market liquidity as measured by trading value increased 61 and 62 times in developed markets in the world respectively during the period 1980 to 2000. The increase has been by more than 170 times in emerging stock markets at the same period (El-Wassal, 2005).

Emerging capital markets have been the centre of unprecedented attention for several reasons. Their potential for international portfolio diversification is the main factor, which depends on the assumption that the portfolio risk of stocks of these markets may be considerably less compared to the portfolios of developed countries' markets. Emerging markets offer high rates of returns and high volatility simultaneously, moreover their reaction to economic crises and market crashes are drastic. So emerging markets do not always move in tandem with developed markets, sometimes they move even in the opposite direction from developed markets. Hence another reason making them very attractive for institutional and individual foreign investors (Arbelaez, Urrutia, & Abbas, 2001) .

The issues relating to how emerging economies will benefit from growth of stock markets are thoroughly investigated by academics, whereas the factors leading to such growth seem not to gain much attention until recently. Most of the studies are general discussions on policies that may lead to stock market development, so today it is still possible to say that there is a big gap in terms of determining the stock market growth using empirical analysis (El-Wassal, 2005).

Cross-border financial flows have been vastly expanded for the last decades. Particularly, equities in emerging markets have attracted substantial attention from globally oriented institutional investors. As a result, emerging markets received vast sums of liquid capital inflows. Therefore, stock market growth has an important role not only in domestic financial liberalization programmes, but also in attracting the foreign capital flows to emerging economies. Singh (1997) demonstrated the importance of this external flow for emerging economies, because financing for the long-term investments of the large corporations rely on this external flow, hence equity markets. At the time of the study, this finding was contrary to the expectations (Arestis et al., 2001; García & Liu, 1999). Even though the subject of liquid capital inflows is beyond the scope of this thesis, at this point it must be noted that countries with emerging economies have generally benefited from such capital movements, however the economic and financial crises experienced by some of these countries may be partly attributed to the short-term nature of these liquid flows. Solnik and Salehizadeh present a detailed discussion on this subject (as cited in Arbelaez et al., 2001). On the other hand, Lee and Chang (2009) investigated the dynamic interrelationships among FDI, financial development, and real output. They reported that the financial development indicators have a larger effect on economic growth than does FDI.

The research on the determinants of stock market development was fairly limited in terms of both theoretical and empirical evidence. The role of stock exchanges in financial growth of an economy was investigated by Calderon-Rossell in 1991. The partial equilibrium model of stock market growth developed by Calderon-Russel is considered to be the most comprehensive one, which formed the foundation in this subject. This model indicates economic growth and stock market liquidity to be the main determinants of stock market growth. He used data from the main active stock markets of 42 countries in the world with annual observations from 1980 to 1987 (as cited in García & Liu, 1999). He developed a financial theory of stock market development, then based on his model several analysis have been conducted by Arbelaez et al. (2001), El-Wassal (2005), Yartey (2010) and Andrianaivo and Yartey (2010).

Stock market development is generally measured by stock market capitalization. The assessment of stock market capitalization can be made either based on institutional or

macroeconomic factors. For the former approach, institutional factors such as property rights, clearance and settlement, issues, transparency and the inside information problems, taxation issues, and accounting standards are used; whereas for the latter factors such as income growth, savings and investment, financial development, and inflation are considered. Needless to say that the two approaches have equal importance (García & Liu, 1999).

The size of equity markets in developing countries (mainly in terms of new shares issued) increased in the last decade remarkably. Rapid growth and high returns in these markets has been closely watched by the portfolio investors. The share of developing countries in the global stock market has been since then increasing. In 2010, more than one fifth of the total market value of companies traded on the stock markets is of the companies from the emerging stock markets. Strong growth and financial developments in the economies of developing countries have been the most significant factors that support and accelerate the development of stock markets (Bailey, 2010). Other key drivers of emerging stock market growth have been identified as domestic financial liberalization, macroeconomic stability and private capital flows (Andrianaivo & Yartey, 2010).

Many studies investigating the relationship between share prices of stock exchanges and macroeconomic variables are available for major economies, especially for United States, United Kingdom and Japan. The literature review for developed economies is presented in the following studies in detail and may be consulted by the interested reader: Cheng (1995) for UK, Guru-Gharan, Rahman, and Parayitam (2009) for US and Mukherjee and Naka (1995) for Japan. These markets have been shown to be sensitive to inflationary variables such as the change in unexpected inflation, expected inflation, the risk premium, and term structure. (Burmeister & Wall, 1986; Chen, 1991; Chen et al., 1986). However, similar studies for emerging economies have been available more recently, particularly in the last decade. Thus, the recent interest in emerging markets is due to the fact that emerging markets' power and role in the global financial world have become more and more important. For instance, in 2003 Wilson and Purushothaman (2003) identified that four biggest emerging economies known as BRIC[5]s together could be larger in U.S. dollar terms

[5] Brazil, Russia, India, and China

than the G6 within the next 40 years. In terms of GDP of all emerging economies, these four emerging economies account for two-fifths of the total when combined.

Whether an increase in the degree of economic growth in per capita output can be explained by the stock market activity level has also been questioned. Harris (1997) uses the same data set used by Atje and Jovanovic (1993): a cross-sectional data of 39 countries over the period 1980 to 1988, but his findings are on the contrary to the conclusions of Atje and Jovanovic (1993). Growth in per capita output is measured as the average annual growth rate of GDP per unit of effective labour which is the difference between annual growth in aggregate GDP, measured at constant prices, and annual growth in the employed labour force. The same variable is used as lagged growth in per capita GDP by backdating the measurement period by 5 years; for period 1975–80. The same applies to other lagged variables. Investment is average annual gross investment including gross capital formation plus net change in stocks and measured over the period 1980–91, as a percentage of GDP. Lagged investment is measured similar to investment only for the period of 1975-80. Growth in labour input is measured by the growth of the total employed labour force, averaged over the twelve year period. Stock market activity is measured as the total annual value of shares traded in 1980 reported as a percentage of GDP. Harris claims that the lagged investment is not a good proxy for current investment, hence including it as an explanatory variable introduces omitted variable bias in the remaining variables. Therefore, he discusses, the level of stock market activity's contribution will be biased upwards. He proposes applying two stage least squares (2SLS) to eliminate the bias and applying it to two sub-samples. All in all, he concludes that the level of stock market activity does not offer much incremental explanatory power neither for the whole sample nor for the developing countries sub-sample, whereas for sub-sample of developed countries, the level of stock market activity does have some impact, but again its statistical significance is weak.

García and Liu (1999) compared the stock market development of major stock exchanges in Latin America with East Asia using macroeconomic factors. They tried to explain the differences of stock market capitalization of these two regions' stock exchanges in terms of real income, saving rate, financial intermediary development, stock market liquidity, and macroeconomic stability. The effects of these macroeconomic factors are also investigated for their prediction power on the future

market development. Pooled data for the period 1980-1995 for 15 countries (including US and Japan as the industrial countries to their sample) is used.

Muradoglu et al. (2000) stated the dynamic linkages between stock markets and macroeconomic variables are even more important in emerging markets of less developed countries. The influence of economic policy is greater on such stock markets and the relationship is assumed to be unidirectional, from economic variables to stock returns.

In another study, stock market development of emerging economies is investigated to find out the role of institutional and macroeconomic factors (Yartey, 2010). Panel data of 42 emerging economies for the period 1990-2004 is used.

Research on stock market behaviour and various multiple macroeconomic variables for South Korean stock market, which was conducted by Kwon, Shin, and Bacon (1997) is known as one of the pioneering studies among emerging financial markets. The independent variables consisted of production index, inflation and expected inflation, risk premium, term structure, dividend yield, trade balance, foreign exchange rate, oil price, and money supply that were time-series regressed on monthly returns of the value-weighted Korea Composite Stock Price Index (KOSPI). Their results showed that the Korean stock market was more sensitive to real economic and international trading activities than that of the U.S. and Japanese stock indexes.

Hammoudeh and Choi (2006) investigated the influence of United States' financial markets, commodity markets and economic policy on the six members of the Gulf Cooperation Council (GCC). This study is of interest and differs from other studies as it examined the effects of global, country and industry factors on the movements and volatilities for the market and not of stock returns. These six exchanges are considered to be very promising emerging markets in the Gulf region: namely Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates. The GCC markets differ from those of developed countries and from other emerging markets in that they are largely segmented from the world equity markets and are overly sensitive to regional political events.

Academic research questioning what benefits stock markets provide to economies, started before questioning what factors underline the stock market expansions. In

1991 both Modigliani and Perotti and Calderon-Rossell have demonstrated that stock exchanges provide benefits and their results led the factors underlining the stock market development gain considerable attention (as cited in Raj Aggarwal & Goodell, 2010; Yartey, 2010) .

El-Wassal (2005) investigated the factors which underlie stock market growth particularly in emerging economies using data for the period 1980-2000. He extended Calderon-Rossell's model including financial and economic policies, foreign portfolio investment and country risk as explanatory variables. Two estimations are performed using a dataset of 40 countries with annual observations over the period 1980 to 2000. Firstly cross-sectional data with dummies is used for estimating cross-sectional regressions. Then country and time series data are combined and OLS regressions are estimated on the pooled data. In order to cater for simultaneity between stock market variables and output growth a Two-Stage Least Squares (TSLS) approach is employed. Secondly, panel data is used to estimate a generalized model with a time trend for both fixed and random effects.

He estimated the models with two dependent variables trading value over GDP and market capitalisation over GDP. There are five explanatory variables in his model; two of them are GNP per capita growth rate and the turnover ratio (only used in the model with market capitalisation over GDP as the dependent variable). For financial liberalisation and privatisation policies three proxies are used interchangeably; the number of listed companies, foreign direct investment FDI over GDP and sum of exports and imports over GDP. Portfolio investment liabilities divided by GDP is used as a measure of foreign portfolio investment. The composite political, financial and economic risk-rating index from ICRG is used (El-Wassal, 2005).

In his model market growth is measured by market capitalisation as a per cent of GDP, economic growth by GNP per capita growth rate and additional stock market liquidity by the increase in turnover ratio. He stated that economic growth, financial and economic policies, foreign portfolio investment and country risk play a significant role in stock market growth for the emerging economies (El-Wassal, 2005).

El-Wassal (2005) noted that trading value ratio and market capitalisation ratio are found to be exchangeable for the top countries since there are no considerable

differences found. He concludes that the economic growth increases the overall stock market activity, but poses the question of whether the growth of stock markets is inherent to countries' economic development and economic structure, or whether the stock market growth was mainly determined by government policies or the behaviour of economic agents. Depending on the current results, his inference is that stock market growth in the emerging economies over the last two decades has been multifaceted.

Claessens et al. (2002) conducted another empirical study on the determinants of stock exchange development. Their study contributed by investigating the migration of trading activity to international exchanges in terms of capital raising, listing and trading activity. Liquidity of the stock market has been found to be a useful predictor of future economic growth (Claessens et al., 2002).

Yartey (2010) depending on the emerging market data, points out to the fact that stock market capitalization hardly relates to the size of the country. He investigated the macroeconomic determinants of stock market development (measured by market capitalization as a percentage of GDP) in emerging markets. He demonstrated that income level, banking sector development, gross domestic investment, private capital flows and stock market liquidity are important determinants, in addition political risk, law and order and bureaucratic quality are also important determinants due to their effect on external finance. He applies a dynamic panel data estimator based on Generalized Method of Moments (GMM) methodology proposed by Arellano and Bond (as cited in Yartey, 2010). The findings of this study demonstrate that the economic growth plays an important role in stock market development. Additionally, it demonstrates that stock market liquidity has a positive effect on stock market development: therefore another approach of promoting stock market development in emerging markets can be based on improving stock market liquidity.

2.7 The Challenges Stock Exchanges Face

The challenges stock exchanges faced in the last three decades is enormous compared to the challenges happened in their long history. They faced transformation, competition, demutualization and globalization all following one other and sometimes facing several of them simultaneously in the last three decades. Demutualization and structural changes had a wide impact scope and triggered a

fierce competition. Competition coupled with technological advances paved the way to merger and acquisitions of stock exchanges. Moreover, demutualization introduced several governance issues for exchanges, which affected the consolidation process as well. Hence, the impact area of structural changes has been extensive. Therefore, in this section these challenges will be summarized referring to their interaction with trading volume.

As the recent global financial crisis showed decisions taken by financial institutions are of paramount importance because of their vast impact scope on corporations, markets, economy and society as a whole. Governance of financial institutions affects a great part of the market they operate in. Additionally in case of exchanges, most of the time their effects are not limited by the market they operate in and their influence reach is far beyond local markets. Securities markets' role in this period has been the subject of debates regarding the aftermath of crises. Putting this subject aside, understanding the structural changes in securities exchanges is important because it lead the way to competition in securities industry for the first time in history.

Deals, alliances, mergers, acquisitions and all sorts of collaborations between exchanges are seen as the exchanges' response to the threat of direct competition (Cybo-Ottone et al., 2000). Despite the competition, exchanges are natural cooperatives (Cybo-Ottone et al., 2000).

Understanding the factors and conditions leading to alliances among stock exchanges was important, but determining the success criteria for assessing these were perhaps even more interesting. Focusing mainly on the European exchanges the factors affecting these deals are examined regarding location, regulation and technology together with the factors that may inhibit the consolidations particularly in Europe. Almost 100 deals among exchanges were examined comprehensively (Cybo-Ottone et al., 2000).

One of the triggers of consolidation is the network effects (Cybo-Ottone et al., 2000). The outcomes of network effects were assessed both in the short and long-term. Cybo-Ottone et al. (2000) highights that network effects can only be seen if the prerequisites are met: the exchanges need to reach a certain size; be it by the

customer base in terms of listed companies or the number of intermediaries, or the reputation of the exchange.

Trading volume takes an important part in the success criteria of these alliances. The planned objectives of many agreements between exchanges included a volume target. Apart from failing to meet this target volume, the concerns about the liquidity split and fragmented trading constituted the reasons for failures of those agreements during the period of 1990-1993 (Cybo-Ottone et al., 2000). Cybo-Ottone et al. (2000) attributes the market power of exchanges to home-country bias of investors, political reasons and currency differences.

In order to analyse the effects of competition on trading volume, one first needs to know about the circumstances causing the structural changes and the outcomes which are the subjects of the following subsections.

2.7.1 Structural Changes and Demutualization

Recent developments in securities markets shall be assessed with a forward-looking vision such that both opportunities and threats introduced by these developments shall be evaluated. Understanding how global competition affected capital markets requires understanding the structures of capital markets, especially of stock markets. Therefore this subsection starts summarizing the needs and drivers of the radical structural changes, followed by the reactions of stock exchanges. By this means, the background necessary for examining the effects of both competition and merger and acquisitions will be provided.

In the last three decades most exchanges have moved from a member-owned structure, in which users of the exchange were also its shareholders, to a for-profit structure. Many have eventually sought to issue shares publicly. Finally, the industry has experienced an unprecedented wave of entry of new platforms for trading. The demutualization wave of exchanges started in 1993 with the Stockholm Stock Exchange. As Reena Aggarwal (2002) stated “structure tends to follow strategy”. The significant changes in organizational structures of exchanges were merely in response to the radical changes in their business environment.

Demutualization can be described as separating trading rights from ownership. As summarized in Figure 2.12, the process of demutualization took place in stages and

ultimately took several different forms. Normal organizational form of early exchanges was similar to a club membership; club members enjoying the exclusive trading privileges (Aggarwal & Dahiya, 2006). This structure enabled ease of contracting and created trust among the members. Thus, exchanges were non-profit membership organizations, which were mainly seen as "national icons" until 1980s. Initially they were transformed to for-profit structures, then they became companies owned by investors, and then again in some countries the local exchanges and related institutions were gathered under one umbrella, in some other countries stock exchanges merged with other countries' exchanges. The process of going public during the demutualization stage or right after it, made those exchanges advantageous by speeding up the decision-making processes during M&As, and also enabling the transfer of shares during M&As rather than cash.

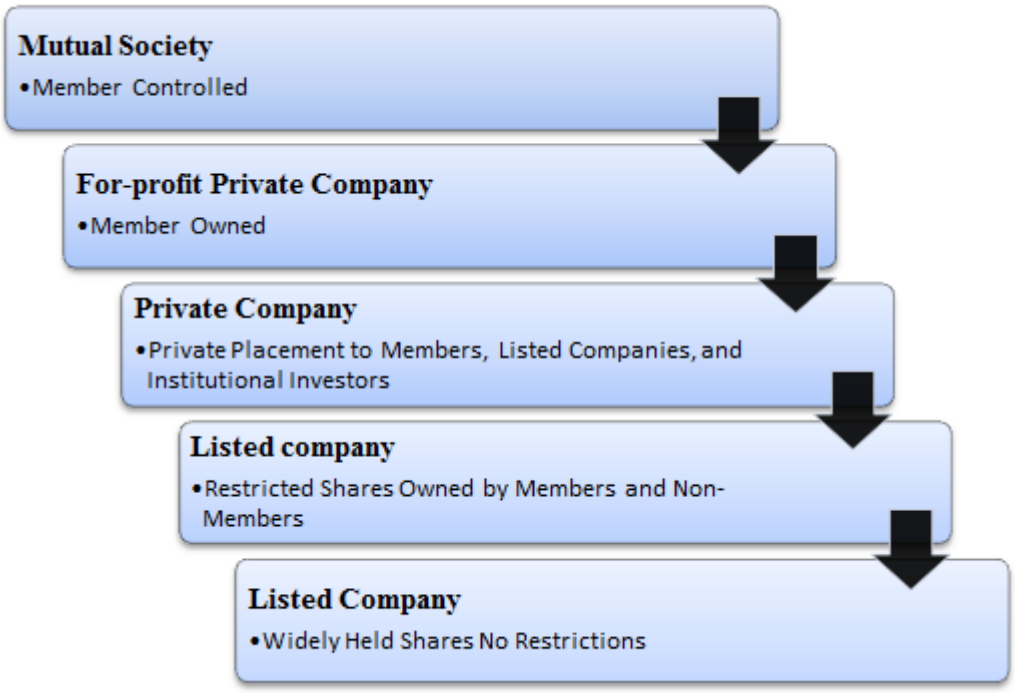

Figure 2.12 : The Process of Exchange Demutualization

The typical government or member owned, national stock exchanges have largely been replaced by for-profit, publicly listed exchanges. Increased product diversity and targeting a wider international investor base accompanied this transition leading to a high level of integration and co-operation among exchanges. The challenges of demutualization are summarized by Islam and Islam (2011).

Today, many countries exchanges have been demutualized. As of November 2012 76% of the World Federation of Exchanges (WFE)'s members have completed the demutualization phase, 44% went to public. The legal status of all the member exchanges can be seen in Table 2.3. For detailed description and the definition of groupings please refer to Devai and Naacke (2012).

Legal status	Number	%
Listed	23	44%
Demutualized	8	16%
Private	8	16%
Association	4	8%
Other	9	17%

Table 2.3 : WFE member exchanges' legal status (Source : WFE, Cost and Revenue Survey, November 2012).

Three main factors are identified leading to the demutualization of financial exchanges (Reena Aggarwal & Dahiya, 2006). Firstly, the interests of member groups diversified as the markets became more sophisticated, creating conflicts both in the governance and decision-making process of exchanges. There was a strong disagreement among institutional investors and floor community on improving the trade execution efficiency and reducing costs. Institutional investors were putting pressure on cost and efficiency issues while these were seen as a threat by the floor community. The traditional organization structure didn't permit to take the necessary steps for the benefit of the exchange timely, because they could hurt some of its member owners. However, the corporate governance structure provided by demutualization is shown to be far more effective in managing conflicts among market participants (Reena Aggarwal, 2002). Consequently, the management of a for-profit, investor-owned organization can easily focus on the mission of maximizing the profits and value of the exchange in a timely manner which is crucial in an increasingly competitive landscape.

Second factor is composed of regulatory issues and market power of exchanges. Exchanges exhibiting "natural monopolies" characteristics introduce issues relating to market power. Market power can be put into use to increase prices and profits at the expense of customers. Regarding regulations the political pressure must also be considered (Reena Aggarwal & Dahiya, 2006). Exchange reputation and branding are two other factors becoming more important in a demutualized environment. The importance and effects of demutualization from a regulatory perspective has been

explained in detail by Reena Aggarwal (2002). Third factor is competition: the subject of the next subsection.

Demutualization is not always followed by going public: for instance Tokyo Stock Exchange was not listed for a long time (more than five years) after demutualization. One of the first requirements of M&As among international exchanges is demutualization of the exchanges. Reena Aggarwal and Dahiya (2006) analysed the effects of becoming public after demutualization on the stock performance and operating performance. For a discussion on the effects of demutualization on exchange members, investors and regulators see Reena Aggarwal and Dahiya (2006). They analysed the performance of demutualized exchanges by comparing the return of the publicly listed exchange with the return of the relevant stock market index. Their findings indicate strong post-listing returns (Reena Aggarwal & Dahiya, 2006). Additionally, more flexible decision mechanisms, better financing, increased accountability (particularly to shareholders) are required for competition, which are provided by demutualization (Reena Aggarwal, 2002).

In recent years, the impact area of the structural changes in stock markets together with mergers and acquisitions, are not limited to the exchanges in this domain, but rather directly or indirectly expanded to all the world's capital markets. The harmonization of regulations was another factor increasing the stock exchange integration. Consequently, the business models and governance structures of the securities market institutions including infrastructure institutions, but particularly exchanges were undergone significant changes. Now that most of the exchanges themselves are listed companies, the primary objective of exchanges is generating profit. The interactions between the structural changes and competition will be examined within the next subsection.

2.7.2 Competition

Three levels of competitiveness affect the success of business enterprises in a globally competitive environment: the competitiveness of the company, the competitiveness of the industry in which the company operates and the competitiveness of the country where the business is located. In a globalised world, both developed and developing countries compete at an international level. For

policy makers in general, one of the most significant issues is making their economies competitive and coping with global risks through rational policies.

The success of a specific industry in a country depends strongly on the national competitiveness of that country (Porter, 2009). Securities markets industry is no exception. Thus, the competitiveness of a nation's industries are greatly affected by the institutions, the infrastructure, the macroeconomic environment and the facilities for health care and primary education (Sala-i-Martín et al., 2012).

The development and continuity of exchanges depend on their ability to survive and succeed in an increasingly competitive environment. For the last two even three decades, competition, globalization and technological advances changed the securities market landscape significantly. For market structure changes and their impact on exchanges refer to O'Hara (2004). Yesterday, competition among domestic exchanges was more common; today, competition is taking place between large consolidated groups operating in an internationalized financial market place. A number of stock exchanges in developed markets are providing multiple equities platforms for a sophisticated equity trading worldwide. The increased competition in securities markets, particularly stock exchanges has been studied by many academics. The first to investigate the competition among trading venues was Demsetz (1969) and Smidt (1971). The literature on competition among stock exchanges from microstructure point of view are presented by Parlour and Seppi (2003), Foucault and Parlour (2004), Chemmanur et al. (2008).

The 1990s was a decade of new exchanges entering the market rapidly. According to Clayton, Jorgensen, and Kavajecz (1999) the factors facilitating the creation of new exchanges were: (1) economic freedom in taxes; (2) regulation and banking; (3) the existence of larger economies. This exchange boom didn't last very long even though the technological advances decreased the costs of establishing a stock exchange significantly, because the same technology simultaneously reduced the need for physically establishing an exchange by providing communication links. These low cost links coupled with the absence of regulatory barriers enabled a favourable environment called electronic communication networks (a.k.a ECNs) for trading (Ramos, 2003).

In markets with higher trading volumes, the price impact of a transaction tends to be smaller, reducing transaction costs. Competition among exchanges is considered to affect the market positively particularly, when the competitive pressure leads to lowering the trading fees charged by the exchanges (Cantillon & Yin, 2011). Another interesting finding of the literature on competition between trading venues is that competition results in self-selecting of traders according to different criteria such as information, trading motive, trading status or access to routing technology. A brief literature survey of this issue is provided by Cantillon and Yin (2011). Three main factors affecting chioce of stock exchange are shown in Figure 2.13.

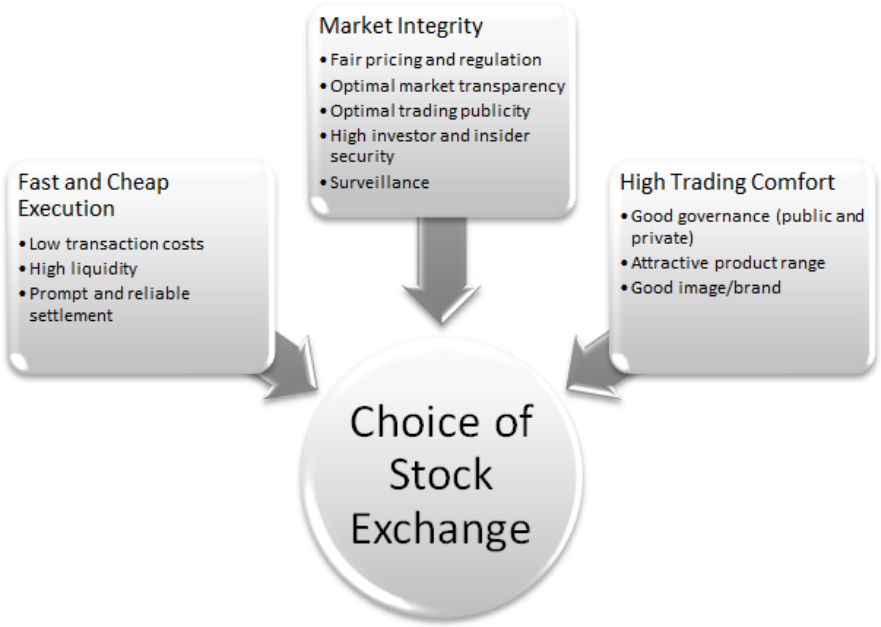

Figure 2.13 : Choice of Stock Exchange.

Exchanges are competing on several issues besides trading and listing; namely price discovery, low price volatility, order flow, price dissemination fees, transparency (Cybo-Ottone et al., 2000; Domowitz et al., 2001). Among them, competition for liquidity and transaction costs being the most important ones (Di Noia, 1998). For the main forces driving the development of competition see Ramos (2003). In some cases, a merger is the only way to survive against these threats, as it will sink costs and create domination in the market.

Kokkoris and Olivares-Caminal (2008) did not anticipate the fierce competition among equity stock exchanges:

> "The degree of competition for trading is consequently low, and the threat of competitive entry (including from a non-European/U.S. exchange) is not likely to place a strong constraint on the major European exchanges. As mentioned above, there is unlikely to be any significant actual competition in the market for the trading of cash equities between stock exchanges."

Nevertheless they didn't fail to emphasize the importance of assuring a sound and effective competition environment for the development and integration of stock exchanges in a global market. They also highlighted the need for an effective regulation to provide confidence and attract investors, which in turn will enable growth and interaction among exchanges. Ultimately these would improve the performance of financial markets. As they conclude, any consolidation in the stock exchange industry calls for the regulatory authorities to ensure an effective and sufficient competition afterwards. The gap between the market expectations and the responses of regulatory bodies is growing rather than diminishing. This is true for all the securities markets throughout the world, though with different degrees. The pace regulatory bodies respond to structural, competitional requirements and technological advances are well behind meeting the expectations of the markets.

Another aspect of competition among stock exchanges is based on the role of market structure of exchanges. Cantillon and Yin (2011) investigated the competition among exchanges in terms of organization structures. Their interpretation of the literature suggested that the market structure of exchanges is shaped by the interaction of exchanges/trading venues and their environments. The responses of exchanges to the heterogeneity of their traders are strategic in nature, playing an important role in shaping the market structure of exchanges. They examined the competition between exchanges in terms of trader heterogeneity, switching costs and market impact. Following their assertion of exchanges being multi-sided markets, they handle the competition issue as a competition issue of multi-sided markets.

Cybo-Ottone et al. (2000) assert that during the competition among exchanges the increase in order flow concentration improves quality of trade execution up to a certain level. That level is reached when the disadvantages of lack of competition outweigh the advantages of the order flow concentration. It is at this point that the quality of execution begins to decline. Therefore the optimum point for

consolidation/competition is determined together with the quality of execution and order flow concentration.

In developed countries intense competition for order flow among securities markets is triggered by technological and regulatory change. Competition reduces both implicit and explicit costs almost at the same rate. This in turn can reduce domestic market spreads (Demsetz & Villalonga, 2001).

As of 2014, Mackintosh and Baudewyn (2014) summarized regional competition and fragmentation of stock exchanges as follows; Asia is fragmented on a geographic and currency basis rather than being competitive within each country. Some markets have introduced competition recently, but it is still at low levels. Europe has a number of stock markets, but they still run along fairly nationalized lines[6]. Primary markets are under more pressure from alternative venues however, the LSE still has 60% market share and the Primary markets in Europe represent closer to 65% share of all trading. In contrast, the primary exchanges in the US trade less than 30% of all volume. Regulations (Reg ATS and RegNMS) are often criticized for the fragmentation that they enable – but they have resulted in the most competitive environment for venues.

It is also possible that mergers may induce competitive harm, causing a post-merger market with reduced degree of competition and reduced degree of innovation, impeding the improvement of exchange services. Sound and effective competition is vital for the development and integration of stock exchanges in the global market whereas effective regulation will provide confidence and attract investors, allowing stock exchanges to grow and interact (Kokkoris & Olivares-Caminal, 2008).

2.7.3 Merger and Acquisitions of Stock Exchanges

Depending on the economic theory, consolidation in a generic industry creates two types of effects; efficiency enhancing effect and potential collusion feature. In case of a network industry like exchanges efficiency, increase come from both supply and demand sides. The increased efficiency through the supply side can be explained by the economies of scale, whereas the increased efficiency due to the demand side is

[6] For more see news article titled "Now or never for Europe's exchanges" published on February 17, 2014 11:29 am in Financial Times (URL-2)

attributed to network effects (Cybo-Ottone et al., 2000). Economies of scale improves cost efficiency by optimizing the use of a fix-cost network, therefore the justification of an investment in new technology is easier after a merger. The required technological infrastructure investments are very high in securities markets, but as reported by Malkamäki (1999) not every exchange may benefit from scale economies, apparently it works only for very large exchanges.

The mergers in the securities market can be grouped into two, namely horizontal and vertical. Horizontal mergers are the mergers of exchanges trying to explore economies of scale and scope. Integration of different parts of the same chain of value: namely listing, trading, clearing, settlement and central custody form the vertical type of mergers (Hart & Moore, 1996). In capital markets, horizontal mergers aim to take advantage of economies of scale by expanding the scope of similar work units (stock markets merging with other stock markets). Vertical integration, on the other hand, is about the integration of the stock exchanges with different sections in order to create value: listing, trading, clearing and settlement services combined under one roof (Hart & Moore, 1996). Sometimes vertical, but most of the time horizontal M&As reduce the number of exchanges, making turnover, market share and profitability figures more closely watched by the market participants.

Malkamäki (2000) investigated whether economies of scale exists in stock exchanges by examining the size and scope of the economies of scale for 38 stock exchanges in 32 countries on 4 continents. The study used panel data for the period 1989-1998, and both linear and non-linear cost functions are applied. The same year in another study, Hasan and Malkamäki (2000) investigated whether expansion would create cost advantages for stock exchanges. They showed that the North American and European markets are more likely to benefit from the economies of scale created by expansion, compared with the Asia-Pacific stock markets. On the other hand, it is noted that mergers among stock exchanges that exhibit small and medium-sized scale of economies might not create cost advantages.

McAndrews and Stefanadis (2002) investigated and compared the stock market M&As that took place in Europe and America, considering the reasons that triggered the mergers, strategies followed, the potential increase in efficiency and restrictions on mergers. Building compatible and shared trading platforms, increasing market

liquidity while reducing fragmentation are among the benefits, whereas product differentiation, legal and regulatory differences, information costs, and homeland bias, and segmentation in clearing and payment systems are considered to be among the blocking elements. Mergers in Europe are foreseen to be completed more quickly. Another study aiming to answer the question of how much progress actually has been achieved in integrating financial markets in Europe in terms of money markets, bank loans, other financial intermediaries (insurance and funds), capital markets, stocks, government bonds, corporate debt instruments, regarding institutional investors in financial and capital markets was carried out. The answer is highest level of integration of financial markets is achieved, but regarding retail financial markets they are still largely fragmented (Muller, 2004).

M&As among securities markets of Europe and America have been investigated by many, whereas M&As in other parts of the world have attracted much less attention. One of the few studies that address M&As in other parts of world examined the financial markets and the exchanges of the countries that make up Southern African Development Community (SADC). It is seen that limited number of companies are listed on the majority of exchanges in the community and those listed companies have low assets and liquidity. The study concludes that resulting benefits and costs of M&As are determined by the market macrostructure, size, scope, institutional and regulatory frameworks. In this respect, unless exchanges provide an appropriate scale, liquidity, strong social and technological infrastructure, it will not be possible to achieve the expected strategic objectives of mergers (Okeahalam, 2005).

Cross-border mergers are of interest for both regulatory and financial points of views. Whether mergers create a synergy is a subject of interest in many sectors, and securities markets is no exception. The structural changes and M&As affect not only the stock exchanges, they also trigger significant changes in post-trading institutions, but this subject beyond the scope of this thesis.

According to Bloomberg LP, the total value of international stock market's mergers is approximately $1 billion since January 2000. In the last 20 years, the M&As among exchanges worldwide has shown no sign of a slowdown. The total size of M&As that took place during the decade between January 2000 and December 2010 was close to $ 1 billion. The value of M&As that took place during 2000 and 2011 are showed in Table 2.4. In February 2012, it was announced that Deutsche Börse

was about to acquire NYSE Euronext, forming the largest stock exchange in the world, but the European Commission vetoed the $ 9.6 billion deal, putting forward that it would harm the competition. The announcement of Intercontinental Exchange to buy NYSE Euronext for 8.2 billion dollars was made on 20 December 2012. Recently even though M&As are decreased in number, regarding the size in monetary terms of the recent single purchase, it is seen that the latest one was more than 8 times of all M&As happened in the previous decade.

Date	Target Name	Target Nation	Acquirer Name	Acquirer Nation	Value ($ mil)
17 Oct 2006	CBOT Holdings	US	CME	US	11,065
27 Mar 2008	Bovespa Holding	Brazil	BM & F	Brazil	10,309
22 May2006	Euronext	Netherlands	NYSE Group	US	10,203
25 Oct 2010	ASX Ltd.	Australia	Singapore Exchange	Singapore	8,305
28 Jan 2008	NYMEX Holdings	US	CME Group	US	7,555
25 May 2007	OMX AB	Sweden	Nasdaq Stock Market	US	4,109
17 Aug 2007	OMX AB	Sweden	DIFC	UAE	3,397
9 Feb 2011	TMX Group	Canada	LSE Group	UK	2,976
30 Apr 2007	ICE Holdings	US	Eurex	Germany	2,821
20 Apr 2005	NYSE	US	Archipelago Holdings	US	2,259

Table 2.4 : Top Exchange Mergers and Acquisitions since 2000 (ordered by value desc) (*Source : Thomas Reuters).*

Cutting costs and becoming more competitive are the two pressures behind the mergers in securities markets. In their study Kokkoris and Olivares-Caminal (2008) examined reasons and properties of primary and secondary listings, factors affecting the preferences of a company for the venue to be listed on for both national and multinational companies and the conditions for an actual competition to exist. The main competitive drivers for listing are nonprice factors of the exchanges: including but not limited to the access to capital/pool of equity capital, openness, and cultural/economic integration (for example, willingness of local investors to invest in foreign companies, economic links, financial links, cultural, and geographic proximity), liquidity of exchange/sectors, regulatory environment particular to exchange, location of business, listing requirements (for example, minimum levels of shareholder equity, minimum number of publicly held shares, minimum operating

track record), reputation, corporate governance of the exchange, presence of analysts covering that exchange, product innovation (for example, new products), post-trade services, process innovation (for example, trading technology), other direct IPO costs, surveillance rules, advertising of the exchange's services, etc. In terms of the competition issues related to primary and secondary listings, they investigated cross-border stock exchange mergers and concluded mainly depending on The Competition Commission Report (2005) and OXERA (2011) report that these cross-border mergers are not likely to raise any competition concerns. The same conclusion was reached for the mergers between exchanges located in different continents or regions for secondary listings, noting that there is a global competition for secondary listing services.

The change caused by mergers may sometimes hurt the competition by reducing the level of competition, which in turn decreases innovation level and slows down the development of services provided by stock exchanges. Kokkoris and Olivares-Caminal (2008) pointed out that robust and efficient competition plays a key role in development and integration of the global markets, additionally efficient regulation attracts the attention of investors due to the confidence it creates, therefore leads to growth of exchanges and interaction among exchanges.

Considering the pros and cons of stock exchange mergers will reveal the following points: the most obvious advantage of a merger is the economies of scale it creates. After a merger, exchanges achieve greater share volumes and this in turn promotes additional liquidity from the combined pools of additional markets. As a consequence, investors with a global strategy benefit from this extra liquidity created by the merger. Moreover, the network effects of consolidated trading reduce operating expenses, and subsequently, could translate to lower fees for traders and brokers (Malkamäki, 1999). On the other hand, this may not be the case; for instance Carey pointed out that liquidity improvement was reduced for the merger between Stockholm and Copenhagen stock exchanges (as cited in Cybo-Ottone et al., 2000).

The cons of mergers shall also be taken into account. Economies of scale may not always be beneficial; there is a possibility that mergers may reduce competition. If few independent exchanges survive along with the reduced competition, the incentive to lower prices could decline (Cybo-Ottone et al., 2000). Actually, it is possible that the competitive harm induced by mergers may have a broader effect: a

post-merger market with reduced degree of competition and reduced degree of innovation, may impede the improvement of exchange services (Kokkoris & Olivares-Caminal, 2008). The overall opinion is that network effects created by mergers are important only after reaching a critical mass.

Another concern may be on the technology side. Instability can be a challenge with exchange mergers since this requires integrating the exchanges' infrastructure, a complex and lengthy undertaking. Disruptions may be experienced during the integration of systems. From liquidity point of view, today dark pools account for about one third of market activity. Exchanges require publicly-transparent pricing, so investors may look for liquidity alternatives to keep their trading anonymous hence mergers may not result in increasing liquidity in this respect.

Network externalities are seen as the most important and powerful economic force behind consolidation (Cybo-Ottone et al., 2000). Networks are defined as utilities in which with every new comer the utility provided by the network is increased for everyone in the network. The growth in a network is not linear, after exceeding a critical mass growth is exponential. Exchanges are considered as networks, because they exhibit both direct and cross network effects. All else being equal, a firm's preference to be listed where others already are, implies the direct-network effect, additionally the preference for a venue with more intermediaries trade imply the cross-network effect. Once the number of listed companies in an exchange exceed a threshold and exchange size reaching a critical mass say in terms of listing, it follows that new additions to listings grow exponentially (Cybo-Ottone et al., 2000). In case of order flow, it is also possible that the growth is affected by an existing lock-in situation which may not favour the more efficient.

Most of the studies investigating how consolidation of exchanges has affected the market liquidity are focused on the liquidity of the stocks traded. Nielsson (2009), examined the effects of mergers forming Euronext (the merger of Amsterdam, Brussels, Lisbon and Paris stock exchanges) on listed firms in the first part of his study and showed that big firms and those with foreign exposure benefited the liquidity gains after the merger. In the second part of the study, the change in the market shares of six major stock exchanges in Europe, which together hold more than 90% of the European market share, has been investigated. The results showed

that Euronext's market share increased by 2.18% after the merger, and that the increase is drawn from the London Stock Exchange.

Cybo-Ottone et al. (2000) presents the factors inhibiting consolidation as country factors, regulatory concerns, lock-in effects, and substitutability of the financial products traded on the competing exchanges. They pointed at the most influential one as barriers in the market regarding the corporate control.

There are common measures even though the competitive position of an exchange is evaluated differently for trading and listing services. In some studies the volume traded is used to measure the exchange liquidity (Cybo-Ottone et al., 2000).

The large impact area of stock exchange mergers involve both economic and regulatory issues affecting investors, firms, financial intermediaries and the overall economy, hence have been the subject of many studies recently. As Nielsson (2009) stated the effects of stock exchange merger is a very broad subject therefore any profound study has to be elective and incomplete in its coverage.

M&As among national or international exchanges in Europe are completed in the early 2000s paving the way for the intercontinental M&As in the late 2000s. In a recent study the effects of macroeconomic variables on the trading volume of stock exchanges are examined for 20 exchanges by taking into account the horizontal mergers in which both sides are equity exchanges. At the beginning of the period the number of the stock exchanges examined was 13, due to the M&As that took place among these exchanges, the number gradually reduced from 13 down to five. The effects of macroeconomic variables on trading volume is observed though with a changing degree and results show that some of the M&As had positive effects on trading volume, whereas some did not (Ülengin & Yobaş, 2012).

2.7.4 Technological Advances

During the 1990s, the impact of technological advances began to be felt, since trading and competition grew outside of the traditional trading floors as explained by Economides in 2002 (as cited in Granados, 2006, p. 102).

Consolidated, average-day volume (total trading in all NYSE-listed stocks) has almost tripled from 2.1 billion shares in 2005 to 5.9 billion shares in 2009. Total daily volume in all stocks listed at the New York Stock Exchange went from about 2

billion shares a day five years ago, to an average of about 5 billion shares a day today. That's a 150 per cent increase, almost all of this gain is due to HFT strategies (Figure 2.14). High-frequency trading now accounts for about 56 per cent of trading volume, according to Tabb Group[7], as Tabb notes this figure includes market makers. Until 2005, it was practically nothing.

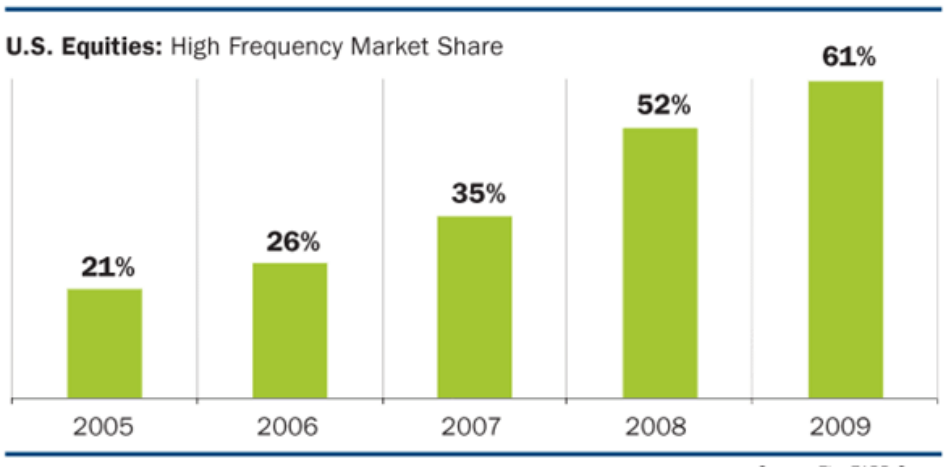

Figure 2.14 : US Equities High Frequency Market Share 2005-2009.

Some approached the technological advances undemonstratively; for instance the study of Massimb and Phelps (1994) on electronic matching systems and their impact on transparency, system performance and liquidity. Back in 1994, they evaluate the strengths and weaknesses of electronic matching systems, criticizing them for not providing sufficient liquidity to meet the demand and the expectations of investors in their paper. Although they accept that electronic matching systems offer operational efficiencies they consider a move from open outcry to electronic matching as a decision between efficiency and liquidity. They suggest applying the technology to the open cry out system for improving the efficiency while maintaining the liquidity advantage. This view is partly shown not to hold, because some electronic matching systems provided liquidity as a source, for a discussion see Cochrane (2013). On the other hand, electronic matching systems are watched and compared with open outcry systems by not only exchanges, but also regulators and customers (Massimb & Phelps, 1994).

ECNs were emerged as a response to the needs of institutional investors and as a reaction to the illegal and unethical practices. The US Securities and Exchange

[7] Man Vs. Machine: What's Right and Wrong with Stock Trading System , (URL-1)

Commission definition of ECNs is "any electronic system that widely disseminates to third parties orders entered into it by an exchange market maker or over-the-counter (OTC) market maker, and permits such orders to be executed in whole or in part." For those who are interested in the history of ECNs there is a comprehensive yet entertaining book by Gorham and Singh (2009).

Technological advances are most felt by the increased speed and connectivity provided. ECNs are viewed as a competitive threat to the traditional markets all over the world, because they enable fast and inexpensive transactions, eliminate intermediaries, and provide anonymity (Schwartz, Beiner, & Humbach, 2001). ECNs have lower trading costs than do exchanges, because of lower commissions, no bid-ask spread, and elimination of market impact. Alternative trading venues enabled by technology played a significant role not only in the fierce competition, but also in market fragmentation. Alternative electronic markets are privately owned business firms rather than membership organizations, hence their organization structure put them a step ahead in raising capital, forming alliances and making acquisitions since they are free from member resistance.

The Island ECN started operating in 1997 as an electronic matching system that accepted, matched, and cancelled orders. In 2002, Island was the most actively traded ECN with considerable market share in Nasdaq traded securities. The Island ECN had 11.2% of the Nasdaq share volume and 21.2% of the Nasdaq trade volume[8]. Island also traded Amex and NYSE listed securities, as well as single stock futures. It was one of the first equity markets to provide a display of the limit order book to all customers on an equal basis. In 2002, Island ECN completed its merger with the Instinet Group and has been renamed INET ATS (Alternative Trading System), Inc. On December 8, 2005, INET completed its merger with Nasdaq.

A recent report on the fragmentation of US markets supported the propositions of Pagano (1989) and Hasbrouck and Saar (2009). According to a 2012 dated Credit Suisse report, the US market is undeniably much more fragmented than it was a few years ago (Avramovic, 2012). No single venue accounts for more than 17% of total consolidated volume. However, this is not because of dominance by dark pools, or even off-exchange (TRF) volumes in general. The biggest change has been the

[8] According to the Island's press release on May 15, 2002.

success of newly-registered exchanges BATS (Nov 2008) and DirectEdge (July 2010). Together they have captured nearly 20% of exchanged-traded volumes.

Technological advances as a whole have changed the economics of the business significantly in several ways: by providing new ways to make markets, by enabling the dissemination of financial information with a greater speed, by ensuring a wide accessibility to exchanges from anywhere in the world, by presenting new interfaces allowing traders to route their orders to the venues most profitable and by introducing algorithmic trading. On the other hand, technology is also changing how geography affects competition within securities markets. Latency times have become an increasingly critical aspect of trading services particularly for those who utilise algorithmic trading.

Technology has dramatically changed the economics of securities industry in a number of ways. Firstly, technology facilitated setting up alternative trading venues and increased competition. Secondly, it changed the role of geography in differentiating exchanges. Thirdly, technology affected the business rules by reducing switching costs and more generally facilitating the routing of traders' orders to different exchanges simultaneously (Cantillon & Yin, 2011). Development of order-routing technologies has increasingly allowed traders to avoid the trading-related switching costs. Algorithmic trading, on the other hand, is having an effect on exchange location decisions and on investment in technology. Today HFTs are the de facto market makers.

If liquidity provision is enhanced when risk is perceived to be lower, then this may explain why ECNs have grown so powerful in the U.S., and why electronic trading systems have proved useful in a wide variety of asset markets (O'Hara, 2004). ECNs have brought more benefits to financial markets in terms of pressure on fees, product innovation, transparency and liquidity than costs, for a survey, see Biais, Glosten, and Spatt (2005). However, high-frequency traders are criticized, because they are mainly concerned about the patterns of prices, volumes, and past trading activity, rather than the "*information*" or opinion about the firm fundamentals (Cochrane, 2013).

Technology affected market transparency of securities markets perhaps more significantly than any other sector. High volume traders prefer ECNs as they provide

the anonymity traders request while diminishing the price impact as a consequence. Transparency is also related to volume as volume is one of the information provided after trade occurs (Madhavan, 2000). In the 1980's exchanges were more isolated technologically (Cybo-Ottone et al., 2000). The underlying technological infrastructure of distribution channels also affects market transparency (Capiello et al., 2003 as cited in Granados, 2006, p. 2). This infrastructure make multiple listing of firms redundant thereby eliminating one of the key reasons for fragmentation of firm listing (Cybo-Ottone et al., 2000).

The developments in information technology enabled electronic trading almost entirely to replace the floor-based traditional trading. According to Reena Aggarwal and Dahiya (2006) the deregulation trend of early 1990s can be associated with and even considered as a response to this shift. Meanwhile, large institutional traders initiated alternative venues where large volumes of trades could be performed bypassing exchanges, known as "*disintermediation*". As a consequence increased deregulation of exchanges is another factor for the increased competition in securities trading (Reena Aggarwal & Dahiya, 2006).

Another main driving force of consolidation in securities exchange industry is related to both the marginal costs of electronic trading systems and the treats of liquidity introduced by ECNs. Even though implementing trading platforms with cutting edge technology requires investing a remarkable capital, exchanges didn't have much alternative since their business model is pretty much determined by the high upfront costs. Particularly after the trading volumes have grown, these investments hence costs were inevitable in order to meet the demands of sophisticated institutional investors (e.g. hedge funds) and to safeguard their liquidity against ECNs. However, once such a trading platform is deployed, the marginal cost of adding more trades being close to zero, provide strong incentives for exchange mergers in which trading systems are combined (Reena Aggarwal & Dahiya, 2006). For exchanges in emerging markets, alliances were more a life and death issue than an advantage for competition.

The main revenue sources of exchanges can be grouped into 4 categories; transaction fees, listing fees, membership fees and sales of information services (e.g. market data). Due to the increased competition in the securities markets industry, exchanges were forced to reduce the listing fees. Meanwhile, as a consequence of

demutualization membership fees are also expected to fall because trading on multiple exchanges or trading platforms became the norm rather than committing to a single venue. Albeit, Reena Aggarwal (2002) state technological advances will diminish the importance of market data as a source of revenue, actually this is not exactly what happened according to the revenue surveys published by WFE. Nevertheless, his proposition that the trading commissions will be the only source of revenue was to a great extent true. He has foreseen that the success of an exchange in generating commissions depends on its ability to generate trading volume which is indeed true.

2.7.5 Institutional Investors and High Frequency Trading

Distinctions between retail and institutional investors are diminishing and seem to disappear. Very sophisticated trading and big volumes were attributed to institutional investors. Foreign institutional investments in the form of portfolio investments are welcome by the developing counties since these do not create debt. Moreover, such investment is expected to increase the liquidity of the stock exchange, consequently reducing the cost of capital for investment. Foreign Portfolio Investment (FPI) is expected to lead to improvement in the functioning of the stock markets, which in turn results in increased trading volume and market capitalization as foreign portfolio investors intend to invest on the basis of well-researched strategies and realistic stock valuation.

The relation between institutional investors and trading volume was investigated in India. Bodla and Kumar (2009) demonstrated that the net investment by foreign institutional investors (FIIs) are influenced by the trading volume of BSE. However, the opposite is not true. The FIIs net investments do not exert significant effect on trading volume of Indian stock market.

According to a Credit Suisse report bid ask spreads continued to widen throughout all of 2012 (Avramovic, 2012). The report attributes this to the fact that low volumes and volatility left fewer profit opportunities for HFT, and the increasingly scarce opportunities could no longer support an industry that swelled so much following the 2008 meltdown. Since HFTs are the de facto market makers today, their competition causes spreads to compress. Therefore now, with less competition, spreads are widening as the report concludes.

Automated trading is seen as a significant contributor to the volatility increase experienced particularly over the past several years. Recently Weisberger and Rosa (2013) discuss this issue by showing that there exists little numerical evidence about overall market volatility increase materially over the past decade, using two different volatility measures in the US equity markets. Secondly, they attribute some of the vulnerabilities in the equity market to changes in market structure (in post-regulation NMS era[9]) by demonstrating that oversized individual orders which are larger than the immediately available liquidity can create sharp price movements. They address these issues and the Flash Crash of 6 May 2010 which they consider a liquidity issue in terms of regulation. They claim the vulnerability issue is directly connected to the mismatched trading volumes of demand and supply hence, volatility is caused by the same mismatch.

Until the end of 1990s almost all trades were executed individually by traders or via the specialists at the NYSE (Weisberger & Rosa, 2013).The first use of automation were mainly for order delivery (DOT), order grouping (program trading) and order matching (primarily in ECNs such as Island and Instinet). In almost two decades automation has come to dominate smart order routing, the handling of institutional orders, and market making. Weisberger and Rosa (2013) estimate that the majority of institutional trades are now handled electronically and most retail trades are handled via automated market making. Public opinion regarding automation is largely negative not only because it is seen responsible for increasing systemic volatility, but also that it works in the expense of retail investors. ECNs match orders anonymously which is a fundamental feature as these systems were developed by and for institutional investors such that they trade among themselves without the interference of middlemen. Weisberger and Rosa (2013) agree that the current market structure is vulnerable to large price dislocations in single stocks. Nevertheless, they believe it is due to other factors: mainly regulation which reduced both the incentive and the means for market participants to commit capital that would provide a buffer against oversized orders. They believe automation has affected markets positively: enabled tighter average bid-offer spreads and reduced trading costs, and improved overall execution quality.

[9] Regulation NMS includes new substantive rules that are designed to modernize and strengthen the regulatory structure of the U.S. equity markets (URL-4)

According to a recent report by Credit Suisse, trading costs for institutional investors decreased 30% between 2005 through 2012 (Mackintosh, 2013). Furthermore, according to data published by Thomson Reuters, retail trading costs have declined even more. The widely used metric of effective spread divided by quoted spread indicates that costs have fallen by more than 35% between January 2006 and January 2013 (Weisberger & Rosa, 2013). However, in a report that dates February, 2014 by Credit Suisse, recently volumes (shares traded) and turnover are down significantly in Europe and the US.

In an attempt to explain the increased transaction costs in all regions over the past two years the changes took place in the same period is examined (Mackintosh & Baudewyn, 2014). Regulators have been quite active in the past five years. Many of those changes come into effect in the past two years – including:

- Transaction taxes in Europe were introduced in France in 2012 and Italy in early 2013.
- Globally, bank capital requirements have been raised and prop-trading has decreased – via new central bank requirements in Europe and the US, and also Dodd-Frank and Volker rule changes.
- Rules to improve the robustness of the US market were also introduced between 2010 and 2013, including eliminating stub quotes[10], defining clearly erroneous trades, market and single stock circuit breakers (replaced by limit-up/down). But it's hard to see how they would increase costs.
- However, some new US rules might impact the willingness of short term traders to participate in the market. This in turn may decrease risk absorption and increase costs for institutional investors. These rules include: large trader reporting, restricting naked market access and new short-sell restrictions (that trigger after a 10% fall).

[10] A stub quote is an order placed well off a stock's market price. Stub quotes are used by trading firms when the firm doesn't want to trade at certain prices and wants to pull away to ensure no trades occur. In order to make this happen, the firm will offer quotes that are out of bounds. A stub quote also serves as a safety net in that if a market maker doesn't have enough liquidity available to trade a stock near its recent price range, then a stub quote is entered so that the market maker complies with its requirements without extending its quotes beyond its available liquidity.

The threatening side of the highly automated current equity market structure is its vulnerability to large, price-insensitive orders that exceed the size of the available liquidity in the first few levels of the order book. Electronic trading by nature involves less human oversight (Weisberger & Rosa, 2013).

For a brief literature review of recent empirical studies related to automated or high frequency trading and its impact on various markets, consisting of 38 empirical studies refer to The Futures Industry Association (2013).

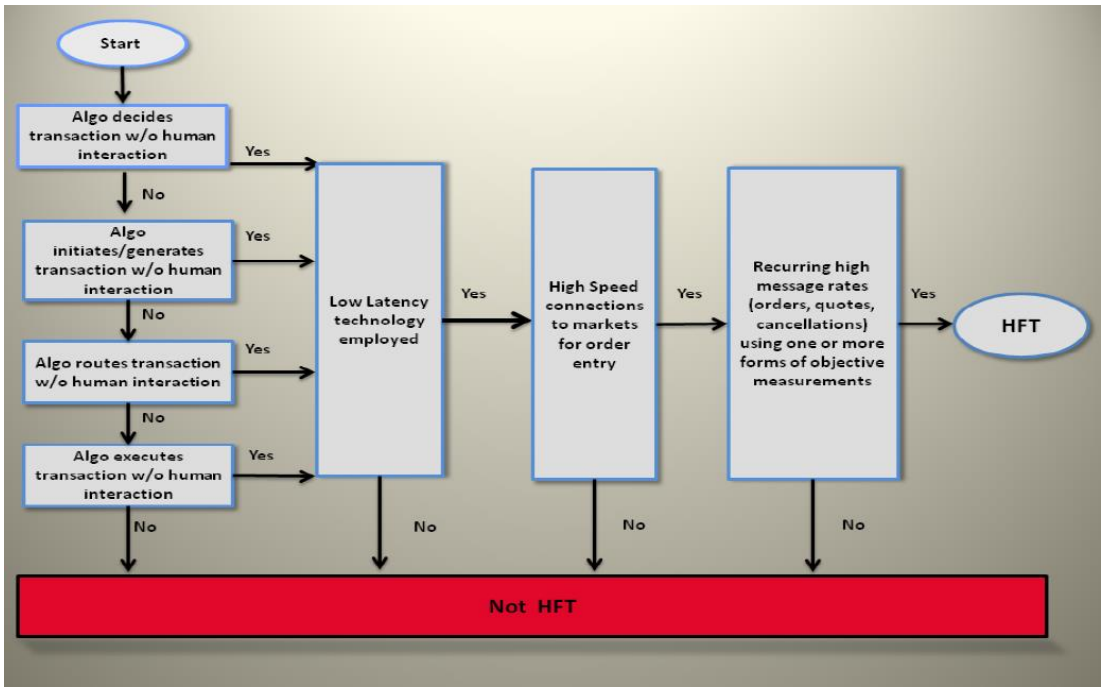

Figure 2.15 : Algorithmic Trading and HFT (*Source: CFTC TAC, Working group 1).*

As the Credit Suisse report dated 20 February 2014 confirms, HFT profits are down, and some notable closures support estimates of HFT activity falling. This also points to an over-allocation to HFT strategies back in 2010, artificially depressing the cost of liquidity. Ultimately, that may have resulted super-optimal trading conditions for real investors (Mackintosh & Baudewyn, 2014).

Silva and Chavez (2002) investigated whether differences in asymmetric information are related to stock characteristics, number and sophistication of security analysts, listing and disclosure requirements, ownership restrictions, and voting rights. They compared the Mexican stock exchange with NYSE and couldn't found any effect of the above factors on asymmetric information. On the other hand, Barclay,

Hendershott, and McCormick (2003) compared ECNs with Nasdaq market makers in terms of informed and uninformed traders and demonstrated that trades are more likely to occur on ECNs when information asymmetry is greater and when trading volume and stock-return volatility are high. Their comperative study indicates that ECN trades have greater permanent price impacts and more private information is revealed through ECN trades than through market-maker trades. They questioned when traders are more likely to prefer ECNs over market-makers and identified three properties of stocks which play a role in this decision: high trading volume, large market capitalization, and fewer market makers. They conclude the higher frequency of ECN trades during periods of high trading volume and high stock-return volatility suggests that ECNs attract a higher fraction of informed trades than market makers. Among others, one reason, especially in fast moving markets, is that informed traders may prefer the ECNs' speed of execution and pre- and post-trade anonymity.

3. ECONOMETRIC APPROACH

In this section panel data methodologies will be presented briefly. The necessity for panel data, its characteristics, the strengths and weaknesses of panel data models will be explained, followed by the appropriate methodologies for modelling dynamic relations. The stationarity properties of time series and cointegrated relationships are two crucial concepts for understanding dynamic relationships, therefore initially they will be explained in Sections 3.1 and 3.2 respectively. Then a brief explanation of error correction models will be presented together with the two complementary subjects namely impulse response analysis and variance decomposition. The panel data methods presented in this section are mainly based on the information provided in Hsiao (2003) chapter 1. A comprehensive analysis and review of panel data is provided in Hsiao (2003) and B. Baltagi (2008).

Analysing the effects of macroeconomic variables on the aggregate trading volume of an exchange calls for a methodology capable of capturing the dynamic relationships, as well as distinguishing short and long-term effects of macroeconomic variables. Many economic and financial times series inherently exhibit trending behaviour and have a more complicated dynamic structure than is captured by a simple auto regression AR(1) model. Analysing dynamic relationships, especially when both long and short term relationships are investigated, is not straightforward and necessitates some preliminary steps to be taken in order to decide on the best methodology to employ. This is particularly so for cases in which macroeconomic variables are used as explanatory variables.

Trends in the data whether deterministic or stochastic, can lead to a spurious result in an OLS regression. The phenomenon known as *spurious regression* causes a too good to be true R^2 even when there is actually no relation at all among the dependent variable and the explanatory variable(s). The time trend causes the high R^2. Thus, trend dominates other stationary variables and the OLS estimators are generated solely by time trends. A partial solution to remove the effects of deterministic trends is including a time trend regressor. A simple solution would be to de-trend the

variables. Unfortunately, neither of the solutions works, if the variables are non-stationary with stochastic trends, thereby inevitably leading to invalid inferences.

A panel dataset, also known as *longitudinal data* is characterised by combining the cross-sectional and time-series properties of the sample. Thus, panel data sets have two dimensions: cross section (N) and time (T). Observations for cross-sectional data can belong to individuals, companies, countries, regions or as in this study stock exchanges. Time-series dimension provides several sequential observations for a single entity in time. The frequency of series can be in a wide range e.g. minute, daily, monthly, quarterly, annually. Panel data sets include more data points since the data set includes data from both time-series and cross-sections.

In economic research, when available, panel data is preferred over time-series or cross-sectional data because of the advantages it offers. One advantage is related to the extended information base by pooling data over both individual cross sections and time: more data points increase degrees of freedom and reduce the collinearity among explanatory variables. This in turn improves the efficiency of econometric estimates. In the empirical literature, it was sometimes difficult to find large time series for some empirical problems. Panel datasets are the solution to this limited time observations problem, as they benefit from the growing multiple cross-sectional dimension.

Now suppose that there are panel observations of Y_{it} and X_{it} with large cross sectional and time series components. In this case, even if the noise in the time series regression is strong, the noise can often be characterized as independent across individuals. Hence, by pooling the cross section and time series observations we may attenuate the strong effect of the residuals in the regression while retaining the strength of the signal (X_{it}). In such a case, we can expect a panel-pooled regression to provide a consistent estimate of some long-run regression coefficient (Soytas & Sari, 2007).

Another advantage of using panel data is related to measurement errors. In the usual circumstances, measurement errors can lead to unidentification of a model. However, the availability of multiple observations for a given individual or at a given time may allow a researcher to identify an otherwise unidentified model.

A key econometric problem that often arises in empirical studies is the presence of omitted (mismeasured or unobserved) variables that are correlated with explanatory variables. Panel data possesses information on both the intertemporal dynamics and the individuality of the entities being investigated. By this means, it provides control in a more natural way for the effects of missing or unobserved variables.

More importantly, some of the economic questions cannot be addressed using conventional cross-sectional or time-series data set, such problems require longitudinal data sets. Panel data allows us to construct and test more complicated behavioural models compared to the models constructed using purely cross-sectional or time-series data. Microdynamic and macrodynamic effects typically cannot be estimated using a cross-sectional data set; a single time-series data set usually cannot provide precise estimates of dynamic coefficients either. It is shown that in certain cases the availability of panel data can actually simplify the computation and inference of estimators. An example is the time-series analysis of nonstationary data. The large sample approximation of the distributions of the least-squares or maximum likelihood estimators when $T \rightarrow \infty$ are no longer normally distributed if data is nonstationary. If panel data is available and observations among cross-sectional units are independent, then one can invoke the central limit theorem across cross-sectional units to show that the limiting distributions of many estimators remain asymptotically normal and the Wald type test statistics are asymptotically chi-square distributed.

However, panel data is not exempt from some issues to be aware of: two of them are heterogeneity and selectivity bias. Heterogeneity bias is related to the differences in individuals that may be subject to the influences of different factors; hence both cross-sectional and panel data are prone to this bias. Ignoring the individual or time-specific effects that exist among cross-sectional or time-series units, but are not captured by the included explanatory variables can lead to parameter heterogeneity in the model specification. Ignoring such heterogeneity could lead to inconsistent or meaningless estimates of interesting parameters.

Selectivity bias can be again a potential issue for both cross-sectional and panel data. It may be encountered if the sample is not being randomly drawn from the population. Using a non-random sample may bias the least-squares estimates. As a result, panel data offers valuable advantages over the conventional cross-sectional or

time-series, by providing unique solutions that others lack. However, it must be noted that when panel data is to be used, selectivity and heterogeneity biases should be cared for.

It has long been recognized by econometricians that panel data can distinguish effects that time series or cross section data alone cannot identify; nonstationary panels provide a further instance of this phenomenon.

When nonstationary variables that are not cointegrated are regressed on each other R^2 tends to unity as $t \to \infty$. A rule of thumb is to be cautious when R^2 is greater than DW. Suppose that we have two nonstationary random vectors, say $Y_{i,t}$ and $X_{i,t}$. When there is no cointegrating relation between Y_{it} and X_{it} if a time series regression for given i is performed, then the regression coefficient is well known to have a nondegenerate limit distribution and the regression is characterized as spurious. The problem with the spurious regression is that t- and F-statistics do not follow standard distributions (C. W. Granger & Newbold, 1974).

Traditional panel data approach cannot be used to analyse non-stationary data since the traditional static fixed effect or random effect model demands for stationary series. However, macroeconomic variables are known to be nonstationary. In order to include non-stationary variables in the model, they have to be converted to stationary series by means of differencing. Only then the traditional fixed effect or random effect model can be estimated. But again, there is the possibility that this conversion may cause the long-run cointegration or long-run causality among variables to disappear.

In order to avoid the spurious regressions, another alternative is to use the logged differenced data (instead of levels); by this way the unit root is removed, however permanent component of the data is also removed with differencing. Consequently, the removal of the permanent component removes important information concerning the evolvement of short-run movements as well (Stock and Watson, 1988 as cited in Nasseh & Strauss, 2000).

In such circumstances cointegration methods can be employed, rather than differencing. In order to overcome such obstacles and to retain dynamic long-term relationships while analysing the data, the panel cointegration and panel vector error correction models are employed.

In a multi-step approach the first step is to identify the stationary properties of the dependent and explanatory variables. The methodology to be used will be decided depending on the outcome of stationarity tests. Investigating a relationship including macroeconomic variables requires special treatment of the dataset due to the characteristics of the variables; thus most of the macroeconomic variables are known to be non-stationary.

If the variables are found to be non-stationary, the second step is checking for the existence of any cointegrated relations among the non-stationary variables. If the two steps indicate that the variables (or some of them) are non-stationary and among those there exists one (or more) cointegrated relationship(s) then the best methodology is to apply Vector Error Correction (VEC) model to the dataset at hand. Vector Error Correction Models enable examining the short and the long-term relationships separately. Moreover impulse response analysis and variance decomposition help to probe the relation far more.

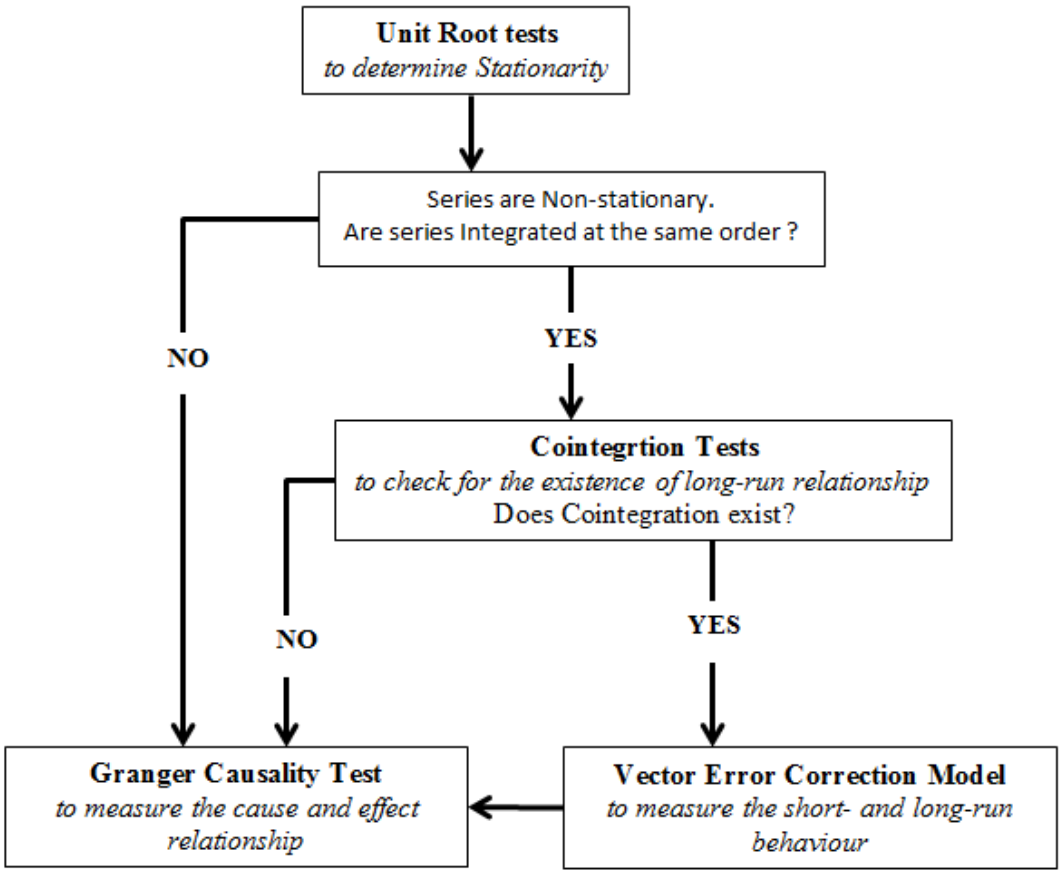

Figure 3.1 : Flow diagram for VECM.

In the following subsections these treatments shown in Figure 3.1 will be briefly explained; namely unit root in Section 3.1, cointegration in Section 3.2, the methodology vector error correction model in Section 3.3, impulse response in Section 3.3.1 and variance decomposition in Section 3.3.2. For those who are familiar with these concepts can skip this section and continue directly to Section 4, in which data set is introduced, empirical model estimation and findings are presented. In the remainder of this section, I will not attempt to provide a complete theoretical review, neither will I give full details of the various procedures. Instead, I will highlight the need, the assumptions and the differences of the procedures, including their relative strength and weaknesses. Additionally, a brief explanation on how to interpret results of the tests will be presented, since there are still ambiguities as how best to interpret the panel test results when the null has been rejected. Throughout the following section great care has been given to provide extensive references to sources where further details can be found.

3.1 Unit Root

This section reviews main concepts of non-stationarity in both time series and panel data starting with a description of the stationary properties of series and panel data followed by the motive and rationale of using unit root tests. Then a brief explanation of the panel UR tests will be presented highlighting their main differences. Lastly, the interpretation of the results will be explained.

Today it has been a common practice in macroeconomic analysis to test for unit roots, however their existence and effects on the models were largely unknown before 1982. It has been three decades since the highly influential work by Nelson and Plosser (1982) on the existence of unit roots in macroeconomic time series was published. Their 1982 paper is usually recognized as an important contribution with repercussions for theory and policy; as the starting point of a large literature in macroeconomics and econometrics. Nelson and Plosser (1982) demonstrated that economic time series has a tendency to move farther away from any given initial state in the long-run. In less than two decades, there were already many empirical econometric works conducted on economic models that used panel data for which the time series component was nonstationary. Testing growth convergence theories in macroeconomics, estimating long-run relations between international financial

series such as relative prices and exchange rates, and spot and future exchange rates are a few examples (Phillips & Moon, 1999).

A series is said to be (weakly or covariance) stationary if the mean and autocovariances of the series do not depend on time. Any series that is not stationary is said to be nonstationary. To put it another way; shock is usually used to describe an unexpected change in a variable or in the value of the error terms at a particular time period. When we have a stationary system, effect of a shock will die out gradually. When we have a non-stationary system, effect of a shock is permanent. The two characteristics of a covariance stationary time series are a fixed mean and a finite variance, known as Wold's theorem (more about Wold theorem later in Section 3.3.1 Impulse Response). There are fundamentally two types of non-stationary processes, so when a series is found not to be stationary, the underlying process can be one of the two types: namely trend and difference stationary processes. Trend stationary series can be expressed as a deterministic function of time (trend) along with a stationary stochastic component. Difference stationary series are series for which first or higher order differences is stationary. The main difference between trend stationary (TS) and difference stationary (DS) processes is that DS is purely stochastic in nature while TS is fundamentally deterministic. Both types of processes can be denoted by a linear function of time plus the deviation from it, however deviations exhibit different characteristics. In TS type processes deviations are stationary. On the other hand, in case of DS type processes deviations are a function of historical events. Since they are accumulation of stationary changes, they are not stationary. As a result, two types of series can and shall not be treated in the same way, otherwise there are important consequences. Any diversion in the short run will affect the long-run expectations of a DS series, whereas its impact will be very limited in the TS series. There is evidence for the non-stationarity of economic series to be of difference stationary type (Nelson & Plosser, 1982).

A nonstationary time series can be transformed into stationary by differencing or detrending. Nonstationary series which can be transformed into stationary by differencing are called difference stationary. The minimum number of times series needs to be differenced to reach stationarity is an important property of the series (as we will see soon), hence it is reflected in the naming of the series using a term; integration. A time series is called integrated followed by a number within the

parenthesis; this number indicates the order of integration. This terminology allows a uniform representation for all series whether they be stationary or nonstationary. For instance an integrated of order 1 series is denoted by *I(1)*, a stationary time series is said to be integrated of order zero, *I(0)*.

In order to investigate the existence of a long-run relationship among variables, the stationarity of variables needs to be identified. Identifying the order of integration of variables is important because the asymptotic distribution of parameter estimates depend on integration *I(n)* level of the variables. Hence, one should first test a time series to see if it is stationary.

There are two main motives behind applying unit root tests. First and the most common one is the necessity to identify the order of integration in order to set up an appropriate econometric model and draw conclusions. It is used as a descriptive tool to investigate the stationarity properties of the series prior to establishing an econometric model. This is a crucial step because as shown by Nelson and Plosser (1982) integrated variables lead to non-standard distributions and possibly spurious regression results. The procedure is as follows; as with many tests, initially assume the series is non-stationary (has a unit root), reject this hypothesis only, and only if, there is clear evidence for rejection. Once the variables are classified as integrated, stationary or perhaps deterministic trend stationary, then one can sort out long-run and short-run effects in the model, so as to set up a model in which statistical inference will be meaningful. Secondly, motivation depends on theory; economic theory suggests that certain variables should be integrated a random walk or a martingale process.

In practice, testing for a unit root takes place in the presence of uncertainty about the appropriate degree of any deterministic trend that the data may contain. Consequently, unit root tests are often conducted after some kind of pre-test for the trend; such pre-tests may be very informal, such as inspection of time plots of the data, or may be implemented by testing the significance of the coefficient on the time trend in an equation fitted to the data. As Engle and Granger (1987) stated there are substantial differences in appearance between a series that is *I(0)* and that is *I(1)*.

As in many areas of statistics one can achieve quite a lot just through fairly simple plots. For example, one might look at a time series plot to see whether the mean or

the variance of the time series changes over time. Another useful indication is to compute the auto covariance or spectrum (or both) on two different parts of the time series (that themselves "seem" stationary). If the two quantities from the different regions look very different then this provides some evidence of non-stationarity (Ayat & Burridge, 2000). Additional graphical procedures might be to look at some kind of time-frequency or time-scale plot and see if this exhibits constancy over time or not. If a test or a plot indicates non-stationarity in a particular way, then that non-stationarity can be modelled in a number of ways as described next. For instance Hammoudeh and Choi (2006) perform the robust and stability test using the graphic analysis described by Hansen and Juselius. Hansen and Juselius suggest looking at the graphical behaviour of the estimated cointegrating relations before deciding on the number of cointegrating vectors when the number of cointegrating vectors is not clear. A detailed explanation of this analysis is provided by Hammoudeh and Choi (2006).

Since the seminal contributions of Dickey and Fuller (1979, 1981), many test procedures have been developed in the statistics and econometrics literature to identify the order of integration of a time series, notably Said and Dickey (1984), Phillips and Perron (1988), Stock (1991), Kwiatkowski et al. (1992), Elliot et al. (1996), and Ng and Perron (2001). Despite the variety of available tests, the Augmented Dickey-Fuller (ADF) test of Said and Dickey (1984) is by far the most favourite one in the applied literature on neutrality.

Initial UR tests were all developed for time-series. Later with the increased availability of panel data, the need for tests applicable to panel data emerged. Panel data tests are developed mainly on the grounds of single time series UR tests. For instance the Kwiatkowski, Phillips, Schmidt, and Shin (1992) (thereafter KPSS) test is developed for single time-series, later Hadri generalized it for panel use; hence Hadri test in panel can be considered as the equivalent of KPSS for panel datasets. Panel unit root tests can have the usual benefits of using a panel, in so far as increasing the number of observations. As Campbell and Perron (1991) indicate the power of the unit root, cointegration and causality tests depend on the size of the datasets used; short-time spans of individual datasets weaken the power of the tests. Hence another reason for the development of these techniques for the panel data, was the low power of the ADF and DF unit root tests for the univariate case against near

unit root alternatives. As Levin and Lin (1992) have shown the panel approach substantially increases the power of the test relative to the time series ADF tests. Recently panel unit root tests are becoming more popular not only because of their ability to capture the cross-section specific effects, but also allowing for heterogeneity in the direction and magnitude of the parameters.

Today there are several UR tests available for both time-series and panel data; however only a handful of them gained an overall acceptance, hence being applied widespreadly. Among the ordinary tests the augmented Dickey-Fuller (ADF) of Said and Dickey (1984) is the most well-known, although the Z tests of Phillips and Perron (1988), and the stationarity KPSS tests of Kwiatkowski, Phillips, Schmidt, and Shin (1992) are also used frequently.

In this subsection the focus will be on panel UR tests while providing the underlying approach of tests and pointing to their differences. The focus will be on six different panel unit root tests that are used in this study: namely Levin, Lin and Chu (hereafter referred to as LLC), Im, Pesaran, and Shin (hereafter referred to as IPS), two Fisher type tests proposed by Choi (2001) and Maddala and Wu (1999), Breitung and Hadri.

The reason for the existence of so many tests is that formal hypothesis tests tend to concentrate on testing one kind of alternative, but are often insensitive to other kinds (but, of course, they are often very powerful for the phenomena that they are designed to detect). Therefore, many test procedures are developed, each being a solution to a particular part. For more information on such tests see Priestley (1983) and Van Bellegem (2003) (as cited in Nason, 2006, p. 14 Chapter 11).

Surprisingly, given that there have been quite a few possible procedures proposed for testing unit roots in panel data, which one to employ is a fairly complex question. Answering the following questions can lead to a better decision:

1. What is the null hypothesis? In most cases, that will be unit root for all cross-section units,

2. What does the alternative hypothesis indicate?

3. What's heterogeneous and what (if anything) is homogeneous?

4. Depending on the sample size available, how do we deal with the small sample effects?

A major difference between tests of single time series and panel datasets lies in the alternative hypothesis of these tests. In case of a single time series the alternative is straightforward to interpret since it is the reverse of the null; if null asserts existing unit root (non-stationary) then alternative means time series is stationary (has unit root). However in a panel setting even though the null is the same, the interpretation of the alternative hypothesis is rather controversial, depending on the assumptions made about the homogeneity/heterogeneity of the panel (Pesaran, 2012). In the event of a rejection in panel UR tests or in applications with a relatively large time dimension of the panel, Pesaran (2012) recommends the test outcome to be augmented with an estimate of the proportion of the cross-section units for which the individual unit root tests are rejected. The alternative hypothesis of the panel UR tests are either in the form of H_{1a} or H_{1b}:

H_{1a} : Each of the series are stationary as a panel,

H_{1b} : At least one of the series in the panel is generated by a nonstationary process.

Tests within homogeneous dynamic panels have a drawback in using H_{1a} since a rejection does not ensure that all series are indeed stationary. Another drawback is that it is inordinately restrictive, particularly for cross-country studies involving differing short-run dynamics. On the other hand, it is demonstrated that H_{1b} is only appropriate when N is finite, namely within the multivariate model with a fixed number of variables analysed in the time series literature, because with large N and T the power of the test is decreased. Therefore Pesaran (2012) proposes a third alternative H_{1c} which lies somewhere between H_{1a} and H_{1b}.

The alternative can be one of three; a single common stationary root, heterogeneous stationary roots, or even the rather vague “not all unit roots” (that is, some could have unit roots, but not all do). In case of the rejection of null Pesaran (2012) criticizes the above tests for not providing the information on which series are stationary. He points out that neglected heterogeneity (even if purely random) can lead to spurious results in dynamic panels due to the asymmetry of the null, therefore he suggests that the alternative hypotheses must be taken into account particularly in cross-country analysis in which slope heterogeneity is a norm. For a survey of panel unit root tests refer to Breitung and Pesaran (2008).

There is an ongoing debate on the tests; ADF is still the most favourite test despite Pantula, Gonzalez-Farias, and Fuller and Elliot, Rothenberg, and Stock present empirical evidence that the power of the standard ADF test is dominated by other test procedures (as cited in Noriega, 2004).

There is a large literature in macroeconomics and econometrics regarding unit root tests. Accordingly, there are many other panel UR tests available; (e.g., Binder, Hsiao, and Pesaran (2000); Choi (2002); Harris and Tzaralis (1999); Im, Pesaran, and Shin (1997); Levin and Lin (1993); Levin, Lin, and Chu (2002); Maddala and Wu (1999)).

The number of ways tests differ are listed below (1,2 and 5 are based on the assumptions of the tests);

1- The assumption of homogeneity of the cross-sections in the panel. This assumption is considered to be restrictive, because in many studies the cross-sectional units (company, country etc.) are not exempt from correlation. So, as a response, new tests are developed allowing for heterogeneity in the autoregressive coefficients for all panel members,

2- The way tests deal with serial correlation and heteroskedasticity in the errors,

3- The assumption of cross-sectional independence among panel units,

4- Whether individual-specific trends are included, if so how the bias correction mechanism work,

5- The assumptions regarding the null hypothesis and the alternative hypothesis,

6- Test being parametric or non-parametric,

7- Whether test requires the determination of lag length beforehand,

8- The power of the test.

Tests can be grouped into two types: "*Common root*" indicates that tests are estimated assuming a common AR structure for all of the series, whereas "*individual root*" is used for tests which allow for different AR coefficients in each series. Panel unit root tests are similar, but not identical, to unit root tests carried out on a single series. For a brief description of the six panel unit root tests applied in this thesis it is recommended to consult the original literature provided in Hsiao (2003).

Regarding the heterogeneity issue, testing procedures almost uniformly allow the short-run dynamics to differ among individuals, not just in coefficients, but also in the number of lags which means allowing for unbalanced samples.

The most critical factor in the ADF test is to find the correct augmentation, lag length of Δx_{t-k}. In general the test performs well if the true value of k is known. In practice it has to be estimated; the outcome of the test might change depending on the choice of k.

There are many perfectly reasonable ways to choose the lag length, however they don't necessarily give the same lag length. Actually selecting an appropriate lag length is an issue particularly when tests are applied to multiple short time series, since the results may vary depending on the selected lag length. Consequently, there is no unique "correct" value for any test which relies upon lag pruning. This is also true if a test depends upon a long run variance, as the value will depend upon the lag window chosen.

Phillips and Perron (1988) have developed a more comprehensive theory of unit root nonstationarity. The Phillips-Perron (thereafter as PP) unit root tests differ from the ADF tests mainly in how they deal with serial correlation and heteroskedasticity in the errors. In particular, where the ADF tests use a parametric auto regression to approximate the Auto Regressive-Moving Average (ARMA) structure of the errors in the test regression, the PP tests ignore any serial correlation in the test regression. The PP tests correct for any serial correlation and heteroskedasticity in the errors out of the test regression by directly modifying the test statistics, therefore the calculation of the test statistics is more complex than ADF. PP tests usually give the same conclusions as the ADF tests; however one advantage of the PP tests over the ADF tests is that the PP tests are robust to general forms of heteroskedasticity in the error term. Another advantage is the user does not have to specify a lag length for the test regression.

The LLC (2002) test is the most commonly used procedure for panel data. It is based on the ADF test; developed as an expansion on the work of Levin and Lin (1992). LLC accepts the same assumption of a homogeneous panel as in LL indicating identical coefficients across cross-sections in both the null and the alternative hypothesis. Additionally, different lags are allowed across different cross sections.

On the other hand, the IPS (2003) test is an extension of the LLC test that relaxes the restrictive homogeneous assumptions of LLC. IPS differs from LLC by allowing for heterogeneity in the autoregressive coefficients for all panel members. In other words, instead of assuming a common unit root process, in which all the ρ (the first-order autoregressive coefficients) are identical, IPS tests for individual unit root processes; for all i cross sections to be stationary. The two tests differ in their alternative hypothesis as well. The null of LLC requires all series to be stationary, whereas the alternative hypothesis of IPS states that at least one of the cross sectional series is stationary. It follows that the rejection of Null for LLC means all the series are stationary, whereas for IPS rejection indicates at least some of the series to be stationary; IPS alternative hypothesis allows that some cross-sections can have a unit root. The drawback of LLC test is due to the assumption of identical first-order autoregressive coefficients across all cross-sections for both the null and the alternative hypotheses. However, there is a cost of relaxing the assumption of a common unit root; the power of the IPS test diminishes quite severely if a substantial fraction has a unit root. This distinction of the alternative hypothesis and its effect on the power of the test must be taken into account in interpreting the results. The null and alternative assumptions in the Fisher type tests proposed by Choi (2001) and Maddala and Wu (1999) are the same as in IPS. But in these tests, the strategy consists of combining the observed significant levels from the unit root individual tests (Hurlin, 2008).

The IPS test is the last one we consider. It also takes a different approach from the foregoing, in that it views the panel data regression as a system of N individual regressions and is based on the combination of independent Dickey-Fuller tests for these N regressions. Besides allowing heteroskedasticity, serial correlation, and non-normality, this test also allows for heterogeneity of trends and of the lag coefficient under the alternative hypothesis of no unit root. With everything heterogeneous, the simplest approach is to compute separate ADF test statistics on each individual and combine those by simple averaging of the t-statistics hence, the IPS test averages all the individual ADF test statistics.

Tests also differ in the way the autocorrelation is removed. For instance the Fisher PP test removes the autocorrelation using an adjustment to the standard errors, as with the usual Phillips-Perron (PP) test.

For many nonstationary panel data applications, the independence condition is restrictive and it is an important limitation. Nevertheless, in panel data theory quite commonly cross section independence is assumed in part because of the difficulties of characterizing and modelling cross sectional dependence. The LLC and the IPS methods both assume cross-sectional independence among panel units (except for a common time effect). This is a restrictive assumption given the cross-sectional correlation and spill overs across countries, states and regions. However, the asymptotic results of the tests IPS and LLC both rely on this assumption of independence across cross sectional units. If there is, for instance, a common time component, that wouldn't be true. Moreover, both tests suffer from the assumption that the error terms across the cross sections are independent, which rules out any cointegration between them. This assumption may not always be valid, particularly if the cross sections are financial markets or banks. Depending on different values of the N and T components, the two test statistics can give different results. As a solution, yet some other tests are developed that try to account for cross-sectional dependence in panel unit root testing. The tests developed by Breitung, Maddala and Wu and Choi, and Hadri are results of such an effort. For instance, multi-country GDP series, exchange rates, and financial assets prices all involve cross sectional dependence arising from global shocks and complicated interdependencies among the variables.

LLC use bias-corrected estimators. In 2000, Breitung shows that the LLC and IPS tests suffer from a loss of power if individual-specific trends are included. This is due to the bias correction that also removes the mean under the sequence of local alternative. Hence, he suggests a test statistic that does not employ a bias adjustment whose power is substantially higher than that of LLC or the IPS tests. Actually Breitung proposes an alternative set of procedures to LLC that use unbiased estimators rather than bias-corrected ones (as cited in Breitung & Pesaran, 2008).

As we have seen there are a variety of different tests with panel data. Tests also differ in their assumptions regarding the null hypothesis. The null hypothesis of IPS depends on the assumption that each series contains a unit root for all i cross sections. The null hypothesis of Breitung's test indicates that the panel series exhibit non-stationary difference and the alternative hypothesis assumes that the panel series are stationary. Unlike the previous tests, the null of Hadri test indicates stationarity;

there is no unit root in any of the series in the panel, against the alternative of a unit root in the panel. It must be noted that by reversing the null hypotheses, since the null then indicates stationarity, rejection means that we find fairly strong evidence of nonstationarity. Thereby, making null a stationary hypothesis, results in a stronger, more powerful test. On the other hand, ADF tests are biased toward non-rejection of the null. Rejection frequency is inversely related to the magnitude of the shift. Estimated values of the autoregressive parameter in the Dickey–Fuller regression were biased toward unity and that this bias increased as the magnitude of the break increased.

In contrast to the IPS test which is a parametric and asymptotic test, Maddala and Wu (1999) and Choi (2001) propose a non-parametric and exact test which is based on Fisher (1932) test, by combining the P-values from individual unit root tests. This test is superior compared to the IPS test (Maddala & Wu, 1999). The advantage of Maddala and Wu is that its value does not depend on different lag lengths in the individual ADF regressions. Moreover, the obvious simplicity of this test and its robustness to statistic choice, lag length and sample size make it extremely attractive. The crucial element that distinguishes the two tests (Fisher and IPS) is that the Fisher test is based on combining the significance levels of the different tests and the IPS is based on combining the test statistics. However, these tests are similar in the sense that they combine independent individual tests. On the other hand, Hadri-test is a residual-based Lagrange Multiplier (LM) test.

A stationary time-series may look like nonstationary when there are structural breaks in the intercept or trend. The unit root tests lead to false non-rejection of the null when we don't consider the structural breaks. A single breakpoint is introduced in Perron (1989) into the regression model; Perron (1997) extended it to a case of unknown breakpoint.

The basic form of UR tests are defined by three features; type of the test to be applied, the specification of the test equation and the choice of the exogenous regressors.

All in all, the available tests for UR don't solve the problem of conflicting results. More than often conflicting results are reported from different tests, therefore now it has become a norm to apply not one but several tests and report all the results.

Although ADF and PP tests are criticized due to their low power properties[11], they have been included in this analysis since most of the studies in the literature still use them. All unit root tests (except Hadri) employed in this study have a null hypothesis stating that the series in question has a unit root, against the alternative that it does not. The null of Hadri, on the other hand, states that the variable is stationary. In the literature, KPSS and Hadri are sometimes used to verify the results of commonly used ADF and PP tests although it also suffers from the same low power problems (Maddala & Kim, 1998, pp. 133-146).

A complete description of unit root tests is beyond the scope of this study; therefore in this subsection the details of the unit root tests are not discussed. For an extensive introduction and discussion of unit root tests, see Maddala and Kim (1998) and for excellent treatment of ADF, PP, KPSS, and DF–GLS see Ng and Perron (2001).

An important practical issue for the implementation of tests is the specification of the lag length *p*, because it is well known that the unit root tests are sensitive to different lag structures. If *p* is too small then the remaining serial correlation in the errors will bias the test. On the other hand if *p* is too large then the power of the test will suffer. Monte Carlo experiments suggest it is better to error on the side of including too many lags than the other way round.

Among the studies investigating the effects of a single currency on exchange integration, one of them examined whether the use of Euro accelerated the compliance among stock exchanges in 15 member countries and the relationships between country markets. Panel data unit root tests and panel data convergence are used and in case of old markets the compliance rate is seen to be higher than the others; the interdependence of the exchanges in European monetary union is found to be increasing since 2002 (Maraoub, 2008).

Apergis and Eleftheriou (2002) investigated the relationship between inflation, interest rates and stock prices in Greece, using a dataset of monthly data over the period 1988-1999. They applied unit root tests (ADF) to the time series data and found all three variables namely; stock prices measured by the ASE stock price general index, the first difference of consumer price index and 3-month yields on treasury bills have unit roots to be all *I(1)* processes. Economic growth is included

[11] probability of rejecting a false hypothesis is low

with a proxy; economic strength, which is found to be stationary, an *I(0)* process. Stock prices are regressed on the explanatory variables and instrumental variables (lagged values of explanatory variables). The necessary precautional steps are taken for the existence of serial correlation, functional misspecification, and heteroscedasticity. They reported that the effect of nominal interest rate was not statistically significant although its sign was positive, whereas negative inflation coefficients were statistically significant. Declining inflation was seen as an indicator of risk reduction by the investors, who responded by investing more in the stock market and contributed to the increase in the stock prices. They concluded that this price increase in turn is expected to contribute to the economic growth.

The notion that macroeconomic variables follow a random walk process and are therefore *I(1)* is generally taken as a stylized fact with existing empirical evidence overwhelmingly supporting it (see e.g. Anari & Kolari, 2001). However, regarding the order of integration of inflation there is a lack of consensus in the empirical time-series literature, thereby motivating the use of panel approach to reduce the probability of spurious non-rejection of the null-unit root.

As stated unit root tests are performed to see if variables exhibit the same order of integration, because a possible long-run relationship among the dependent and explanatory variables can only exist among the series with the same order of integration. After determining the order of integration of the variables one proceed as follows; in case the dependent variable is *I(n)* such that $n>0$, then a possible long-run relationship may exist between the dependent and explanatory variables of *I(j)* such that $j=n$ or $j=0$. Co-movement among two or more nonstationary series can only be possible if the series have the same order of integration.

Hurlin (2008) conducted an interesting study to evaluate the advantages and drawbacks of panel unit root tests for macroeconomic and financial series. Their study differentiated from others by applying nine panel unit root tests to the same fourteen macroeconomic and financial series as those considered in the seminal paper by Nelson and Plosser (1982). While Nelson and Plosser (1982) investigated the stationarity properties of the series on US data only, Hurlin extended the dataset by including OECD countries' data as cross sectional dimension over the period 1950 to 2003. Their study highlight the influence of (i) the heterogeneous specification of the model, (ii) the cross-sectional independence assumption and (iii)

the specification of these dependences. Panel unit root tests can be grouped into two categories depending on their assumption on the dependencies of the cross-sections. First group also known as first generation tests are based on the assumption of independent cross section units, whereas the second generation tests allow for cross section dependence. For a survey see Banerjee Banerjee (1999) and B. H. Baltagi and Kao (2000).

The test appropriate to the type of stationarity of the series shall be applied, because types of stationarity, if ignored, has important implications on the outcomes of tests causing the rejection of the null hypothesis of a unit root, even if it is correct. For instance in cases when first generation unit root tests are used even though the assumption of no cross-unit correlation or cross-unit cointegrating is violated (Banerjee, Marcellino, & Osbat, 2005). The same applies when second generation unit root tests are used in a context of cross-unit dependences for which they are not designed (Hurlin, 2008).

The panel unit root tests applied by Hurlin (2008) were chosen among the most used in the literature. Four first generation tests applied were (i) LLC, (ii) IPS, the Fisher–type tests of (iii) Maddala and Wu (1999) and (iv) Choi (2001). For a literature on second generation tests refer to Bai and Ng (2004), Choi (2002), Phillips and Sul (2003), Moon and Perron (2004), Pesaran (2004) and Chang, (2002, 2004). Second generation of tests differentiate in specifying the cross-sectional dependency and can be grouped into two. In the first group the cross-sectional dependency is attributed to the presence of one or more common factors or to a random time effect. On the contrary, the second group of tests propose either specific or more general specifications of the cross-sectional correlations. They conducted five of the second generation tests including tests from each of the two groups; namely Bai and Ng, Moon and Perron, Choi, Peseran, and Chang nonlinear IV unit root tests. The first group tests are based on a dynamic factor model (Bai and Ng, 2004; Moon and Perron, 2004; Pesaran, 2003) or an error-component model (Choi, 2002).

Nasseh and Strauss (2000) use domestic and international macroeconomic variables: domestic industrial production, business surveys of manufacturing orders, short- and long-term interest rates as well as foreign stock prices, short-term interest rates and production. In six economies they applied panel ADF tests and results show that the

non-stationarity cannot be rejected for industrial production and CPI (in all six economies), and for both short-term and long-term interest rates (in five economies).

A fact confirmed by many studies points out that one must be very careful with the use of panel root tests on macroeconomic time–series, since panel unit root tests cannot provide a simple and clear-cut diagnosis Hurlin (2008).

Lee and Chang (2009) used logarithm of real gross domestic product (GDP) as an explanatory variable. They found the four series including GDP show strong evidence of having a unit root depending on the results of LLC, IPC and Hadri tests; not surprisingly two statistics rejected the unit root in the LLC test, however intrinsically this didn't prevent them to interpret the series as being *I(1)*.

Bodla and Kumar (2009) employed ADF test to check for the stationarity of trading volume series of Bombay Stock Exchange (BSE) and found it to be integrated of order 1, technically *I(1)*.

While interpreting the results of IPS panel tests, as pointed out by Hurlin (2008), rejection of the null hypothesis does not necessarily imply that the nonstationarity is rejected for all countries, but only that the null hypothesis is rejected for a sub-group of N_1>N countries. Therefore, such a result is not incompatible with the fact that, based on pure time series, the ADF tests lead to accept the nonstationarity hypothesis for the majority of OECD countries.

Hurlin (2008) demonstrated that the conclusions on the nonstationarity of OECD macroeconomic variables are no clear-cut for the heterogeneous panel unit root tests based on the cross-sectional independence assumption (first generation tests). The unit root hypothesis is strongly rejected for four macroeconomic variables (real GDP, wages, real wages and money stocks), which are generally considered as nonstationary for the most of OECD countries. On the other hand only for six variables: employment, GDP deflator, consumer prices, velocity, bond yield and common stock prices results indicated non-stationarity robustly.

The specification of the cross-sectional dependencies is an issue for the second generation tests as they relax the cross-sectional independence assumption. In summary conclusions depending on the second generation tests' results are globally in favour of nonstationarity for all financial and macroeconomic variables. There are three important outcomes of Hurlin's study; first the unit root hypothesis is largely

rejected when homogenous specifications are used to test the nonstationarity hypothesis. Second, the results based on heterogeneous specifications are more in favour of the nonstationary hypothesis. However, under the cross-sectional independence assumption, results are mitigated: the null is rejected for some macroeconomic variables generally considered as nonstationary such as the real GDP. Third, when international cross-correlations are taken into account, conclusions depend on the specification of these cross-sectional dependencies.

Gregoriou and Kontonikas (2010) employed a panel unit root test established by Maddala and Wu (1999) to determine the stationarity of monthly inflation for 16 OECD countries. Results suggest that both stock prices (monthly nominal stock returns) and goods prices (monthly inflation) are *I(1)* variables.

Once the order of integration of the variable is identified, the next step is to model stationary relations among the variables such that standard inference is possible. The necessary criterion for setting up a stationary model among non-stationary variables is the so called cointegration. Only in case of existing cointegration among variables, it is possible to model empirically meaningful relationships, because if variables have different trends, they cannot stay in a fixed long-run relation to each other, actually drifting away from each other in the long-run. This in turn implies that it is not possible to model the long-run, hence usually there is no valid base for inference either (since the distributions are not standard). As a result the next step is testing for the existence of cointegration.

The following subsection reviews main concepts of a cointegrated relationship among two or more non-stationary time series. Cointegration tests followed a similar path to unit root tests; they initially developed for time series and later adapted to panel datasets. Therefore as with unit root tests, a brief explanation of the panel cointegration tests will be presented highlighting their main differences followed by information on how to interpret results.

3.2 Cointegration

Long-run steady state relationships among non-stationary variables are identified as cointegrated relationships. As a long-run property, co-integration among two non-stationary time series implies that deviations from equilibrium are stationary, with

finite variance, even though the series themselves have infinite variance (Engle & Granger, 1987).

Equilibrium relationships exhibit properties akin to economic theory in the sense that equilibrium is a stationary point characterized by forces. These forces work such that any deviations from the equilibrium point, for whatever reason, will be responded by these forces pushing back toward equilibrium (Engle & Granger, 1987).

The number of cointegrating or long-run relationships in the data, which is known as the cointegrating rank, can be estimated using the methodology of Johansen, (1988, 1991). If the number of cointegrating vectors among variables is more than one, it implies the existence of several equilibrium relations that govern the joint behaviour of the variables. If the rank (r) equals zero, no cointegrating equilibrium exists, and the equations should be differenced. If $r = 1$, then the data support one long-run equilibrium among the variables (Engle & Granger, 1987).

The determination of the order of integration for the variables is important for setting up the cointegration analysis. If there is a linear combination of two or more non-stationary series that is stationary, the non-stationary time-series are said to be cointegrated; in the presence of a cointegrating relationship, the residuals are expected to be stationary. This stationary combination can be interpreted as a long-run equilibrium. Therefore, only the non-stationary series will enter the cointegration relationship, all stationary series will enter as exogenous variables in the estimation of the corresponding ECM.

Whether a set of variables are co-integrated has importance for several reasons; in order to find out whether a system is in equilibrium in the long run or to make sure that employing a multivariate dynamic model is appropriate.

Testing for cointegration has become one of the standard tools in applied economic research. Numerous procedures exist for testing whether nonstationary series are cointegrated or not. Some methods are based on single equation analysis, whereas others use a systems approach, which requires solving an identification problem, typically by principal components, canonical correlations, or restrictions on the parameter space. Tests also differ on the null hypothesis examined – noncointegration versus cointegration. This is an important distinction as these tests are not very powerful; at traditional choices of the significance level (e.g. 1%, 5%,

and 10%), they usually fail to reject their null hypothesis under test in applications (Clarke & Mirza, 2006). Actually panel unit root tests are not solely used for testing stationarity but they have also been generalized to test for cointegration (for residual-based cointegration tests), as a consequence the extension of the cointegration tests to the panel data has grasped a wide interest in the literature (Engle & Granger, 1987).

By nature for some econometric problems, it is not acceptable to assume homogeneity among the members of the panel. Model is required to allow for heterogeneity both in the long-run cointegration vectors and in the dynamics (for instance growth regressions). Panel cointegration estimators are specifically designed to address such econometric problems.

As a pioneer Engle and Granger (1987) suggest a two-step analysis to test for cointegration: estimate the cointegrating regression by OLS in the first step and then test for a unit root in the residuals from the cointegrating regression in the second step. The OLS regression equation in the first step represents the assumed economically meaningful (or understandable) steady state or equilibrium relationship among the variables. If the variables are cointegrating, they will share a common trend and form a stationary relationship in the long run. Furthermore, the residuals can be used as an error correction term in an error correction model. The second step, in Engle and Granger's two-step procedure, is to test for a unit root in the residual process of the cointegrating regression above. The null hypothesis is no cointegration. If the null of a unit root in the residuals is rejected, then there is evidence of cointegration meaning that the integrated variable cointegrates at least with one of the variables on the right hand side. Unfortunately, the test does not tell us if the integrated variable is cointegrating with all, some or only one of the variables on the right hand side. One must be aware of the possibility that the choice of variable on the left hand side may affect the results of the test.

Pedroni (1999) and Pedroni (2004) propose two types of tests for a total of seven different panel cointegration tests. These may be categorized according to what information on the different units of the panel is pooled. First, the panel tests are based on the within dimension approach which includes four statistics: panel *v*, panel ρ, panel PP, and panel ADF-statistics. These statistics essentially pool the autoregressive coefficients across different cross-sections for the unit root tests on the estimated residuals. These statistics take into account common time factors and

heterogeneity across cross sections. Second, the group tests are based on the between dimension approach which includes three statistics: group ρ, group PP, and group ADF-statistics. The "Group-Mean" Statistics are essentially means of the conventional time series tests (Phillips & Ouliaris, 1990). These statistics are based on averages of the individual autoregressive coefficients associated with the unit root tests of the residuals for each cross section unit in the panel. All seven tests are distributed asymptotically as standard normal. Pedroni tests have a comparative advantage of being able to detect cross-sectional heterogeneity in the slope coefficients.

The main panel approaches to cointegration have the same advantages as the panel unit root tests, in that they increase the power of the test. The cointegration methodology extended to panel data include tests proposed by Pedroni (2004) and Kao (1999) generalize residual-based tests, Larsson, Lyhagen, and Løthgren (2001) extend the Johansen (1988) tests, while McCoskey and Kao (1998) propose a test for the null of panel cointegration in the spirit of Shin (1994). Hanck (2005) as cited in Datar et al. (1998) extends the p-value combination panel unit root tests of Maddala and Wu (1999) and Choi (2001) to the panel cointegration case. There are essentially two approaches, one based on the residual-based test of Engle-Granger approach; by testing if the regression residual is stationary or integrated of order 1 (e.g., Breitung and Mayer (1994); Kao and Chiang (2000); McCoskey and Kao (1998) follow this approach) and the other using the system-based tests of Johansen ML type methodology (e.g. Groen and Kleibergen (1999), Larsson and Lyhagen (1999) and Larsson et al. (2001) as cited in (Örsal, 2007)).There are in turn variations of both approaches, for example in the Engle –Granger approach, there is the Kao test, which assumes the same values across all cross sections, whereas Pedroni assumes they can vary across the cross sections, in effect allowing considerable differences in the dynamics across the cross sections. McCoskey and Kao (1998) derive a panel cointegration test for the null of cointegration which is an extension of the LM test and the locally best unbiased invariant (LBUI) test for an MA root. They take Harris and Inder (1994) and Shin (1994) as a basis for their research. Kao (1999) considers the spurious regression for the panel data and introduces two types of panel cointegration tests, the Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) type tests. He proposes four different DF type tests, and makes use of the sequential limit

theory of Phillips and Moon (1999) for the asymptotic distributions of these tests. Fisher's test aggregate the p-values of the individual Johansen maximum likelihood cointegration test statistics (see Maddala and Kim (1998, pp. 155-242); Maddala and Wu (1999)). The Fisher test is a non-parametric test that does not assume homogeneity in the coefficients. Error-Correction-based tests have been suggested by Boswijk (1994) and Banerjee et al.(1998), while Breitung (2001) covers the nonlinear case. In this section the comparison of cointegration tests are mainly based on Datar et al. (1998) and Örsal (2007).

Testing the null of cointegration, rather than the null of no cointegration can be very appealing in applications if cointegration is predicted a priori by economic theory. In addition, failure to reject the null of no cointegration could be caused, in many cases, by the power of the test and not the true underlying nature of the data (McCoskey & Kao, 1998).

For a comparison of the properties of the residual-based panel cointegration tests of Pedroni(1999) to the properties of the maximum-likelihood-based panel cointegration rank test of Larsson et al. (2001) refer to Örsal (2007). She made the comparison considering size, power and size-adjusted power of the panel cointegration tests when time and cross-section dimensions and various parameters in the data generating process vary.

The panel v-test is a one sided test in which large positive value reject the null of no cointegration. For the remaining statistics of Pedroni tests, large negative values reject the null hypothesis of no cointegration. In Kao test, the null hypothesis of no cointegration is tested using an ADF-type test.

Under cross-sectional independence all the above-mentioned panel tests provide a means to better exploit the variation in the data. Furthermore, Phillips and Moon (1999) show that panel data can help mitigate the spurious regression phenomenon. McCoskey and Kao (1998) evaluated both theoretically and empirically several co-integration tests for panel data aiming to answer the question of which test is best. Tests compared are based on ADF test, Pedroni’s pooled test and LM test; including null of cointegration and no cointegration. They conclude that the panel data usage increase the power of the tests.

The Levin et al. and Harris and Tzavalis tests do not allow for heterogeneity in the autoregressive coefficient of the panel. On the other hand, Maddala and Kim's Fisher's test does not assume homogeneity of coefficients in different cross-sectional units, because it aggregates the p-values of individual Johansen maximum likelihood cointegration test statistics. For a comprehensive survey on panel unit-root tests and cointegration literature refer to Banerjee (1999) or B. H. Baltagi and Kao (2000).

Fisher effect is a widely tested economic relation in the macroeconomic literature with mixed results. The Fisher Hypothesis states that the real interest rate is the difference between the nominal interest rate and the expected inflation rate which means that no one will lend at a nominal rate lower than the expected inflation, and the nominal interest rate will be equal to the cost of borrowing plus the expected inflation. Empirical research conducted to test this hypothesis is a good empirical example for the usage of panel unit root and cointegration tests. The non-stationarity of the nominal interest and inflation rates made the application of the cointegration techniques possible in order to test for the long-run relation between the nominal interest and inflation rates. The results are mixed: there are several studies which cannot find evidence for the Fisher effect, and still others which conclude that it exists. To summarize residual-based panel cointegration tests of Pedroni pointed out the existence of the Fisher relation for two different data sets. However, the maximum-likelihood based test statistics failed to find any evidence. Likewise it is not unusual to see conflicting results from the cointegration tests (Örsal, 2007).

As we have seen various tests have been suggested, they beg the question of "which are the most commonly applied cointegration tests?" For several reasons it has become a general practice to conduct several panel cointegration tests simultaneously rather than adhering to a single test. First of all, applying tests are easier today than a decade ago, since most of which are implemented in standard econometric software packages and hence are easily available. Another reason is to circumvent the possibility of power problems in Johansen's time-series test. As we have seen each of these tests are established to address a problem others were lacking, therefore none of them is capable of producing the most reliable outcome with the highest power for every condition. More often than not tests produce mixed results; accordingly several tests are employed all at once since it helps come up with a decision. Besides comparing different results from different test methods is a good

way of testing the sensitivity of one's conclusions. A clear answer to the question requires a through comparison of the tests which is beyond the scope of this study, nevertheless Clarke and Mirza (2006) conducted an ad hoc survey based on 218 posts, publications, or discussion papers to help answer this question. Testing strategies for Granger noncausality in vector auto regressions (VARs) that may or may not have unit roots and cointegration were compared. Their findings are reported in a table regarding the cointegration test applied; the method employed to choose the augmentation or bandwidth parameter (as necessary); and the strategy adopted to determine the lag order for any estimated autoregressive models (as applicable). Of the 218 papers they sampled, 173 applied one or more cointegration tests.

It is not unusual that in some applied VAR users simply rely on conventional lag order choices (say 4 or 8 lags for quarterly data, 6 or 12 lags for monthly data) rather than explicitly estimating the lag order from the data. Kilian (2001) examined the three most popularly used lag order selection criteria; namely Akaike Information Criterion (AIC), the Schwarz Information Criterion (SIC) and the Hannan Quinn Criterion (HQC) and a modified version of AIC as the fourth. He also investigated how accuracy of the impulse response point estimates is affected by the choice of lag order selection criterion. He demonstrates that depending on the lag order properties the best criterion may differ, but points that AIC outperformed others.

Nasseh and Strauss (2000) demonstrated the existence of a significant, long-run relationship between stock prices and domestic and international economic activity in six European economies using a multivariate-cointegrating framework. They applied Johansen Cointegration tests to investigate how stock price levels are affected from industrial production, business surveys of manufacturing orders, short- and long-term interest rates as well as foreign stock prices, short-term interest rates and production. The results of Johansen cointegration rank tests supported one to three cointegrated relationships. The CPI is significant in all cases, and not significantly different from one in five economies. Their results support the existence of a significant, long-run relationship between the stock price levels and macroeconomic variables.

Omran and Pointon (2001) applied co-integration analysis through error correction mechanisms (ECM) and found significant long-run and short-run relationships

suggesting that the inflation rate has had an impact upon the Egyptian stock market performance in terms of market activity and market liquidity.

Arbelaez et al. (2001) analyse the Colombian stock market as an emerging market in general and examine the relationship of four stock indexes testing for the stationarity of the variables, conducting Granger causality tests checking for cointegration among the indexes and applying VEC model to the daily data of stock indexes for the period including January 2, 1988 through August 9, 1994.

Maysami et al. (2004) investigated the relationship of macroeconomic variables and stock market returns for Singapore stock exchange. Macroeconomic variables they used were industrial production, proxies for long and short-run interest rates, money supply (M2), and exchange rates. They applied VECM on a monthly dataset over the period January 1989 to December 2001.

Lee and Chang (2009) applied panel cointegration and panel error correction models for a set of 37 countries using annual data for the period 1970-2002 to analyse the directions of causality among FDI, financial development, and economic growth.

In order to examine the long-run co-movement among stock prices and goods prices Gregoriou and Kontonikas (2010) conducted three panel cointegration tests; namely the Levin et al. (2002), Harris and Tzavalis (1999), and Maddala and Kim's (1998) panel cointegration tests. Results suggest that a long-run relationship between stock prices and goods prices does exist with long-run causality pointing from the latter to the former.

In a more recent study Cavenaile et al. (2013) used a Johansen-based panel cointegration methodology allowing for cross-country dependence for investigating the existence of a long run relationship between the development of banks and/or stock markets and economic growth. The analysis is conducted using the annual data of five countries; namely Malaysia, Mexico, Nigeria, Philippines and Thailand for the period of 1977-2007.

In short, the power of cointegration comes from its ability to extend the correlation to nonstationary time series. As a result, cointegration allows simple estimation methods such as least squares regression or maximum likelihood to capture dependencies between non-stationary series (such as stock prices), while still

encompassing the dynamic correlation of the associated stationary series (such as stock returns) (Alexander & Dimitriu, 2004).

The relationship between error correction models and co-integration was first pointed out in Granger (1981). Co-integrated series can be represented by error correction models, for the underlying theorem see (Granger, 1983 as cited in Engle & Granger, 1987). Thus, co-integration is a prerequisite for a class of models known as error-correcting which will be explained in the next subsection. Depending on the outcome of the cointegration test either a differenced VAR or a vector error correction model (VECM) is used to model the nonstationary data.

3.3 Model

The purpose of modelling is not to mimic the reality but is to capture the essential forces affecting the outcome. When investigating processes in economic life simplification is inevitable, provided that the right kind of simplification is employed.

In panel models the framework for fixed effects attributes the differences across units to group specific characteristics hence these are captured in the differences in the constant term of each group. Therefore, each constant term is an unknown parameter to be estimated. The framework for random effects, on the other hand, attributes the differences to random disturbance rather than a common characteristic of the cross-section. Cross-sectional data models and traditional static panel data models including both fixed effect and random effects provide unsatisfactory estimations in modelling dynamic relations regardless of whether they are time-averaged or not.

Dynamic panel data models capture the dynamic effects by the addition of a lagged dependent variable to the explanatory variables. Then the model is estimated using Generalised Method of Moments (GMM), which works in a similar way to Two Stage Least Squares, overcoming problems of endogeneity. This approach requires that $N > T$, i.e. the cross-sectional observations exceed the time series. Dynamic panel models are theoretically based on a partial adjustment approach. In a partial adjustment process, the coefficient on the lagged dependent variable measures the speed of adjustment (i.e. 1 – coefficient is speed of adjustment). Additionally including the lagged dependent variable can remove any autocorrelation. However,

the model is criticized because dynamics may be more complicated than a single lagged dependent variable can speak for.

The dynamic panel approach accounts for the individual effects, though it is difficult to include dummy variables in these models. However, although the individual effects apply to the cross section, two-way individual effects can also be included using time dummy variables.

GMM technique is basically a method trying to estimate parameters such that the theoretical model is satisfied as 'closely' as possible. The estimates are chosen to minimise the weighted distance between the theoretical and actual values. In order to achieve that, prerequisite so called '*orthogonality conditions*' must be satisfied by the theoretical relations between the parameters. The condition necessitates the sample correlations between the explanatory variables and instruments be as close to zero as possible. Thus, OLS is a special case of GMM, assuming no correlation exists between the explanatory variables and error term.

In dynamic panel models there are basically two approaches on how individual effects are included in the model; namely Arellano-Bond and Arellano-Bovver. Former uses differencing and has been most popular, latter uses orthogonal deviations. Both of the approaches have limited capability to account for unobserved heterogeneity (Pesaran & Smith, 1995).

One of the most powerful methods of analysing multivariate time series is the vector autoregressive model (thereafter VAR) hence it is used commonly in econometrics. Most of the previous studies that used VAR models and innovation accounting techniques for the similar modelling are subject to the orthogonality critique of Lutkepohl (1991). The traditional method of Sims (1980) has been criticized for the orthogonality assumption, as results may differ depending on the ordering of the variables in the VAR. Engle and Granger (1987) warns that estimating a typical VAR using co-integrated variables has serious implications whether or not the data is differenced. In case data is differenced, VAR will be misspecified. In case data is used in levels, then VAR will have omitted important constraints.

The VECM is a VAR that builds in cointegration by incorporating error correction terms that account more fully for short-run dynamics. Thus, if the long run

equilibrium condition is valid and cointegration exists, it explains short-run fluctuations in the dependent variable (Nasseh & Strauss, 2000).

Error correction mechanisms have often been used in economics. The basic idea is that when a diversion from the equilibrium occurs in one period, it is corrected in the next period hence the name error correction. The class of models known as error correcting, are characterized by allowing long-run components of variables to comply with equilibrium constraints, while short-run components of variables have a flexible dynamic specification. In multivariate error correction models the model definition doesn't rely on exogeneity of a subset of the variables. Additionally all terms in the error correction models are *I(0)* (Engle & Granger, 1987).

Error correction models have a two-step procedure. In the first step, the long-run relationship, i.e., regression in levels and test residuals for I(0) are estimated. In the second step, the residuals of the first step is used in ECM regression. Johansen's (1990) VECM on the other hand, is a full information maximum likelihood estimation model, which allows for testing cointegration in a whole system of equations in one step, without requiring a specific variable to be normalized. This allows researchers to avoid carrying over the errors from the first- into the second step, unlike the case of Engle and Granger's (1987) methodology. It also allows the avoidance of a priori of assumptions of endogenity or exogeniety of variables (Maysami et al., 2004).

When employing panel data techniques, the relationships among the explanatory variables shall be checked against joint endogeneity problem. This is an issue when most of the explanatory variables in a model are either simultaneously determined with the dependent variable or have a two-way causal relationship with it. Necessary precautions must also be taken against autocorrelation and heterogeneity.

Unobserved cross-section specific effects may have significant results on the model estimation; therefore even the potential of its presence must be checked for. If cross-section specific effects are likely to be correlated with the explanatory variables, then ignoring them results in inconsistent estimates, since the assumption of strict exogeneity of the explanatory variables is violated. In such cases applying methods such as ordinary least squares will not be consistent hence appropriate. Additionally, the orthogonality condition between the error term and the regressors must be

checked for as well. Unless this condition is met, the fixed effects estimator can't produce consistent estimates either. Fortunately, the orthogonality condition can be achieved through appropriate differencing of the data.

García and Liu (1999) used pooled data for 15 countries over the period 1980 to 1995. They applied regression with fixed effects.

Investigating the relation between stock prices and macroeconomic variables several different models have been used; Balvers et al., (1990) use a consumption asset pricing model, Canova and De Nicolo (1995) adopt a general equilibrium model, Campbell and Ammer (1993) use a vector auto regressive (VAR) approach (as cited in Nasseh & Strauss, 2000). Nasseh and Strauss (2000) preferred to apply the Johansen framework to study the channels through which macroeconomic variables affect asset prices as well as their relative importance, because the Johansen framework incorporates dynamic co-movements or simultaneous interactions which are necessary for analysing stock market and macroeconomic activity.

Demsetz and Villalonga (2001) used panel data for a broad sample of 42 countries' data from September 1996 to December 1998 in order to examine magnitude and determinants of execution costs, and analyses the interactions between cost, liquidity and volatility.

Omran and Pointon (2001) applied ECM to capture dynamics of both long- and short-run effects between inflation and market activity and liquidity using annual data for the period of 1980-1997. ADF unit root tests were performed to determine the order of integration for both the inflation rate and the chosen stock market performance variables. Test results suggested all the variables to be I(1). The inflation rate, the raw data were used without a log transformation. The results indicated that the inflation rate has a significant impact on the market activity in Egypt including trading volume.

El-Wassal (2005) used panel data for the estimation with a time trend for both fixed and random effects. For fixed effects he estimated as a classical regression (OLS) including a dummy for each cross-section. He also employed the random effects followed by a Hausman test to decide which approach is more appropriate. The Hausman test results suggested that the fixed effects model had a better fit for the dataset at hand compared to the random effects model.

Dey (2005) conducted an analysis for 48 global stock exchange portfolios employing pooled OLS regressions, one-way fixed effect panel regression, and two-stage GLS estimation. Even though the concern for nonstationarity of the series and as a consequence spurious regression results is stated neither UR tests are employed nor is the existence of cointegration checked for.

Hammoudeh and Choi (2006) applied VEC model, to investigate the relationship among Gulf Cooperation Council's (GCC) weekly equity index returns and the oil price, the US S&P 500 index, and the US T-bill rate. They demonstrated that the short-run bilateral causal relationships are limited and mostly unidirectional. The effects of shocks are analysed by conducting impulse response analysis and found GCC stock markets rise with US markets; the impact of the T-bill rate is found to be important but mixed. The variance decomposition is used to analyse the total variations in GCC index returns and found that the largest variation is caused by their own domestic or other GCC shocks over the forecast horizon. They demonstrated that the global factors account for only a small percentage of these stock markets' total variations.

Yartey (2010) makes use of the panel data techniques for a panel data set of 42 emerging economies to investigate the institutional and macroeconomic determinants of stock market development over the period 1990-2004. He applied a modified version of Calderon-Russell model. Market capitalization as a percentage of GDP is used as a measure for the dependent variable stock market development. The existence of a joint endogeneity problem among many of the independent variables is reported.

Gregoriou and Kontonikas (2010) investigated whether there exists a long-run relationship between stock prices and goods prices. They applied a panel unit root and panel cointegration econometric framework to the panel data of 16 OECD countries over the period 1970-2006. They performed several estimates; beyond the whole dataset sub-samples were also used. In order to maintain the power of tests in the small sample sizes, time-series data are combined across the sample countries forming a panel suitable for unit root and panel cointegration econometric framework. They employed several tests; the panel unit root test of Maddala and Wu (1999) and panel cointegration tests developed by Levin et al. (2002), Harris and Tzavalis (1999) and Maddala and Kim (1998). Cointegrating vectors were estimated

using the fully modified OLS estimation technique for heterogeneous cointegrated panels developed by Pedroni (2000).

Impulse responses and variance decompositions, the subjects of the following two subsections, are regarded to indicate higher-order dynamics.

3.3.1 Impulse Response

Granger defined causality as a concept depending on the basic idea that a cause cannot come after the effect. If a variable *x* affects a variable *z*, the former should help improving the predictions of the latter variable. Granger-causality may not tell us the complete story about the interactions between the variables of a system. In applied work, it is often of interest to know the response of one variable to an impulse in another variable in a system that involves a number of further variables as well. One would like to investigate the impulse response relationship between two variables in a higher dimensional system. Of course, if there is a reaction of one variable to an impulse in another variable, we may call the latter causal for the former. This type of causality can be examined by tracing out the effect of an exogenous shock or innovation in one of the variables on some or all of the other variables. The methodology will not be discussed here; the detailed explanations of the generalized approaches can be found in Pesaran and Pesaran (1997).

Impulse response functions are used to economically interpret the behaviour of the variables in the VEC model (Hammoudeh & Choi, 2006). An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. A shock to the i^{th} variable not only directly affects the i-th variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. Impulse Response function is used to investigate the dynamic interactions between endogenous variables. It is technically based on Wold decomposition of a stable VAR(*p*). Expected responses can be cumulated through time such that it is possible to analyse the cumulated impact of a unit change in variable *j* to the variable *i* at time *s*.

If the innovations ε_t are contemporaneously uncorrelated, interpretation of the impulse response is straightforward. The i^{th} innovation ε_{it} is simply a shock to the *i*-th endogenous variable y_{it}. Innovations, however, are usually correlated, and may be viewed as having a common component which cannot be associated with a specific

variable. Accumulated responses for *s* periods ahead of a unit shock in variable *i* on variable *j* may be determined by summing up the corresponding response coefficients. Particularly these may be of interest if the variables are first differences, like the stock returns. For instance in case of stock returns the impulse responses indicate the return effects while the accumulated responses indicate the price effects.

A problematic assumption in this type of impulse response analysis is that a shock occurs only in one variable at a time. Such an assumption may be reasonable if the shocks in different variables are independent. If they are not independent, one may argue that the error terms consist of all the influences and variables that are not directly included in the set of *y* variables. On the other hand, correlation of the error terms may indicate that a shock in one variable is likely to be accompanied by a shock in another variable. In that case, setting all other errors to zero may provide a misleading picture of the actual dynamic relationships between the variables. It is reasonable to assume that a change in one component has no effect on the other components because the components are orthogonal (uncorrelated).

One problem with this type of impulse response analysis is that the ordering of the variables cannot be determined with statistical methods but has to be specified by the analyst. The ordering has to be such that the first variable is the only one with a potential immediate impact on all other variables. The choice of the ordering, the Wold causal ordering, may, to a large extent, determine the impulse responses and is therefore critical for the interpretation of the system. Besides specifying the relevant impulses to a system, there are a number of further problems that render the interpretation of impulse responses difficult. However, in real economic systems almost everything depends on everything else.

The biggest criticism of impulse response analysis was regarding the ordering of variables. If important variables are omitted from the system, their effects go to the residuals and hence may lead to major distortions in the impulse responses and the structural interpretations of the results. The ‘generalised’ impulse response analysis for unrestricted VAR and cointegrated VAR models are developed as a remedy to this ordering problem (Koop, Pesaran, & Potter, 1996; Pesaran & Shin, 1998). Unlike the traditional impulse response analysis, generalised impulse response analysis doesn’t require the shocks to be orthogonal and it is indifferent to the order of the variables in the VAR model.

Structural VECM has some important advantages in systems with stochastic trends and cointegration; other things being equal, estimators of impulse responses from structural VECM are more precise. Moreover it is possible to impose long-run restrictions as well as short-run restrictions to identify shocks.

3.3.2 Variance Decomposition

Variance Decomposition a.k.a. Forecast Error Variance Decomposition is technically based on orthogonalised impulse response coefficient matrices. It is used to analyse the contribution of variable *j* to the *h*-step forecast error variance of variable *k*.

The uncorrelatedness of lagged explanatory variables (v_{ts}) allow the error variance of the *s* step-ahead forecast of the dependent variable (y_{it}) to be decomposed into components accounted for by these shocks, or innovations (this is why this technique is usually called innovation accounting). The forecast variance decomposition determines the proportion of the variation of dependent variable due to shock u_{jt} versus shocks of other variables u_{it} for $i \neq j$.

Comparing the innovation of one component to the sum of innovation responses give a relative measure of how important that particular variable's innovation in explaining the variation in aforementioned variable at different step-ahead forecasts.

Nasseh and Strauss (2000) employed variance decomposition methods in order to analyse the existence of a long-run relationship between stock prices and domestic and international economic activity in six European economies. Results support the strong explanatory power of macroeconomic variables in contributing to the forecast variance of stock prices. In the variance decomposition analysis of Nasseh and Strauss (2000) short-term interest rates are found have a minor role in effecting stock price variance, except in the U.K., although they are a significant factor in the cointegrating equations. They explain this with the hypothesis that short-term interest rates may represent the effect of other macroeconomic activity, such as production. Long-term interest rates on the other hand, explain a substantial portion of the forecast variance of stock prices and attributed to the hypothesis that long-term rates proxy for the discount rate. They concluded there is strong evidence for stock prices being determined by macroeconomic activity.

4. DATA AND EMPIRICAL FINDINGS

In this section empirical study conducted will be presented. In the first subsection data set will be introduced. Next, results of unit root tests and cointegration tests will be presented followed by the explanation of the empirical model. The model findings will be reported including impulse response and variance decomposition analysis of the results.

4.1 Data

The time dimension and the exchange coverage are based on two factors: (a) the availability of data especially monthly data on the aggregate trading volume of stock exchanges and macroeconomic variables, and (b) the fact that the stock markets' trading volume has not been remarkable before the early 1990s.

The analysis in this thesis is carried out using a monthly dataset. Initially the dataset started from January, 1995 to December 2010, however due to missing data for some exchanges and countries, analysis has been carried out using data for the period of January 1999 to June 2010.

The stock exchanges are chosen among the members of World Federation of Exchanges (WFE), as it is the largest organization for stock exchanges, monthly statistics of member exchanges are published regularly. In panel data models, it is important to use same assumptions and formulations in calculating the statistics for all the cross section units, so when possible using a single source for cross section data is preferred.

Stock exchanges in the dataset include both quote-driven (namely NYSE and Nasdaq) and order-driven markets. The sample included stock exchanges operating in emerging economies as well as developed ones. Data were collected from World Federation of Exchanges (WFE) for 17 countries: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Korea, Luxemburg, Mexico, Netherlands, Poland, Spain, United Kingdom, and United States. A total of 22 exchanges are analysed as from US two stock exchanges; namely Nasdaq and NYSE and four exchanges from Spain are included. Additionally, Euronext was formed in September 2000, within the period analysis is carried out, by Amsterdam, Brussels

and Paris stock exchanges; and then in April 2007 it has been acquired by NYSE. As all four exchanges were among the dataset Euronext is also included, making the total number of exchanges 22. Trading volume and market index data were obtained from WFE, mainly from their web site, but their monthly newsletters were also consulted. Macroeconomic variables are obtained from World Bank IFS database and OECD web site.

There is no single reliable indicator for the overall economy. Therefore, studies on the economy as a whole, try to capture several aspects of economy by using different indicators. The big picture can be seen by considering productivity, unemployment rate, long-term interest rates, changes in price levels together. Even though none of these variables are exempt from imperfections, they are considered to be fundamental indicators, as their values signal the current trends in the economy. The monetary value of all the finished goods and services produced within a country's borders in a specific time period is one of the fundamental indictors of economy. However, the information exhibited by it alone will be limited, compared with the information, when it is accompanied by unemployment rate and other indicators listed above. Major variables describing the macroeconomy are the same for all countries, making them an attractive measurement for multi country analysis.

Changes in the levels of these indicators usually reflect similar outcomes in overall economic activity, therefore are considered to capture important information. The absolute change in an economic indicator is important, but how it compares to market expectations is more important (Cheng, 1995). Thus, only the innovations or unanticipated changes in the economic indicators are of interest.

The macro economic variables used in this study were chosen mainly based on prior studies and intuitive a priori reasoning. These macroeconomic variables were used in various studies focused on stock exchanges, because of their importance. Details of such studies including their reasoning in using these macroeconomic variables were presented in Sections 2.3 and 2.6, therefore will not be repeated here, instead references will be provided where appropriate.

The monthly macroeconomic data is consisted of industrial production, inflation rate, long term (10 years) government bond yield, unemployment rate, and money supply (narrow and broad M1 and M3 respectively). Institutional factors of stock exchanges

are not included as these are directly reflected in macroeconomic factors. It has been shown that some institutional measures such as legal rule are highly correlated with stock market liquidity (García & Liu, 1999). Now, each of the variables under consideration will be explained in detail.

Industrial production

As a measure of well-being of a country for international and temporal comparisons, the Gross Domestic Product provides a good first approximation[12]. The most important measure of economic activity in a country, GDP is the crossing point of three sides of the economy: expenditure, output, and income as shown in Figure 4.1. The three sides of GDP interact to determine the aggregate. An increase of effective demand (consumption, investment, public expenditure, exports) will increase GDP, provided national producers can meet the quality/price requirements of buyers. If not, imports will grow instead. If national production cannot grow for physical reasons, firms producing already at full capacity probably will decide to raise prices, vanishing effective demand with inflation.

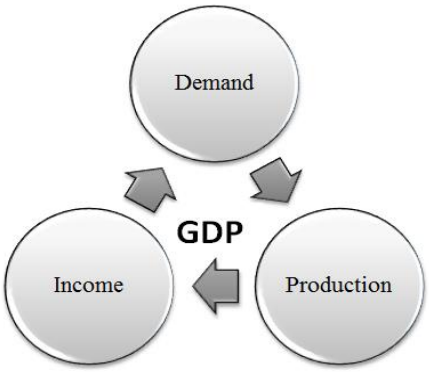

Figure 4.1 : GDP and three sides of the economy.

Common GDP trend is a continuous growth with periods of acceleration and deceleration. In many countries, especially small and in the emerging economies, growth is hectic and irregular, with frequent and deep absolute falls and booms.

Industrial production used as a proxy for real economic activity, is generally assumed to exhibit a positive relationship with stock returns due to the positive effects of industrial production on expected future cash flows.

[12] It must be noted that,GDP ignores many crucial elements of general well-being, like environment conservation, safety, life expectance, and population literacy. In this respect, one should rather look at the Human Development Index.

Real GDP in U.S. dollars is used to measure the income level. VPVOBARSA is in millions of US dollars. It is calculated as volume estimates, fixed PPPs, OECD reference year, annual levels, seasonally adjusted quarterly data. GDP expenditure and output approaches (current prices and volume estimates) is employed for the calculation.

Inflation

Inflation is the main macroeconomic variable that depends on price level. The general price level depends first and foremost to individual decisions of firms. For most common consumer goods, prices are determined by producers and by distribution channels (together or separately). Prices and quantities of all goods and services determine the overall price level. Since inflation is the main variable that depends on price level, an increase of price level without a corresponding wage increase will reduce the real income of workers. Real money will be reduced by a price level increase, provided nominal money does not grow by the same amount.

In literature, inflation is used as a proxy for macroeconomic stability (García & Liu, 1999; Gregoriou & Kontonikas, 2010; Omran & Pointon, 2001; Wongbangpo & Sharma, 2002). Inflation rate, inflation change, and the standard deviation of inflation rate are all used as proxies for the macroeconomic stability (García & Liu, 1999). A negative relation between inflation and stock prices were reported by many studies including but not limited to Fama and Schwert (1977), Chen, Roll and Ross (1986), Nelson (1976) and Jaffe and Mandelker (1976) (as cited in Maysami et al., 2004). The rationale is as follows: an increase in the rate of inflation is likely to lead to economic tightening policies, which in turn increases the nominal risk-free rate and hence raises the discount rate.

Long-term government bond yield

The interest rate is the profit over time due to financial instruments. Real interest rates somehow adjust the nominal ones to keep inflation into account. Apart from bank loans, a key interest rate in the economy is that paid on Treasury bonds. To the extent the Ministry of Treasury influences the interest rates on its own bonds, it provides an important reference point for the economy. Interest rates primarily depend on policy and expectations.

Changes in interest rates structure depend on reasons that are both internal and external to financial markets. Firstly, different types of interest rate are linked and influence each other, so that the functioning of the financial markets and their international relationships explain a good deal of interest rate fluctuations. Secondly, economic performance, perspective and expectations of potential loan receivers play an important role as well as the overall economy.

Traditional effects of an increase in interest rates are, among others, the following:

1. a fall in stock exchange and in the value of other assets (as private and Treasury bonds or houses and real estate);

2. a fall in profitability of firms;

3. a fall in private investment;

4. a fall in consumption credit;

5. an inflow of foreign capital for buying bonds;

6. an upward pressure on exchange rate;

7. a larger public expenditure to pay for a previously cumulated public debt, whose burden might lead to reduction in other chapters in public expenditure;

8. a narrower disposable income for households having a large debt taken at variable rates;

9. a larger disposable income for households that have lent to others at variable rates (e.g. they own government bonds with variable rates);

10. a redistribution of income from debtors to lenders (in the part of debt that has variable rates).

A small change in the official discount rate might arguably have no real effect at all, while triggering substantial echoes on financial markets. By contrast, a large and abrupt increase in general interest rates can have devastating effects on crucial real variables, exerting a depressing pressure on GDP and the economy at large. In particular, if prices in the real estate (including housing) market and Treasury bonds are falling, their value as collateral for loans would be reduced. The credit crunch would squeeze private investment.

Interest rates fluctuate over time with an historical ceiling, i.e. a maximum level. Even though in high-inflation periods the nominal interest rate can reach extremely high levels, for long decades a ceiling of 10% is a rule for many countries. Changes in both short- and long-term government bond rates would affect the nominal risk-free rate and consequently affect the discount rate (Mukherjee & Naka, 1995). On the other hand, Maysami et al. (2004) hypothesize a negative relationship between interest rates and stock prices.

Long-term interest rates, explain a substantial portion of the forecast variance of stock prices. This is attributed to the hypothesis that long-term rates proxy for the discount rate. An increase in long-term interest rates may trigger a revaluation of the portfolios causing a move from stocks to bonds, resulting in increased trading volume. Therefore, in this study long term interest rates is included, but not the short term, as industrial production data is already among the explanatory variables.

Money supply

Money quantity is the nominal value of particularly "liquid" financial instruments in an economy. High growth rates in nominal money quantity, if clearly exceeding nominal GDP rates, can exert inflationary pressures. Many short run acceleration or deceleration of the money quantity remains without any noticeable effects on other macroeconomic variables.

M1 is known as the narrow money supply, aka monetary base whereas M2 and M3 are called broader money supplies. Narrowly-defined money is heavily influenced by central banks, whereas for broad money aggregates depositors, banks, financial and public institutions play a crucial role. Money supply (M3) was used as a financial intermediary development measure (García & Liu, 1999; Wongbangpo & Sharma, 2002). García and Liu (1999) used the ratio of broad money supply M3 to GDP as a measure for the financial intermediary development.

Back in 1963, Friedman and Schwartz hypothesized the relationship between money supply and stock returns to be positive as the growth rate of money supply would affect the aggregate economy and hence the expected stock returns (as cited in Maysami et al., 2004). An increase in money supply would result in excess liquidity available for buying securities, resulting in higher security prices. However there is a debate on this relationship, since an increase in money supply would also lead to

inflation, and may increase discount rate and reduce stock prices (Fama, 1981). There are supporting empirical studies for both sides, as well as studies reporting no existence of such a relation, for instance the studies conducted in 1974 by Cooper and in 1988 by Nozar and Taylor (as cited in Maysami et al., 2004).

Money supply data is taken from OECD web site: M1 is defined as currency i.e. banknotes and coins, plus overnight deposits. M2 is defined as the sum of M1, deposits with an agreed maturity of up to two years and deposits redeemable at notice of up to three months. And broad money – M3 is defined as the sum of M2, repurchase agreements, money market fund shares/units and debt securities up to two years. The narrow (M1) and broad money indices (M3) are calculated by OECD from the national stock series[13]. Country indices are calculated by first estimating period averages when the country only supplies end-of-period stock data. The figure for the end of the previous period is taken as the opening stock for the current period. The arithmetic average of the two is the estimate for the period average. These, or true monthly averages when available, are divided by the annual average of the monthly data in the base period to obtain the index.

Unemployment

In a macroeconomic perspective, levels of employment depend on levels of economic activity (broadly measured by GDP) and on intensity of labour per unit of product (productivity). Economic losses from unemployment are large, since they relate to all goods and services that could be produced by the unemployed, to income losses for the unemployed household, to consumption and employment losses caused by reduced demand of the latter, to a wide range of social pathologies and health diseases. A reduction in GDP means that employees are redundant and, depending on institutional arrangements, a dismissal tide will take place. This, in turn, may depress consumption, leading to a further reduction in GDP ("Keynesian multiplier"). In many countries, employment has followed short-term GDP dynamics, especially in prolonged recessions when a fall in employment takes place, with more moderate growth than GDP along growth path in the long-term, because of increases in productivity.

[13] Narrow Money (M1) and Broad Money (M3) for both Index 2005=100, seasonally adjusted calculations as stated in OECD metadata can be accessed at OECD web site.

Monthly unemployment rate data is obtained from OECD and IFS databases.

Market index

Market indexes are intended to represent an entire stock market and thus, track the market's changes over time; therefore they are used as a metric that tracks the overall performance of the market. Market index is an aggregate value produced by combining several stocks together and expressing their total values against a base value from a specific date. Market index is computed from the prices of selected stocks (typically a weighted average) and is used as a tool by investors and financial managers to describe the market, and to compare the return on specific investments. A 'national' index represents the performance of the stock market of a given nation—and by proxy, reflects investor sentiment on the state of its economy. The most regularly quoted market indices are national indices composed of the stocks of large companies listed on a nation's largest stock exchanges.

Market index is included in the analysis as it captures the market dynamics. As Higgins and Pearce stated stock price indexes are believed to produce useful predictive information about the economy and have long been used as leading indicators of economic activity (as cited in Arbelaez et al., 2001).

Value Share Trading

The value of share trading is the total number of shares traded multiplied by their respective matching prices. Figures are single counted (only one side of the transaction is considered). Companies admitted to listing and admitted to trading are included in the data.

In this study, all variables except for inflation (cpipctchg) and unemployment rate (unemp) are used in natural logarithmic form. Inflation and unemployment rate, by definition, indicate the change rate.

4.2 Econometric Model Estimation

The panel nature of the data allows analysing the macroeconomic determinants of trading volume both across stock exchanges and over time. The dataset at hand includes a wide range of stock exchanges, indicating the existence of heterogen dynamics across exchanges rather than homogen. Therefore, models allowing the

heterogeneity in the estimated parameters and dynamics are required. Panel cointegration techniques and panel error correction models are capable of modelling such relations.

Macroeconomic variables and volume relation, by nature, exhibit both short-run fluctuations and long-run trends. Panel-based cointegration analysis enable investigating the potential existence of a long run equilibrium and causality among dependent and explanatory variables. At the same time it reduces the well-known size and power distortions which arise in time series analyses with short time dimension. VEC models are appropriate for modelling such relationships since the dynamics are given by the combination of current and past shocks and the gradual adjustment towards equilibrium. VEC model presumes that variables included are non-stationary but cointegrated, meaning that linear combinations of the variables are stationary. Hence, these linear combinations can be interpreted as equilibrium relations.

In order to examine the short- and long- run impacts of macroeconomic variables on trading volume, first the stationary properties of the variables must be determined.

4.2.1 Unit root test results

Identifying the order of integration of the time series data is crucial, because non-stationarity invalidates many standard empirical results. Moreover as it is explained in Section 3.1, integration order of each variable must be known in advance in order to apply VECM methodologies. Therefore, the first step to develop an appropriate model is to determine the stationary properties of the relevant series by means of unit root tests.

In order to evaluate a possible long-run relationship between macroeconomic variables and trading volume of stock exchanges first one needs to establish the order of integration of the variables (for order of integration see Section 3.1). It is widely recognized that time-series unit root tests may suffer from low power, especially with short spanned data. Therefore, in this study the more powerful panel approach is followed to examine the degree of non-stationarity in the variables.

In literature, there are many occasions in which several unit root tests are applied in order to identify the order of integration of series. The reason is twofold; firstly, none of the unit root tests has gained an overall acceptance. Secondly, it is likely that

different tests produce conflicting results. So, conducting more than one test and identifying the stationarity of the series depending on the results is a generally accepted procedure. The null hypothesis of all tests with two exceptions, state the series in question has a unit root meaning the series are non-stationary. KPSS and Hadri on the other hand reverse the null; their null states the series to be stationary. One of these two tests is almost always included among the tests performed, particularly when the results are conflicting, the rationale being to verify results of commonly used tests with an opposite null hypothesis.

Macroeconomic variables and trading volume data are in panel form, therefore panel UR tests[14] were applied to the dataset at hand. There are two types of panel UR tests; namely common and individual unit root tests. In this study three tests from each type making a total of six tests were applied to the panel dataset at hand. Levin, Lin, Chu (LLC), Breitung, and Hadri are of common root tests, whereas Im, Pesaran, Shin (IPS), Fisher - ADF[15], and Fisher – PP (Maddala and Wu, and Choi) are of individual root tests. All tests were conducted both on level and first difference of the series. Additionally, both individual fixed effects and fixed effects and trends[16] were experimented with.

LLC and IPS are parametric tests. Null hypothesis of both tests state the stationarity of the series whereas the alternative hypothesis differ. In case of LLC, the alternative states all series within the panel to be non-stationary, whereas the alternative of IPS states that at least one series in the panel is non-stationary.

LLC, Breitung, IPS, Fisher – ADF tests involve regressions on lagged difference terms, therefore the choice of the number of lags to be included must be determined beforehand. It is well known that the unit root tests are sensitive to different lag structures: as a consequence various types of information criteria are available for determining the number of lagged difference terms (lag length).

In this study six different information criterions were used for lag selection namely: Schwarz Information Criterion (SIC), Akaiki Information Criterion (AIC), Hannan-Quinn Information Criterion (HQC) and their modified versions. Lag length selection

[14] The UR tests for panel data and time series differ slightly, detailed information on tests were presented at section 3.1 and will not be repeated here.
[15] the Augmented Dickey-Fuller
[16] There is a third option "None" is to be selected for no regressors, which is not used in this study

was determined after experimenting with different information criterion and max lengths. Lag lengths experimented with were started from 12 up to 36. The most stable lag length computed by Hannan-Quinn, was 13 regardless of the maximum lag length specified.

LLC, Fisher - PP, and Hadri, involve kernel weighting, therefore these tests require the choice of bandwidth and kernel type to be determined beforehand. Commonly used three kernel types are namely: Bartlett, Parzen, and Quadratic spectral. As for bandwidth selection either an automatic selection method of Andrews, or Newey-West can be chosen or a fixed bandwidth can be specified by the user. In this study Bartlett was chosen as the kernel type method and for bandwidth selection Newey-West was used.

At level all of the results, but unemployment indicate the presence of a unit root (Table 4.3), as the LLC, IPS, and both Fisher tests fail to reject the null of a unit root implying stationarity, whereas Hadri reject the null, but its null indeed implies stationarity. Some test results conflicts with others (I will come to this later). The results of UR tests conducted for inflation D(CPCHG) as an example are presented in the following tables 4.1 and 4.2 at first differences for individual effects and individual effects and trends, respectively.

For 1st diff	**Individual effects**					**Inf. Crit./ lag length**
Variable / Methods	**LLC**	**IPS**	**ADF**	**PP**	**Hadri**	
D(CPICHG)	0.000	0.000	0.000	0.000	0.871	SIC 0-12
D(CPICHG)	0.000	0.000	0.000	0.000		MSIC 0-10

Notes : D(<variable>) first difference operator, probabilities are given in cells. For all test types except for Hadri *Null : has Unit Root (Non-stationarity),* Hadri *Null : No unit root (Stationarity)* Lag length is not required for Hadri therefore experimenting with different Information criterion is not applicable. Newey-West automatic bandwidth selection and Bartlett kernel were used. The last column of the table contains the method and lag length used when applicable.

Table 4.1 : UR Test results for inflation ind. effects (CPICHG).

The summary of the results for all variables for level are presented in Table 4.3. The tests are, then applied to the first differences of the series with URs, except for unemployment (unemp). The first differences of the series are tested for unit root and none of the results indicated the presence of a unit root. Although some test results seem to be conflicting, depending on results it can be concluded that only

unemployment (unemp) was stationary at level, all others were nonstationary exhibiting unit root at level and were stationary at their first differences.

For 1st diff	Individual effects, Individual linear trends						Inf. Crit./ lag length
Variable / Methods	LLC	Breitung	IPS	ADF	PP	Hadri	
D(CPICHG)	0.000	0.000	0.000	0.000	0.000	0.941	SIC 0-12
D(CPICHG)	0.000	0.000	0.000	0.000	0.000		MSIC 0-10

Notes : D(<variable>) first difference operator, probabilities are given in cells. For all test types except for Hadri *Null : has Unit Root (Non-stationarity),* Hadri *Null : No unit root (Stationarity)* Lag length is not required for Hadri therefore experimenting with different Information criterion is not applicable. Newey-West automatic bandwidth selection and Bartlett kernel are used. The last column of the table contains the method and lag length used when applicable. In this table the lag length selection is performed by four information criteria as presented in the last column.

Table 4.2 : UR Test results for inflation ind. effects & trends (CPICHG).

In literature it is quite common for the various UR test statistics not to agree as reported by Soytas and Sari (2007) and B. Hall and Mairesse (2002), hence conflicting cases are encountered for different UR tests. Regarding the results reported, conflicting ADF and PP test results can be attributed to the fact that although ADF and PP tests are asymptotically equivalent they may differ substantially in finite samples due to the different ways in which they correct for serial correlation in the test regression refer to Schwert (2002) and Perron and Ng (1996).

There are many publications investigating conflicting results of UR tests both for time series and for panel data. Among them B. Hall and Mairesse (2002) compares the small sample performance of six unit root tests in short panels using simulated panel data. Our results are consistent with his finding that the IPS test with trend is more likely to find a unit root compared to IPS without a trend. Hall warns that the power of IPS with trend is low when the first order serial correlation is high. In another study A. Hall (1994) applied the ADF tests to 10 inventory series finding that roughly half of the series were in agreement. He points out that the misspecification of the trend term may be causing this conflicting result which he considers as evidence against a unit root.

To summarize, test results suggested that all variables are integrated of order 1; technically *I(1),* except for unemployment which is *I(0)*. The results of other tests are presented in Appendix A.

As for GDP results are in line with studies of Lee and Chang (2009) and Nasseh and Strauss (2000). The former used logarithm of real gross domestic product (GDP) as an explanatory variable and found the four series including GDP show strong evidence of having a unit root depending on the results of LLC, IPC and Hadri tests; not surprisingly two statistics rejected the unit root in the LLC test, however intrinsically this didn't prevent them to interpret the series as being I(1). The latter applied ADF tests and could not reject the non stationarity.

Nonstationarity of CPI is in line with the results of ADF tests conducted by Nasseh and Strauss (2000), three panel cointegration tests[17] applied by Gregoriou and Kontonikas (2010) and the results Hurlin (2008) demonstrated.

UR results for unemployment rate rejected the null of non-stationarity. In the study Hurlin (2008) conducted, the null was also rejected for unemployment rate. This is noteworthy as the stationarity of unemployment rate is the only result he and Nelson and Plosser (1982) are in agreement.

The UR test results for both short-term and long-term interest rates reported by Nasseh and Strauss (2000) could not reject the nonstationarity, hence is in line with the results for long term government bond yield. Bond yield was one of the six variables Hurlin (2008) reported robust results of non-stationarity.

Money supply either measured by M1 or M3 is found to be non-stationary, which is in line with the findings of Hurlin (2008)[18]. The results are also in line with the reported results of Maysami et al. (2004) ADF test using AIC.

Trading volume is found to be non-stationary, technically *I(1)*. This finding is in line with the results reported by Bodla and Kumar (2009), who employed Augmented Dickey Fuller (ADF) test to test for the stationarity of trading volume and found monthly trading volume series to be *I(1)*.

[17] Levin et al. (2002), Harris and Tzavalis (1999), and Maddala and Kim's (1998)
[18] He stated money supply is measured by broad definition, M2 or M3

Table 4.3 : Unit Root Test Results – Level. (* denotes 10% significance)

Variable	LLC	IPS	ADF	PP	Hadri	LLC	Breitung	IPS	ADF	PP	Hadri	lag length
CPICHG	I(0)	I(0)	I(0)	I(0)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)	SIC 0-12
CPICHG	I(1)	I(0)	I(0)	I(0)		I(1)	I(1)	I(1)	I(1)	I(0)		MSIC 0-12
CPICHG	I(1)	I(0)	I(0)	I(0)		I(1)	I(1)	I(1)	I(1)	I(0)		AIC 12-13
CPICHG	I(1)	I(0)	I(0)	I(0)		I(1)	I(1)	I(1)	I(1)	I(0)		MAIC 0-13
CPICHG	I(1)	I(0)	I(0)	I(0)		I(1)	I(1)	I(1)	I(1)	I(0)		HQ 12, 12-13
CPICHG	I(1)	I(0)	I(0)	I(0)		I(1)	I(1)	I(1)	I(1)	I(0)		MHQ 0-13
UNEMP	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)	I(1)	I(1)	I(0)	I(0)	I(1)	SIC 0-12
UNEMP	I(1)	I(1)	I(1)	I(0)		I(1)	I(1)	I(1)	I(1)	I(0)		MSIC 0-12, 0-11
UNEMP	I(0)	I(0)	I(0)	I(0)		I(0)	I(1)	I(0)	I(0)	I(0)		AIC 1-13
UNEMP	I(0)	I(0)	I(0)	I(0)		I(0)	I(1)	I(1)	I(1)	I(0)		MAIC 1-12, 1-13
UNEMP	I(0)	I(0)	I(0)	I(0)		I(0)	I(1)	I(0)	I(0)	I(0)		HQ 0-12, 0-13
UNEMP	I(1)	I(1)	I(1)	I(0)		I(1)	I(1)	I(1)	I(1)	I(0)		MHQ 0-12
ln(VALSHR)	I(0)	I(0)	I(0)*	I(0)	I(1)	I(0)*	I(0)	I(0)	I(0)	I(0)	I(1)	SIC 0-3
ln(VALSHR)	I(1)	I(1)	I(1)	I(0)		I(1)	I(0)	I(1)	I(1)	I(0)		MSIC 0-7, 0-6
ln(VALSHR)	I(1)	I(1)	I(1)	I(0)		I(1)	I(0)	I(1)	I(1)	I(0)		AIC 0-13
ln(VALSHR)	I(1)	I(1)	I(1)	I(0)		I(1)	I(0)	I(1)	I(1)	I(0)		MAIC 0-12
ln(VALSHR)	I(1)	I(1)	I(1)	I(0)		I(1)	I(0)	I(0)	I(1)	I(0)		HQ 0-7,0-8
ln(VALSHR)	I(1)	I(1)	I(1)	I(0)		I(1)	I(0)	I(1)	I(1)	I(0)		MHQ 0-10, 0-11
ln(INDPROD)	I(1)	I(0)	I(0)	I(0)	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)	I(1)	SIC 0-13
ln(INDPROD)	I(1)	I(1)	I(1)	I(0)		I(1)	I(1)	I(1)	I(1)	I(0)		MSIC 0-13, 0-12
ln(INDPROD)	I(1)	I(0)	I(0)	I(0)		I(1)	I(1)	I(0)	I(0)	I(0)		AIC 0-13
ln(INDPROD)	I(1)	I(0)	I(0)	I(0)		I(1)	I(1)	I(1)	I(0)	I(0)		MAIC 0-13, 0-12
ln(INDPROD)	I(1)	I(0)	I(0)	I(0)		I(1)	I(1)	I(0)	I(0)	I(0)		HQ 0-13
ln(INDPROD)	I(1)	I(1)	I(1)	I(0)		I(1)	I(1)	I(1)	I(1)	I(0)		MHQ 0-13, 0-12
ln(VPVOBARSA)	I(0)	I(1)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(0)	I(1)	I(1)	SIC 1-13
ln(VPVOBARSA)	I(0)	I(1)	I(1)	I(0)		I(0)*	I(1)	I(1)	I(1)	I(1)		MSIC 1-13

ln(VPVOBARSA)	I(0)	I(1)	I(1)	I(0)		I(0)	I(1)	I(0)	I(0)	I(1)		AIC 1-13
ln(VPVOBARSA)	I(0)	I(1)	I(1)	I(0)		I(0)	I(1)	I(1)	I(1)	I(1)		MAIC 1-13
ln(VPVOBARSA)	I(0)	I(1)	I(1)	I(0)		I(0)	I(1)	I(0)	I(0)	I(1)		HQ 1-13
ln(VPVOBARSA)	I(0)	I(1)	I(1)	I(0)		I(0)	I(1)	I(1)	I(1)	I(1)		MHQ
ln(M1)	I(0)	I(1)	I(1)	I(1)		I(0)	I(1)	I(1)	I(1)	I(1)		SIC
ln(M1)	I(0)	I(1)	I(1)	I(1)		I(0)	I(1)	I(1)	I(1)	I(1)		MSIC
ln(M1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	AIC 0-13
ln(M1)	I(0)	I(1)	I(1)	I(1)		I(1)	I(1)	I(1)	I(1)	I(1)		MAIC
ln(M1)	I(0)	I(1)	I(1)	I(1)		I(0)	I(1)	I(1)	I(1)	I(1)		HQ
ln(M1)	I(0)	I(1)	I(1)	I(1)		I(0)	I(1)	I(1)	I(1)	I(1)		MHQ
ln(M3)	I(0)	I(1)	I(1)	I(1)		I(0)	I(1)	I(0)	I(0)	I(0)		SIC
ln(M3)	I(0)	I(1)	I(1)	I(1)		I(1)	I(1)	I(1)	I(1)	I(0)		MSIC
ln(M3)	I(0)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(0)	I(0)	I(0)	I(1)	AIC
ln(M3)	I(0)	I(1)	I(1)	I(1)		I(0)	I(1)	I(0)	I(0)	I(0)		MAIC
ln(M3)	I(0)	I(1)	I(1)	I(1)		I(0)	I(1)	I(0)	I(0)	I(0)		HQ
ln(M3)	I(0)	I(1)	I(1)	I(1)		I(0)	I(1)	I(0)*	I(1)	I(0)		MHQ
ln(MRKINX)	I(1)	I(1)	I(1)	I(0)*		I(1)	I(0)*	I(1)	I(1)	I(1)		SIC
ln(MRKINX)	I(1)	I(1)	I(1)	I(0)*		I(1)	I(1)	I(1)	I(1)	I(1)		MSIC
ln(MRKINX)	I(1)	I(0)*	I(0)	I(0)*	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	AIC
ln(MRKINX)	I(1)	I(1)	I(1)	I(0)*		I(1)	I(0)*	I(1)	I(1)	I(1)		MAIC
ln(MRKINX)	I(1)	I(1)	I(0)*	I(0)*		I(1)	I(0)	I(1)	I(1)	I(1)		HQ
ln(MRKINX)	I(1)	I(1)	I(1)	I(0)*		I(1)	I(1)	I(1)	I(1)	I(1)		MHQ
ln(GOBNDY)	I(1)	I(1)	I(1)	I(1)		I(1)	I(0)	I(0)	I(0)	I(0)		SIC
ln(GOBNDY)	I(1)	I(1)	I(1)	I(1)		I(1)	I(1)	I(0)*	I(1)	I(0)		MSIC
ln(GOBNDY)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)	I(0)	I(1)	AIC
ln(GOBNDY)	I(1)	I(1)	I(1)	I(1)		I(1)	I(1)	I(0)	I(1)	I(0)		MAIC
ln(GOBNDY)	I(1)	I(1)	I(1)	I(1)		I(1)	I(0)	I(0)	I(0)	I(0)		HQ
ln(GOBNDY)	I(1)	I(1)	I(1)	I(1)		I(1)	I(1)	I(0)	I(1)	I(0)		MHQ

Hurlin explains the mix results in terms of heterogeneous nature of the alternative hypothesis, pointing out the rejection of the null hypothesis does not necessarily imply the nonstationarity is rejected for all countries, but only that the null hypothesis is rejected for a sub-group of $N_1 < N$ countries.

Table 4.4 shows the panel unit root test results for macroeconomic variables reported by Hurlin (2008).

Table 4.4 : Unit Root Results reported by Hurlin.

Tests	LLC	IPS	MW	CH	BN_c	BN_i	MP	CH2	P	IV
Real GDP	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)
Nominal GDP	I(0)	I(1)	I(0)	I(0)	I(1)	I(0)	I(0)	I(1)	I(0)	I(1)
Real per capita GDP	I(0)	I(1)	I(1)	I(0)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)
Industrial production	I(0)	I(0)	I(0)	I(0)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)
Employment	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)
Unemployment rate	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)	I(0)	I(0)	I(0)	I(1)
GDP deflator	I(0)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)
Consumer prices	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)
Wages	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)
Real wages	I(0)	I(0)	I(0)	I(0)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)
Money stock	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)	I(0)	I(1)	I(0)	I(1)
Velocity	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)	I(1)
Bond yield	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)	I(0)	I(1)
Common stock prices	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(0)	I(1)

Notes: All results are obtained in a model with fixed effects at the 5% level. LLC denotes the Levin *et al.* (2002) test (statistic t_ρ^*), IPS denotes Im, Pesaran and Shin (2003) test (statistic W), MW denotes the Maddala and Wu (1999) test (statistic P_{MW}), CH denotes the Choi (2001) test (statistic Z_{MW}), BN_c denotes the Bai and Ng (2004) test for common factors (ADF_F^c or MQ statistics), BN_i denotes the Bai and Ng (2004) test for idiosyncratic shocks (statistic P_e^c), MP denotes the Moon and Perron (2004) test (statistic t_a^*), CH2 denotes the Choi (2002) test (statistic P_m), P denotes the Pesaran (2003) test (statistic CIPS with $p = 2$) and IV denotes the Chang (2002) test (statistic IGF_2).

To summarize, tests were conducted for all the variables (except for unemployment) once again with the first differences. This time the results of all tests agreed for the stationarity of the variables. All the variables except for unemployment were found to be non-stationary *I(1)*, therefore in the next step a possible cointegrating relationship between these variables should be searched for.

4.2.2 Cointegration test results

The existence of cointegration among variables of *I(1)* indicates a long-run relationship, therefore cointegration test result has a crucial role in modelling the relationship between trading volume and macroeconomic variables. Johansen multivariate cointegration technique, proposed by Johansen (1988) and Johansen and Juselius (1990), was applied to the dataset. In this respect variables namely; value share (VALSHR), market index (MRKINX), 10 year government bond yield (GOBNDY), industrial production (both VPVOBARSA and INDPROD), money

supply (both M1 and M3) were tested. Panel cointegration tests, including both within and between dimension are applied. Several tests, with various options for information criterions and lag intervals were conducted to search for the possible existence of cointegrating relationship(s) among these variables. Cointegration tests, namely: Pedroni (1999, 2004), Kao (1999) and Fisher-type test using Johansen's test methodology (Maddala and Wu, 1999) were applied. All tests require an appropriate lag length to be defined beforehand. The optimum lag length was identified in a similar way explained in the unit root test, Section 4.2.1.

Three types of trend specifications are possible in case of Pedroni; whereas Kao test allows only for one trend type; individual intercept. Pedroni tests consists of 11 tests, all has the null of no cointegration. As for alternatives, eight of them; namely panel and weighted panel tests, have the alternative hypothesis of common AR coefficients, whereas three which are known as group tests have the alternative of individual AR coefficients.

Cointegration test results are presented in Table 4.5 to Table 4.8. Pedroni test was carried out for two trend specifications: individual intercept and individual intercept and individual trend. In Table 4.5 the Pedroni test results for individual intercept were summarized for all 11 tests: panel tests, panel weighted tests and group tests. Each test is conducted for each one of six information criterions namely AIC, SIC and HQIC together with their modified versions. The information criterions experimented with were reported in the first column of the table.

Table 4.5 : Cointegration results – Pedroni (Engle-Granger Based) Indvidual intercept.

H_0: No cointegration
(X) indicates H_0 cannot be rejected, Numbers in the cells show probability values.

lag length	Panel				Panel weighted				Group		
	v-stat	rho-stat	PP-stat	ADF-stat	v-stat	rho-stat	PP-stat	ADF-stat	rho-stat	PP-stat	ADF-stat
AIC	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000
SIC	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000
HQIC	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000
MAIC	0.000	0.000	0.000	0.978 X	0.011	0.000	0.000	0.968 X	0.000	0.000	0.953 X
MSIC	0.000	0.000	0.000	0.978 X	0.005	0.000	0.000	0.707 X	0.000	0.000	0.896 X
MHQIC	0.000	0.000	0.000	0.971 X	0.011	0.000	0.000	0.917 X	0.000	0.000	0.924 X

In case of deterministic intercept, but no deterministic trend, regardless of the information criterion used, all 11 tests of Pedroni reject null of no-cointegration with

1% significance, the only exception was the ADF-stat test depending on the information criterion used. ADF-stat test when applied using modified information criterions could not reject the null regardless of the alternative hypothesis being common or individual or the test being panel, panel weighted or group.

Results for 11 tests with individual intercept and individual trend option are presented in Table 4.6. In case of deterministic intercept and trend, the results were very similar to intercept only. Hence all the Pedroni tests conducted in total 11 (tests) x 2 (ind intercept /ind intercept & tend) x 6 (information criterion used) makes 132 results.

Table 4.6 : Cointegration results – Pedroni (Engle-Granger Based) individual intercept and individual.trend.

H_0: No cointegration
(X) indicates H_0 can not be rejected, Numbers in the cells show probability values

	Panel				**Panel weighted**				**Group**		
lag length	v-stat	rho-stat	PP-stat	ADF-stat	v-stat	rho-stat	PP-stat	ADF-stat	rho-stat	PP-stat	ADF-stat
AIC	0.016	0.000	0.000	0.000	0.314 X	0.000	0.000	0.000	0.000	0.000	0.000
SIC	0.005	0.000	0.000	0.000	0.229 X	0.000	0.000	0.000	0.000	0.000	0.000
HQIC	0.016	0.000	0.000	0.000	0.314 X	0.000	0.000	0.000	0.000	0.000	0.000
MAIC	0.016	0.000	0.000	1.000 X	0.314 X	0.000	0.000	0.925 X	0.000	0.000	0.971 X
MSIC	0.005	0.000	0.000	1.000 X	0.229 X	0.000	0.000	0.873 X	0.000	0.000	0.975 X
MHQIC	0.016	0.000	0.000	1.000 X	0.314 X	0.000	0.000	0.826 X	0.000	0.000	0.949 X

Regardless of the information criterion used all but two tests reject null of no-cointegration with 1% significance. Two exceptions; the ADF-stat test results were identical with the intercept only, depending on the information criterion used. On the other hand the panel weighted v-stat tests rejected the null of no-cointegration for all information criterion used.

Results of Kao, assuming no deterministic trend are reported for six tests in Table 4.7. Test results could not reject the null of no cointegration regardless of the information criterion used.

To summarize 138 tests (132 plus 6) were conducted in total.

Table 4.7 : Cointegration results – Kao.

Numbers in the cells show probability values, M denotes modified version of the test

Information criterion	Individual intercept
AIC	0.217
MAIC	0.217
SIC	0.377
MSIC	0.377
HQIC	0.217
MHQIC	0.412

Fisher (combined Johansen) test results are reported in Table 4.8 Cointegration results - Fisher. Both the maximum eigenvalue and trace statistics suggested one cointegrating vector driving the series with common stochastic trends in the data and in the cointegrating equation. The null hypothesis of r=0 was rejected, since probability values were below 10 per cent, whereas r=2 could not be rejected. This outcome implied that there was at most one cointegrating relationship among the variables. Different lag intervals were also experimented with. Tests were conducted for lag intervals of (1,2) and (1,3) nevertheless the same results were obtained.

Table 4.8 : Cointegration results - Fisher (combined Johansen).

Lag interval / Trend specification	1-1	1-2	1-3
intercept (no trend) in CE and VAR	at most 1	at most 1	at most 1
intercept & trend in CE - no trend in VAR	at most 1	at most 1	at most 1

The results of Pedroni and Fisher were consistent and implied a cointegration relation among the variables whereas this conflicted with the results of Kao which could not reject no cointegration. Cointegration tests yielding conflicting conclusions ("mixed signals") is an issue encountered by several researchers. Datar et al. (1998) made a comparison for the popular panel cointegration tests of Kao (1999), Pedroni (2004) and Larsson et al. (2001) and concluded that the panel versions also exhibit a low correlation of empirical p-values under the null.

The cointegrations tests were conducted with the same macroeconomic variables with alternating money supply and industrial production variables. Tests were conducted using two different industrial production proxies; namely ln(INDPROD)

and ln(VPVOBARSA). Similar results were obtained. Money supply variable is also alternated; tests are conducted once with M1 and then with M3. Similar results were obtained. Hence, tests are conducted for four sets of variables.

The results of all cointegration tests carried out are summarized in Table 4.9. For each set, the number of tests indicating the existence of a cointegration relationship among the variables over the total number of tests are presented.

Table 4.9 : Cointegration Test Results Summarized.

Variable Set	No. of tests Nonstationarity can't be rejected / Total
LNVALSHR, LNMRKINX, LNBONDY, LNINDPROD , LNM1	96 / 138
LNVALSHR, LNMRKINX, LNBONDY, LNINDPROD , LNM3	132 / 138
LNVALSHR, LNMRKINX, LNBONDY, LNVPVOBARSA , LNM1	108 / 138
LNVALSHR, LNMRKINX, LNBONDY, LNVPVOBARSA , LNM3	115 / 138

As Datar et al. (1998) stated "researchers are likely to be confronted with conflicting test decisions when using different tests in applied work. Given that there rarely is a compelling theoretical reason to prefer one test over another in practice, this issue is rather troublesome".

As a result, following Pedroni and Fisher test results, I concluded that there was one cointegration relationship among the variables. Macroeconomic variables might indeed, contain important information regarding trading volume.

4.2.3 Model estimation

While investigating the existence of one or more long-run relationships among the non-stationary variables is informative, it is of more interest to determine the nature of these relationships. In the previous subsection, the existence of a cointegrated relationship was demonstrated, so the next step is to implement the causality tests.

A cointegrated relationship implies Granger causality; however, does not point out the direction. If variables in concern are cointegrated, a VECM should be estimated rather than a VAR (Granger, 1988). Therefore, in order to assess the direction, a vector error correction (VEC) model was used. A VEC model is a restricted VAR, designed for use with nonstationary series, which are known to be cointegrated. The VEC has cointegration relations built into the specification, so that it restricts the

long-run behaviour of the endogenous variables to converge to their cointegrating relationships, while allowing for short-run adjustment dynamics. The cointegration term is known as the error correction term (ECT), since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. If no cointegrating relationship existed, the variables would be made stationary by first differencing, and then a test for causality in a VAR context would be conducted. Following Granger (1988) and Engle and Granger (1987), for non-stationary variables and a cointegrated relationship, which is the case with the panel dataset at hand, a VEC model for the Granger causality test was estimated.

A panel-based error correction model was used to identify the nature of the long-run relationship using the two-step procedure of Engle and Granger (1987). In the first step, the long-run model for equation Model 1 was estimated (Table 4.10), in order to obtain the estimated residual ε_{it-1} (error correction terms). In the second step, the Granger causality model with the dynamic error correction terms was estimated (Table 4.12).

Since one cointegrating equation exists among the variables, a VEC model without trend is estimated. Long run parameter estimates for Model 1 (VEC with M1) are presented in Table 4.10 with t-stats given in brackets. Results indicated that not all variables were significant. Coefficients of industrial production (VPVOBARSA), long-term government bond yield (GOBNDY), inflation (CPICHG) and unemployment rate (UNEMP) were statistically significant; whereas market index (MRKINX) and money supply (M1) were not. According to normalized equation, industrial production and long term government bond yield contributed to trading volume in the long-run; whereas the increase in inflation and unemployment rate had a decreasing effect on volume.

A second model Model 2 is estimated replacing narrow money supply M1 with broader M3. Results are reported in Table 4.11. Similar results were obtained: the same variables were significant with the same signs as in Model 1. Neither M1 nor M3 seemed to have significant effect on trading volume. The only difference between the models was the increased significance of unemployment rate in Model 2 compared to Model 1.

Table 4.10 : Model 1.

$LNVALSHR_{t-1}$=	-35.246	+ 1.483 $LNVPBOBARSA_{t-1}$	- 0.256 $LNMRKINX_{t-1}$	+ 4.180 $LNM1_{t-1}$	+ 22.932 $LNGOBNDY_{t-1}$	- 9.941 $CPICHG_{t-1}$	- 0.454 $UNEMP_{t-1}$
		[-2.764] **	[0.395]	[-1.360]	[-6.635] **	[10.273] **	[1.655] +

Table 4.11 : Model 2.

$LNVALSHR_{t-1}$=	-20.562	+1.871 $LNVPBOBARSA_{t-1}$	+ 0.084 $LNMRKINX_{t-1}$	+ 0.226 $LNM3_{t-1}$	+ 22.715 $LNGOBNDY_{t-1}$	- 11.373 $CPICHG_{t-1}$	- 0.649 $UNEMP_{t-1}$
		[-3.069] **	[0.114]	[-0.067]	[-5.751] **	[10.212] **	[2.121] **

Notes t-statistics are in brackets []
+, * and ** denote significancy at 10%, 5% and 1% respectively
Δ denotes the first difference of the variables,
k is the lag length

As to my knowledge, this is the first study investigating the relationship between macroeconomic variables and aggregate trading volume for a group of stock exchanges, therefore my expectations on the signs, predominantly depend on the previous studies regarding macroeconomic variables and stock markets; even though most of them were focused on stock returns.

There is evidence that trading volume is positively and significantly related to the level of real economic activity as proxied by the industrial production.

The results indicated a negative relationship between inflation and trading volume. The effect of inflation, in terms of its sign being positive or negative, has been a subject of debate for a long time. Fama's (1990) explanation for negative stock return-inflation relationship has found many supporters; but there are as many studies that reported contrary results. Apergis and Eleftheriou (2002) who found similar results state that declining inflation was seen as an indicator of risk reduction by the investors, who responded by investing more in the stock market and contributed to the increase in the stock prices. They concluded that this price increase in turn is expected to contribute to the economic growth. García and Liu (1999), on the other hand, demonstrate that macroeconomic stability measured by inflation is not significant in market capitalization.

Long-term interest rates are found to be significant and affect trading volume positively. Maysami et al. (2004) and Mukherjee and Naka (1995) reported a negative relation with stock returns for Singapore and Japan respectively, which may seem contrary to the results of this study, but this is about trading volume. Maysami et al. (2004) explain it by long-term interest rate serving as a better proxy for the nominal risk-free component used in the discount rate in the stock valuation models and that it may also serve as a surrogate for expected inflation in the discount rate.

Money supply not being significant either as M1 or M3 is in line with the findings of Cooper (1974) and Nozar and Taylor (1988) (as cited by Maysami et al., 2004). Mukherjee and Naka (1995) and Maysami et al. (2004) reported a positive relationship between money supply and stock returns. However, the results of this study indicate no significant relationship between money supply and trading volume.

$$\Delta VALSHR_{it} = \xi_{1i} + \Sigma^{k}_{j=1}\beta_{11j}\,\Delta VALSHR_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{12j}\,\Delta VPVOBARSA_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{13j}\,\Delta MRKINX_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{14j}\,\Delta M1_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{15j}\,\Delta GOBNDY_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{16j}\,\Delta CPICHG_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{17j}\,\Delta UNEMP_{i(t-j)} + \lambda_{1i}\varepsilon_{it-1} + u_{1it} \quad \textbf{(4.1)}$$

$$\Delta VPVOBARSA_{it} = \xi_{2i} + \Sigma^{k}_{j=1}\beta_{21j}\,\Delta VALSHR_{it-k} + \Sigma^{k}_{j=1}\beta_{22j}\,\Delta VPVOBARSA_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{23j}\,\Delta MRKINX_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{24j}\,\Delta M1_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{25j}\,\Delta GOBNDY_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{26j}\,\Delta CPICHG_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{27j}\,\Delta UNEMP_{i(t-j)} + \lambda_{2i}\varepsilon_{it-1} + u_{2it} \quad \textbf{(4.2)}$$

$$\Delta MRKINX_{it} = \xi_{3i} + \Sigma^{k}_{j=1}\beta_{31j}\,\Delta VALSHR_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{32j}\,\Delta VPVOBARSA_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{33j}\,\Delta MRKINX_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{34j}\,\Delta M1_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{35j}\,\Delta GOBNDY_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{36j}\,\Delta CPICHG_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{37j}\,\Delta UNEMP_{i(t-j)} + \lambda_{3i}\varepsilon_{it-1} + u_{3it} \quad \textbf{(4.3)}$$

$$\Delta M1_{it} = \xi_{4i} + \Sigma^{k}_{j=1}\beta_{41ik}\,\Delta VALSHR_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{42j}\,\Delta VPVOBARSA_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{43j}\,\Delta MRKINX_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{44j}\,\Delta M1_{it-k} + \Sigma^{k}_{j=1}\beta_{45j}\,\Delta GOBNDY_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{46j}\,\Delta CPICHG_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{47j}\,\Delta UNEMP_{i(t-j)} + \lambda_{4i}\varepsilon_{it-1} + u_{4it} \quad \textbf{(4.4)}$$

$$\Delta GOBNDY_{it} = \xi_{5i} + \Sigma^{k}_{j=1}\beta_{51j}\,\Delta VALSHR_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{52j}\,\Delta VPVOBARSA_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{53j}\,\Delta MRKINX_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{54j}\,\Delta M1_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{55j}\,\Delta GOBNDY_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{56j}\,\Delta CPICHG_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{57j}\,\Delta UNEMP_{i(t-j)} + \lambda_{5i}\varepsilon_{it-1} + u_{5it} \quad \textbf{(4.5)}$$

$$\Delta CPICHG_{it} = \xi_{6i} + \Sigma^{k}_{j=1}\beta_{61j}\,\Delta VALSHR_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{62j}\,\Delta VPVOBARSA_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{63j}\,\Delta MRKINX_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{64j}\,\Delta M1_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{65j}\,\Delta GOBNDY_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{66j}\,\Delta CPICHG_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{67j}\,\Delta UNEMP_{i(t-j)} + \lambda_{6i}\varepsilon_{it-1} + u_{6it} \quad \textbf{(4.6)}$$

$$\Delta UNEMP_{it} = \xi_{7i} + \Sigma^{k}_{j=1}\beta_{71j}\,\Delta VALSHR_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{72j}\,\Delta VPVOBARSA_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{73j}\,\Delta MRKINX_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{74j}\,\Delta M1_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{75j}\,\Delta GOBNDY_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{76j}\,\Delta CPICHG_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{77j}\,\Delta UNEMP_{i(t-j)} + \lambda_{7i}\varepsilon_{it-1} + u_{7it} \quad \textbf{(4.7)}$$

$$\Delta M3_{it} = \xi_{8i} + \Sigma^{k}_{j=1}\beta_{81j}\,\Delta VALSHR_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{82j}\,\Delta VPVOBARSA_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{83j}\,\Delta MRKINX_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{84j}\,\Delta M3_{it-k} + \Sigma^{k}_{j=1}\beta_{85j}\,\Delta GOBNDY_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{86j}\,\Delta CPICHG_{i(t-j)} + \Sigma^{k}_{j=1}\beta_{87j}\,\Delta UNEMP_{i(t-j)} + \lambda_{8i}\varepsilon_{it-1} + u_{8it} \quad \textbf{(4.8)}$$

Notes : Δ : First difference operator, *k*: Lag length, ε_{it-1} : Error Correction Term, u_{jit} : Error of this equation

Table 4.12 : Short Run Causality - Sources of causation (independent variables).

Eq. no	Equation/ Short-Long Run	Δ(LN VALSHR)	Δ(LN VPVOBARSA)	Δ(LN MRKINX)	Δ(LN M1)	Δ(LN GOBNDY)	Δ(CPICHG)	Δ(UNEMP)	ECT long-run
1	**Δ(LNVALSHR)**	-	25.438 [0.020] *	33.944 [0.001] **	9.361 [0.745]	57.899 [0.000] **	36.445 [0.000] **	6.672 [0.918]	-0.000 (-0.669)
2	**Δ(LNVPVOBARSA)**	59.343 [0.000] **	-	42.460 [0.000] **	26.569 [0.014] *	47.595 [0.000] **	53.090 [0.000] **	14.695 [0.327]	-0.000 (-4.703) ***
3	**Δ(LNMRKINX)**	16.083 [0.245]	7.107 [0.897]	-	13.080 [0.442]	14.334 [0.351]	15.658 [0.268]	33.109 [0.002] **	-0.000 (-0.817)
4	**Δ(LNM1)**	15.147 [0.298]	15.212 [0.294]	5.2371 [0.970]	-	51.234 [0.000] **	39.410 [0.000] **	12.527 [0.485]	-0.000 (-0.421)
5	**Δ(LNGOBNDY)**	39.931 [0.000] *	36.103 [0.001] **	12.431 [0.493]	23.383 [0.037] *	-	65.316 [0.000] **	17.917 [0.161]	0.000 (0.465)
6	**Δ(CPICHG)**	25.527 [0.020] *	41.089 [0.000] **	5.2558 [0.969]	53.094 [0.000] *	41.741 [0.000] **	-	31.311 [0.003] **	-0.007 (-8.698) ***
7	**Δ(UNEMP)**	16.296 [0.233]	71.533 [0.000] **	14.858 [0.316]	20.710 [0.079] +	27.678 [0.010] **	28.661 [0.007] **	-	0.002 (3.086) ***

Notes : Probability values are in brackets, t-statistics in () Stars denote significancy ; + , * and ** denote 10%, 5% and 1% significancy respectively
Δ : denotes the first difference of the variables
LN : denotes natural logarithm

All the variables in Eqs. 4.1 to 4.8 are as previously defined, Δ denotes the first difference of the variables, ξ_{ji} (j = 1,2,3) represents fixed exchange effect, and k is the lag length. Lag length (k) of 13 is found to be necessary to satisfy the classical assumptions concerning the error term. Term λ_{ji} (j = 1,2,3) is the adjustment coefficient and u_{ji} (j = 1,2,3) is the disturbance term assumed to be uncorrelated with mean zero. The short-run adjustment coefficients are constrained to be the same for all exchanges. The first-differences of equations are used (Eq. 4.1 to 4.8) to eliminate the exchange specific effects.

The ECT in VECM provide an additional channel for Granger causality to emerge that is completely ignored by the standard Granger causality tests. In addition to the direction of Granger causality amongst variables, the VECM approach allows us to distinguish between short-run and long-run causality. Sources of causation between the variables in Eqs. (4.1) to (4.8) can be identified through three channels: (i) the lagged ECT (β values) by a t-test; (ii) the coefficients of each explanatory variable in one equation (weak or short-run Granger causality); (iii) the terms just described in (i) and (ii) jointly (strong or long-run Granger causality). The null and alternative hypothesis for the Eq.s are as follows;

$H_0 : \beta_{11j} = \beta_{12j} = \beta_{13j} = \beta_{14j} = \beta_{15j} = \beta_{16j} = \beta_{17j} = \beta_{18j} = 0$

H_a : at least one $\beta_{1.j} <> 0$ (j=1..k and k : lag length)

The directions of causation are identified by testing for the significance of the coefficient of each of the dependent variables in Eq.s 4.1 to 4.8. The short-run effects can be considered transitory. The long-run causality is tested by looking at the significance of the speed of adjustment, which is the coefficient of the error correction term (Table 4.12). The significance of ECT indicates the long-run relationship of the cointegrated process, and so movements along this path can be considered permanent.

There are times when for a reason a diversion from the long run relation happens. In such circumstances the characteristics of the reversion is determined by the short run relations among the variables. It must be stated that short run causality only tells about the existence of causality but gives no clue on the direction or the magnitude. Granger Causality/Block Exogeneity Wald tests based upon VEC model was performed to determine the short run causality among variables (Eq.s 4.1 to 4.8). The

null hypothesis of this test asserts that there is no short-run causality among the variables. The error correction terms imply the dynamic interaction between the variables to return to the long-run equilibrium whenever there is a deviation from the cointegrating relationship.

Error correction terms in the equations whose coefficients measure speeds of adjustment were derived from long-run cointegrating relationships during cointegration tests and were normalized.

As it was stated previously, in a VEC model, there are two possible sources of causality: ECT, which shows long-run causality and lagged explanatory variables, revealing short-run causality. Coefficients of ECTs, which were calculated using the normalized cointegrating equations obtained from the VEC model, are presented in the last column of Table 4.12.

Depending on the test results presented in Table 4.12 short run causality findings are as follows;

With respect to Eq. 4.1 all macroeconomic variables except for unemployment rate and money supply (M1) had significant impacts on trading volume in the short-run. The results showed there appeared to be bi-directional relations from government bond yield, inflation and industrial production to trading volume. There was only one uni-directional link; between market index and trading volume.

As shown in Eq. 4.2 all the macroeconomic variables except for unemployment rate were found to be significant in the industrial production equation. There were bi-directional links from money supply (M1), government bond yield, and inflation to industrial production.

In Eq. 4.3 market index was found not be significant in the long-run. In the short-run interestingly, only unemployment rate seemed to be significant in the market index equation which was uni-directional.

As presented in Eq. 4.4 money supply seemed to be exogenous in the long-run. There appeared to be a strong bi-directional relation between money supply (M1) and both government bond yield and inflation in the short-run.

Eq. 4.5 showed that trading volume, money supply, inflation and industrial production all had significant impact on the short-term government bond yield.

Neither market index nor unemployment rate seemed to be significant in the government bond yield equation. The link from trading volume to government bond yield seemed to be uni-directional. There were bi-directional links from money supply (M1), inflation and industrial production to government bond yield.

In terms of short-run dynamics Eq. 4.6 showed that all the macroeconomic variables and trading volume were significant in the inflation equation except for market index. There were bi-directional links from money supply (M1), government bond yield, unemployment rate and industrial production to inflation.

Finally, Eq. 4.7 showed that money supply[19] (M1), long-term government bond yield, inflation and industrial production all had significant impact on unemployment in the short-run whereas neither trading volume nor market index was significant. The links from money supply (M1)[20] and government bond yield to unemployment rate were uni-directional. There were bi-directional links from both inflation and industrial production to unemployment.

To summarize, short run causality was found to be two-way both from the macroeconomic variables to trading volume and vice versa. The results were also used to determine if selected endogenous variables should not be treated as exogenous. The results indicated that all variables in the model could be treated as endogenous; the remaining variables had significant impact on them jointly, but not always individually. There was no block exogeneity.

Even though market index had no significant impact in the long-run, as it is seen it had a significant effect on trading volume in the short-run. As for money supply it had no significant impact either in the long or short-run. Unemployment rate is of macroeconomic variables which has generally long term impacts on the economy. The long-term relationship showed it has significant impact on trading volume too. Unemployment rate not having a short-term impact on trading volume was, therefore not unexpected.

Unemployment rate had significant short-term effect on the market index but not on trading volume. This effect of unemployment rate can be attributed to its effect on the price information rather than volume in the short-run. Unemployment had an

[19] At 10% significance level
[20] Significance at 10%

effect on trading volume in the long-run. Market index exhibit information on price and generally used as a direct indicator of price movements.

In this study the advanced generalized forecast error variance decomposition and generalized impulse response techniques of Koop et al. (1996) and Pesaran and Shin (1998) were used to determine the relationship between trading volume and macroeconomic variables. The new generalized methodologies were preferred since they are not sensitive to the ordering of the variables in the system. In the following subsection short-run dynamics will be analysed through the use of Generalised Impulse Response Functions followed by the variance decomposition analysis. Thus, while impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in the VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR.

4.2.3.1 Impulse response results

How are fundamental shocks in macroeconomic variables transmitted into trading volume? How does trading volume react to shocks? The answers according to the estimated model can be illustrated by means of impulse response functions, showing the impact of one-standard-deviation shocks. If the variables have different scales, it is sometimes useful to consider innovations of one standard deviation rather than unit shocks.

The direction of Granger causality can be determined via the VEC framework; however, the importance of the causal impact is also an interesting question. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. A shock to the i^{th} variable not only directly affects the i^{th} variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. Therefore generalized impulse response and variance decomposition analyses are utilized in order to assess how a shock to one variable affects other variables and how long the affects last.

Most of the previous studies that used VAR models and innovation accounting techniques for the similar modelling are subject to the orthogonality critique of Lutkepohl (1991). The traditional method of Sims (1980) has been criticized for the orthogonality assumption, since results may differ depending on the ordering of the

variables in the VAR. In this study the advanced generalized forecast error variance decomposition and generalized impulse response techniques of Koop et al. (1996) and Pesaran and Shin (1998) were applied to determine the relationship between trading volume and macroeconomic variables. There are different options for transforming the impulses[21]. In this study, impulse responses were conducted using generalized impulses to transform the impulses, because they are not sensitive to the ordering of the variables in the system. The rationale for choosing generalized impulse response function was explained in detail in Section 3.3.1.

Impulse Response Function results for 48 periods[22] are presented in Figure 4.2. Shocks (generalized impulses) have been introduced one by one for all variables and for all variables their impacts have been calculated (responses).

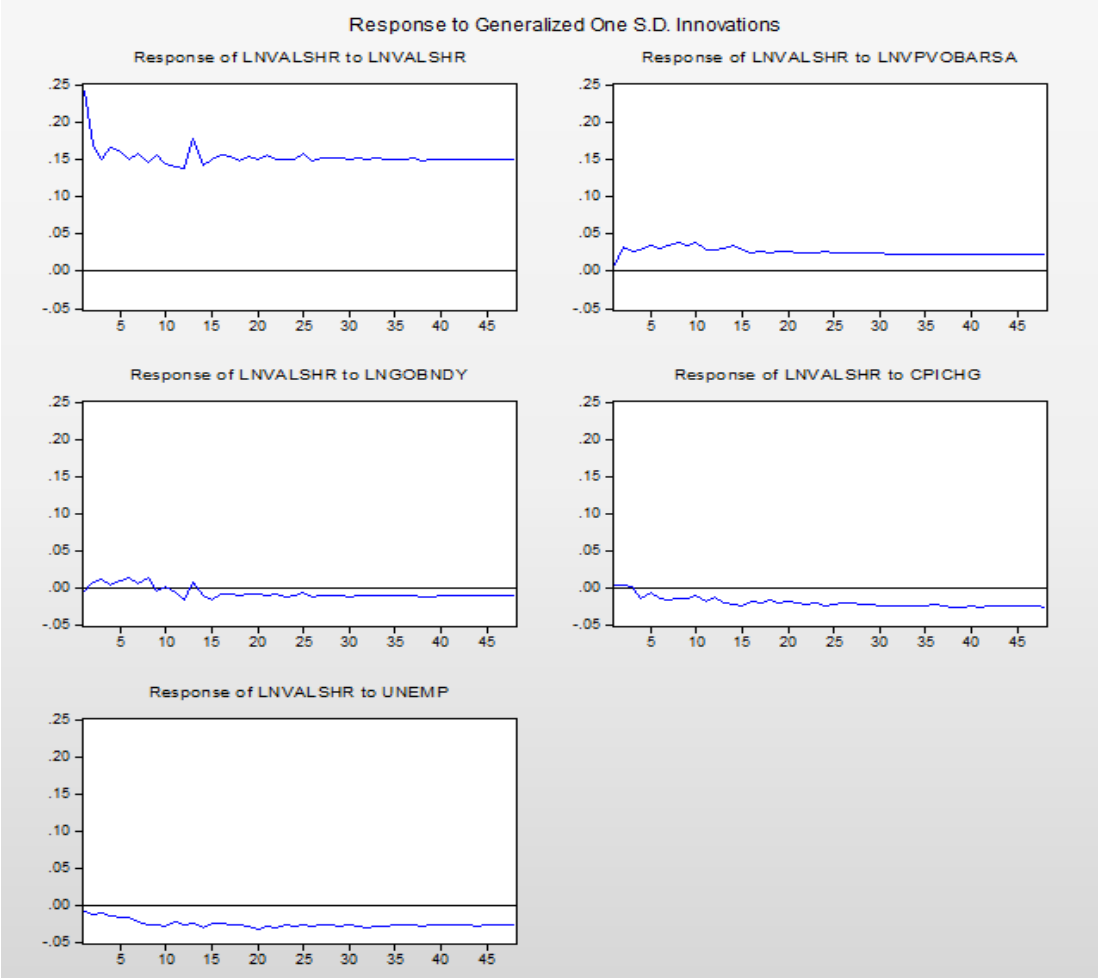

Figure 4.2 : Impulse Response of independent variables.

[21] Details are available in Appendix – impulse Responses. The results obtained using other transformations are also available at appendix.
[22] Another period also experimented with was 36, its results are presented in the appendix.

An impulse on trading volume initially resulted in a significant response in the first three months and had a second late impact on 13th month. After 15 months it is almost stabilized but it must be noted that the effect was not faded down to zero.

Trading volume responded almost instantly to the innovation of industrial production, reaching a peak in the 8th month with slight downs. It stabilized at a level above the initial level in almost 18 months' time.

The initial response of trading volume to government bond yields was negative. Starting with 2nd month the response was a mixture of ups and downs reaching a peak at months 6 and 8. This peak was followed by a sharp decrease down to 0 in month 9. It hit the bottom twice; once in month 12, second in month 15. It is not possible to talk about a stabilization before almost 28 months which is at a level below zero.

Trading volume responded negatively to the inflation starting from the first month. Although the response starts from a point above zero with a sharp decrease it takes only three months to take the response below zero. The first three months are followed by some ups and downs all below zero so it is not possible to talk about a stabilized level before month 30.

Trading volume responded negatively to the unemployment rate in the first 10 months. The following 10 months there were relative ups and downs all below zero and the stabilized level which was well below zero was reached after month 39.

4.2.3.2 Variance decomposition results

While impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in the VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR. In other words, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR.

Results of variance decomposition tests carried out using generalized one SD innovations are presented below for 48 months in Table 5.1. The second column, labelled "S.E.", contains the forecast error of the variable at the given forecast

horizon. The source of this forecast error is the variation in the current and future values of the innovations to each endogenous variable in the VAR. The remaining columns give the percentage of the forecast variance due to each innovation, with each row adding up to 100.

The variance in trading volume was largely caused by itself; even after 48 months 90% of the variation was caused by itself.

Table 4.13 : Variance Decomposition of LNVALSHR.

Period	S.E.	LNVALSHR	LNVPVOBARSA	LNMRKINX	LNM1	LNGOBNDY	CPICHG	UNEMP
1	0,241	100,000	0,000	0,000	0,000	0,000	0,000	0,000
2	0,297	98,570	0,710	0,545	0,022	0,130	0,006	0,018
3	0,335	97,615	0,946	1,123	0,035	0,232	0,025	0,024
...								
6	0,440	95,220	1,495	2,222	0,094	0,306	0,546	0,118
9	0,523	93,363	2,062	2,926	0,085	0,311	0,832	0,421
12	0,584	92,062	2,274	3,654	0,152	0,316	0,913	0,629
...								
18	0,708	91,636	2,124	3,477	0,332	0,315	1,284	0,832
...								
24	0,808	91,379	1,973	3,289	0,535	0,289	1,470	1,064
...								
36	0,977	91,112	1,735	3,046	0,818	0,270	1,787	1,232
...								
48	1,120	90,928	1,578	2,893	0,996	0,265	2,045	1,295

4.2.4 Discussion of Empirical Findings

Two models are estimated as given in Table 4.10 and Table 4.11. They differ in the money supply variable used. Model 1 is estimated with narrow money supply (M1) whereas Model 2 is estimated with broader money supply (M3). The results show no significant difference between the coefficients of the varaibles of two models or the significance of the coefficients. The only difference being the increased significance of unemployement from 10% to 1% when M3 is used. Since the two models exhibit very similar results, in the following discussion Model 2 (with M3) will be discussed.

Industrial production, long term government bond yield, and inflation had all significant effects on trading volume not only in the long term, but also in the short term. On the other hand, unemployment had only long term effect on trading volume whereas market index affected only in the short term. In the long term both industrial production and long term government bond yield had a positive effect, whereas inflation and unemployment had a negative effect.

In terms of drifts from the long term, industrial production responded such drifts negatively which is consistent with its short and long term effects.

Instant changes in industrial production affected trading volume almost instantly and trading volume response reached a peak in 8 months' time, thereafter effect of industrial production on trading volume was positive and permanent. The response stabilized at the end of 18 months period.

When one standard deviation positive shock was introduced to long term government bond yield, the trading volume responded negatively in the first month. Fluctuations followed and the effect of this shock was almost completely faded away after 28 months.

Trading volume was affected negatively and permanently by the shocks of inflation.

One SD positive deviation introduced to unemployment caused a negative response; the effect was permanent.

To summarize regarding the variance of trading volume none of the macroeconomic variables seemed to play a significant role.

5. CONCLUSIONS

In a banking system the fund suppliers (deposit owners) have no say to whom and under what conditions the fund shall be given to the fund seekers. Banks, standing in between supplier and demander of funds, define the rules and conditions for both parties and claim a commission in turn for the service they provide. Investors in a banking system a priori know how much return they will earn, hence bear little risk, if at all. On the other hand in stock exchanges the individual investor potentially can make all the decisions by picking up the company she will invest in. The return is not fixed, hence the investor takes risk. In terms of institutional investors the investment decisions are made by the management regardless of the investment type; be it in banking sector or in securities markets. In the case of institutional investors, the role of individual investor and her influence on the decisions is another subject of interest which became prevalent recently; the responsible investment concept. The difference stated above is therefore, valid for retail investors in the financial system.

As a very broad example think of a bank manager, who may not be able to approve a credit to a company, because the project proposed by the company does not meet the requirements of the bank. However, the project proposed may actually exhibit a great potential, even though it doesn't meet the corporate requirements of that bank and yet the bank manager in person may be convinced that the project is a successful initiative. In such a situation stock exchange enables the bank manager to invest in that company personally by buying its stocks if the company is publicly listed.

Whether the financial system causes economic growth or economic growth drives the improvement in financial system has been discussed, generating numerous studies from both sides. The debate on the economic growth and the role of financial system does not seem to end in the near future.

This study focuses on the stock exchanges and differs from the many studies conducted until now in three ways; firstly it investigates the stock exchange itself, not the stocks traded within. Most of the studies in securities markets have been focused on the stock returns. Even though stock exchanges have been around for

many years (some exchanges have been operating since 1600s) studies making stock exchanges themselves as their focus have been conducted only after the 1980s. Starting with the 1980s the technological advances, financial liberalization and globalization affected securities market landscape significantly.

Secondly, this study provides a different view for the economic growth and financial system debate by sitting on the fence, equally distant from both sides of the debate. Macroeconomic variables are used to measure the trends and overall state of the economy. There have been studies on the relationship between macroeconomic variables and stock exchanges; however they were limited to a single country in their analysis. Until now, as to my knowledge, this is the first study to investigate the relationship among the economy and aggregate trading volume of stock markets in several countries. The previous studies were either for a single exchange in a country, or for multiple exchanges but not on their relation with macroeconomic variables, or even for multiple countries macroeconomic variables but not for stock exchanges as a whole.

Thirdly, the aggregate trading volume of an exchange has been capturing more information today than three decades ago. Moreover, the information conveyed by trading volume may be vital for stock exchanges, since there is a fierce competition in securities markets in terms of order flow, liquidity, low price volatility, and transparency. This study considers stock exchanges as any other publicly listed company. In fact, this is what has been to exchanges; they are transformed into publicly listed companies. Nevertheless they cannot be handled exactly in the same way as other listed companies, for exchanges are listed on themselves. Macroeconomic variables affect any company in the economy; however stock exchanges are affected two fold, both directly and indirectly. Directly affected just like any other company, because their focus is making profit in the current economy. Indirectly affected through not only the companies listed but also the investors who are also affected from macroeconomic conditions and they all have a significant impact on the profitability of the exchange.

This study, attempting to investigate whether trading volume of an exchange is affected by macroeconomic variables, points out interesting impacts for policy makers, investors, companies seeking low cost capitals, and regulators. The impact

area of stock markets is beyond national borders for a long time, so the impacts shall be evaluated considering the international conjuncture.

The conclusions drawn from the study will be beneficial in the following ways:

The presence of a cointegrating relationship between macroeconomic variables and trading volume may have an impact on the policy makers' decisions. Securities markets may boom in terms of price and return which sound very appealing; however unless it is supported by increased GDP, reduced interest rates, inflation and unemployment this boom may be pointing out to incompentency in evaluationg risks as we all witnessed in 2008. It is my belief that the growth of securities markets, particularly equity exchanges shall be evaluated not on its own, but together with the whole economy. Policy-makers may need to revaluate their policies if securities markets are enjoying a boom which is not backed up by the macroeconomic indicators, hence is not sustainable and prone to creating bubbles. This may be more of an issue for emerging economies, as their securities markets are more prone to crises and unless they have sufficient FDI then the growth of securities markets, increased trading volume may all be deceptive.

Increased trading volume attracts the attention of institutional investors, not the other way round (Bodla & Kumar, 2009). This relationship has significant potential consequences for emerging markets. First of all, institutional investors are desirable since they come with many benefits which emerging markets are lacking, as explained in Section 2.7.5. Secondly, it implies that stock exchanges with a sound domestic investor base (be it retail or institutional investors) investing in the national market are more likely to boost the confidence of foreign investors. As a consequence, it is possible to infer that macroeconomic policies affecting trading volume positively will also play a significant role in attracting foreign institutional investors.

The implications of this study is of interest for public policy setters since government involvement in macroeconomics is significant. Policy-makers influence the economy through their decisions affecting macroeconomic variables. They shall be aware of the cascading impacts of their decisions on the securities markets. While aiming to correct macroeconomic ills such as inflation or unemployment, they may

inadvertently depress the stock market, and curtail capital formation, which itself would lead to further slowdown of the economy.

This study attempts to show how macroeconomics affect stock exchanges in terms of trading volume. However, macroeconomic variables fluctuate within a band; no policy is capable to make them move beyond those natural limits. For instance, unemployment rate can only be brought down at a level but not to zero; "*full employment*" in economic terms does not necessary mean zero unemployment. Rather, it is the lowest possible unemployment rate with the economy growing and all factors of production being used as efficiently as possible. The same is valid for other macroeconomic variables used in this study; each one has its own lower and upper limits. Consequently, the changes in macroeconomic variables are bounded by their vary nature, so are their effects on trading volume. Since macroecomic policies targeting to increase trading volume will not be effective after a certain point, policy makers shall search for other ways to increase the trading volume. Now the question is about identifying these other ways.

Trading volume has long been used as a proxy for liquidity, hence there is a strong relationship between the two. Increasing liquidity will result in increased trading volume, therefore the first step shall be focusing on liquidity. Market structures also affect liquidity, in fact the performance of market structures are measured by liquidity of the markets. Efforts in increasing market depth, improving market structures and the overall market quality will no doubt pay off by increased liquidity followed by an increase in trading volume. The amount of this increase shall be investigated in terms of trading volume.

As we have seen in Section 2, transaction and in general trading costs affect trading volume negatively. So reducing transaction costs will help increase trading volume. This can be achieved in a number of ways; increasing operational efficiency and exploiting networks of scale are two ways, which has been discussed within Section 2 throughly. Additionally, the alternative trading platforms, dark pools and ECNs all became fierce competitors of exchanges utilizing cutting edge technology to lower transaction costs. Studies regarding trading costs have been limited, partly due to the difficulty in obtaining required cost information which is far from being standard. Another aspect of trading costs is their contrary effect on fragmented markets as discussed in Section 2. Some trading continue, some investors even prefer those

venues despite the higher costs. Henceforth the analysis regarding fragmented trading volume and questioning how to attract the trading from fragmented markets and become a center of attraction are of equal interest. The relationship between trading costs and trading volume shall be investigated with an analysis comprising different costs for fragmentated securities, liquidity providers, and institutional investors. Only then, it may be possible to make a conclusion whether reducing trading costs will increase volume.

Technological investments are unavoidable for the aforementioned efforts. Those investments are not once in a lifetime investments, rather they need to be recurring from time to time as the technological progress is never ending and exchanges can not afford to stay behind. In order to increase trading volume, the most fundamental requirement is to have the cutting edge technology. Once such an investment is made, then the marginal cost of new trading is very close to zero. As a result, such technological investments are another driving force for increasing trading volume by means of merger and acquisitions. It is demonstrated that only exchanges with a certain level of liquidity, sound regulation and investor protection utilize the benefits of a M&A, therefore exchanges considering M&As shall pay importance to liquidity, regulation, and investor protection.

Algorithmic trading and HFTs are another aspect of technology. There are mixed interpretations regarding whether they increase liquidity or on the contrary increase volatility. Arbitrage opportunities and any trading volume increase due to arbitrage creates a conflict of interest for exchanges. On one hand, trading volume increase is desired, but on the other hand, regulatory responsibilities of exchanges urge them to take preventive actions against problems like flash crash. Algorithmic trading is used not only for exploiting arbitrage opportunities but also for market making, therefore exchange management shall be prepared how to use technology and at times shall be ready to colloborate with regulators.

I propose liquidity, technology and economy form the three pillars of trading volume. Unless all three are combined properly, even if there is an increase in trading volume it will not be sustainable and would require a close monitoring.

REFERENCES

Aggarwal, R. (2002). Demutualization and Corporate Governance of Stock Exchanges. *Journal of Applied Corporate Finance, 15*(1), 105-113.

Aggarwal, R., & Dahiya, S. (2006). Demutualization and Public Offerings of Financial Exchanges. *Journal of Applied Corporate Finance, 18*(3), 96-106. doi: 10.1111/j.1745-6622.2006.00102.x

Aggarwal, R., & Goodell, J. W. (2010). Financial markets versus institutions in European countries: Influence of culture and other national characteristics. *International Business Review, 19*(5), 502-520. doi: 10.1016/j.ibusrev.2009.07.010

Alexander, C., & Dimitriu, A. (2004). A Comparison of Cointegration and Tracking Error Models for Mutual Funds and Hedge Funds. *ISMA Centre Discussion Papers in Finance, 4*, 1-26.

Amihud, Y., & Mendelson, H. (1986). Asset pricing and the bid-ask spread. *Journal of Financial Economics, 17*(2), 223-249.

Anari, A., & Kolari, J. (2001). Stock Prices and Inflation. *Journal of Financial Research, 24*(4), 587-602.

Andrianaivo, M., & Yartey, C. A. (2010). Understanding the growth of African financial markets. *African Development Review, 22*(3), 394-418. doi: 10.1111/j.1467-8268.2010.00253.x

Apergis, N., Dincer, O. C., & Payne, J. E. (2012). Live free or bribe: On the causal dynamics between economic freedom and corruption in U.S. states. *European Journal of Political Economy, 28*(2), 215-226. doi: http://dx.doi.org/10.1016/j.ejpoleco.2011.10.001

Apergis, N., & Eleftheriou, S. (2002). Interest rates, inflation, and stock prices: the case of the Athens Stock Exchange. *Journal of Policy Modeling, 24*(3), 231-236. doi: http://dx.doi.org/10.1016/S0161-8938(02)00105-9

Arbelaez, H., Urrutia, J., & Abbas, N. (2001). Short-term and long-term linkages among the Colombian capital market indexes. *International Review of Financial Analysis, 10*(3), 237-273.

Arestis, P., Demetriades, P. O., & Luintel, K. B. (2001). Financial development and economic growth: The role of stock markets. *Journal of Money, Credit & Banking (Ohio State University Press), 33*(1), 16-41.

Atje, R., & Jovanovic, B. (1993). Stock markets and development. *European Economic Review, 37*(2-3), 632-640.

Avramovic, A. (2012). US Monthly Chartbook – Charting 2012. In C. S. Q. S. Teams (Ed.), *Trading Strategy Market Commentary* (7 January 2013 ed., pp. 1-12): Credit Suisse Trading Strategy.

Ayat, L., & Burridge, P. (2000). Unit root tests in the presence of uncertainty about the non-stochastic trend. *Journal of Econometrics, 95*(1), 71-96.

Bailey, O. (2010). Developments in Emerging Equity Markets. *RBA Bulletin*, 53-60.

Baltagi, B. (2008). *Econometric analysis of panel data*: John Wiley & Sons.

Baltagi, B. H., & Kao, C. (2000). Nonstationary Panels, Cointegration in Panels and Dynamic Panels: A Survey. In B. H. Baltagi (Ed.), *Nonstationary panels, panel cointegration, and dynamic panels* (pp. 7-51): Advances in Econometrics, vol. 15. Amsterdam New York and Tokyo Elsevier Science, JAI.

Banerjee, A. (1999). Panel Data Unit Roots and Cointegration: An Overview. *Oxford Bulletin of Economics & Statistics, 61*(4), 607.

Banerjee, A., Marcellino, M., & Osbat, C. (2005). Testing for PPP: Should we use panel methods? *Empirical Economics, 30*(1), 77-91.

Barclay, M. J., Hendershott, T., & McCormick, D. T. (2003). Competition among Trading Venues Information andTrading on Electronic Communications Networks. *The Journal of Finance, 58*(6), 2637-2666. doi: 10.1046/j.1540-6261.2003.00618.x

Basher, S. A., & Sadorsky, P. (2006). Oil price risk and emerging stock markets. *Global Finance Journal, 17*(2), 224-251. doi: http://dx.doi.org/10.1016/j.gfj.2006.04.001

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2000). A new database on the structure and development of the financial sector. *The World Bank Economic Review, 14*(3), 597-605. doi: 10.1093/wber/14.3.597

Beck, T., & Levine, R. (2004). Stock markets, banks, and growth: Panel evidence. *Journal of Banking & Finance, 28*(3), 423-442.

Bessembinder, H., Maxwell, W., & Venkataraman, K. (2006). Market transparency, liquidity externalities, and institutional trading costs in corporate bonds. *Journal of Financial Economics, 82*(2), 251-288. doi: 10.1016/j.jfineco.2005.10.002

Biais, B., Glosten, L., & Spatt, C. (2005). Market microstructure: A survey of microfoundations, empirical results, and policy implications. *Journal of Financial Markets, 8*(2), 217-264. doi: http://dx.doi.org/10.1016/j.finmar.2004.11.001

Black, F. (1971). Towards a fully automated exchange Part I. *Financial Analysts Journal, 27*, 29–35,44.

Bodla, B. S., & Kumar, A. (2009). Foreign Institutional Investors and Macroeconomic Variables In India: A Study of Causal Relation. *Paradigm (Institute of Management Technology), 13*(2), 80-87.

Boulatov, A., Hatch, B. C., Johnson, S. A., & Lei, A. Y. C. (2009). Dealer attention, the speed of quote adjustment to information, and net dealer revenue. *Journal of Banking & Finance, 33*(8), 1531-1542. doi: 10.1016/j.jbankfin.2009.03.001

Breitung, J., & Pesaran, M. H. (2008). *Unit roots and cointegration in panels*: Springer.

Brown, J., Crocker, D. K., & Foerster, S. R. (2007). Trading Volume Liquidity and Investment Styles. *Available at SSRN 1077824*.

Burmeister, E., & Wall, K. D. (1986). THE ARBITRAGE PRICING THEORY AND MACROECONOMIC FACTOR MEASURES. *Financial Review, 21*(1), 1-20. doi: 10.1111/j.1540-6288.1986.tb01103.x

Campbell, J. Y., & Perron, P. (1991). Pitfalls and Opportunities: What Macroeconomists Should Know About Unit Roots. *National Bureau of Economic Research Technical Working Paper Series, No. 100*.

Cantillon, E., & Yin, P.-L. (2011). Competition between exchanges: A research agenda. *International Journal of Industrial Organization, 29*(3), 329-336. doi: http://dx.doi.org/10.1016/j.ijindorg.2010.12.001

Cavenaile, L., Gengenbach, C., & Palm, F. (2013). Stock Markets, Banks and Long Run Economic Growth: A Panel Cointegration-Based Analysis. *De Economist*, 1-22. doi: 10.1007/s10645-013-9220-6

Chai, D., Faff, R., & Gharghori, P. (2010). New evidence on the relation between stock liquidity and measures of trading activity. *International Review of Financial Analysis, 19*(3), 181-192. doi: 10.1016/j.irfa.2010.02.005

Chemmanur, T. J., He, J., & Fulghieri, P. (2008). Competition and Cooperation among Exchanges: Effects on Corporate Cross-Listing Decisions and Listing Standards. *Journal of Applied Corporate Finance, 20*(3), 76-90.

Chen, N.-F. (1991). Financial Investment Opportunities and the Macroeconomy. *The Journal of Finance, 46*(2), 529-554. doi: 10.1111/j.1540-6261.1991.tb02673.x

Chen, N.-F., Roll, R., & Ross, S. A. (1986). Economic Forces and the Stock Market. *Journal of Business, 59*(3), 383-403.

Cheng, A. C. S. (1995). The UK Stock Market And Economic Factors: A New Approach. *Journal of Business Finance & Accounting, 22*(1), 129-142. doi: 10.1111/j.1468-5957.1995.tb00675.x

Chordia, T., Roll, R., & Subrahmanyam, A. (2000a). Commonality in liquidity. *Journal of Financial Economics, 56*(1), 3-28.

Chordia, T., Roll, R., & Subrahmanyam, A. (2000b). Market Liquidity and trading activity. *The Journal of Finance, 56*(2), 501-530. doi: 10.1111/0022-1082.00335

Claessens, S., Klingebiel, D., & Schmukler, S. L. (2002). The Future of Stock Exchanges in Emerging Economies: Evolution and Prosepcts (pp. 1-50): Wharton School Center for Financial Institutions, University of Pennsylvania.

Clarke, J. A., & Mirza, S. (2006). A comparison of some common methods for detecting Granger noncausality. *Journal of Statistical Computation and Simulation, 76*(3), 207-231. doi: 10.1080/10629360500107741

Clayton, M., J., Jorgensen, B., N., & Kavajecz, K., A. (1999). On the Formation and Structure of International Exchanges (pp. 37): Wharton School Rodney L. White Center for Financial Research.

Cochrane, J. H. (2013). Finance: Function Matters, Not Size. *The Journal of Economic Perspectives, 27*(2), 29-49.

Competition Commission, Great Britain. (2005). *Deutsche Borse AG, Euronext NV and London Stock Exchange plc : a report on the proposed acquisition of London Stock Exchange plc by Deutsche Borse AG or Euronext NV*. Norwich, [England]: Stationery Office.

Cybo-Ottone, A., Di Noia, C., & Murgia, M. (2000). The consolidation of securities exchange. *Brooking-Wharton Papers on Financial Services*.

Datar, V. T., Naik, N. Y., & Radcliffe, R. (1998). Liquidity and stock returns: An alternative test. *Journal of Financial Markets, 1*(2), 203-219.

De Gregorio, J., & Guidotti, P. E. (1995). Financial development and economic growth. *World development, 23*(3), 433-448. doi: http://dx.doi.org/10.1016/0305-750X(94)00132-I

Demirgüç-Kunt, A., & Levine, R. (1996). Stock markets, corporate finance, and economic growth: An overview. *The World Bank Economic Review, 10*(2), 223-239.

Demsetz, H. (1968). The cost of transacting. *The Quarterly Journal of Economics, 82*(1), 33-53.

Demsetz, H. (1969). Information and Efficiency: Another Viewpoint. *Journal of Law & Economics, 12(1)*, 1-22.

Demsetz, H., & Villalonga, B. (2001). Ownership structure and corporate performance. *Journal of Corporate Finance, 7*(3), 209-233.

Devai, R., & Naacke, G. (2011). 2010 Cost and Revenue Survey (pp. 60): World Federation of Exchanges.

Devai, R., & Naacke, G. (2012). 2012 Cost and Revenue Survey (pp. 1-41): World Federation of Exchanges.

Dey, M. K. (2005). Turnover and return in global stock markets. *Emerging Markets Review, 6*(1), 45-67. doi: 10.1016/j.ememar.2004.09.003

Di Noia, C. (1998). Competition and Integration among Stock Exchanges in Europe: Network Effects, Implicit Mergers and Remote Access. *Wharton Financial Institutions Center, Working Paper Series, 3*.

Diacogiamnis, G. P., Tsiritakis, E. D., & Manolas, G. A. (2001). Macroeconomic factors and stock returns in a changing economic framework: The case of the Athens stock exchange. *Managerial Finance, 27*(6), 23-41. doi: 10.1108/03074350110767213

Domowitz, I., Glen, J., & Madhavan, A. (2001). Liquidity, Volatility and Equity Trading Costs Across Countries and Over Time. *International Finance, 4*(2), 221-255.

Domowitz, I., & Steil, B. (1999). Automation, Trading Costs, and the Structure of the Securities Trading Industry. *Brookings-Wharton Papers on Financial Services*, 33-81. doi: http://muse.jhu.edu/journals/brookings-wharton_papers_on_financial_services/

Döpke, J., Hartmann, D., & Pierdzioch, C. (2005). Forecasting stock market volatility with macroeconomic variables in real time: Deutsche Bundesbank, Research Centre.

Easley, D., & O'Hara, M. (2010). Microstructure and Ambiguity. *The Journal of Finance, 65*(5), 1817-1846. doi: 10.1111/j.1540-6261.2010.01595.x

El-Wassal, K. A. (2005). Understanding the Growth in Emerging Stock Markets. *Journal of Emerging Market Finance, Vol. 4, No. 3*, 227-261.

El-Wassal, K. A. (2013). The Development of Stock Markets: In Search of a Theory. *International Journal of Economics & Financial Issues (IJEFI), 3*(3), 606-624.

Engle, R. F., & Granger, C. W. J. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica, 55*(2), 251-276. doi: 10.2307/1913236

Evans, D. S., & Schmalensee, R. (2002). Some Economic Aspects of Antitrust Analysis in Dynamically Competitive Industries *Innovation Policy and the Economy, Volume 2* (pp. 1-50): MIT Press.

Foucault, T., & Parlour, C. A. (2004). Competition for Listings. *The RAND Journal of Economics, 35*(2), 329-355. doi: 10.2307/1593694

García, V. F., & Liu, L. (1999). Macroeconomic Determinants of Stock Market Development. *Journal of Applied Economics, II*, 29-59.

Gay, R. D., Jr. . (2011). Effect Of Macroeconomic Variables On Stock Market Returns For Four Emerging Economies: Brazil, Russia, India, And China. *International Business & Economics Research Journal (IBER), 7*(3), 1-8.

Goodhart, C., Mahadeva, L., & Spicer, J. (2003). Monetary policy's effects during the financial crises in Brazil and Korea. *International Journal of Finance & Economics, 8*(1), 55-79. doi: 10.1002/ijfe.200

Gorham, M., & Singh, N. (2009). *Electronic exchanges : the global transformation from pits to bits*: Elsevier Science; 1 edition (June 12, 2009).

Granados, N. F. (2006). *The Impact of IT-driven Market Transparency on Demand, Prices and Market Structure.* (Doctor of Philosophy), The University of Minnesota.

Granger, C. W., & Newbold, P. (1974). Spurious regressions in econometrics. *Journal of Econometrics, 2*(2), 111-120.

Granger, C. W. J., & Morgenstern, O. (1963). Spectral Analysis Of New York Stock Market Prices. *Kyklos, 16*(1), 1-27. doi: 10.1111/j.1467-6435.1963.tb00270.x

Greenwood, J., & Jovanovic, B. (1990). Financial Development, Growth, and the Distribution of Income. *Journal of Political Economy, 98*(5), 1076-1107. doi: http://www.jstor.org/action/showPublication?journalCode=jpoliecon

Gregoriou, A., & Kontonikas, A. (2010). The long-run relationship between stock prices and goods prices: New evidence from panel cointegration. *Journal of International Financial Markets, Institutions and Money, 20*(2), 166-176. doi: http://dx.doi.org/10.1016/j.intfin.2009.12.002

Guru-Gharan, K. K., Rahman, M., & Parayitam, S. (2009). Influences of Selected Macroeconomic Variables on US Stock Market Returns and Their Predictability Over Varying Time Horizons. *Academy of Accounting & Financial Studies Journal, 13*(1), 13-31.

Hackard, J. (2008). *Recent Studies in the Relationship between Financial Market Volume and Price Volatility: A Survey.* Paper presented at the Eastern Finance Association Conference, St. Pete Beach, Florida.

Hall, A. (1994). Testing for a unit root in time series with pretest data-based model selection. *Journal of Business & Economic Statistics, 12*(4), 461-470. doi: 10.2307/1392214

Hall, B., & Mairesse, J. (2002). Testing for unit roots in panel data: An exploration using real and simulated data. In D. W. K. Andrews & J. H. Stock (Eds.), *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg* (pp. 451-479): Cambridge University Press.

Hammoudeh, S., & Choi, K. (2006). Behavior of GCC stock markets and impacts of US oil and financial markets. *Research in International Business and Finance, 20*(1), 22-44. doi: http://dx.doi.org/10.1016/j.ribaf.2005.05.008

Harris, R. D. F. (1997). Stock markets and development: A re-assessment. *European Economic Review, 41*(1), 139 - 146.

Hart, O., & Moore, J. (1996). The Governance of Exchanges: Members' Cooperatives versus Outside Ownership. *Oxford Review of Economic Policy, 12*(4), 53-69.

Hasan, I., Heiko, S., & Song, L. (2010). Growth Strategies and Value Creation: What Works Best for Stock Exchanges? (Working Paper No. 1201).

Hasan, I., & Malkamäki, M. (2000). Are Expansions Cost Effective for Stock Exchanges? A Global Perspective: Bank of Finland.

Hasan, I., Malkamäki, M., & Schmiedel, H. (2003). Technology, automation, and productivity of stock exchanges: International evidence. *Journal of Banking & Finance, 27*(9), 1743-1773. doi: 10.1016/s0378-4266(03)00099-2

Hasbrouck, J., & Saar, G. (2009). Technology and liquidity provision: The blurring of traditional definitions. *Journal of Financial Markets, 12*(2), 143-172. doi: 10.1016/j.finmar.2008.06.002

Hasbrouck, J., & Seppi, D. J. (2001). Common factors in prices, order flows, and liquidity. *Journal of Financial Economics, 59*(3), 383-411.

Hsiao, C. (2003). *Analysis of panel data [electronic resource] / Cheng Hsiao* (2nd ed.): Cambridge ; New York : Cambridge University Press, 2003.

Hurlin, C. (2008). What would Nelson and Plosser find had they used panel unit root tests? *Applied Economics, 42*(12), 1515-1531. doi: 10.1080/00036840701721539

Islam, M. S., & Islam, M. R. (2011). Demutualization: Pros and Cons for Dhaka Stock Exchange (DSE). *European Journal of Business and Management, 3*(12), 24-33.

Johnson, T. C. (2008). Volume, liquidity, and liquidity risk. *Journal of Financial Economics, 87*(2), 388-417. doi: http://dx.doi.org/10.1016/j.jfineco.2007.03.006

Jones, C. M., Kaul, G., & Lipson, M. L. (1994). Transactions, Volume, and Volatility. *Review of Financial Studies, 7*(4), 631-651.

Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics, 90*(1), 1-44. doi: http://dx.doi.org/10.1016/S0304-4076(98)00023-2

Karpoff, J. M. (1987). The relation between price changes and trading volume: A survey. *Journal of Financial and quantitative Analysis, 22*(1), 109-126. doi: 10.2307/2330874

Kilian, L. (2001). Impulse Response Analysis in vector Autoregressions with Unknown Lag Order. *Journal of Forecasting, 20*(3), 161-179.

King, R. G., & Levine, R. (1993). Finance, entrepreneurship and growth. *Journal of Monetary Economics, 32*(3), 513-542. doi: http://dx.doi.org/10.1016/0304-3932(93)90028-E

Kokkoris, I., & Olivares-Caminal, D. R. (2008). Lessons from the Recent Stock Exchange Merger Activity. *Journal of Competition Law and Economics, 4*(3), 837-869.

Koop, G., Pesaran, M. H., & Potter, S. M. (1996). Impulse response analysis in nonlinear multivariate models. *Journal of Econometrics, 74*(1), 119-147.

Kwon, C. S., Shin, T. S., & Bacon, F. W. (1997). The effect of macroeconomic variables on stock market returns in developing markets. *Multinational Business Review, 5*, 63-70.

Kyle, A. S. (1985). Continuous auctions and insider trading. *Econometrica: Journal of the Econometric Society*, 1315-1335.

Larsson, R., Lyhagen, J., & Løthgren, M. (2001). Likelihood-based cointegration tests in heterogeneous panels. *Econometrics Journal, 4*(1), 109-142. doi: 10.1111/1368-423X.00059

Lee, C.-C., & Chang, C.-P. (2009). FDI, financial development, and economic growth: international evidence. *Journal of Applied Economics, 12*(2), 249 - 271.

Levin, A., Lin, C.-F., & Chu, C.-S. J. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of Econometrics, 108*(1), 1-24. doi: http://dx.doi.org/10.1016/S0304-4076(01)00098-7

Levine, R., Loayza, N., & Beck, T. (2000). Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics, 46*(1), 31-77. doi: http://dx.doi.org/10.1016/S0304-3932(00)00017-9

Levine, R., & Zervos, S. (1998). Stock Markets, Banks, and Economic Growth. *American Economic Review 88*(2), 537-558.

Lo, A. W., & Wang, J. (2010). Handbook of Financial Econometrics. In Y. Ait-Sahalia & L. Hansen (Eds.), *Handbooks in Finance* (1st ed., Vol. 2, pp. 384): North Holland.

Mackintosh, P. (2013). How Much is Market Structure Hurting Investors? In C. S. Q. S. Teams (Ed.), *Trading Strategy* Credit Suisse Trading Strategy.

Mackintosh, P., & Baudewyn, L. (2014). Beware, Transaction Costs are Trending Up. In C. S. Q. S. Teams (Ed.), *Trading Strategy Market Structure* (pp. 1-5): Credit Suisse Trading Strategy.

Maddala, G. S., & Kim, I.-M. (1998). *Unit roots, cointegration, and structural change*: Cambridge (England) ; New York : Cambridge University Press, 1998.

Maddala, G. S., & Wu, S. (1999). A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test. *Oxford Bulletin of Economics and Statistics, 61*(S1), 631-652. doi: 10.1111/1468-0084.0610s1631

Madhavan, A. (2000). Market microstructure: A survey. *Journal of Financial Markets, 3*(3), 205-258.

Malkamäki, M. (1999). Are there economies of scale in stock exchange activities? *Discussion Papers*: Bank of Finland.

Malkamäki, M. (2000). Economies of scale and implicit mergers in stock exchange activities. *Unpublished paper.*

Maraoub, N. (2008). European Stock Market Integration: Panel Data Convergence and Stationarity Analysis. *Euro-Mediterranean Economics and Finance Review, 3*, 154-169.

Marsh, T. A., & Rock, K. (1986). *Exchange listing and liquidity: A comparison of the American Stock Exchange with the NASDAQ National Market System*: American Stock Exchange.

Massimb, M. N., & Phelps, B. D. (1994). Electronic Trading, Market Structure and Liquidity. *Financial Analysts Journal, 50*(1), 39-50. doi: 10.2307/4479711

Maysami, R. C., Howe, L. C., & Hamzah, M. A. (2004). Relationship Between Macroeconomic Variables and Stock Market Indices: Cointegration Evidence from Stock Exchange of Singapore's All-S Sector Indices. *Jurnal Pengurusan, 24*, 47-77.

McAndrews, J., & Stefanadis, C. (2002). The consolidation of European stock exchanges. *Current Issues in Economics and Finance, 8*(Jun), 1-6.

McCoskey, S., & Kao, C. (1998). A residual-based test of the null of cointegration in panel data. *Econometric Reviews, 17*(1), 57-84. doi: 10.1080/07474939808800403

Morsy, A., & Rwegasira, K. (2010). Does Demutualization Matter to the Financial Performance of Stock Exchanges? An Investigation of Demutualized Member of the Stock Exchanges of the World Federation Exchanges. *International Research Journal of Finance and Economics*(40), 155-167.

Mukherjee, T. K., & Naka, A. (1995). Dynamic Relations between Macroeconomic Variables and the Japanese Stock Market: An Application of a Vector Error Correction Model. *Journal of Financial Research, 18*(2), 223-237. doi: http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291475-6803/issues

Mukhopadhyay, D., & Sarkar, N. (2003). Stock Return and Macroeconomic Fundamentals in Model Specification Framework: Evidence from Indian Stock Market. *Economic Research Unit, Indian Statistical Institute*, 1-29.

Mulherin, J. H., Netter, J. M., & Overdahl, J. A. (1991). Prices are property: the organization of financial exchanges from a transaction cost perspective. *Journal of Law & Economics, 34*(2), 591-644.

Muller, P. (2004). European Financial Market Integration Distant dream or nascent reality? *World Economics, Volume 5, Number 3*, 139 - 158.

Muradoglu, G., Taskin, F., & Bigan, I. (2000). Causality Between Stock Returns and Macroeconomic Variables in Emerging Markets. *Russian & East European Finance & Trade, 36*(6), 33-53.

Nason, G. (2006). Stationary and non-stationary times series. In H. M. Mader, C. B. Connor & S. G. Coles (Eds.), *Statistics in Volcanology. Special Publications of IAVCEI* (Vol. 1, pp. 129-142). London: GSL on behalf of IAVCEI

Nasseh, A., & Strauss, J. (2000). Stock prices and domestic and international macroeconomic activity: a cointegration approach. *Quarterly Review of Economics & Finance, 40*(2), 229-245. doi: http://dx.doi.org/10.1016/S1062-9769(99)00054-X

Nelson, C. R., & Plosser, C. R. (1982). Trends and random walks in macroeconmic time series: Some evidence and implications. *Journal of Monetary Economics, 10*(2), 139-162. doi: http://dx.doi.org/10.1016/0304-3932(82)90012-5

Ng, S., & Perron, P. (2001). Lag length selection and the construction of unit root tests with good size and power. *Econometrica, 69*(6), 1519-1554. doi: 10.1111/1468-0262.00256

Nielsson, U. (2009). Stock exchange merger and liquidity: The case of Euronext. *Journal of Financial Markets, 12*(2), 229-267. doi: http://dx.doi.org/10.1016/j.finmar.2008.07.002

Noriega, A. E. (2004). Long-run monetary neutrality and the unit-root hypothesis: further international evidence. *The North American Journal of Economics and Finance, 15*(2), 179-197.

O'Brien, R. (1992). *Global financial integration : the end of geography*: New York : Council on Foreign Relations Press, c1992.

O'Hara, M. (1995). *Market microstructure theory*: Blackwell Publishers Cambridge, Mass.

O'Hara, M. (2001). Overview: market structure issues in market liquidity. *BCEng*, 1.

O'Hara, M. (2004). Searching for a new center: U.S. securities markets in transition. *Economic Review*(Q 4), 37-52.

Okeahalam, C. C. (2005). Strategic alliances and mergers of financial exchanges: the case of the SADC. *Journal of Southern African Studies, 31*(1), 75-93.

Omran, M., & Pointon, J. (2001). Does the inflation rate affect the performance of the stock market? the case of Egypt. *Emerging Markets Review, 2*(3), 263-279. doi: 10.1016/S1566-0141(01)00020-6

OXERA. (2011). Monitoring prices, costs and volumes of trading and post-trading services (pp. 1-174): Oxera Consulting Ltd.

Örsal, D. D. K. (2007). Comparison of panel cointegration tests *SFB 649 Discussion Paper* (pp. 1-34). Berlin, Germany: Humboldt-Universität zu Berlin.

Pagano, M. (1989). Trading Volume and Asset Liquidity. *The Quarterly Journal of Economics, 104*(2), 255-274. doi: 10.2307/2937847

Pagano, M., & Roell, A. (1990). Trading Systems in European Stock Markets: Current Performance and Policy Options. *Economic Policy, 10*, 63-115.

Parlour, C. A., & Seppi, D. J. (2003). Liquidity-Based Competition for Order Flow. *Review of Financial Studies, 16*(2), 301-343. doi: 10.1093/rfs/hhg008

Pedroni, P. (2004). Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis. *Econometric Theory, 20*(3), 597-625. doi: 10.2307/3533533

Perold, A. (1988). The Implementation Shortfall: Paper vs. Reality. *Journal of Portfolio Management, Spring 1988*(3), 4-9.

Perron, P. (1989). The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Econometrica, 57*(6), 1361-1401. doi: http://www.econometricsociety.org/tocs.asp

Perron, P., & Ng, S. (1996). Useful modifications to some unit root tests with dependent errors and their local asymptotic properties. *The Review of Economic Studies, 63*(3), 435-463.

Pesaran, M. H. (2012). On the interpretation of panel unit root tests. *Economics Letters, 116*(3), 545-546. doi: http://dx.doi.org/10.1016/j.econlet.2012.04.049

Pesaran, M. H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters, 58*(1), 17-29.

Pesaran, M. H., & Smith, R. (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics, 68*(1), 79-113. doi: http://dx.doi.org/10.1016/0304-4076(94)01644-F

Phillips, P. C. B., & Moon, H. R. (1999). Linear Regression Limit Theory for Nonstationary Panel Data. *Econometrica, 67*(5), 1057-1111. doi: 10.2307/2999513

Phillips, P. C. B., & Ouliaris, S. (1990). Asymptotic properties of residual based tests for cointegration. *Econometrica: Journal of the Econometric Society*, 165-193.

Pirrong, C. (1999). The organization of Financial exchange markets: Theory and evidence. *Journal of Financial Markets, 2*, 329-357.

Porter, M. E. (2009). *The competitive advantage of Nations, States and Regions*. Harvard Business School Management Programs. Retrieved from http://www.isc.hbs.edu/pdf/20090415_AMP.pdf

Ram, R. (1999). Financial development and economic growth: Additional evidence. *The Journal of Development Studies, 35*(4), 164-174. doi: 10.1080/00220389908422585

Ramos, S. B. (2003). Competition Between Stock Exchanges: A Survey: International Center for Financial Asset Management and Engineering.

Sala-i-Martín, X., Bilbao-Osorio, B., Blanke, J., Crotti, R., Hanouz, M. D., Geiger, T., & Ko, C. (2012). The Global Competitiveness Index 2012–2013: Strengthening Recovery by Raising Productivity *The Global Competitiveness Report 2012–2013* (pp. 49-68).

Schmiedel, H., Malkamäki, M., & Tarkka, J. (2006). Economies of scale and technological development in securities depository and settlement systems.

Journal of Banking & Finance, 30(6), 1783-1806. doi: 10.1016/j.jbankfin.2005.09.003

Schwartz, R. A., Beiner, N., & Humbach, M. J. (2001). *The Electronic Call Auction: Market Mechanism and Trading: Building a Better Stock Market*: Kluwer Academic Publishers.

Schwert, G. W. (1990). Stock returns and real activity: A century of evidence. *The Journal of Finance, 45*(4), 1237-1257.

Schwert, G. W. (2002). Tests for unit roots: A Monte Carlo investigation. *Journal of Business & Economic Statistics, 20*(1), 5-17.

Silva, A. C., & Chavez, G. (2002). Components of execution costs: Evidence of asymmetric information at the Mexican Stock Exchange. *Journal of International Financial Markets, Institutions and Money, 12*(3), 253-278. doi: 10.1016/S1042-4431(02)00006-9

Singh, A. (1997). Stock markets, financial liberalization and economic development. *Economic Journal, 107*(4), 771-782.

Smidt, S. (1971). Which Road to an Efficient Stock Market free competition or regulated monopoly? *Financial Analysts Journal, 27*(5), 18-68.

Soytas, U., & Sari, R. (2007). The relationship between energy and production: Evidence from Turkish manufacturing industry. *Energy Economics, 29*(6), 1151-1165. doi: http://dx.doi.org/10.1016/j.eneco.2006.05.019

Stiglitz, J. (2003). Globalization and growth in emerging markets and the New Economy. *Journal of Policy Modeling, 25*(5), 505-524.

Stiglitz, J. (2011). RETHINKING MACROECONOMICS: WHAT FAILED, AND HOW TO REPAIR IT. *Journal of the European Economic Association, 9*(4), 591-645. doi: 10.1111/j.1542-4774.2011.01030.x

The Futures Industry Association, F. (2013). High-Frequency Trading: Literature Review The FIA Principal Traders Group.

URL-1. Man Vs. Machine: What's Right and Wrong with Stock Trading System. Retrieved 14 March 2014, from http://www.cnbc.com/id/38950004

URL-2. Now or never for Europe's exchanges. Retrieved 14 March 2014, from http://www.ft.com/intl/cms/s/0/62e7ef00-9587-11e3-8371-00144feab7de.html#axzz2vBS3TWeb

URL-3. NYSE Arca Equities Order Types. Retrieved 14 March 2014, from http://usequities.nyx.com/markets/nyse-arca-equities/order-types

URL-4. Regulation NMS. Retrieved 16 March 2014, from https://www.sec.gov/rules/final/34-51808.pdf

Ülengin, B., & Yobaş, M. B. (2012). Effects Of Horizontal M&As Trading Volume Of Stock Exchanges. *Associate Editors Board Academicians, 13*(52), 38.

Weisberger, D., & Rosa, P. (2013). Automated equity trading: The evolution of market structure and its effect on volatility and liquidity: 2 Sigma.

Wilson, D., & Purushothaman, R. (2003). Dreaming with BRICs: the path to 2050 *Global Economics Paper* (pp. 1-24): Goldman, Sachs & Company.

Wongbangpo, P., & Sharma, S. C. (2002). Stock market and macroeconomic fundamental dynamic interactions: ASEAN-5 countries. *Journal of Asian Economics, 13*(1), 27-51.

World Federation of Exchanges Retrieved 1 March 2014, from http://www.world-exchanges.org

Yartey, C. A. (2010). The institutional and macroeconomic determinants of stock market development in emerging economies. *Applied Financial Economics, 20*(21), 1615-1625. doi: 10.1080/09603107.2010.522519

APPENDICES

APPENDIX A: Unit Root Test Results
APPENDIX B: Impulse Response Results
APPENDIX C: Variance Decomposition Results

APPENDIX A : Unit Root Test Results

Table A.1 : UR Test results

For Level	Individual effects					Individual effects, Individual linear trends						
Variable / methods	LLC	IPS	ADF	PP	Hadri	LLC	Breitung	IPS	ADF	PP	Hadri	lag length
CPICHG	0.048	0.000	0.000	0.000		1.000	0.928	0.174	0.039	0.004		SIC 0-12
CPICHG	0.546	0.002	0.001	0.000		1.000	0.985	0.635	0.492	0.004		MSIC 0-12
CPICHG	0.951	0.000	0.000	0.000		1.000	1.000	0.528	0.417	0.004		AIC 12-13
CPICHG	0.988	0.005	0.003	0.000	0.000	1.000	1.000	0.870	0.836	0.004	0.000	MAIC 0-13
CPICHG	0.943	0.000	0.000	0.000		1.000	1.000	0.547	0.422	0.004		HQ 12, 12-13
CPICHG	0.887	0.008	0.005	0.000		1.000	1.000	0.881	0.808	0.004		MHQ 0-13
UNEMP	0.000	0.003	0.000	0.000		0.000	0.708	0.384	0.033	0.017		SIC 0-12
UNEMP	0.189	0.430	0.320	0.000		0.652	1.000	1.000	1.000	0.017		MSIC 0-12, 0-11
UNEMP	0.000	0.000	0.000	0.000		0.000	0.185	0.005	0.000	0.017		AIC 1-13
UNEMP	0.003	0.023	0.015	0.000	0.000	0.030	0.942	0.955	0.925	0.017	0.000	MAIC 1-12, 1-13
UNEMP	0.000	0.000	0.000	0.000		0.000	0.389	0.050	0.002	0.017		HQ 0-12, 0-13
UNEMP	0.117	0.326	0.241	0.000		0.230	0.988	0.997	0.999	0.017		MHQ 0-12
ln(VALSHR)	0.015	0.016	0.062	0.000		0.084	0.000	0.002	0.000	0.000		SIC 0-3
ln(VALSHR)	0.119	0.158	0.466	0.000		0.980	0.000	0.638	0.897	0.000		MSIC 0-7, 0-6
ln(VALSHR)	0.114	0.106	0.293	0.000		0.956	0.000	0.136	0.434	0.000		AIC 0-13
ln(VALSHR)	0.195	0.244	0.571	0.000	0.000	0.999	0.012	0.882	0.994	0.000	0.000	MAIC 0-12
ln(VALSHR)	0.074	0.097	0.315	0.000		0.648	0.000	0.095	0.159	0.000		HQ 0-7,0-8
ln(VALSHR)	0.149	0.189	0.477	0.000		0.997	0.013	0.843	0.991	0.000		MHQ 0-10, 0-11

ln(INDPROD)	0.986	0.003	0.001	0.000		1.000	0.208	0.000	0.000	0.000		SIC 0-13
ln(INDPROD)	0.958	0.106	0.100	0.000		1.000	0.934	1.000	1.000	0.000		MSIC 0-13, 0-12
ln(INDPROD)	0.986	0.003	0.001	0.000	0.000	1.000	0.496	0.001	0.000	0.000	0.000	AIC 0-13
ln(INDPROD)	0.994	0.005	0.002	0.000		1.000	0.973	0.874	0.020	0.000		MAIC 0-13, 0-12
ln(INDPROD)	0.986	0.003	0.001	0.000		1.000	0.496	0.001	0.000	0.000		HQ 0-13
ln(INDPROD)	0.995	0.436	0.128	0.000		1.000	1.000	1.000	0.998	0.000		MHQ 0-13, 0-12
ln(VPVOBARSA)	0.000	0.223	0.574	0.016		0.000	0.689	0.012	0.021	0.999		SIC 1-13
ln(VPVOBARSA)	0.000	0.235	0.589	0.016		0.083	0.958	0.615	0.506	0.999		MSIC 1-13
ln(VPVOBARSA)	0.000	0.191	0.596	0.016	0.000	0.005	0.826	0.004	0.008	0.999	0.000	AIC 1-13
ln(VPVOBARSA)	0.000	0.223	0.664	0.016		0.002	0.829	0.114	0.110	0.999		MAIC 1-13
ln(VPVOBARSA)	0.000	0.172	0.512	0.016		0.000	0.805	0.008	0.016	0.999		HQ 1-13
ln(M1)	0.008	1.000	0.790	0.735		0.009	0.931	0.254	0.543	0.999		AIC 0-13

APPENDIX B : Impulse Response Results

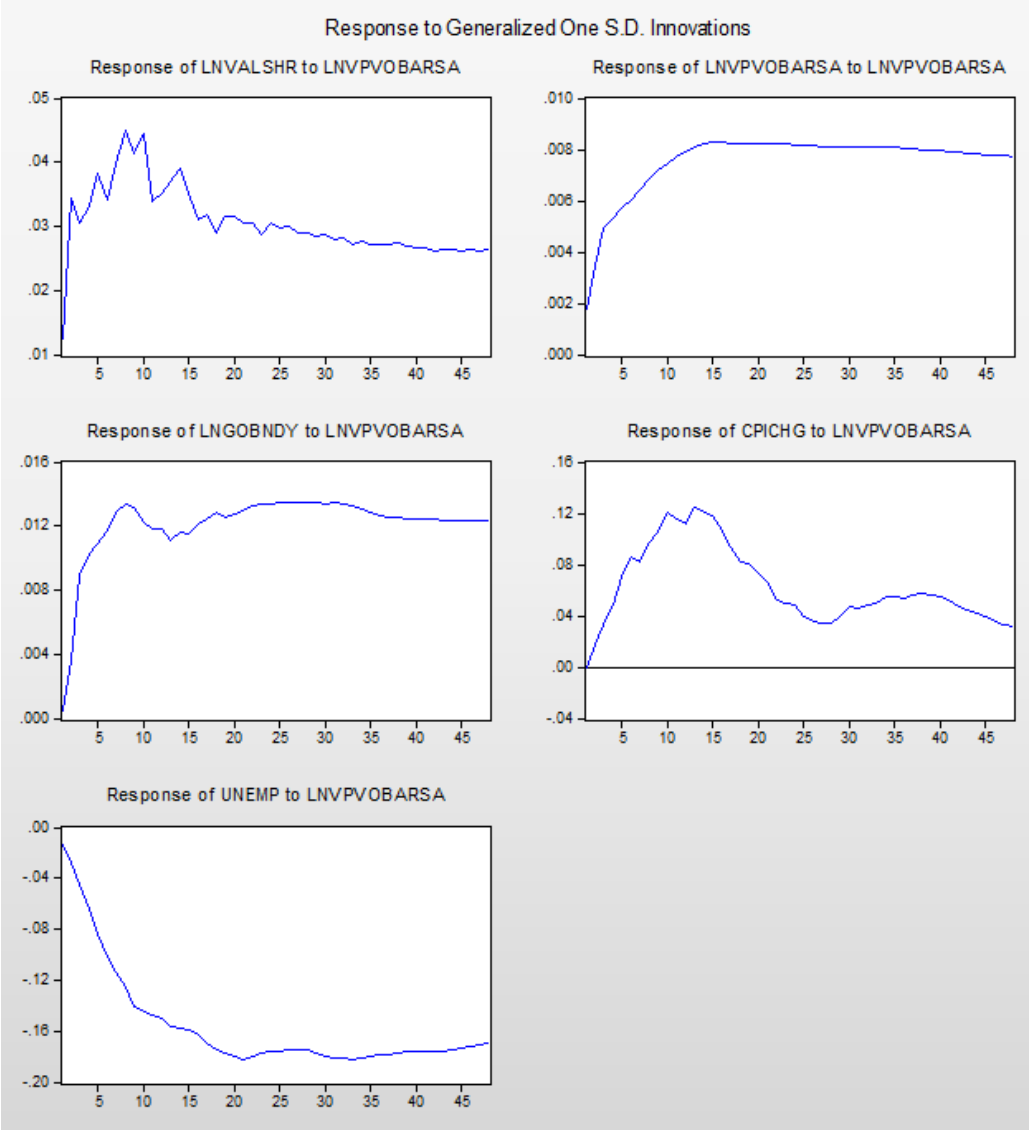

Figure A.1 : IR to industrial production

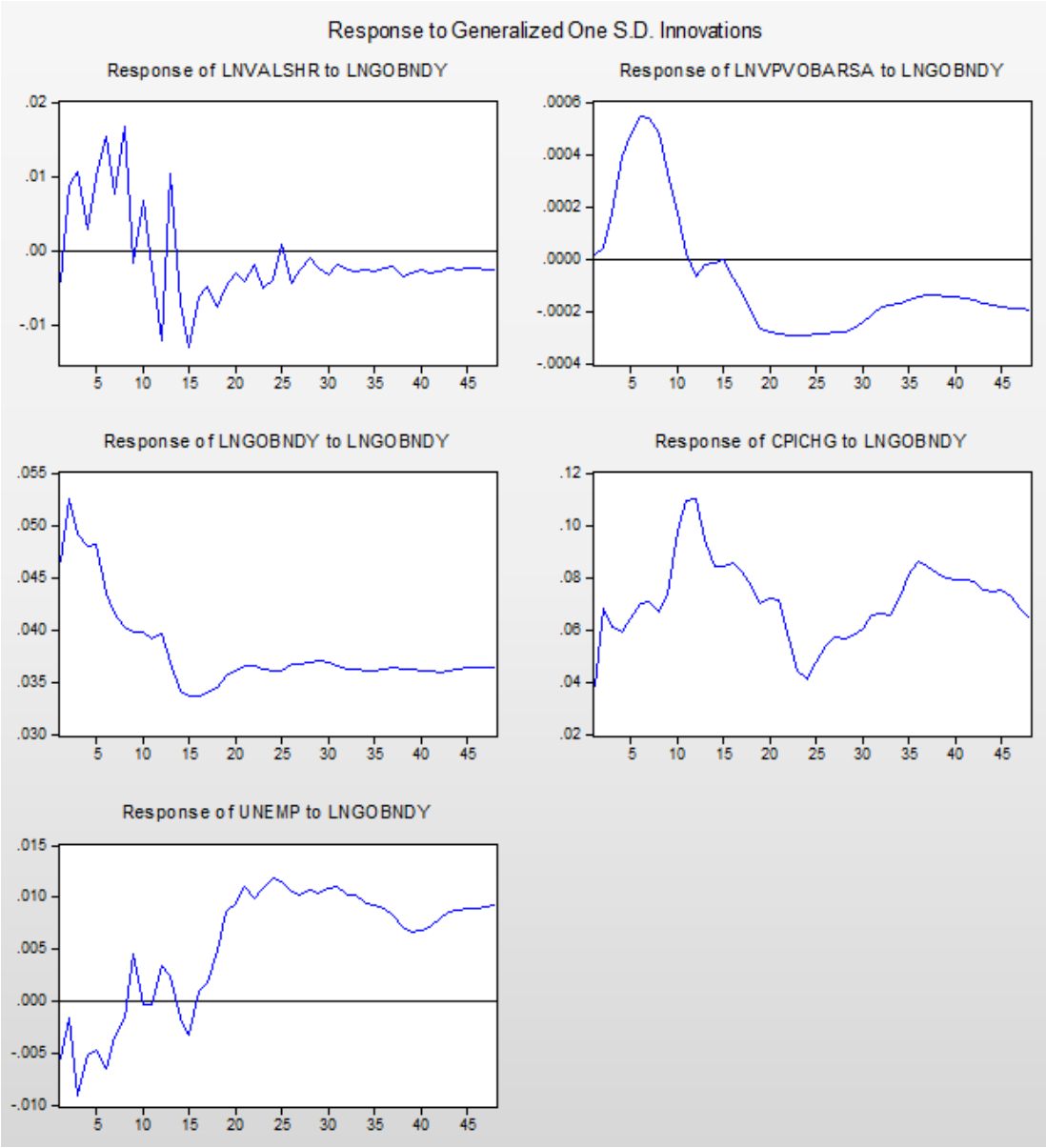

Figure A.2 : IR to 10 years government bond yield

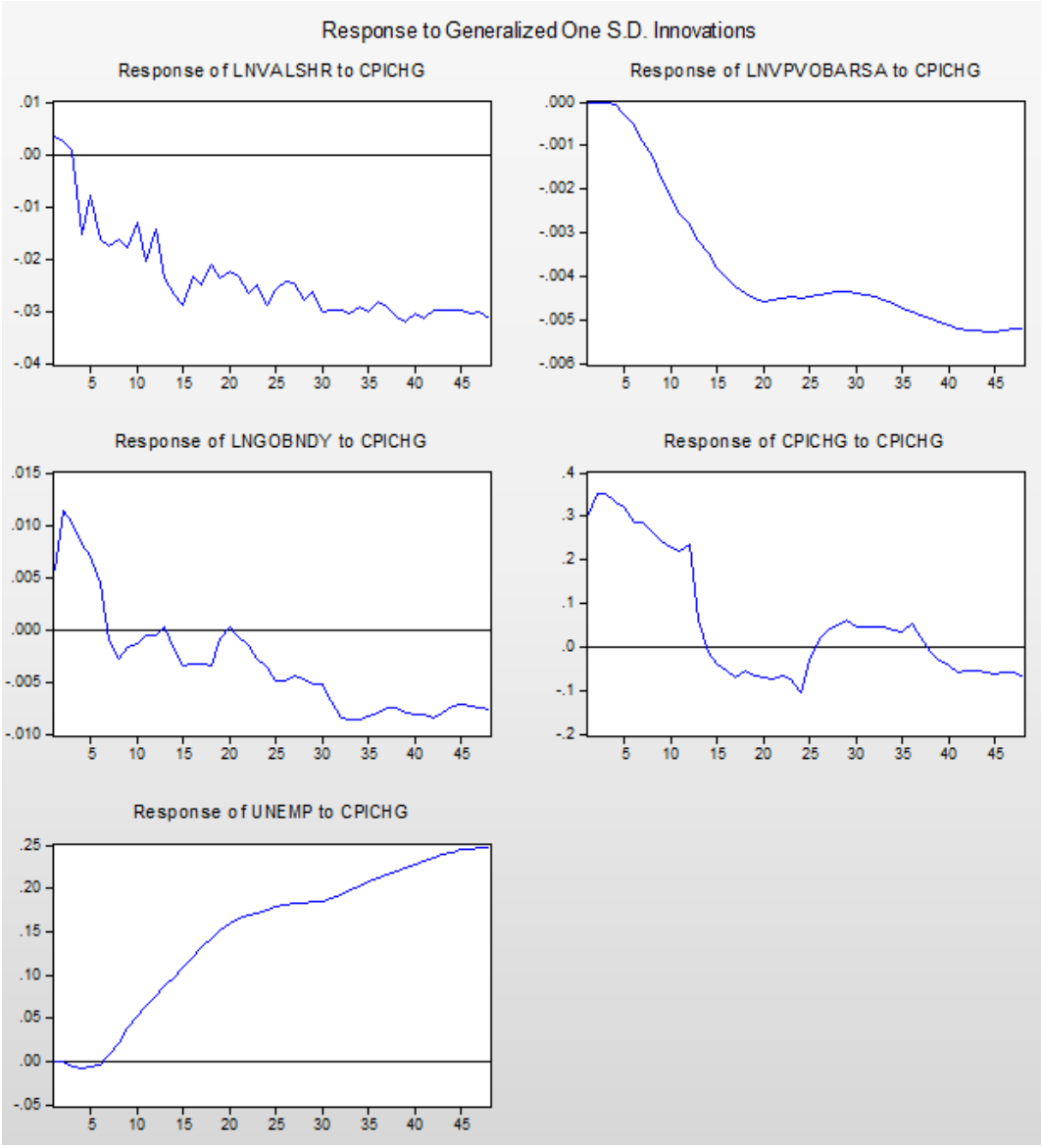

Figure A.3 : IR to inflation

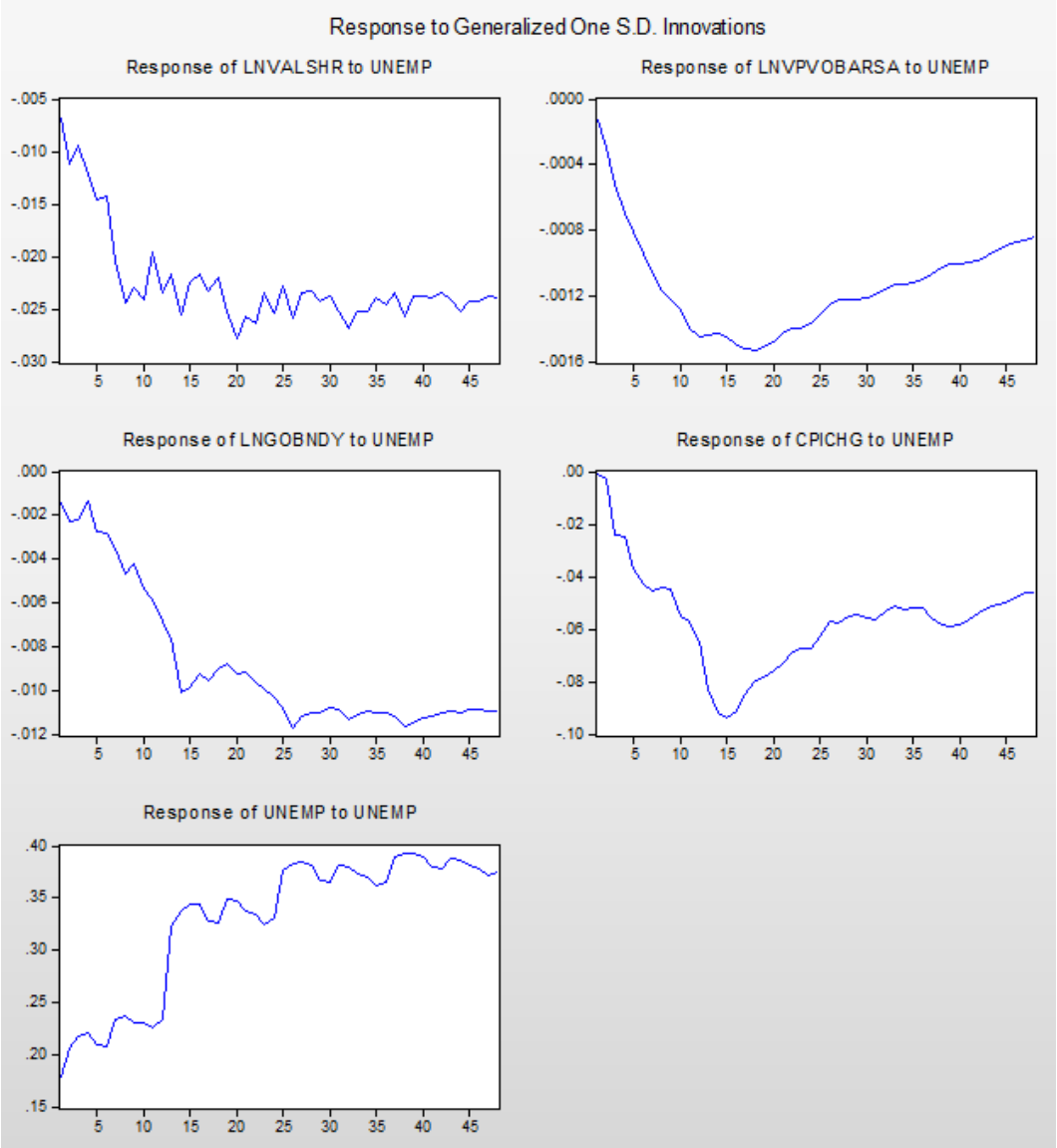

Figure A.4 : IR to unemp

APPENDIX C : Variance Decomposition Results

Table A.2 : Variance Decomposition of LNVPVOBARSA.

Period	S.E.	LNVALSHR	LNVPVOBARSA	LNMRKINX	LNM1	LNGOBNDY	CPICHG	UNEMP
1	0,002	0,155	99,845	0,000	0,000	0,000	0,000	0,000
2	0,004	0,361	99,543	0,080	0,002	0,000	0,000	0,012
3	0,006	0,814	98,906	0,171	0,002	0,041	0,000	0,065
6	0,012	2,563	94,786	1,566	0,002	0,398	0,375	0,310
9	0,017	2,905	91,523	2,260	0,161	0,409	2,234	0,507
12	0,022	2,961	87,656	2,566	0,880	0,253	5,060	0,624
18	0,031	3,418	79,858	2,144	3,055	0,130	10,755	0,640
24	0,038	3,478	74,835	1,604	5,676	0,134	13,718	0,554
36	0,050	3,407	70,561	1,001	8,788	0,251	15,639	0,354
48	0,060	3,171	67,275	0,708	10,232	0,295	18,064	0,256

The result of variance decomposition for market index showed that there is only one component; itself. Even at the end of the 48 months period 97% of the variance was caused by itself.

Table A.3 : Variance Decomposition of LNMRKINX.

Period	S.E.	LNVALSHR	LNVPVOBARSA	LNMRKINX	LNM1	LNGOBNDY	CPICHG	UNEMP
1	0,148	0,328	0,379	99,292	0,000	0,000	0,000	0,000
2	0,213	0,557	0,576	98,751	0,000	0,066	0,000	0,049
3	0,263	0,569	0,790	98,511	0,006	0,075	0,000	0,048
6	0,377	0,625	1,279	97,710	0,015	0,098	0,215	0,058
9	0,466	0,765	1,166	96,998	0,189	0,082	0,640	0,160
12	0,539	0,746	0,987	96,637	0,383	0,142	0,890	0,215
18	0,652	0,745	0,718	96,008	0,585	0,230	1,473	0,241
24	0,744	0,687	0,554	96,172	0,715	0,271	1,406	0,196
36	0,898	0,607	0,380	96,754	0,668	0,288	1,163	0,140
48	1,030	0,553	0,289	97,046	0,615	0,281	1,108	0,107

The main component of variance of money supply was largely itself, at the end of the 48 months period 86% was caused by itself alone and only 10% by long term government bond yield.

Table A.4 : Variance Decomposition of LNM1.

Period	S.E.	LNVALSHR	LNVPVOBARSA	LNMRKINX	LNM1	LNGOBNDY	CPICHG	UNEMP
1	0,007	0,427	0,219	0,127	99,228	0,000	0,000	0,000
2	0,013	0,625	0,293	0,089	98,658	0,132	0,192	0,011
3	0,017	0,741	0,230	0,072	97,986	0,371	0,531	0,070
6	0,027	1,039	0,107	0,172	96,259	1,487	0,833	0,104
9	0,037	1,375	0,058	0,323	94,768	2,433	0,973	0,071
12	0,047	1,240	0,041	0,488	93,129	4,027	1,020	0,054
18	0,065	1,138	0,047	0,969	89,969	7,162	0,670	0,046
24	0,079	1,041	0,054	1,318	88,457	8,580	0,457	0,093
36	0,102	0,885	0,087	1,725	87,064	9,590	0,348	0,300
48	0,121	0,771	0,136	1,996	86,195	10,101	0,265	0,536

The variance of long-term government bond yield was also largely caused by itself, 79%. At the end of the 48 months period, industrial production and market index was contributing the variance only 8% and 4% respectively.

Table A.5 : Variance Decomposition of LNGOBNDY.

Period	S.E.	LNVALSHR	LNVPVOBARSA	LNMRKINX	LNM1	LNGOBNDY	CPICHG	UNEMP
1	0,047	0,036	0,003	0,095	0,813	99,053	0,000	0,000
2	0,070	0,048	0,232	0,329	1,161	97,713	0,504	0,013
3	0,086	0,135	1,162	0,706	1,518	95,871	0,599	0,010
6	0,119	0,735	2,990	1,488	2,144	92,250	0,379	0,014
9	0,140	0,799	4,523	1,990	1,943	89,861	0,828	0,056
12	0,158	0,897	5,007	2,597	1,787	88,661	0,867	0,183
18	0,185	1,573	5,997	3,290	1,620	85,572	1,036	0,911
24	0,211	1,931	6,952	3,598	1,499	83,766	0,929	1,324
36	0,256	2,385	8,021	3,945	1,169	80,689	1,593	2,198
48	0,294	2,594	8,443	4,019	0,914	79,253	2,067	2,710

The variance decomposition results for inflation showed the most balanced distribution among the variables tested, at the end of the 48 months period the distribution of the variance was 55% by inflation itself, 16% by long term government bond yield, 9% by industrial production and 8% by unemployment rate.

Table A.6 : Variance Decomposition of CPICHG.

Period	S.E.	LNVALSHR	LNVPVOBARSA	LNMRKINX	LNM1	LNGOBNDY	CPICHG	UNEMP
1	0,307	0,020	0,007	0,295	0,316	1,614	97,748	0,000
2	0,466	0,014	0,218	0,309	0,371	2,888	96,199	0,000
3	0,584	0,032	0,540	0,419	0,562	2,966	95,338	0,143
6	0,804	0,320	2,639	0,736	0,937	3,501	91,305	0,563
9	0,945	0,783	4,682	1,248	2,435	3,958	85,838	1,057
12	1,063	1,200	6,675	2,079	4,087	5,853	78,397	1,709
18	1,156	2,015	9,140	3,387	4,374	8,670	67,940	4,475
24	1,212	2,081	9,116	3,565	4,313	10,828	64,246	5,851
36	1,271	2,083	9,584	3,437	4,320	13,440	59,904	7,231
48	1,337	2,044	9,987	3,389	4,012	16,666	55,873	8,029

The variance decomposition for unemployment was also distributed evenly at the end of the 48 months period. In the first 6 months the main component for variation was itself by 90% but it decreased down to 62% at the end of the 48 months period, the rest was caused 11% by inflation, 11% by industrial production and 10% by money supply.

Table A.7 : Variance Decomposition of UNEMP.

Period	S.E.	LNVALSHR	LNVPVOBARSA	LNMRKINX	LNM1	LNGOBNDY	CPICHG	UNEMP
1	0,181	0,136	0,489	0,113	0,246	0,115	0,000	98,901
2	0,275	0,347	1,072	0,058	0,179	0,056	0,003	98,286
3	0,353	0,557	1,924	0,067	0,264	0,118	0,050	97,020
6	0,526	1,638	7,220	0,493	0,270	0,092	0,130	90,157
9	0,693	2,839	12,253	1,087	0,437	0,063	0,337	82,984
12	0,837	3,571	15,314	1,635	1,035	0,049	1,501	76,895
18	1,253	3,750	13,938	2,059	2,787	0,035	4,266	73,166
24	1,601	4,042	13,580	1,942	5,035	0,044	6,967	68,389
36	2,229	3,969	12,064	1,559	8,260	0,126	9,217	64,804
48	2,758	3,782	11,058	1,294	10,071	0,176	11,526	62,093

CURRICULUM VITAE

Name Surname: M. Banu Yobaş

Place and Date of Birth: Konya, 21.05.1972

Address: Merkezi Kayıt Kuruluşu Askerocağı Cad. Süzer Plaza Kat:2 3436 Elmadağ 34367 İstanbul

E-Mail: banuyobas@yahoo.com

B.Sc.: Computer Sciences and Engineering, Hacettepe University

M.Sc. : Department of Artificial Intelligence, University of Edinburgh

Professional Experience and Rewards:

2003 - … Central Registry Agency of Turkey

1994-2003 : In worked as a DBA in finance, telecom sectors (TEB, KocBank, Turkcell, Provus)

List of Publications and Patents:

M. Banu Yobaş, Jonathan Crook, Peter Ross, Credit scoring using Neural and Evolutionary Techniques, IMA Journal of Mathematics Applied in Business and Industry Vol. 11, 2000, p. 111-125, 2000

M. Banu Yobaş, Jonathan Crook, Peter Ross, Credit scoring using neural and evolutionary techniques, Readings in Credit Scoring Foundations, Developments, and Aims, Oxford Finance Series, July 8, 2004 (book section)

PUBLICATIONS/PRESENTATIONS ON THE THESIS

- **M. Banu Yobaş, Burç Ülengin, "**Effects Of Horizontal M&As On Trading Volume Of Stock Exchanges", 06/2012, International İstanbul Finance Congress, 2012,
- **M. Banu Yobaş, "**Effects Of Horizontal M&As On Trading Volume Of

Stock Exchanges", ABIS Doctoral Workshop, Nyenrode University, Netherlands, 2013

- **M. Banu Yobaş,** Hisse Senedi Borsalarındaki Yatay Birleşme ve Satın Almaların İşlem Hacmi Üzerindeki Etkisi, Sermaye Piyasası Meslek Personeli Derneği, October 2012
- **Burç Ülengin, M. Banu Yobaş, "**Effects Of Horizontal M&As On Trading Volume Of Stock Exchanges", ISE (IMKB) Review, No:52, May 2013 http://borsaistanbul.com/en/corporate/publications/ise-review/article-52