

ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

**FINANCIAL RESILIENCE OF CONVENTIONAL VERSUS PARTICIPATION
BANKING: EVIDENCE FROM MACRO STRESS TESTING APPROACH AND
RISK SPILLOVERS ANALYSIS**



Ph.D. THESIS

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Department of Economics

Economics Programme

JUNE 2022

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ

**KONVANSİYONEL BANKACILIK VE KATILIM BANKACILIĞININ
FİNANSAL DAYANIKLILIKLARININ KARŞILAŞTIRILMASI: MAKRO
STRES TESTİ VE RİSK YAYILIMI ANALİZİ YAKLAŞIMLARI**

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FOREWORD

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ABBREVIATIONS

AAOIFI	:The Accounting and Auditing Organization for Islamic Financial Institutions
BDDK	: Bankacılık Düzenleme ve Denetleme Kurumu
CAR	: Capital Adequacy Ratio
DEA	: Data Envelopment Analysis
DJI	: Dow Jones Industrial Index
IFSB	: Islamic Financial Services Board
MENA	: Middle East and Northern Africa
SSB	: Shariah Supervisory Board
MENA	: Middle East and North Africa Countries
MSCIEM	: Morgan Stanley Capital International Emerging Market Index
MSCIW	: Morgan Stanley Capital International World Index
VIX	: Chicago Board Options Exchange Volatility Index



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FINANCIAL RESILIENCE OF CONVENTIONAL VERSUS PARTICIPATION BANKING: EVIDENCE FROM MACRO STRESS TESTING APPROACH AND RISK SPILLOVERS ANALYSIS

SUMMARY

Islamic banking, which provides an alternative to the traditional banking system through the principals of interest-free finance, has risen in global markets over the last 20 years and is already present in many countries. Rising consumer demand for Islamic-law-based products and services has propelled Islamic banking to the forefront of the global economy during this period.

Another factor that may appeal to investors is the approach Islamic banking manages financial risks. Several studies that showed, during the 2008 global recession, Islamic banks outperformed their conventional counterparts suggesting that the Islamic banking system may be a safe haven for global risk spillovers. In that regard, several studies have been performed to compare and contrast conventional and Islamic banking.

In light to these advances in Islamic banking, this dissertation is made up of three chapters that compare Islamic and conventional banks on a worldwide scale as well as in the context of Turkey. In the first chapter, we examine how equity returns of conventional and Islamic banks are affected by shocks to major financial indices using the multivariate quantile autoregression technique. We analyze the resilience of the dual banking systems to financial risk spillovers at the global and regional levels based on data from 16 countries for the period between 2008-2018. The primary goal of this research is to see if there is a link between key financial indices and bank stock prices, as well as to compare conventional and Islamic banks in this regard. Recent research has found that bank stock price is linked to banks' overall performance. In this regard, bank stock performance is critical in terms of providing information about the bank's overall success. The findings of the first chapter show that there is no substantial difference in sensitivity to financial shocks between Islamic and conventional banks at the global and regional levels. As a result, this conclusion may suggest that Islamic markets have lost their safe haven status over interest-based financial systems since the 2008 financial crisis. Moreover, in contrast to earlier reports on Islamic banking competitiveness that argue that double layers of Shariah systems may generate heterogeneity across countries, our results reveal that the effects of individual shocks to Islamic banks are homogeneous in the Gulf, MENA, and Asian countries. This uniformity may be attributable, among other things, to recent advancements in Islamic financial principles and standards released by AAOIFI and IFSB.

Second chapter extends the data timeline in first chapter to investigate stability and risk characteristics of dual banking system using 170 banks from 14 emerging market countries with multivariate quantile regression technique for 2008-2020 period. The primary purpose of this chapter is to examine how bank-specific factors influence risk spreads on conventional and Islamic banks' stock price returns. For this purpose, we choose leverage ratio, capital adequacy ratio and market value as bank specific

determinants. Our findings reveal that bank equity prices tend to be more sensitive to shocks in major financial indices as bank's leverage ratio increases for both Islamic and conventional banks. This result is important especially for Islamic banks as recent reports claim that recently developed instruments in Islamic financial system which have led to increases in the debt and leverage ratio, endangers stability of the Islamic banks as they are relatively more affected to financial risk spillovers.

For bank size, the impact of financial shocks over bank equity returns increases with bank size for Islamic banks. The primary cause might be that when Islamic banks increase in size, credit risk management gets more complex owing to specific risk management requirements for different PLS transactions which may cause moral hazard and adverse selection concerns. However, we observe the impact of the financial shocks doesn't vary according to different bank size levels for conventional banks. Last, our findings imply that when the capital adequacy ratio reduces for conventional banks, they become more vulnerable to financial shocks.

Third chapter compares determinants of capital adequacy requirements for participation and conventional banks in Turkey employing an innovative stress test approach. We use two models for our analysis: an additive semi-parametric quantile regression model (Koenker 2010,2011) and a semi-parametric quantile panel model (Cai et al (2018)). Also, with probability analyses, the likelihood of capital adequacy ratio being lower or greater than a given value is calculated based on values of explanatory factors in the context of various scenarios. The public debt ratio for conventional banks and the exchange rate for Islamic banks are the key drivers in establishing the capital adequacy ratio, according to the findings in the third chapter. Although unemployment has a positive marginal impact on the capital adequacy ratio in both Islamic and conventional banks, the results imply that this positive impact is unaffected by the fluctuations in the unemployment rate.

The semi-parametric panel quantile technique is used only for conventional banks, as there are very few banks for Islamic banks in our sample, and the determinants of capital adequacy ratio are explored while taking bank size into account. Banks improve their capital adequacy ratios regarding increases in the public debt ratio and interest rate as their size and capital adequacy grow.

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ÖZET

Faizsiz finans ilkeleriyle geleneksel finans sistemine alternatif bir yaklaşım sunan katılım bankacılık sistemi, son 20 yılda küresel piyasalarda yükselerek birçok ülkede varlığını sürdürmektedir. İslam hukukuna dayalı ürün ve hizmetlere yönelik artan tüketici talebi, bu dönemde katılım bankacılığını küresel ekonominin ön saflarına taşımıştır.

Yatırımcıların ilgisini çekebilecek bir diğer faktör de katılım bankacılığının finansal riskleri yönetme yaklaşımıdır. Katılım bankalarının, özellikle 2008 mali krizi sırasında, geleneksel bankalardan daha iyi performans gösterdiğini belirten çalışmalar, katılım bankacılık sisteminin küresel risk yayılımları için güvenli bir liman olabileceği savını ortaya koymuştur. Bu bağlamda son dönemde geleneksel bankacılık sistemi ile katılım bankacılık sistemi arasındaki farklılıklar ve benzerlikler üzerine birçok araştırma yapılmıştır.

Literatürde katılım bankacılığını geleneksel bankacılıktan ayıran temel özellikler tartışılmıştır. Bu bağlamda İslami finans sistemi, İslam Hukuku tarafından kısıtlanan işlemleri tamamen yasaklamaktadır. İslam hukukunda en belirgin kısıtlama faizdir (Riba). Katılım bankaları, miktarı sabit veya önceden belirlenmiş herhangi bir ödemeye izin vermemektedir. Bunun yerine mevduat sahiplerinin bir ortak olarak düşünüldüğü kar-zarar risk paylaşım anlaşmalarını teşvik etmektedir. Ayrıca, herhangi bir mali eylem aşırı belirsizlikten (Gharar) ve spekülasyonlardan (Maysir) uzak olmalıdır.

Bu farklarla birlikte katılım bankalarını geleneksel bankalardan ayıran temel özelliklerden biri de ikili denetleme sistemine sahip olmasıdır. Bu bağlamda katılım bankaları geleneksel bankaların sahip olduğu banka denetleme kurullarının yanı sıra finansal işlemlerin İslam hukuk kurallarına uygun olup olmadığının gözetildiği ikinci bir denetleme kuruluna sahiptir. Literatürde yapılan bazı çalışmalar ikili denetleme sisteminin katılım bankalarının performanslarına olumlu yönde katkı sağladığını tespit etmiştir.

Katılım bankacılığının bu farklılıklara sahip olmasının özellikle katılım bankalarını yüksek borçluluk ve kaldıraç oranlarının risklerinden koruduğunu söylemekle birlikte son dönemde yapılan çalışmalar katılım bankalarının eskiye nazaran daha güvenli olmayabileceği belirtilmiştir. Son dönemde geliştirilen teverrük, emtia murabahası gibi araçların katılım bankacılığı ilkeleri ile çelişebileceği ve katılım bankacılığını geleneksel finans sistemine karşı daha dayanıklı kılan özelliklerin ortadan kalkabileceği savunulmuştur. Bu noktada katılım bankalarının geleneksel bankalara bir alternatif mi, yoksa onlarla rekabet eden bankalar mı olduğu sorusu gün geçtikçe önem kazanmıştır.

Katılım bankaları ile ilgili öne çıkan bir diğer konu ise katılım banka uygulamalarının dünya genelinde bir standardı olup olmadığı tartışmasıdır. Özellikle katılım bankacılığının geleneksel bankacılık sistemine göre yeni olması ve farklı ülkelerde farklı İslam hukuk ilkelerine göre uygulamaların olması bazı araştırmacılar tarafından katılım bankalarının dünya genelinde heterojen bir sisteme sahip olmasıyla açıklanmıştır. Bununla birlikte bazı araştırmacılar son dönemde gelişen İslami Finansal Kuruluşlar Muhasebe ve Denetim Kurumu(AAOIFI/ The Accounting and Auditing Organization for Islamic Financial Institutions), İslami Finansal Hizmetler Kurulu (IFSB/Islamic Financial Services Board) gibi katılım bankacılığı standartları ve ilkeleri oluşturan kurumların artmasıyla katılım bankacılığının genel olarak homojen bir düzene evrildiğini savunmaktadır.

Yukarıda bahsettiğimiz bu gelişmeler ışığında, bu tez katılım ve geleneksel bankaları dünya ölçeğinde ve Türkiye bağlamında karşılaştıran üç makaleden oluşmaktadır. Birinci bölümde, çok değişkenli kantil otoregresyon tekniğini kullanarak İslami ve geleneksel bankaların hisse senedi getirilerinin büyük finansal şoklardan nasıl etkilendiğini incelemektedir. 2009-2018 dönemi için 16 ülkeden gelen 192 bankanın verilerine dayanarak, katılım ve geleneksel bankaların finansal risk yayılımlarına karşı olan duyarlılıklarını hem küresel hem de bölgesel düzeyde mukayese etmiştir. Küresel finans endeksler için Dow Jones Endüstriyel Endeksi, MSCI Dünya Endeksi, 10 yıllık Amerika hazine tahvil fiyatları ve Volatilite Endeksi kullanılmıştır. Bölgesel mukayese yapılırken katılım bankacılığının bulunduğu ülkeler Kuzey Afrika ve Orta Doğu (MENA) ülkeleri, Körfez ülkeleri ve Asya ülkeleri olmak üzere üç grupta incelenmiştir. Bankaların risk duyarlılıkları incelenirken model doğrultusunda elde ettiğimiz kantil etki tepki fonksiyonları ilk gün şoku üzerinden değerlendirilmiştir. Bu bağlamda bankalar küresel finansal endekslerde meydana gelen bir şok karşısında hisse senedi fiyatlarındaki değişimin ilk gün etkilerine göre farklı gruplara ayrılmıştır ve bu gruplar arasında bir fark olup olmadığı Wilcoxon Rank Sum testi ile analiz edilmiştir. Bu araştırmanın temel amacı, temel finansal endeksler ile banka hisse fiyatları arasında bir bağlantı olup olmadığını gözlemlemektir. Son araştırmalar, banka hisse senedi fiyatının bankaların genel performansıyla bağlantılı olduğunu bulmuştur. Bu bağlamda banka hisse senedi performansı, bankanın genel risk duyarlılığı hakkında bilgi vermesi açısından kritik öneme sahiptir.

Elde ettiğimiz sonuçlar küresel finansal endekslerle banka hisse senet getirileri arasında kuyruk bağımlılığı olduğunu ortaya koymuştur. Katılım ve geleneksel bankaları mukayese ettiğimizde ise küresel ve bölgesel finansal şoklara duyarlılık açısından bir fark tespit edilememiştir. Bu sonuç, katılım bankacılık piyasalarının 2008 mali krizinden bu yana faize dayalı finansal sistemler üzerindeki göreceli finansal dayanıklılığını kaybettiği anlamına gelebilir. Bununla birlikte bazı raporların katılım bankacılığının uygulandığı bölgelere göre farklı performans gösterdiğini iddia eden çalışmaların aksine, sonuçlarımız katılım bankalarına yönelik şokların etkilerinin Körfez, MENA ve Asya ülkelerinde homojen olduğunu ortaya koymaktadır. Bu sonuçlar yukarıda bahsettiğimiz son 10 yılda etkinliği artan AAOIFI ve IFSB tarafından yayınlanan İslami finans ilkeleri ve standartlarındaki son gelişmelerin küresel anlamda katılım bankalarını performans açısından birbirlerine yakınlaştırmasıyla açıklanabilir.

Tezin ikinci bölümünde ise ilk bölümde yaptığımız analiz genişletilerek, 2010-2020 dönemi için çok değişkenli kantil regresyon tekniği ile 14 gelişen piyasa ülkesinden 170 banka üzerinde analiz yapılmıştır. Bu araştırmanın temel amacı, bankaya özgü değişkenlerin katılım ve geleneksel banka hisse senedi fiyatları üzerindeki risk

yayımlarını nasıl etkilediğini gözlemlemektir. Bankaya özgü değişkenler için literatürde ikili bankacılık sistemini mukayese ederken en çok kullanılan kaldıraç oranı, toplam varlıklar ve sermaye yeterlilik oranı verileri kullanılmıştır. Bulgularımız katılım ve geleneksel bankaların risk duyarlılıklarına etki etmesi açısından bankaya özgü değişikliklerin benzerlikler ve farklılıklar gösterdiğini ortaya koymuştur. Bu bağlamda her iki banka türü için de yüksek kaldıraç oranları küresel hisse senetlerinde meydana gelecek bir şok karşısında bankanın maruz kaldığı şokun etkisini artırmaktadır. Veri setimizde kullandığımız kaldıraç oranları Datastream'den alınmıştır ve toplam borcun toplam varlıklara oranı olarak tanımlanmıştır. Bu açıdan kaldıraç oranları adına elde edilen sonuçlar bankaların borçlarının artması ile birlikte risk duyarlılıklarının artması şeklinde yorumlanabilir. Diğer önemli bankaya özgü değişken banka büyüklüğünün her iki banka türü için farklı etkileri bulunmaktadır. Katılım bankaları adına küçük bankalar finansal şoklara karşı büyük katılım bankalarına oranla daha dayanıklı bir performans sergilemiştir. Literatürde yapılan çalışmalar katılım bankalarının uyguladığı kar-zarar ortaklık sisteminin farklılıkları dolayısıyla kredi riskinin artabileceğini vurgulamaktadır. Dolayısıyla büyük bankalarda kar zarar ortaklık sisteminin takibi daha karmaşık bir hal alacağından ötürü kredi risklerinin yüksek olacağı ve küçük bankalara oranla risklere karşı daha duyarlı olacağı vurgulanmıştır. Bununla birlikte geleneksel bankalara baktığımızda şokun etkisinin banka büyüklüğünün her seviyesinde aynı olduğunu görmekteyiz. Bu sonuç, literatürde banka büyüklüğünün finansal istikrar üzerinde etkisi adına elde edilen farklı bulgularla uyumlu olduğunu söyleyebiliriz.

Son olarak sermaye yeterlilik oranları yüksek olan geleneksel bankalar sermaye yeterlilik oranı düşük olan geleneksel bankalara oranla daha iyi bir performans sergilerken, katılım bankalarında sermaye yeterlilik oranlarının etkisi açısından farklı sonuçlar elde edilmiştir. Bu durum, geleneksel bankalar için geliştirilen sermaye yeterlilik standartlarının katılım bankalarının sahip olduğu farklı finans modelini tam anlamıyla ölçememesi sebebiyle izah edilebilir.

Üçüncü bölümde ise Türkiye'deki İslami ve konvansiyonel bankaları karşılaştırmak için stres testi analizi yapılmıştır. Bu bölümün temel amacı, Türkiye'deki bankaların sermaye yeterlilik oranlarının makroekonomik tehditlere karşı ne kadar hassas olduğunu belirlemektir. Ayrıca, bankacılık sektörünü geleneksel ve katılım bankaları olarak ikiye ayırarak, hangi bankacılık türünün sermaye yeterlilik oranlarının makroekonomik değişkenlerden daha fazla etkilendiği araştırılmıştır. Stres test analizimiz için iki model kullanılmıştır: toplamsal yarı parametrik kantil regresyon modeli (Koenker 2010,2011) ve yarı parametrik kantil panel modeli (Cai ve diğerleri (2018) Bunun yanı sıra son dönem verileri kullanılarak yarı parametrik kantil regresyon sonuçlarını desteklemek amacıyla senaryo analizi oluşturulmuştur. Stres test üzerinde yapılan çalışmalar ışığında, bu bölümde sermaye yeterlilik oranları üzerinde etki edebilecek değişkenler kamu stok borçluluk oranı, döviz kuru (dolar), repo faiz oranı ve işsizlik oranı olarak belirlenmiştir.

Toplamsal yarı parametrik kantil regresyon modeli doğrultusunda elde ettiğimiz sonuçlarda açıklayıcı değişkenler parametrik olmayan, yarı parametrik ve tam parametrik değişken olarak kullanılmıştır. Elde ettiğimiz sonuçlar doğrultusunda verilerin doğrusal kullanılmadığı parametrik olmayan analizlerden elde edilen sonuçların yarı parametrik ve parametrik analizlere oranla istatistiksel olarak daha anlamlı sonuçlar verdiği görülmüştür.

Bu bölümde elde ettiğimiz sonuçlarda ise katılım ve geleneksel bankaların sermaye yeterlilik oranlarına etki eden değişkenlerin hepsi pozitif ve anlamlı olmakla birlikte

marjinal etkileri açısından farklılıklar gösterdiğini görmekteyiz. Öncelikle kamu borç stok oranının etkisi geleneksel bankaların sermaye yeterlilik oranları üzerinde pozitif ve artan bir etkisi olmaktadır. Katılım bankaları için bu etki pozitif olmakla birlikte bu etki bazen azalan bazen artan seviyelerde seyretmektedir. Aynı şekilde döviz kurundaki artış karşısındaki marjinal etki katılım bankaları yeterlilik oranları üzerinde pozitif ve artan bir etkiye sahipken geleneksel bankalar için bu etki pozitif ama dalgalı şekilde seyretmektedir. Dolayısıyla sermaye yeterlilik oranları için geleneksel bankalarda kamu borç stoğunun katılım bankalarında ise döviz kurunun daha etkili bir değişken olduğunu söylememiz mümkündür. Bununla birlikte işsizlik oranlarının sermaye yeterlilik oranları üzerindeki etkisi her iki banka türü için de pozitif olmakla birlikte bu etki, işsizliğin bütün oranları için aynı seviyede seyretmektedir. İşsizlik oranının sermaye yeterlilik oranları üzerinde diğer değişkenler kadar etkili olmadığı görülmektedir. Son olarak repo faizinin etkisini incelediğimizde ise her iki banka türü için de sermaye yeterlilik oranı üzerindeki marjinal etkinin bazen azalan bazen artan bir etkiye sahip olduğu tespit edilmiştir.

Stres test senaryo analizleri doğrultusunda bir adımlık öngörü senaryoları ve olasılık analizleri gerçekleştirilmiştir. Bir adımlık senaryo öngörüsünde uç kantil değerleri parametrik olmayan analizlerine elde edilen sonuçlar kullanılarak hem açıklayıcı değişken hem de sermaye yeterlilik oranı kantil değerlerine göre ayrı ayrı gerçekleştirilmiştir. Elde edilen sonuçlar parametrik olmayan kantil regresyon sonuçlarını desteklemektedir. Bu doğrultuda geleneksel bankalar için borçluluk oranında meydana gelen artış sermaye yeterlilik oranlarında ciddi oranda yükselişe sebep olurken katılım bankaları için bu değişken döviz kuru olmaktadır.

Bir adımlık tahmin yöntemi kısmında mevcut veriler değerlendirilerek bankaların açıklayıcı değişkenlerin sermaye yeterlilik oranlarına farklı kantiller üzerinde etkisi araştırılmıştır. Olasılık analizlerinde ise kötü senaryo ve iyi senaryo oluşturularak sermaye yeterlilik oranlarının açıklayıcı değişkenlerde meydana gelebilecek bir şok karşısında eşik değerlerinin altında ya da üstünde kalıp kalmayacağı irdelenmiştir. Elde edilen sonuçlar katılım bankaları için dövizde meydana gelen şokların daha belirleyici olduğunu gösterirken geleneksel bankalar için kamu borçluluk oranı daha etkili olmaktadır. İşsizlik oranındaki değişimler sermaye yeterlilik oranları üzerinde her iki banka türü için de fazla bir değişikliğe sebep olmazken repo faiz oranındaki değişimler katılım ve geleneksel bankalar için dalgalı bir seyir izlemektedir.

Olasılık analizlerinde ise her bağımsız değişken için oluşturulan senaryo değerleri karşısında sermaye yeterlilik oranlarının iyi ve kötü koşullarda eşik değerlerinin altında kalma veya üstüne çıkma ihtimalleri hesaplanmıştır. Bu analizlerde de, daha önce yapılan çalışmaları destekler nitelikte, katılım bankaları için döviz kurundaki değişimler ve geleneksel bankalar için kamu borç stok oranındaki değişimler kötü senaryolar için sermaye yeterlilik oranının eşik altında çıkma ihtimalinde etkili rol oynamıştır.

Yarı parametrik kantil regresyon modelinden elde edilen sonuçlar ise katılım bankalarının sayısının az olması dolayısıyla sadece geleneksel bankaları kapsamaktadır. Bu kısımda banka büyüklüğü dikkate alınarak zaman serisinde kullanılan değişkenlerin sermaye yeterlilik oranlarına olan etkisi araştırılmıştır. Bulgular, geleneksel bankaların büyüklüğü ve sermaye yeterlilik düzeyi arttıkça, kamu borç oranı ve faiz oranındaki artışa karşı sermaye yeterlilik oranlarını küçük ve orta ölçekli bankalara oranla daha fazla artırabildiğini ortaya koymuştur.

1. INTRODUCTION

This dissertation is comprised of three chapters that compare conventional and Islamic banks. The literature has disputed several aspects of Islamic banks and their advantages in comparison to conventional banking systems. In this respect, some studies support the idea of Islamic banks stands as an alternative of conventional banking system as the others claim that Islamic banks are competitor of their counterpart which have no advantages against conventional banking system. Especially, after COVID-19 pandemic crisis, this debate rekindled among the scholars and discussed in many studies.

In various aspects, the Islamic banking system differs from the traditional banking. The prohibition of any interest rate in financial transactions is the most notable feature of the Islamic financial system. Instead, they support their system's profit and loss (PLS) sharing mechanism. The primary purpose of interest free banking system is to diversify the risks between depositors and investors. Moreover, Islamic banking system does not allow any financial transaction which is prohibited by the Islamic law such as porks, drugs etc.

Also, Islamic banks have additional supervisory board which investigates the financial instruments of the banks whether they are permissible under Islamic law. Some scholars debate that additional supervisory board of Islamic banks lead to better financial performance due to two layer of governance. The dual banking system will be analyzed in both global and Tukey in this doctoral thesis, taking into consideration the variations in financial structure between Islamic and conventional banks.

In the first chapter, we analyze how a shock to important indices such as the DJUSI index, the MSCI World Index, the Volatility index, and the United States 10-year Treasury bond interest rate impact the stock returns of Islamic and conventional banks using the multivariate quantile autoregression approach. Our data consists of 16 countries from MENA, Gulf and Asian countries after 2008 crisis. Main purpose of this chapter is to investigate whether there is a difference between Islamic and conventional banks' stability using bank equity price returns. Recent studies point out

that there is a strong relationship between stock market prices and banks' performance. Furthermore, the geographical disparities between the dual banking system are observed. Our findings reveal that there is no difference between the resilience of conventional and Islamic banks to a shock in major indices both in global and regional level. Asian conventional banks outperform conventional banks in MENA and Gulf countries in regional comparisons of the same bank types. However, there is no distinction in financial stability between Islamic banks in different regions when it comes to Islamic banking.

In the second chapter, similar to the previous chapter, we use a multivariate quantile model to investigate financial risk spillovers in the values-at-risk (VaR) that may occur between major financial indices (Dow Jones Industrial Index (DJI), S&P500, MSCI Emerging Market Index and MSCI World Index) and the equity prices of 138 conventional and 32 Islamic banks over the period 1 January 2009 and 31 March 2020. In this chapter, our aim is to observe how bank specific variables (leverage ratio, capital adequacy ratio and bank size) affect banks' resilience due to financial risk spillovers. Results in this section shows that bank specific factors play a key role in assessing the impact on the bank equity prices due to a shock to the financial indices. When comparing bank types, we find that the size of the bank has a greater influence on Islamic banks, whereas the capital adequacy ratio has a greater impact on conventional banks. On the other hand, the impact of a shock to financial indices on bank equity returns increases with leverage ratio for both bank of the types.

In the third chapter, we use novel stress test methodologies to investigate the drivers of capital adequacy ratios in the Turkish banking industry. For analysis, we employ a semi-parametric quantile panel model and an additive semi-parametric quantile regression model. Furthermore, scenario analysis is conducted to support the quantile estimate results. In this section, findings show that unemployment rate, exchange rate and public debt stock ratio positively impact capital adequacy ratio for both bank types. The impact of these variables, on the other hand, varies depending on the type of bank. Also, large conventional banks tend to rise their capital ratio more than small banks due to increase in public debt stock ratio and interest rate. However, our results show that there is no statistically significant result for impact of bank size for Islamic banks.

2. HOW DO THE GLOBAL EQUITY AND BOND MARKETS AFFECT ISLAMIC AND CONVENTIONAL BANKS? ¹

2.1 Introduction

Financial crashes and spillover effects over global markets is of increasing interest in empirical finance literature recently. During the 2008 recession, the United States stock markets adversely affected global markets as major global indices fell down to record low levels. For example, the Dow Jones industrial index hit an historical low return with 777.68 basis points on 29 September 2008, while the MSCI index recorded 53.18 percentage loss. These shocks in major financial markets like the United States have significantly affected other stock markets during the last decade. (Chulia et al., 2017)

As the frequency of financial crises has forced international investors to seek out alternatives for risk diversification, interest-free Islamic banking as an alternative to conventional banking has started to attract attention from academics as well as policy makers. Many researchers find that Islamic banks were not affected by the adverse conditions conventional banks faced during the 2008 crisis due to several factors. (Boumediene and Caby, 2009; Boumediene, 2010; Hasan and Dridi, 2011). Recent research shows, however, that Islamic financial institutions may have lost this advantage over the interest-based financial system, and the economic climate has grown less favorable for Islamic banking as systemic risks have risen. (IFSB², 2017)

This section aims to investigate the Islamic banking system's stability to financial risk spillovers and compare it with the conventional banking system. Using multivariate quantile autoregressive model, we look at financial risk spillovers that may occur in major financial indices to banks' equity prices. The model offers a suitable setting to assess directly the responsiveness of value at risk (VaR) of a bank to financial shocks (Acharya et al., 2010; White et al., 2015). Bank equity price provides information

¹ This chapter of the dissertation is published by Eurasian Economic Review on 14th February 2022. Aydemir, R., Atan, H. Z., & Guloglu, B. 2022. How do the global equity and bond markets affect Islamic and conventional banks? A comparative cross-country analysis using multivariate regression quantiles. *Eurasian Economic Review*, 12(1), 95-114.5

² Islamic Financial Services Board

about overall performance of a bank's management and its cost efficiency (Beccalli et al., 2006; Ionnadis et al., 2008). Moreover, if a bank which performs poorly in terms of its stock price in a crisis, then it fails to act cautiously and is more likely to perform badly in upcoming crises (Fahlenbrach et al., 2011). Therefore, investigating bank equity returns is important for understanding its current cost efficiency and future performance during a crisis among other things.

To analyze the nexus between major global financial indices and bank equity prices of dual banking system, we measure the 1st quantile of several indices including the Dow Jones US Index (a proxy for the overall US stock market), the MSCI World Index (a benchmark for global stock funds representing a broad cross-section of global markets), the US 10-year Treasury bond interest rate (a proxy for global interest rates) and the Volatility index (the fear index capturing the US stock market volatility) with multivariate quantile model. Producing pseudo impulse response functions (PIRFs), multivariate quantile models enable us to compare a financial shock's impact on different kinds of banks.

We know that Islamic law jurisdictions vary significantly by regions. Therefore, Islamic financial tools exhibit some heterogeneity across regions which may result in different risk concepts for each country (Ernst and Young, 2013). Differences in Shariah governance practices across countries can be identified as strict, moderate and flexible approaches in developing regulations for Shariah governance structure and processes. For example, Islamic banks operating in countries which adopt moderate and flexible approaches are likely to be more varied in terms of Shariah governance practitioners and practice to ensure Shariah compliance as opposed to those Islamic banks in countries with strict approaches (Fatmawati et al., 2020). Meanwhile, institutions such as Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI), IFSB recently published general standards for global Islamic banking system that is intended to reduce this heterogeneity across regions. We compare dual banking system not only at the global level, but also across different regions (i.e. MENA, Gulf and Asian countries) to figure out whether there exists any heterogeneity between Islamic banks in terms of their performance.

The remaining of the chapter is arranged as follows. Section 2 briefly touches upon the background of the interest-free Islamic banking system and its main differences with the conventional banking system. Section 3 presents the literature about

comparative studies between dual banking system. Sections 4 and 5 describe the multivariate quantile regression methodology and data, respectively. Finally, Section 6 summarizes the empirical findings before discussion and conclusion in Section 7.

2.2 Brief Background on Islamic Banking

The Islamic financial system differs from conventional one in several ways. First, the Islamic financial model prohibits transactions restricted by the Islamic Law (Sharia). The most prominent restriction in Islamic law is interest (Riba). Islamic banks do not allow any payment with fixed or predetermined rate. In lieu of interest rate, Islamic financial model encourages profit-loss risk sharing agreements (PLS). Furthermore, every financial transaction must be devoid of undue ambiguity (Gharar) and speculation (Maysir). Moreover, the Islamic law prohibits activities which are against the Islamic principles like gambling, drugs, alcohol, pork etc.

Second, interest-free financial system generates additional cost for Islamic banks. Islamic bank depositors are investment account holders (IAHs) participate in the gains, losses, and risks of investments associated to their bank accounts. Islamic banks confront with two ways of agency cost within their system. First, religious factors may reduce agency cost through moral constraints. Second, IAHs don't have any board representation and bank performance can't be directly monitored which in turn causes an additional agency cost for depositors. (Abdelselam, 2016).

Aside from the prohibitions of Islamic law, participation banks have two levels of governance: regular conventional financial board and Sharia supervisory board. Sharia supervisory board (SSB) checks whether banking activities align with the Islamic law. Several studies find that large Sharia supervisory board leads to better performance in Islamic banking (Hamza, 2016; Nomran et al., 2018). Double layer of governance system may result in heterogeneity between Islamic banks as the interpretation of Islamic laws (fatwas) might vary according to different Sharia boards. Ernst and Young (2013) points that Islamic financial tools exhibit some heterogeneity across the regions. A few studies point out that differences in Sharia supervisory boards may influence the performance of Islamic banking in several ways. According to Nawaz et al. (2018), there is a negative relationship between bank market performance and influential Shariah board scholars. According to the authors, Islamic banks should not invest on notable Islamic law figures in order to justify their actions in relation to

market performance. Farag et al. (2017) posit that the size of Shariah boards increases the financial performance of Islamic banks by lowering agency expenses. Mollah and Zaman (2015) suggest that Shariah boards have a favorable influence on Islamic bank performance when they serve as supervisors, but the impact is minor when they just serve as advisors.

On the other hand, growth of Islamic banking and finance necessitates the development of additional standards at the global level. For this purpose, Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI), Islamic Financial Stability Board (IFSB) and International Islamic Financial Markets standards (IIFM) were established and published general standards for interest free financial system with global practices. (Hassan et al., 2019a) Therefore, these recent improvements in Islamic standards may reduce heterogeneity of Islamic banking system as they rely on global standards.

Last, the Islamic banking system can affect both bank and consumer behavior due to its religious characteristics. Abdelsalam et al. (2016) state that religious norms prevent accounting misstatements and benefits from earnings management opportunities. It concludes that Islamic banks may have lower earnings from management in comparison to conventional banks. Recent studies unveil that new financial instruments are created for the Islamic finance system which may contradict the Islamic law. These new financial instruments in the Islamic financial system have led to increase in the debt and leverage ratio of Islamic banks. (Lewis, 2015; Nienhaus, 2014). This may expose Islamic banks to a risky situation than conventional banks during the next financial crisis.

2.3 Literature Review

The number of comparative studies of conventional and Islamic banks has increased after the 2008 global recession. Many scholars argue that, depending on the historical period or the bank's unique structure, participation banks are more robust than conventional equivalents. Covering subprime crisis era, Boumediene and Caby (2009) look at financial resilience of Islamic and conventional banks with volatility of stock returns. They conclude that Islamic banks are partially resistant to the subprime crisis and their risk perspective differs than conventional banks. Boumediene (2010) compares credit risks of 9 participation and 9 conventional banks in Egypt, the United

Arab Emirates, Kuwait, Qatar, Malaysia and Bahrain from 2005 to 2009 using the default probability (DP) and distance to default (DD) methods. According to their findings, Islamic banks have lower credit risk than their counterparts. Hasan and Dridi (2011) perform cross-country analysis of 120 banks between 2007 and 2010 using the OLS estimator. Islamic banks were not affected by the adverse conditions that hit conventional banks in the 2008 crisis due to the factors related to specific business model of Islamic finance. Credit and asset growth for Islamic banks have been higher than those for conventional banks during 2008-2009 years which helped them maintain financial and economic stability. They also observe that profit of some Islamic banks has fallen after the crisis due to poor risk management.

As comparative studies between banking systems increase, some scholars analyze the performance of banking systems with z-score technique. One of the most prominent study is Cihak and Hesse (2010) cross-country empirical analysis of Islamic banks' impact on financial stability after the 2008 recession with z-score technique. According to their findings, large commercial banks outperform large Islamic banks, whereas small Islamic banks outperform both types of large banks. Authors claim that Islamic banks have a complex credit risk monitoring system in comparison to conventional banks. As Islamic banks get bigger, surveillance of the PLS arrangements become more complex which results in adverse selection and moral hazard problems. Therefore, interest-free financial system is more stable than their counterpart as long as they avoid the adverse selection and moral hazard problems.

Beck et al. (2013) use the z-score to compare Islamic banks to conventional banks in terms of efficiency, job orientation rates, asset quality, bank stability, and maturity. They conclude that the business models of Islamic banks are comparable to those of conventional banks. However, stronger capitalization of Islamic banks, as well as this capital buffer with larger liquidity reserves, explain why Islamic banks performed substantially better during the 2008 crisis. Abedifar et al. (2013) use the z-score approach to compare credit and bankruptcy risks between Islamic and mainstream banks. Islamic banks with a bigger market share have lower credit risk than regular banks.

Unlike the previous research that found Islamic banks to be more stable than regular banks, some researchers failed to identify any meaningful difference between the two financial systems. For example, Bourkhis and Nabi (2013) analyze the resilience of

Islamic banks during the 2007-2008 crisis. They examine 34 Islamic and 34 conventional banks with Wilcoxon signed rank test and GLS technique. Their results suggest that there was no significant difference in terms of robustness of Islamic and conventional banks during the 2008 financial recession period.

Pappas et al. (2017) examine the risk of failure between Islam and conventional banks by the survival analysis method. Using Bankscope data, they study 106 Islamic and 315 conventional banks from the Middle Eastern countries between 1995-2010. They find that overall Islamic banks are more stable than conventional banks.

Abdelsalam et al. (2016) focus on the effects of organizational religiosity on earnings quality for banks in the Middle East and Northern Africa. Islamic and conventional banks are compared in terms of accounting behavior, income management and management style. At this point, risks of two types of banks are evaluated based on the fact that credit losses are affected by non-performing loans. They argue that Islamic banks have more cautious accounting standards and are less prone to manage earnings than traditional equivalents. According to these findings, moral responsibility limitations and religious standards have an influence on financial reporting quality and agency costs.

Modeling financial strength index (BOFSI) with CAMEL variables, Doumpos et al. (2017) compare the dual banking system in terms of financial strength. They find no statistically significant difference between conventional banks and Islamic banks in all 22 countries. However, Islamic banks perform better in Senegal and the Middle East and North Africa (MENA) region, whereas conventional banks outperform their counterparts in the GCC and Asian countries. Hassan et al. (2019b) compares Islamic and conventional banks for bank stability, liquidity risk and credit risk during 2007-2015 period. Authors find that there is a positive link between bank stability and liquidity risk for conventional banks during post 2008 crisis period while they are negatively correlated for participation banks during both 2008 crisis and post crisis era. They conclude that Islamic banks' performance is better than conventional banks in terms of managing both liquidity and credit risks.

While comparative studies suggest that there are similarities and differences between the two banking systems, some authors claim that stability results of the two banking systems largely depend on the specific econometric model. Kabir et al. (2015) investigate whether the comparative analysis of dual banking system is related to the

type of econometric method. Credit risk of conventional and Islamic banks is analyzed with z-score and the Merton's distance to default model (DD) for 13 countries during 2000-2012 period. The paper suggests that according to the DD model, Islamic banks have lower credit risk. Results also indicate that Islamic banks have lower credit risk than conventional banks on the DD model while they have higher credit risk in z-scores. Hence, the method used to measure credit risk has an important role to play in comparing credit risk of dual banking system.

Another strand of the literature examines the nexus between bank stability and its stock market performance. For example, Nier (2005) claims that when stock prices fall sharply in a given timeframe, banks may confront with significant financial problems. The author posits that large drops in bank stock prices are used as a market signal of financial distress for banks. The empirical findings suggest that openness may improve overall financial stability by lowering the likelihood of bank collapses. Beccalli et al. (2006) link bank cost efficiency to stock market performance, combining stock market research in accounting with the bank efficiency literature. They find that movements in the bank stock prices represents percentage changes in cost efficiency with Data Envelopment Analysis and Stochastic Frontier Approach models.

Kirkwood and Nahm (2006) evaluate cost efficiency of Australian banks in producing banking services and profit employing Data Envelopment Analysis (DEA) for 1995-2002. They linked changes in efficiency to stock returns and discovered that improvements in bank efficiency are mirrored in stock returns.

Some studies argue that stock prices and profitability of banks are related with each other. For instance, Ioannidis et al. (2008) use stochastic frontier analysis to examine the cost and profit efficiency of Asian and Latin American banks from 2000 to 2006. The authors discover a strong link between stock returns and profit efficiency, implying that profit efficiency measurements contain useful information for shareholders looking to understand bank stock returns.

Our chapter is also related to empirical studies focusing on the risk spillovers between the US financial markets and various developed and developing markets including Islamic ones (Majdoub and Mansour, 2014) and (Alotaibi and Mishra, 2015). Their findings mainly indicate risk spillovers from developed to developing economies. In particular, the domination of US shocks on all developing markets is well documented. Some papers specifically focus on spillovers among equity prices of international

banks. (Elyasiani and Mansur, 2003; Moussa, 2014; Allegret et al., 2017). More recently, Alqahtani et al. (2020) look at the tail dependence and risk spillover from the US and GCC banking sectors. They find that the GCC banking sectors show lower tail dependence with the US banking sector.

2.4 Methodology

After Koenker and Basset's (1978) seminal paper, quantile regression model has been used in many studies of financial risk analysis. Quantile regression model allows us to analyze economic or financial indicators for the entire conditional distribution of the response variable. Namely, quantile regression model is more useful than the techniques focusing only on the first two conditional moments of the return distributions for analyzing financial spillovers.

We use the multivariate quantile autoregression model developed by White et al. (2015). The model is an extended version of Engel and Manganelli's (2004) univariate conditional autoregressive value at risk (CAViaR) model for risk analysis. Indeed, Acharya et al. (2010) shows that the multivariate quantile regression model is ideal for explaining the value at risk models that is important in determining the response of financial institutions to cross-country shocks.

The multivariate regression quantile model can provide important insights on whether there is any divergence between the Islamic banking system and the traditional banking system, as it allows detecting tail codependence among random variables. Tail codependency represents the relationship between pair of random variables which measures their comovements in the tails of the distributions. This model has several empirical benefits for our purposes. First, the multivariate regression quantile model uses the information in the quantiles of the empirical distribution to obtain the value at risk (VaR) values dynamically and demonstrates the effect of changes in the value at risk. Thus, it allows the direct analysis of the impact of the financial risk shocks occurring during the sampling period on the basis of the value exposed to the dynamic risk.

It also enables the simulation of the potential future impact of a risk shock through the quantitative impulse response functions. The studies based on the multivariate GARCH model, where financial risk is measured indirectly based on volatility, differ

from studies based on standard vector autoregression and cointegration techniques where financial risk is not directly or indirectly measured.

Two variable quantile vector autoregression model is defined as:

$$Q_t^1 = Z_t \lambda_1 + h_{11} Q_{t-1}^1 + h_{12} Q_{t-1}^2 \quad (2.1)$$

$$Q_t^2 = Z_t \lambda_2 + h_{21} Q_{t-1}^1 + h_{22} Q_{t-1}^2 \quad (2.2)$$

In these equations, Z_t is included in information set Ω_t as Z_t contains the lagged values of Y_t . The quantile q_{it} at time t for random variables Y_{1t} and Y_{2t} with a given level of confidence $\theta \in (0, 1)$,

$$\Pr[Y_{it} \leq Q_t^i | \Omega_{t-1}] = \theta, \quad i = 1, 2 \quad (2.3)$$

If $h_{12} = h_{21} = 0$, aforementioned model simplifies to Engle and Manganelli's (2004) univariate CAViaR model, and the two specifications may be evaluated independently of each other. In other words, joint significance result of these coefficients indicates whether there exists a tail codependency between two different time series or not.

In the end, our multivariate quantile vector model can be expressed as

$$Q_t^1 = c_1(\theta) + g_{11}(\theta)|Y_{1t-1}| + g_{12}(\theta)|Y_{2t-1}| + h_{11}(\theta) Q_{t-1}^1 + h_{12}(\theta) Q_{t-1}^2 \quad (2.4)$$

$$Q_t^2 = c_2(\theta) + g_{21}(\theta)|Y_{1t-1}| + g_{22}(\theta)|Y_{2t-1}| + h_{21}(\theta) Q_{t-1}^1 + h_{22}(\theta) Q_{t-1}^2 \quad (2.5)$$

In matrix form we can state the above equations as

$$Q_t = c + G|Y_{t-1}| + H Q_{t-1} \quad (2.6)$$

According to the above expressions, we can deduce the impulse response functions with following equations.

$$\Delta_s(\tilde{Y}_{1t}) = G D_t, \quad s = 1 \quad (2.7)$$

$$\Delta_s(\tilde{Y}_{1t}) = H^{s-1} G D_t, \quad s > 1 \quad (2.8)$$

In that equation, $D_t = |\tilde{Y}_{1t}| - |Y_{1t}|$, \tilde{Y}_{1t} represents affected variable while Y_{1t} is unaffected variable by the shock.

Multivariate quantile regression model enables us to obtain pseudo impulse response functions (PIRF) to measure the effect of shock on bank equity level. We have too many banks in our sample. The first day impulse response function values for each bank are going to be compared in order to single out the initial effect of the shock. Daily return series for both values of indices and bank equities (Y_{it} in the model) are calculated as log differences of share price levels as follows:

$$r_t = [\ln P_{i,t} - \ln P_{i,t-1}] \times 100 \quad (2.9)$$

To make comparison across bank types and regions, we group the first day PIRF values with respect to their bank types and regions. Wilcoxon rank sum test compares two paired groups to determine whether two samples come from the same population. Hence, Wilcoxon test allows us to tell if there is any difference between impacts of shocks among various categories of bank groups.

2.5 Data

We use daily closing equity prices of 155 conventional and 36 Islamic banks from 16 countries between 1 January 2009 to 31 August 2017 (Table 1). We specifically look at 1% tail codependency between the major indices and bank equity prices for post crisis era for both types of banks. We consider the Dow Jones 65 Average Stock³ (DJUSI), the United States 10-year Treasury bond interest rate, the Volatility Index (VIX) and the MSCI World index as major financial indices between 1 January 2009 to 31 August 2017. All variables are obtained from Datastream.

Regarding the DJUSI index⁴, we would like to analyze the resilience of Islamic and conventional banks in response to a shock in the United States economy. Recent studies point out that shocks in the United States financial markets have affected emerging and frontier markets depending on some regional variations during both crisis normal times (Samarakoon, 2011). These points are important for our case as

⁴ The Dow Jones 65 Composite Average represents 20 stocks that make up the Dow Jones Transportation Average, 30 stocks that form the Dow Jones Industrial Average (DJIA), and 15 stocks of the Dow Jones Utility Average. All of the Dow Jones averages are price-weighted indices.

Islamic banks are mainly established in emerging and frontier markets. Our study investigates whether Islamic banks are affected by these risks similar to conventional banks. The MSCI World index including 1.650 firms over 23 developed markets⁵ captures equity market performance of global emerging markets. It represents overall performance of developed markets around the world. With these two indices we aim to find whether there exist any spillover effects from the US and developed markets to participation banks and conventional banks.

Table 2.1 : Distribution of Listed Banks by Country and Region.

Country	Conventional Banks	Islamic Banks	Total Banks
Gulf Region			
Bahrain	3	7	10
Kuwait	5	4	9
Saudi Arabia	6	5	11
Qatar	5	3	8
Oman	6	0	6
Asia Region			
Bangladesh	35	8	43
Malaysia	9	1	10
Pakistan	15	1	16
Indonesia	25	0	25
MENA Region			
Egypt	8	2	10
Lebanon	6	0	6
Palestine	3	1	4
Jordan	9	2	11
Turkey	14	1	15
Europe			
United Kingdom	6	1	7

Note: Lebanon, Indonesia and Oman have dual banking system but our period doesn't include any Islamic bank for these countries. We include these countries due for comparison between conventional banks as they have similarities with other countries.

In addition to global equity market performance of developed countries, we also utilize the United States 10-year Treasury bond interest and the volatility index as other

⁵ 23 countries are Italy, Ireland, Germany, Finland, Spain, Denmark, Austria, Switzerland, New Zealand, Singapore, Canada, Australia, Belgium, France, Hong Kong, Israel, Japan, Netherlands, Norway, Portugal, Sweden, the UK and the United States.

sources of financial shocks. We know that fluctuations of the US 10-year treasury bond rates affect emerging market bond prices (Moore et al., 2013). Hence, it allows us to capture changes in bond yields in emerging markets indirectly. The volatility index measures the volatility of 500 stocks which represents riskiness of global markets. Known as a fear index, the VIX basically captures expectations of volatility of major stock prices in the next 30 days. Next, we present and discuss our estimation results.

2.6 Results

2.6.1 Vector autoregression reduced form results

We estimate multivariate quantile autoregressive model between 191 banks taking into account all four indices. As there are too many banks in our sample, we only report estimation results for Jordan Islamic Bank as an illustration in Table 2 to save some space. We obtain similar results for other banks in our sample. Jordan Islamic Bank is just a representative example which represents the similar properties like that of other banks in our sample. In this table, we generate a shock from DJUSI to equity returns of Jordan Islamic bank using equations 4 and 5 above.

Table 2.2 : Jordan Islamic Bank - DJUSI 1% VaR Results.

	c1	g11	g12	h11	h12
Coeff:	-0.097**	-0.199***	-0.055	0.909***	-0.016
P-value:	0.037	0.003	0.204	0	0.237
	c2	g21	g22	h21	h22
Coeff:	0.000	0.012	-0.107	0.008	0.966***
P-value:	0.499	0.169	0.103	0.229	0
	JS:	1.477	P-value:	0.830	

Note: Multivariate Quantile Autoregressive coefficients at 1th percentile. The coefficients (g_{ij} and h_{ij} for $i, j = 1, 2$) correspond to the model specified in equations (4) and (5). The cross coefficients' joint significance statistics are represented by JS.

Quantile coefficients for all tables of 191 banks in our sample with respect to different financial shocks are estimated to be around 0.90 and they are all statistically significant indicating significance of the autocorrelated value-at-risk process. Regarding the joint significant test, our results hinge on the financial shock and bank types. Joint significant test suggests whether there exists a spillover effect between financial shock and bank equity prices. Since there are too many banks in our sample, we summarize the number of significant results of joint significant test for each financial shock to bank equity prices. Our goal is to compare dependencies between equity prices of both

types of banks and major financial indicators. In Table 3, the proportion of significant test findings for the total number of banks, conventional banks, and Islamic banks are reported in parentheses.

Table 2.3 : Joint Significance Test Summary.

Index Name	Total Bank	Conventional Bank	Islamic Bank
DJUSI	71 (37%)	60 (39%)	11 (31%)
MSCI	68 (36%)	57 (37%)	11 (31%)
US10	45 (24%)	34 (22%)	11 (31%)
VIX	97 (51%)	82 (53%)	15 (42%)

Notes: Values in parenthesis indicate percentage of banks in the sample or subsample which have significant joint coefficient at 0.05 level. We have 155 conventional banks and 36 Islamic banks in our sample (total 191 banks).

Table 3 indicates that shock hitting the volatility index is the most effective for conventional banks and Islamic banks as it significantly affects 51% (first column, fourth row) of all banks in our sample. When we compare different bank types, we observe that 53% of conventional banks and to a lesser degree only 42% of Islamic banks in our sample are affected by a shock associated with the VIX index. Since the VIX index is considered as a fear index by investors, it turns out that the VIX shock has the tail codependency with many banks regardless of their type.

Furthermore, both types of banks' equities are affected by a shock in the US and the other major developed stock markets in Table 3. Our results regarding the DJUSI and MSCI indices indicate that 37% and 36% of all banks have codependence with these indices, respectively. It is worth noting that Islamic banks have less codependence with VIX, DJUSI and MSCI indices in comparison to their conventional counterparts. This conclusion might be explained by the restricted nature of interest free finance model which forbids excessive speculation and uncertainty in financial transactions as we mention in Section 2. Hence, our findings reveal that conventional banks are more sensitive to these three shocks hitting developed markets than Islamic banks.

We find that the US10 year treasury bonds have tail dependency with 24% of banks in our sample. In terms of bank types, we observe that 31% of Islamic banks and only 22% of conventional banks have tail codependency with the US 10-year bond interest rates. Although Islamic banks are known to use interest-free financial instruments in their operations, their codependency with the US10 year treasury bond rates is higher

than conventional banking system. Recently some scholars argue that Islamic banks are not free from the interest rate risk (Zainol and Kassim, 2010; Ergeç and Arslan, 2013). They find that Islamic banks follow market trends with respect to changes in interest rates while they compete with conventional banks. Moreover, this result may be attributed to the adjustment of profit-loss sharing system adopted in Islamic banks. Even though depositors of Islamic banks share risk of profit and loss, their earning rates are similar to fixed rates offered by conventional banks. Islamic banks tend to employ non PLS debt-like instruments in creating their assets but collect deposits largely through the PLS model. As a result, the balance sheet structure of Islamic banks is sensitive to changes in interest rates. The reasons why interest rates might affect Islamic banks include the lack of arbitrage opportunities and the encounter with negative fund gap among others (Cevik and Charap, 2011). Therefore, in response to a shock to the US 10-year Treasury bond rate, Islamic banks may not adjust their PLS system as properly as conventional banks which may result in Islamic banks being more vulnerable to fluctuations in the US Treasury bond market.

2.6.2 Pseudo impulse response functions

In this section, our analysis summarize the pseudo impulse response functions (PIRF) of 191 banks for each financial shock separately. For example, Figure 1 represents the PIRF of Turkey İş Bank for the US 10-year Treasury bond in which vertical axis represents the change in the 1% quantiles of bank equity prices in response to the shock and horizontal axis represents the number of days. We observe that Turkey İş Bank's 1% quantiles of equity returns are reduced approximately by 1.2% on the first day as a reaction to the US 10-year bond shock (Blue line: PIRF; Red and Yellow lines: 95% Confidence Interval). It is not practical to present and discuss each bank's response to the shocks due to the size of the sample. Rather, to economize on space while showing the overall effects of each financial shock, we order the first day impact of the shocks to 191 banks' equity prices in our sample in Figures 2-5. In these figures, similar to example we have given, vertical axis represents change in the 1% quantiles of the banks equity returns and horizontal axis represents the quantiles between 0 and 1. We color conventional banks in blue and Islamic banks in red in order to show the initial effect of each shock with respect to bank types.

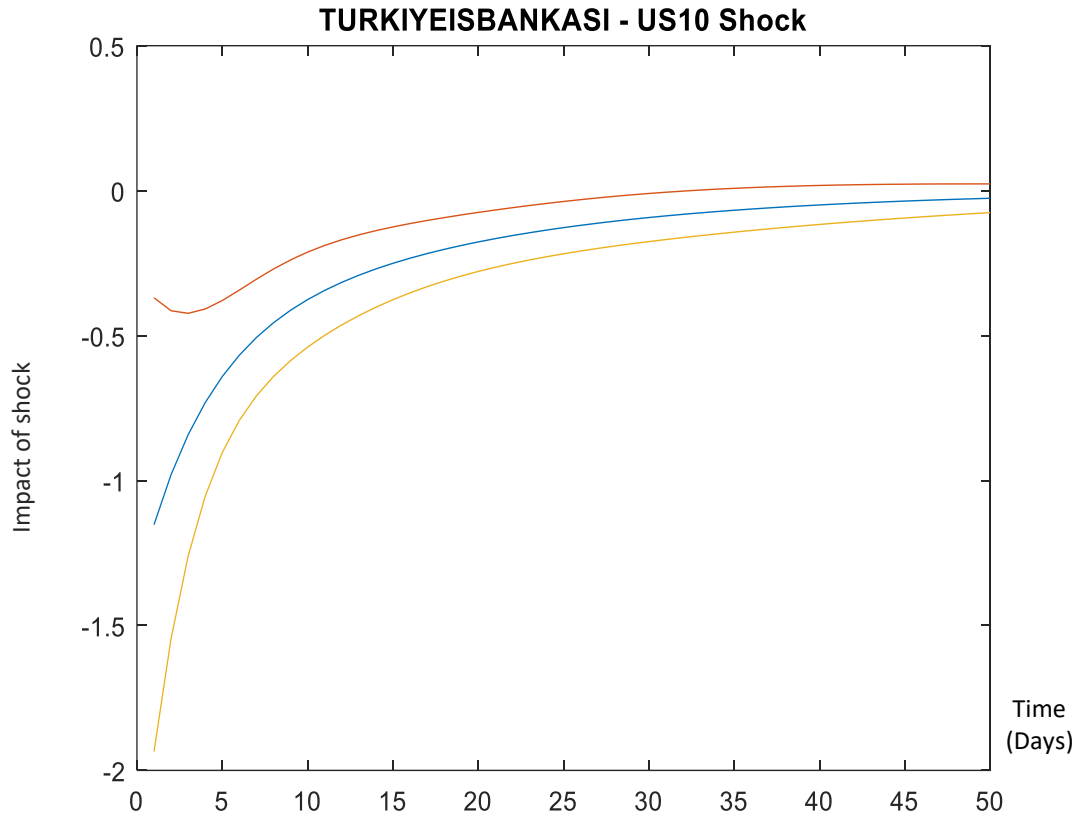


Figure 2.1 : Pseudo-Impulse Response Function (PIRF) of Turkey Is Bank.

The DJUSI index has the lowest impact among other indices on banks' equity prices which range between -0.1 to -0.76 percent in Figure 2. On the other hand, decrease in banks' equity performance ranges between -0.1 to -1.43 percent as a result of shock to the MSCI index (Figure 3). This result indicates that banks in our sample are not affected from the US markets as much as the other developed markets included in the MSCI global index.

In Figure 4, we show the range, -0.4 to -1.4, in which 1% quantiles of banks equity returns lie in response to a shock to the US 10-year Treasury bond. The US 10-year government bond rate is considered as a proxy for the level of global interest rates by investors and policy makers. Therefore, it is not surprising to see that the US 10-year bond market affect banks in our sample. These effects may occur indirectly through the US 10-year bond's impact on emerging countries' government bonds (Moore et al., 2013). It turns out that the 10-year United states Treasury bond is more influential than the DJUSI and the MSCI indices on banks in our sample. Finally, Figure 5 shows the impact of volatility index on 1% quantile of bank equity returns. Overall the volatility index among other indices has the greatest impact on our banks, as shock to VIX reduces 1% quantile of banks' equity prices in the range of -3 % to -8 %. The

results suggest that the US 10-year Treasury bond and the VIX are important indicators for stock market performance of banks in our sample.

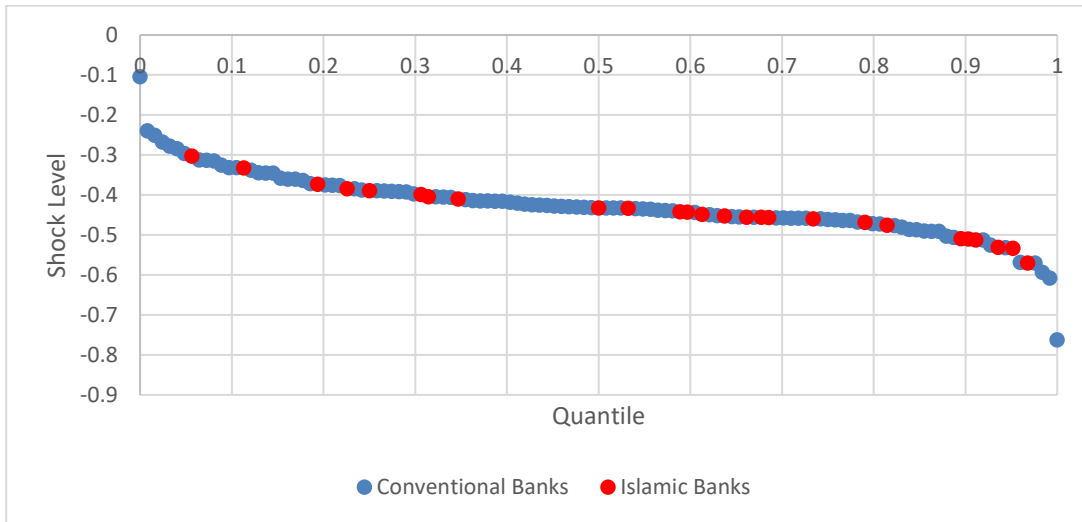


Figure 2.2 : DJUSI Index.

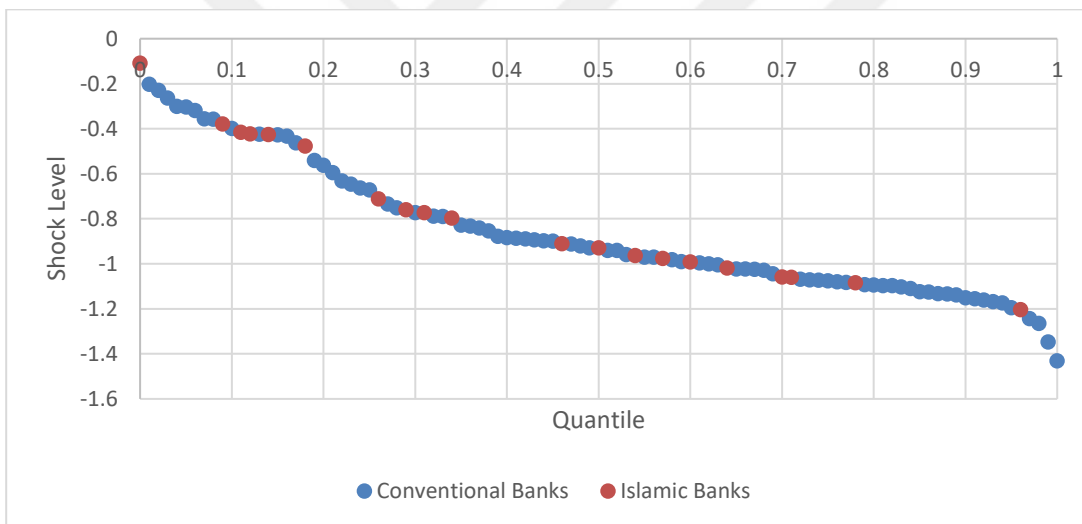


Figure 2.3 : MSCI Index.

So far we have looked at each bank’s resilience to shocks that hit major financial indices and rank them according to their sensitivity without discerning their types being Islamic or otherwise. At this moment, one may question whether bank type has any influence on the resilience of a bank in our sample. Therefore, in order to understand the differences between bank types in terms of their resilience to a given shock, we conduct the Wilcoxon Rank – Sum test. Wilcoxon Rank Sum test is a non-parametric statistical test that compares two paired groups. It allows us to compare that a randomly selected value from one sample will be close to a randomly selected value from the second sample.

In Table 3, we summarize the Wilcoxon rank sum-test results for the whole sample. The first column indicates the name of the major financial index. The following three columns indicate the significant number of PIRF results for different bank types. We only include the statistically significant results for comparison. Z-score and p-value indicates the results of Wilcoxon Rank sum test for each analysis.

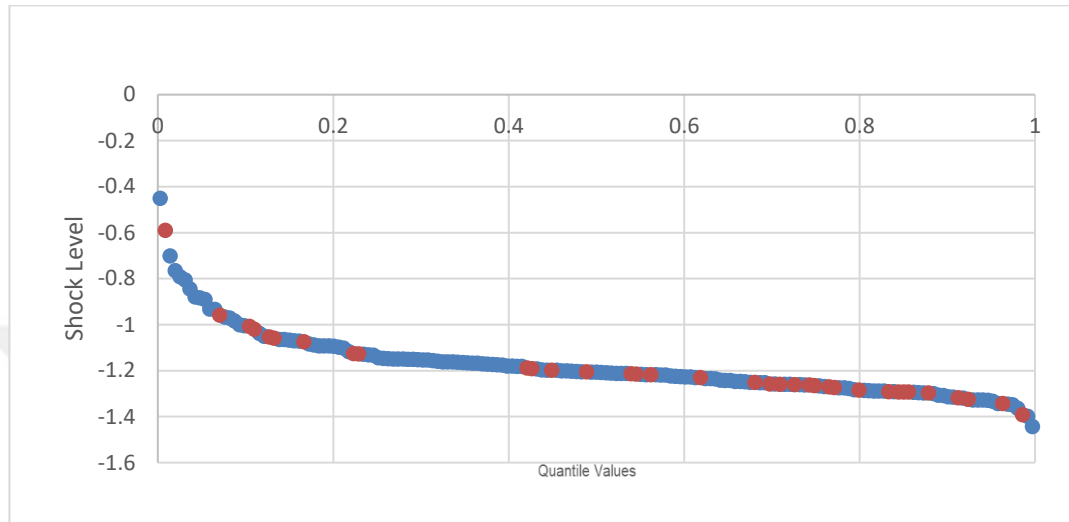


Figure 2.4 : US 10-Year Treasury Bond Rate.

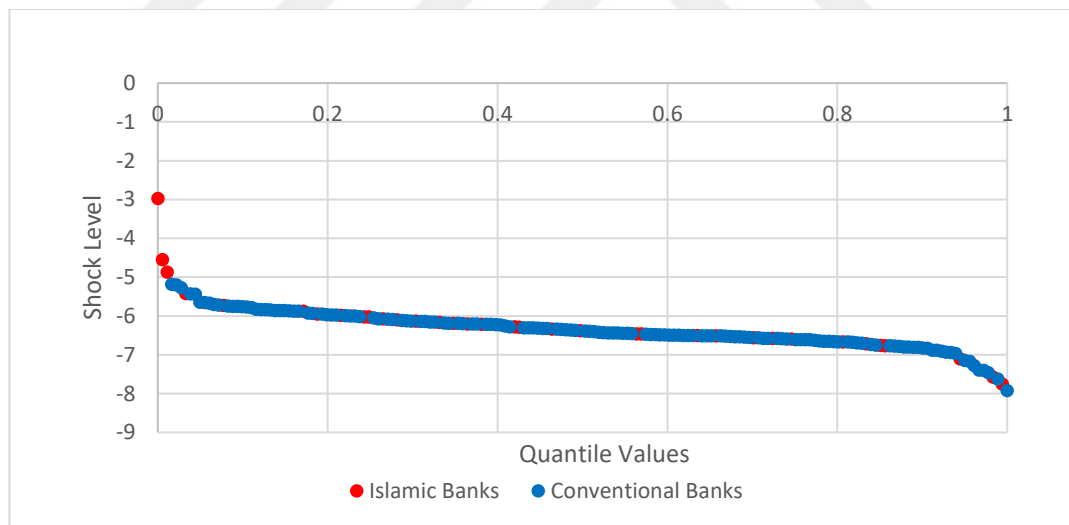


Figure 2.5 : Volatility Index.

The results show that by and large there is no difference between Islamic and conventional banks' exposure to the shocks. In other words, when a shock hits one of our major financial indices, both Islamic and conventional banks' equity prices have similar reactions. In the following section, we discuss whether geographical region might play a role in the resilience of a bank.

Table 2.4 : Wilcoxon Rank Sum-Test Comparison of PIRF for the Whole Sample.

Shock Name	Total Banks	Number of CB	Number of IB	Z-score	P-val.
DJUSI	125	99	26	1.661*	0.096
MSCI	101	81	20	-1.449	0.147
US10	177	142	35	1.573	0.115
VIX	182	146	36	-0.692	0.488

Notes: Number of CB and IB columns represent the statistically significant PIRF results for all financial indices.

2.6.2.1 Regional comparison

To see whether regional differences might affect the resilience of an Islamic or conventional bank, we first divide our sample into three regions as Asian countries (Bangladesh, Malaysia, Indonesia, Pakistan), GULF countries (Bahrain, Kuwait, Oman, Saudi Arabia, Qatar) and MENA countries (Jordan, Turkey, Lebanon, Egypt, Palestine). We investigate both within and between regions comparisons in the paper.

Within region comparison results using Wilcoxon-Rank sum test statistics are given in Table 2.4. Wilcoxon rank-sum tests yield statistically significant results only for the DJUSI index for Asia and the MSCI index for Gulf region. Regarding the DJUSI shock, CBs (Average: -0.42) perform slightly better than IBs (Average: -0.465) in Asia region. Doumpos et al. (2017) find that overall there is no difference between Islamic and conventional banks. However, they also find that Asian conventional banks perform better than Asian Islamic banks. Our results are consistent with theirs in that Asian conventional banks may be more resilient than Islamic banks in response to different financial shocks. On the other hand, IBs (Average: -0.809) performed better than CBs (Average: -1.04) in Gulf region as per the MSCI shock. We conclude that generally there is no statistically significant difference between Islamic and conventional banks within regions. However, in some cases such as DJUSI, Asian conventional banks may perform better than Islamic banks. Furthermore, Islamic banks in Gulf countries may perform better than conventional banks.

Table 2.5 : Wilcoxon Rank Sum-Test Comparison Within the Regions.

Shock Name	Region Name	Number of CB	Number of IB	Z-score	<i>P-Val.</i>
DJUSI	Gulf Countries	17	13	0.314	<i>0.7436</i>
	Asia	59	9	1.964**	<i>0.0496</i>
	MENA	19	4	0.000	<i>1.000</i>
MSCI	Gulf Countries	14	11	-2.135**	<i>0.0328</i>
	Asia	42	6	0.156	<i>0.8761</i>
	MENA	20	2	-1.142	<i>0.2534</i>
US10	Gulf Countries	24	18	0.229	<i>0.8191</i>
	Asia	79	10	0.000	<i>1.000</i>
	MENA	36	6	1.474	<i>0.1406</i>
VIX	Gulf Countries	24	19	-0.514	<i>0.6076</i>
	Asia	79	10	-0.611	<i>0.5415</i>
	MENA	37	6	-0.175	<i>0.8609</i>

Notes: Number of CB and IB columns represent the statistically significant PIRF for all shocks under consideration. *** Significant at 1%, ** Significant at 5%.

When we examine differences between Islamic and conventional banks' resilience across regions, overall we observe that the impact of DJUSI and MSCI shocks do not vary across regions for conventional and Islamic banks, although for MSCI index results reveal that Asian CBs (-0.82) perform better than Gulf CBs (-1.04). However, the US 10-year bond rate and the VIX statistically significantly affect bank performances across regions. Specifically, Asian CBs (-1.16) turn out to be better than both Gulf CBs (-1.23) and MENA CBs (-1.24) for the US 10-year rate. Moreover, we find that Asian CBs (-6.25) are better than both Gulf CBs (-6.47) and MENA CBs (-6.52) regarding the VIX index. These results indicate that conventional banks in Asia outperform than those in MENA and Gulf countries. This result may be due to recent financial improvements in Asian countries. It is very important to note that regarding Islamic banks, we discover no significant differences across regions in terms of shock resilience in our study. Previous studies claim that Islamic finance markets have some sort of heterogeneity over regions (Ernst and Young, 2013). Our findings indicate that as Islamic markets and their market shares grows globally, Islamic banks and markets become more and more homogenous in terms of their riskiness recently. Recent Islamic standards like AAOIFI and IFSB may lead to homogeneity across markets.

Table 2.6 : Wilcoxon Rank Sum-Test Comparison Between the Regions.

Shock	Region	All Sample	IB Perf.	CB Perf.
	Gulf vs Asia	-0.077(0.93)	0.902(0.37)	-0.013 (0.99)
DJUSI	Asia vs MENA	-1.260(0.21)	-1.234 (0.22)	-0.797 (0.43)
	Gulf vs MENA	-1.077(0.28)	-0.793 (0.43)	-0.491 (0.62)
	Gulf vs Asia	-1.627 (0.10)	-0.101 (0.92)	-2.498**
MSCI				(0.012)
	Asia vs MENA	0.164 (0.87)	-1.000 (0.32)	0.467 (0.64)
	Gulf vs MENA	-1.151 (0.25)	-0.592 (0.55)	-1.89 (0.058)
	Gulf vs Asia	-3.615*** (0.00)	-1.822 (0.0685)	-2.52** (0.011)
US10	Asia vs MENA	2.875*** (0.00)	1.519 (0.13)	2.418** (0.015)
	Gulf vs MENA	-1.002 (0.31)	0.533 (0.60)	-0.966 (0.33)
	Gulf vs Asia	-2.246** (0.02)	-1.147 (0.25)	-2.059** (0.04)
VIX	Asia vs MENA	3.615*** (0.00)	0.976 (0.33)	3.486*** (0.00)
	Gulf vs MENA	1.818** (0.06)	0.509 (0.61)	1.432** (0.15)

Notes: *** Significant at 1%, ** Significant at 5%. Values represent z-score as the numbers in brackets represent p-values.

2.7 Conclusion

We analyze the equities market performance of conventional and Islamic banks in the face of various significant financial shocks using a quantile autoregression model. The sample covers daily frequency data for the period from 1 January 2009 to 31 August 2017. Our findings, first of all, suggest that Islamic banks' equity prices have weaker codependency between the DJUSI and MSCI World indices than conventional banks indicating that Islamic based financial model may significantly reduce dependency with major stock markets. On the other hand, our results reveal that conventional banks have weaker codependency than participation banks for US 10-year Treasury bond rates. Namely, interest free banking financial system seems to be more vulnerable to interest rate risk than their conventional counterparts which may be attributed to Islamic banks' inability to respond to interest rate fluctuations as opposed to conventional banks, resulting in greater exposure to interest rate risk (Khaliq et al., 2017). Regulators and managers of Islamic banks must be cautious about this risk exposure. There are several ways Islamic banks may avoid interest rate risk. For example, they might simply remove or modify risk-weighted assets backed by

profit and loss sharing (PLS) accounts (IFSB, 2011). Otherwise, they may narrow down their focus more on PLS contracts such as mudarabah instead of financial instruments which offer fixed rate returns such as murabaha contracts (Zainol and Kassim, 2010).

Second, our results through pseudo-impulse response functions designate that overall there is no substantial difference among conventional and Islamic banks with respect to sensitivity to financial shocks both at the global and regional levels. Henceforth, this result may also suggest that Islamic markets may have lost its advantage over interest based financial system after the 2008 crisis. It might consequently have implications for portfolio management as the diversification benefits of Islamic finance decline. International fund managers must take into account this fact when they design their hedging strategies or their optimal portfolio choices including Islamic and conventional banking assets.

Third, we also find that the effects of each individual shocks for Islamic banks are homogenous in the regions of Gulf, MENA and Asian countries unlike earlier reports of Islamic banking competitiveness that argue that double layers of Shariah systems may generate heterogeneity across countries (Ernst and Young, 2013). This homogeneity result might be due to improvements in the Islamic finance principles and standards recently published by AAOIFI and IFSB among other things. In this regard, it is important for regulators to encourage similar Islamic banking practices across the board so that there will be less confusion for practitioners and investors.



3. HOW DO BANK SPECIFIC VARIABLES AFFECT THE RESILIENCE OF DUAL BANKING SYSTEM IN EMERGING MARKETS?

3.1 Introduction

The market share of Islamic banks in the global financial system has grown rapidly in Asian and Middle Eastern countries over the last three decades, particularly after the 2008 financial crisis (IMF, 2020). Some scholars claim this development might be explained by the fact that the interest free banking system, which is guided by Shariah principles that encourages profit-loss risk sharing agreements (PLS) instead of interest (riba) outperforms their conventional counterparts in terms of financial performance, stability, liquidity and credit risks (Beck et al., 2013; Hassan et al., 2019).

Recently, however, these seemingly superior features of Islamic financial system are scrutinized. While some scholars propose that due to Islamic law's restriction on interest rates, Islamic banks were more efficient than conventional banks during the 2008 financial crisis, (riba) (Zehri and Al-Herch, 2013; Onakoya et al., 2013), others claim that financial instruments, such as tawarruq and commodity murabaha, that were developed after the 2008 financial crisis, may have been detrimental to Islamic banks' performance by increasing their leverage ratio and debt (Nienhaus, 2014; Lewis, 2015). Indeed, recent reports on Islamic finance indicate that non-interest based banking system might have lost its advantage over conventional counterparts due to significant rise in leverage ratios and but also a market environment that has become less favorable than before as systemic risks tend to rise across the globe (Islamic Financial Services Board, 2017).

Furthermore, similar to leverage ratio, bank size, another bank specific factor, is also known to affect the riskiness of both types of banks. Some studies indicate that Islamic organizations are more vulnerable to credit risk due to limits in credit risk management requirements. (Cihak and Hesse, 2010) and imposing regulatory framework for the conventional banks that ignores Islamic finance's unique characteristics. (Ali et. al. , 2021) Likewise, some studies find that capital adequacy ratio negatively affects the

profitability (Alnajjar and Othman, 2021) and stability (Ibrahim, 2019) of Islamic banks due to challenges in implementing requirements of interest free banking system. These difficulties might arise because of the following two reasons. First, liability and asset accounting of interest free financial system differs from their conventional counterparts in that profit loss sharing (PLS) paradigm in Islamic banks involves contracts such as investment deposits that are quasi-equity in nature. With PLS paradigm, Islamic financial system diversifies the risk of investment equally among the depositors and investors which may not be measured by standard capital adequacy ratio. Second, Islamic banks have additional risks, including as pricing risk, fiduciary risk, rate of return risk, and displaced commercial risk, that are not addressed by the Basel framework, which focuses primarily on credit risk, market risk, and operational risk. (Smolo and Hassan, 2010)

In second chapter, this article examines how bank specific variables affect the resilience of dual banking system in emerging markets using a novel approach. For this purpose, we estimate a multivariate quantile model to analyze financial risk spillovers in the values-at-risk (VaR) that may occur among banks' equity prices and major financial indices. To our knowledge, this is the first study that compares resilience of dual banking system with respect to their stock market performance while taking into account bank specific variables. Recent studies show that banks' stock market performance during a financial crisis is closely linked with their stock market performance during previous crisis, as financial institutions appear to follow their business model, which make them prone to success or failures. (Fahlenbrach et al., 2011) Furthermore, market volatility in bank stock returns reflects the cost efficiency performance of financial institutions. (Beccalli et al, (2006). Hence, bank equity returns provide important insights regarding the efficiency of bank management and its future performance and vulnerability during a crisis.

Overall, our results suggest that bank specific factors has an important role in assessing the impact on the bank equity prices due to a shock to the financial indices. Specifically, we find that a shock to the financial indices have greater impact on the most leveraged banks regardless of bank type. Furthermore, Islamic banks become more vulnerable to risk spillovers as their size increases. Credit risk management has become more difficult as a result of recent risk management regulations for certain PLS transactions. Because of the greater quantity of PLS contracts, larger Islamic

banks may face a higher credit risk than smaller ones. (Cihak and Hesse, 2010; Windarjoro et. al., 2020) For conventional banks, however, the impact of the shock on equity returns doesn't vary according to different levels of bank size.

The findings also indicate that Islamic banks with a high capital adequacy ratio are more exposed to financial shocks than those with a lower capital adequacy ratio. It is important to note that one significant distinction among dual banking system is that the risk weighted assets' definition (i.e., denominator of CAR) in Islamic banking system differs from the one in the conventional counterpart as non-interest based financial system has Shariah compliant products. (Ariss and Saredidine, 2007; Basher et al., 2017) Similarly, Islamic banks confront risks that are distinct from those faced by conventional banks, and Basel risk weights may not be adequate to appropriately assess their capitalization. Therefore, authorities of Islamic finance should adopt capital regulations with caution due to notable differences with conventional banking system regarding the definition of bank capital.

The following is how the rest of the chapter is organized: The literature on comparative analyses of dual banking systems is included in Section 2. Sections 3 and 4 detail the multivariate quantile regression technique and data, respectively. Finally, Section 5 summarizes the empirical findings before conclusion in Section 6.

3.2 Literature Review

The literature has recently seen a spike in interest in studying the relationship between bank stock market prices and bank performance. Beccali et al. (2006) looked at the link between European banks' cost efficiency and their stock price performance. They discover that fluctuation in bank stock prices represent percentage changes in cost efficiency for European banks using Data Envelopment Analysis(DEA) and the Stochastic Frontier Approach models. Similarly, Majid et al. (2008) investigate the efficiency of Chinese commercial banks between 1997 and 2006 utilizing market share price performance and the DEA Window analysis approach. Their findings show that bank efficiency is linked to specific bank characteristics such as bank size, management quality, and non-interest revenue diversification. According to Nier (2006), bank stock market prices are significant indicators for banks' financial soundness during financial turmoil.

Between 1995 and 2002, Kirkwood and Nahm (2006) used Data Envelopment Analysis (DEA) to analyze the cost-effectiveness of Australian banks in providing banking services and profits. They link improvements in efficiency to stock returns and find that stock returns reflect the adjustments in bank efficiency.

Some studies argue that stock prices and profitability of banks are related with each other. For instance, Ionnadis et al. (2008) examine the cost and profit efficiency of Asian and Latin American banks using stochastic frontier analysis from 2000 to 2006. They show a strong link between stock returns and profit efficiency, implying that profit efficiency measurements contain useful information concerning bank stock returns for shareholders.

Recently, Atukalp (2020) investigates relationship between stock return and financial performance of Turkish deposit banks for the 2014-2018 period with the TOPSIS method. He finds that there is no statistically significant correlation between banks' stock returns and their financial performance in Turkey. Mirzaei et al. (2021) evaluate stock price performance of both Islamic and conventional banks during the initial phase of the coronavirus pandemic (1 October 2020- 1 April 2020). Their results show that Islamic banks stock returns fared better than conventional banks due to pre-crisis higher level of efficiency of Islamic banks during the first three months of the COVID-19 pandemic.

The aforementioned studies above mainly argue that equity prices reflect bank performance in different ways. In this chapter, we attempt to investigate how a shock to major financial indices may affect bank equity prices as bank specific variables such as bank size, leverage ratio, return on equity and capital adequacy ratio change. In this context, many authors compare the dual banking system regarding different aspects of banks.

Some studies demonstrate an association between bank size and credit risk. Research comparing Islamic and conventional banks with respect to the impact of bank size and market share on bank stability provides different results. Cihak and Hesse (2010) analyze the impact of global recession on the dual banking system with z-score model. Their results indicate that bank size plays an important role between both bank types. Specifically, they show that small Islamic banks outperform both types of large banks, while we have mixed results for conventional banks. They posit that Islamic financial system has complex credit risk monitoring system than conventional financial system

due to restrictions of Islamic law. They conclude that bigger surveillance of the PLS arrangements being complex results in moral hazard and adverse selection problems. Some authors point out that asset and credit growth of Islamic banking system outperform conventional banks during the 2008 financial crisis providing financial and economic stability for Islamic banking system. (Hasan and Dridi, 2010) Likewise, several studies posit that conventional banks are more prone to credit risk than Islamic banks with larger market shares. (Abedifar et al., 2013)

Korbi and Boutagef (2017) investigate the factors that influence the stability of the dual banking system for MENA countries between 1999-2014 using z-score. They find that bank size is an important variable for bank instability, especially for Islamic banks. Trad et al. (2017) compare the dual banking system in terms of credit risk and insolvency risk using z-score and EQL or IMLGL ratio with various bank specific variables. They find that bank size and capitalization are two key bank specific determinants for profitability, and stability. Chen et al. (2018) also show that bank size plays an important role in performance of both bank types because asset variety positively affect large bank's profitability with the positive effect being greater for Islamic banks.

Fakhrunnas et al. (2019) study the link between macroeconomic and bank-specific characteristics and risk-taking behavior in Indonesian Islamic and conventional banks from 2010-Q4 to 2017-Q1. They find that each bank's exposure to risk varies due to their different nature in their business operations. Furthermore, they contend that bank size and equity to asset ratio are the most influential bank-specific characteristics for risk reduction.

Kamarudin et al. (2019) investigate the profit, cost, and revenue efficiency of 17 Malaysian participation banks between 2006 and 2015 using the non-parametric Data Envelopment Analysis approach. They try to identify potential bank-specific and macroeconomic determinants that could impact the efficiency of the financial system. Using several factors such as bank size, asset quality, capitalization level, liquidity and bank market power they show that there exist different efficiencies among Islamic banks in Malaysia between domestic and foreign banks which cause differences in cost, revenue and profit efficiencies. They claim that in order for banks to improve their efficiency, they must use the same regulatory procedures as efficient banks.

Widarjono et al. (2020) examine the effects on profit-loss sharing contracts on Islamic banks, concentrating on the size and geographical location of the institutions for Indonesian banks between 2013-2018. Due to funding and financing portfolio sizes, they discover that larger Islamic banks have a higher share of PLS contracts, which leads to riskier financing than smaller Islamic banks.

However, Ali et al. (2021) compare the credit risk of dual banking system focusing on bank size and competition on 283 conventional and 60 participation banks between 2006-2017. Contrary to previous studies, the findings demonstrate that large conventional banks are riskier than large Islamic banks, whilst small conventional banks are less riskier than small Islamic banks. The paper posits that regulatory framework for conventional banks is not effective for Islamic banks because it might increase the credit risk for them.

While numerous papers studying conventional banks find that capital adequacy ratio has a positive effect on bank performance, recent studies posit that capital adequacy ratio adversely affects on Islamic banks' performance. For instance, Hussien et al. (2019) investigate Islamic banks' profitability in Gulf countries for the period between 2005 to 2011. They conclude that credit risk in Islamic banks tends to rise with profitability, which is influenced by capital adequacy ratios positively during the 2008 financial crisis. Ibrahim (2019) focuses on capital regulation and bank performance for Islamic banks in 13 countries. He finds that capital regulation reduces the profitability of Islamic banking system due to high capital holdings and low liquidity. Likewise, Alnajjar and Othman (2021) analyzes the influence of CAR on profitability, using return on equity and return on assets of Islamic banks in MENA countries between 2017-2019. They find that capital adequacy ratio negatively affects the return on equity and return on assets of Islamic banks.

Hence, as the literature review suggests although there are studies which look at how various bank specific factors affect certain bank performance measures, to the best of our knowledge, this is the first study that compares the resilience of dual banking system with respect to their stock market performance while taking into account bank specific variables.

3.3 Methodology

In this chapter, we employ the multivariate quantile autoregression model developed by White et al. (2015) to uncover dynamic tail codependence between bank equity returns and financial risk spillovers. This model is a multivariate version of univariate conditional value-at-risk quantile regression (CAViaR) developed by Engle and Manganelli (2004). It provides an ideal environment to scrutinize the response of financial institutions to cross-country shocks (Acharya et al., 2010).

We utilize bivariate version of quantile regression model which relates the conditional quantiles of bank equity returns and major financial indices. Specifically, we examine the two variable quantile model by the following two equations:

$$Q_t^1 = Z_t \lambda_1 + h_{11} Q_{t-1}^1 + h_{12} Q_{t-1}^2 \quad (3.1)$$

$$Q_t^2 = Z_t \lambda_2 + h_{21} Q_{t-1}^1 + h_{22} Q_{t-1}^2 \quad (3.2)$$

where Z_t in information set Ω_t contains the lagged values of Y_t . The quantile q_{it} at time t for random variables Y_{1t} and Y_{2t} with a given level of confidence $\theta \in (0, 1)$, where Q_t^i is implicitly defined as $\Pr[Y_{it} \leq Q_t^i | \Omega_{t-1}] = \theta$, $i = 1, 2$. Particularly, the multivariate quantile model used in this paper can be represented as follows:

$$Q_t^1 = c_1(\theta) + g_{11}(\theta)|Y_{1t-1}| + g_{12}(\theta)|Y_{2t-1}| + h_{11}(\theta) Q_{t-1}^1 + h_{12}(\theta) Q_{t-1}^2 \quad (3.3)$$

$$Q_t^2 = c_2(\theta) + g_{21}(\theta)|Y_{1t-1}| + g_{22}(\theta)|Y_{2t-1}| + h_{21}(\theta) Q_{t-1}^1 + h_{22}(\theta) Q_{t-1}^2 \quad (3.4)$$

We can summarize these two equations in matrix form,

$$Q_t = c + G|Y_{t-1}| + H Q_{t-1} \quad (3.5)$$

If $h_{12} = h_{21} = 0$, the model boils down to Engle and Manganelli's (2004) univariate CAViaR model, and the two specifications may be evaluated independently of each other. In other words, joint significance result of these coefficients indicates whether there exists a tail codependency between two different time series or not.

Our model allows us to obtain pseudo impulse response functions (PIRF) to compare an impact of a financial shock to bank equity prices. Unlike conventional impulse

response function models where intervention γ is applied to the error terms, pseudo impulse response functions (PIRFs) presume that the intervention γ is only applied to the observable return Y_{1t} only at time t indicating that there is no change in Y_{1t} at other times. Hence, we can deduce the impulse response functions with the following equations:

$$\Delta_s(\tilde{Y}_{1t}) = GD_t, s = 1 \quad (3.6)$$

$$\Delta_s(\tilde{Y}_{1t}) = H^{s-1}GD_t, s > 1 \quad (3.7)$$

where $D_t = |\tilde{Y}_{1t}| - |Y_{1t}|$, \tilde{Y}_{1t} represents θ th conditional quantile of the affected variable and Y_{1t} is the initial value of the variable.

Since we have a large number of banks in our data set, we evaluate pseudo impulse response function results in two steps. First, we obtain the first day impulse response function values for each bank which simply captures the initial effect of a financial shock. Then, we order all statistically significant results with respect to bank specific variables in order to measure how bank specific variables affect the impact of financial shocks to bank equity price returns. Daily return series for both financial indices and bank equity returns are calculated as log differences as follows:

$$r_t = [\ln P_{i,t} - \ln P_{i,t-1}] \times 100 \quad (3.8)$$

The multivariate quantile regression technique has several advantages in our analysis. First, quantile models can track tail codependence among random variables which measures the comovements of a pair of random variables in the tails of the distributions. As we measure the financial risk spillovers between major markets and bank equity prices, quantile models determine whether there exists a relationship between risk spillovers between these two series.

Second, our model helps compute the potential impact of a shock via pseudo impulse response functions (PIRF) and monitor the dynamics of the banks' equity price reactions after confronting a shock conditional on the quantiles of the returns distribution. The main purpose of our analysis is to compare the stability of dual banking system according to various bank specific variables. In other words, as certain bank specific factors vary, we look at what happens to the resilience of both types of

banks. To this end, PIRF allows to measure the impact of a shock to equity prices and compare them with bank specific variables. The multivariate vector autoregression model has an advantage in this regard since it differs from the multivariate GARCH model, which calculates volatility risk indirectly, as well as standard vector autoregressive and cointegration methods.

Last, our model uses the information in the quantiles of the empirical distribution to obtain the value at risk (VaR) values dynamically and demonstrates the effect of changes in the value at risk. Therefore, it enables direct analysis of the impact of financial risk shocks occurring during the sampling period based on the value exposed to dynamic risk.

3.4 Data

We use the Dow Jones Industrial Index (DJI), the S&P 500 index, the MSCI Emerging Market Index and the MSCI World index as major financial indices between 1 January 2009 and 31 March 2020, obtained from Datastream. These financial indices are chosen for several reasons for the analysis.

Using the Dow Jones Industrial Index and the S&P500 Index, we aim to examine the impact of shocks associated with the United States financial markets and their cross-country spillover effects over dual banking system. Depending on regional differences we already know that the US financial markets have affected emerging markets during both crisis and non-crisis periods (Samarakoon, 2011) As Islamic banking system prevails in several important emerging and frontier markets generally, spillover effects of these major indices might be expected to affect bank equity prices of countries in our sample. Similarly, the MSCI World index is chosen to assess the impact of the global performance of developed markets as it represents developed market index which includes 1.650 firms over 23 developed markets. Last, the MSCI Emerging Market index, which includes 1.424 members from 27 emerging market countries, aims to measure overall performance and financial risk spillovers of emerging markets.

Apart from these global financial indices, we also looked at the impact of other potential types of shocks. For example, we examine how commodity price shocks affect bank stock prices and bank resilience as recent reports suggest the existence of the impact of oil and other commodities on the returns of Islamic financial instruments.

(Paltrinieri and Kutan, 2019) In order to capture the effect of commodity price shocks, we observe S&P GSCI Total Commodity Return index, gold prices and WTI petrol prices. Commodity price shocks might particularly impact Islamic banks, as commodities serve as collateral for the vast majority of their borrowing and lending activities in Islamic financial system. (IMF, 2020) However, we didn't find any statistically significant impact of shocks associated with aforementioned commodity prices on bank equity price performance in our data. We could have chosen several other alternative indices. However, these four indices somehow capturing the behavior of three important layer of markets (the US, emerging and global markets in general) would serve for our purposes.

Moreover, we consider daily closing equity prices of 138 conventional and 32 Islamic banks from 14 emerging countries between 1 January 2009 and 31 March 2020 (Table 1). We investigate the tail codependency between the financial indices and bank equity prices for both bank types after 2008 crisis and to compare the effect of these shocks with respect to certain bank specific determinants.

Bank specific variables and bank equity prices are collected from Datastream. Bank equity prices are selected primarily on the basis of banks being listed on markets and availability of data for the whole sample. As bank specific determinants, we consider leverage ratio, capital adequacy ratio and market value quarterly data from Q1 2009 to Q1 2020.

Leverage ratio for a bank is defined by Datastream as the ratio of total debts over common equity. For Islamic banks, IFSB-15 reports that Islamic financial system is less prone to engage in leveraged products. A few studies point out that one of the central tenets of the interest free banking system, especially in aftermath of the 2008 crisis, is to prevent excessive leverage and to avoid debt creation. However, recent practices and transactions in instruments like CMT (Tawwaruq) deposits in the Islamic financial system have led to increases in the debt and leverage ratios of Islamic banks. (Lewis, 2015; Nienhaus, 2014; IFSB-15, 2013).

Table 3.1 : Summary of Islamic and Conventional Banks by Countries.

Country	Number of Banks (Islamic Banks)
Bahrain	9(5)
Egypt	10(4)
Kuwait	9(4)
Saudi Arabia	9(3)
Qatar	8(3)
Oman	6
Bangladesh	35(7)
Malaysia	10(1)
Pakistan	16(1)
Indonesia	24
Lebanon	6
Palestine	4(1)
Jordan	11(2)
Turkey	13(1)

Note: Lebanon, Indonesia and Oman both have dual banking system in their financial system. However, data period doesn't include any Islamic bank for these countries. We use conventional banks in these countries as they have similarities with other conventional banks in our sample. The number of Islamic banks is reported in parentheses next to the number of banks.

The capital adequacy ratio is calculated as the ratio of a bank's capital to its risk-weighted assets and liabilities. It is defined as the measurement of Tier 1 and Tier 2 capital in the Datastream database, which includes subordinated debt, hybrid capital, loan-loss reserves, and valuation reserves as a proportion of risk weighted assets, as well as off-balance sheet risks. It seeks to ensure that banks have enough capital in hand so that they can withstand a specific level of losses before any potential bankruptcy. Recent practices, however, have raised concerns that capital adequacy requirements may result in a considerable reduction in bank credit supply in order to meet certain regulatory requirements, particularly in MENA nations. (Awdeh and Moussawi, 2021). Implementing capital adequacy requirements for Islamic banking system may be arduous as we discussed earlier.

Our last bank specific variable is the bank's asset size which measured in logarithm in U.S. billion dollars. In the literature, there are two contrasting arguments concerning the impact of conventional bank size. According to one perspective, due to scale

efficiencies, larger conventional banks are more robust than smaller conventional banks. Another point of view is that banks with greater transactions are more vulnerable to risk, resulting in big conventional banks becoming riskier than small banks. (Sun et al. 2016) For Islamic banks, some authors argue that participation banks have more complex credit risk monitoring system than their conventional counterparts because of their authentic profit and loss sharing system. This complexity increases with bank size and leads to bigger surveillance of the PLS arrangements that causes moral hazard and adverse selection problems. As a result of their lower credit risk, small Islamic banks may become stronger and financially better positioned against bankruptcy concerns than major participation banks. (Cihak and Hesse, 2010; Abedifar et. al., 2013).

3.5 Results

3.5.1 Tail codependence analysis

We estimate 170 bivariate 1% quantile models among the 170 banks (conventional and Islamic) and the four financial indices, DJI, S&P 500, MSCI Emerging Market Index and MSCI World Index. As a typical example, Table 2 reports estimation results of a case between Saudi Investment Bank and S&P 500 index. In this example, diagonal coefficients of H matrix are around 0.90 and statistically significant for the two values which in turn imply that value-at-risk process is significantly autocorrelated. In other words, reduced form of multivariate autoregression model is consistent with univariate autoregression model (CAViar model). For non-diagonal values of the G and H matrices, we find that some of the coefficients are significantly different from zero. These findings suggest that a multivariate quantile model can provide information about important indices and bank equity prices that can't be found using univariate quantile regression models. Last, Wald joint significant test confirms that there exists a tail codependency between equity price of Saudi Investment Bank and S&P 500 index.

Table 3.2 : Saudi Investment Bank – S&P500 %1 VaR Results.

	c1	g11	g12	h11	h12
Coefficient	-0,981	-0,420***	-0,152**	-0,883**	0,553**
P-value	0,170	0,000	0,018	0,043	0,040
	c2	g21	g22	h21	h22
Coefficient	-0,359	-0,621***	-0,197	-0,035	0,828**
P-value	0,307	0,004	0,137	0,491	0,035
	JS:	72,774	P-value:	0,000	

Note: Multivariate Quantile Autoregressive coefficients at 1th percentile. Estimated coefficients are in the first rows which are obtained from equation 4 and 5, respectively. P-values are reported in the second row. The autoregressive cross-coefficients of the findings are represented by the non-diagonal coefficients of the G and H matrices, and JS is the joint significance Wald test for the statistics of the cross-coefficients.

For the purpose of brevity, we present the summary of all estimation results regarding the impact of a shock in four financial indices to bank stock price returns of 170 banks separately. In order to test whether there exists a tail codependence between major global financial indices and bank equity price returns, Table 3 shows the descriptive statistics for all estimation results' entire coefficients. The average values of summary statistics in this table correspond to the example in Table 2. For instance, the values represent in congruence with the example above where H matrix coefficient values vary between 0.82-0.87 and standard deviation values of cross-sectional coefficients illustrates that there exists tail codependency between financial indices and bank equity price returns.

Table 3.3 : Summary Statistics of the Full Autoregression Coefficients.

DJI.

	c1	g11	g12	h11	h12
Average	-0.115	-0.466	-0.013	0.793	0.023
Std. Dev.	0.545	0.098	0.054	0.180	0.192
Min	-5.365	-0.625	-0.511	-0.932	-0.144
Max	5.863	0.019	0.107	1.003	2.681
	c2	g21	g22	h21	h22
Average	-0.525	-0.259	-0.242	-0.029	0.814
Std. Dev.	0.776	0.325	0.213	0.221	0.257
Min	-5.997	-2.378	-1.687	-0.751	-0.989
Max	0.219	0.701	0.023	2.231	1.206

Table 3.3(Continued) : Summary Statistics of the Full Autoregression Coefficients.*S&P500.*

	c1	g11	g12	h11	h12
Average	-0.106	-0.410	-0.008	0.829	0.017
Std. Dev.	0.169	0.093	0.052	0.080	0.075
Min	-1.179	-0.575	-0.499	-0.057	-0.141
Max	1.389	0.020	0.141	1.004	0.927
	c2	g21	g22	h21	h22
Average	-0.534	-0.239	-0.245	-0.025	0.817
Std. Dev.	0.763	0.291	0.204	0.172	0.218
Min	-4.605	-1.651	-0.939	-0.360	-0.289
Max	0.314	0.650	0.025	0.982	1.018

MSCI World Index.

	c1	g11	g12	h11	h12
Average	-0.099	-0.596	-0.013	0.771	0.019
Std. Dev.	0.579	0.137	0.048	0.16	0.083
Min	-8.9	-0.966	-0.312	-0.972	-0.274
Max	0.44	0.027	0.342	1.003	0.866
	c2	g21	g22	h21	h22
Average	-0.476	-0.267	-0.248	-0.027	0.826
Std. Dev.	0.703	0.337	0.237	0.204	0.213
Min	-4.247	-1.644	-2.015	-0.653	-0.605
Max	0.308	0.636	0.034	1.802	1.026

MSCI Emerging Market Index.

	c1	g11	g12	h11	h12
Average	-0.169	-0.436	-0.021	0.777	0.012
Std. Dev.	0.724	0.102	0.061	0.249	0.111
Min	-7.517	-0.683	-0.395	-1.062	-0.898
Max	0.867	0.018	0.119	1.003	0.925
	c2	g21	g22	h21	h22
Average	-0.470	-0.177	-0.259	0.027	0.807
Std. Dev.	0.767	0.319	0.200	0.327	0.227
Min	-5.250	-1.221	-0.912	-0.486	-0.614
Max	0.970	2.034	0.025	3.213	1.004

3.5.2 Bank specific variable analysis

We generate the pseudo-impulse response functions (PIRF) of 170 banks for each financial shock separately using a vector autoregressive model. As a typical example, Figure 3.1 below plots the pseudo impulse-response function of Denizbank to two standard deviation shock to the MSCI Emerging Market Index. The horizontal axis in this chart reflects the period (number of days), while the vertical axis indicates the

percentage change in the 1 percent quantiles of Denizbank's share prices in reaction to the financial shock. In this example, a two standard deviation shock to the MSCI Emerging Market index produces an initial increase of approximately 1.1% in the daily Value at Risk of Denizbank. (Red and yellow lines represent 95% Confidence Interval). We want to observe the role of each bank specific variables on the spillover effects of major indices. It would be rather challenging and somewhat unnecessary to show and explain each bank's response to a given shock considering bank specific determinants. Hence, we look at the initial effect, which is the first day statistically significant PIRF for a shock to the four financial indices for 170 bank equity prices and order them according to bank specific variables to understand how equity price returns of banks are affected.

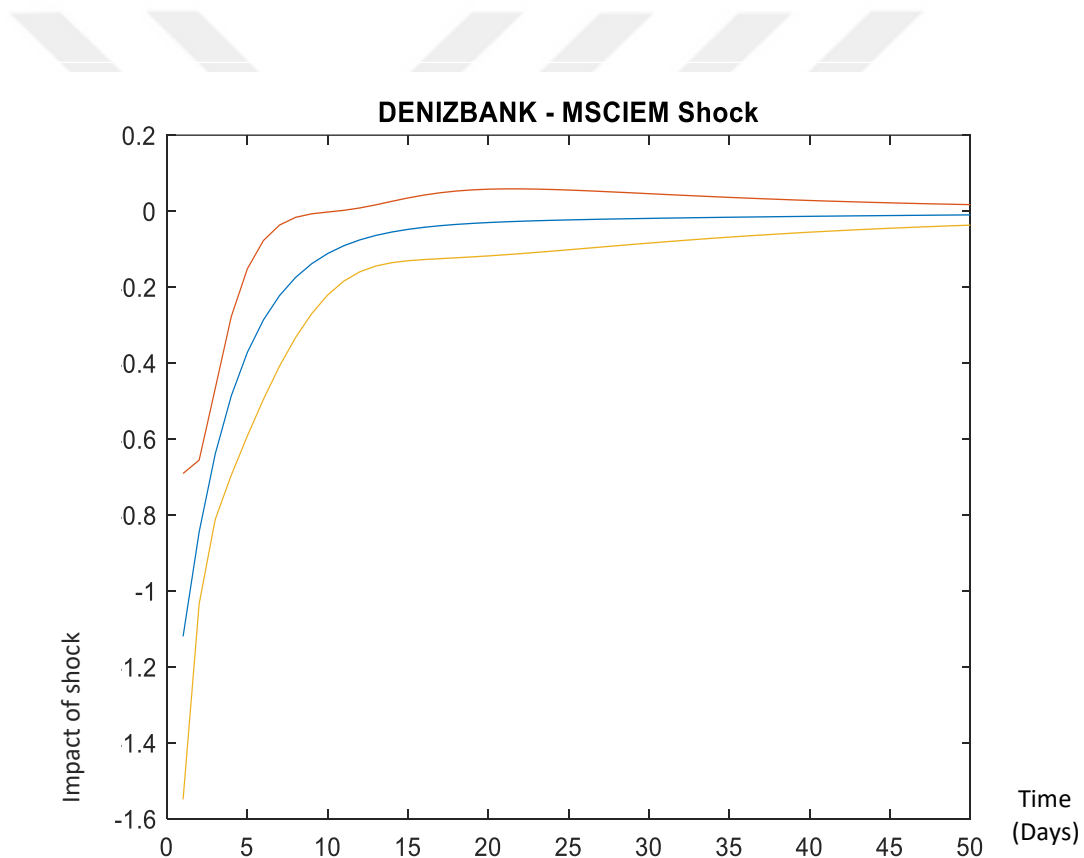


Figure 3.1 : Pseudo-Impulse Response Function (PIRF) of Denizbank (Turkey).

Figures 3.2 to 3.4 statistically significant pseudo impulse responses to a shock to the four major financial indices for bank equity prices. The vertical axis in these figures reflects the first day impulse-response values. Horizontal axis indicates the average values of bank specific variables including the logarithm of bank size, CAR, leverage and return on equity ratio for the given period. For clarification, we depict

conventional banks as blue dots and Islamic banks as red dots in the same figure and draw trendline for comparison.

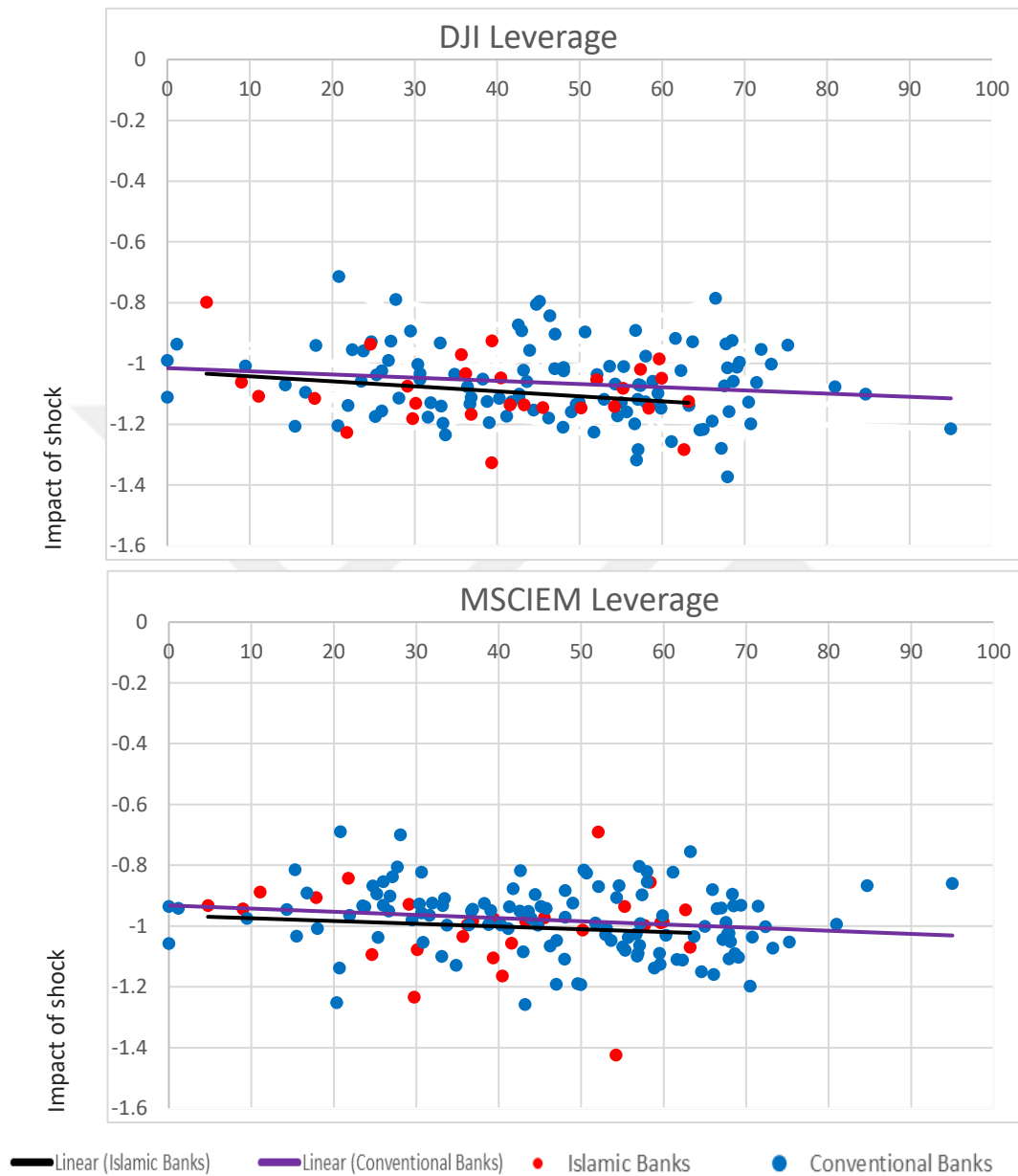


Figure 3.2 : Leverage Ratio.

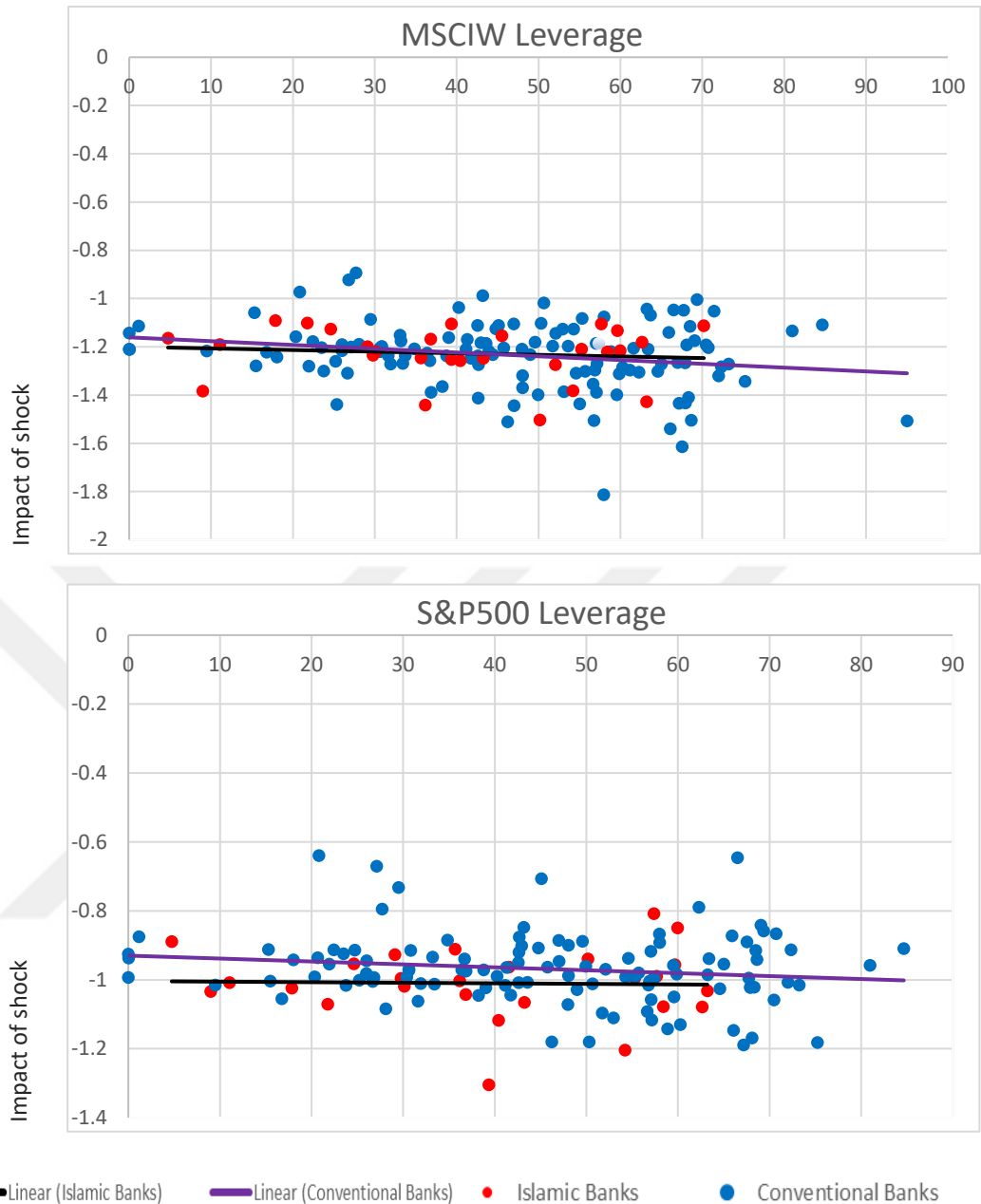


Figure 3.2 (Continued): Leverage Ratio.

Figure 3.2, represents the bank’s equity first day pseudo Impulse Response function values to bank’s leverage ratios. We can infer two important observations in Figure 2. First, the higher the leverage ratio becomes, the more adversely these financial institutions are affected by the shocks investigated. In other words, we find that financial shocks have more severe impact on more leveraged banks regardless of their type which is supported by the literature. (White et al., 2015)

These findings illustrate that leverage ratio clearly impacts the Islamic banks, just as it does the conventional banks. As mentioned in earlier sections, one of the major

concepts of the Islamic financial system has been to avoid excessively leveraged products, which has resulted in the Islamic financial system's financial strength thus far. Our finding is in line with this behavior, because we see that a shock to all financial indices have a relatively bigger impact on Islamic banks with the highest leverage than Islamic banks with the lowest leverage. Moreover, recent reports claim that systemic risk tend to rise across the globe for Islamic financial system. This may be related to Islamic banks' growing leverage ratio, which was recently introduced by transactions in Islamic financing instruments such as commodities murabaha and Tawarruq. As a result of the increased leverage ratio, Islamic banks may not be as financially robust as they were during the 2008 financial crisis. (Lewis 2015; Nienhaus 2014, IFSB 2017) Another noteworthy result is participation banks are more vulnerable to major financial shocks than conventional banks for given leverage level. Figure 4 presents that trend lines for Islamic banks are consistently lower for each shock than those for conventional banks. Although there are some disparities in shock resilience between participation and conventional banks, it is reasonable to conclude that Islamic banks are more exposed to risk than their counterparts on average. Third, MSCI World Index (MSCIW) seems to be the most critical one among the four financial indices in terms of adverse effects on banks in our sample.

Figure 3.3 depicts the effect of bank size on both banks' equity price returns. Our results reveal bank size has different effects on bank types according to a shock in major financial indices. First, our findings imply that larger participation banks are more vulnerable than smaller Islamic banks when the S&P500, DJI and MSCI emerging market indices are subjected to a shock. However, for conventional banks, we see the impact of shock does not varies according to different bank size levels of conventional banks for each shock.

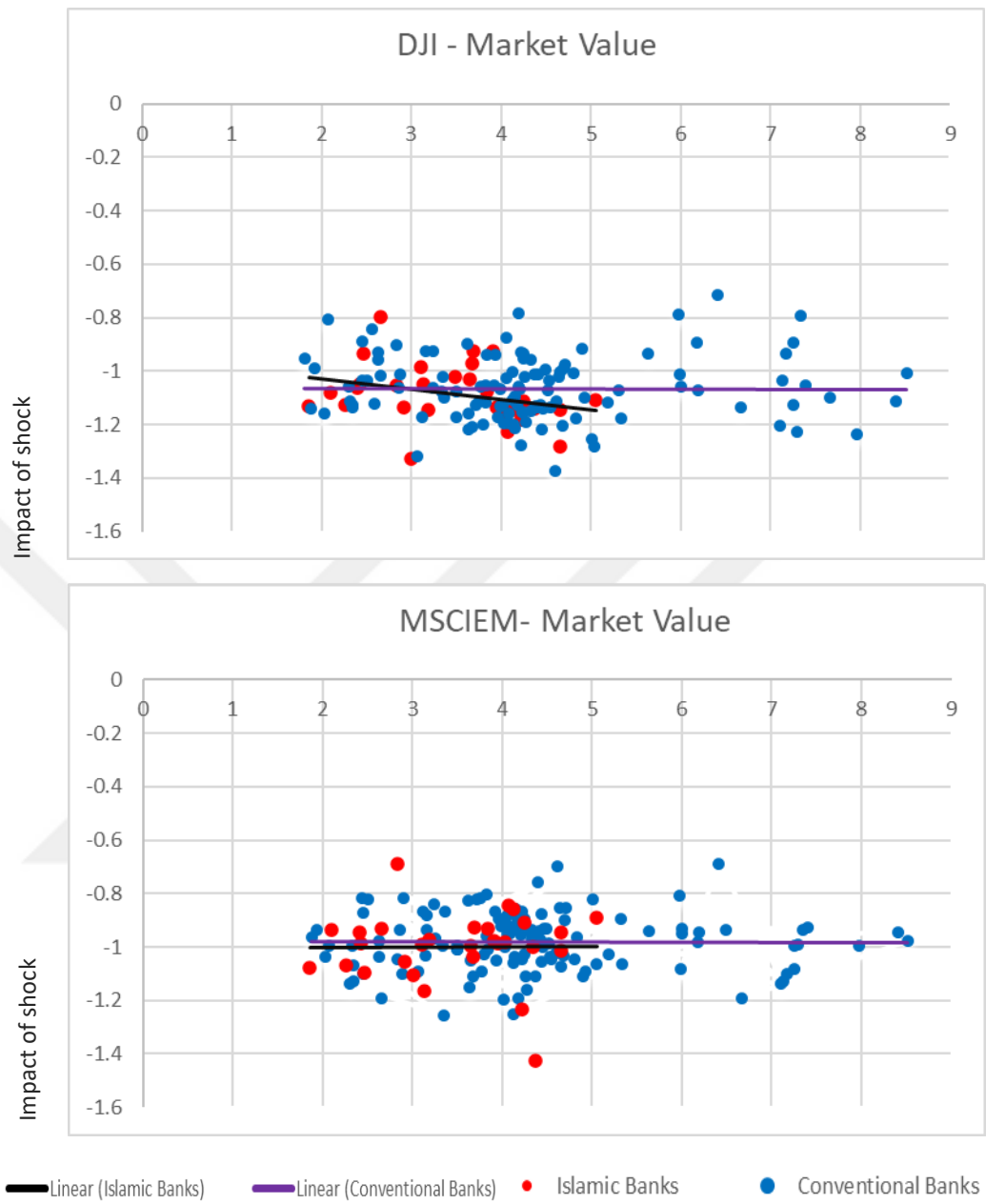


Figure 3.3 : Market Size (Bank Size).

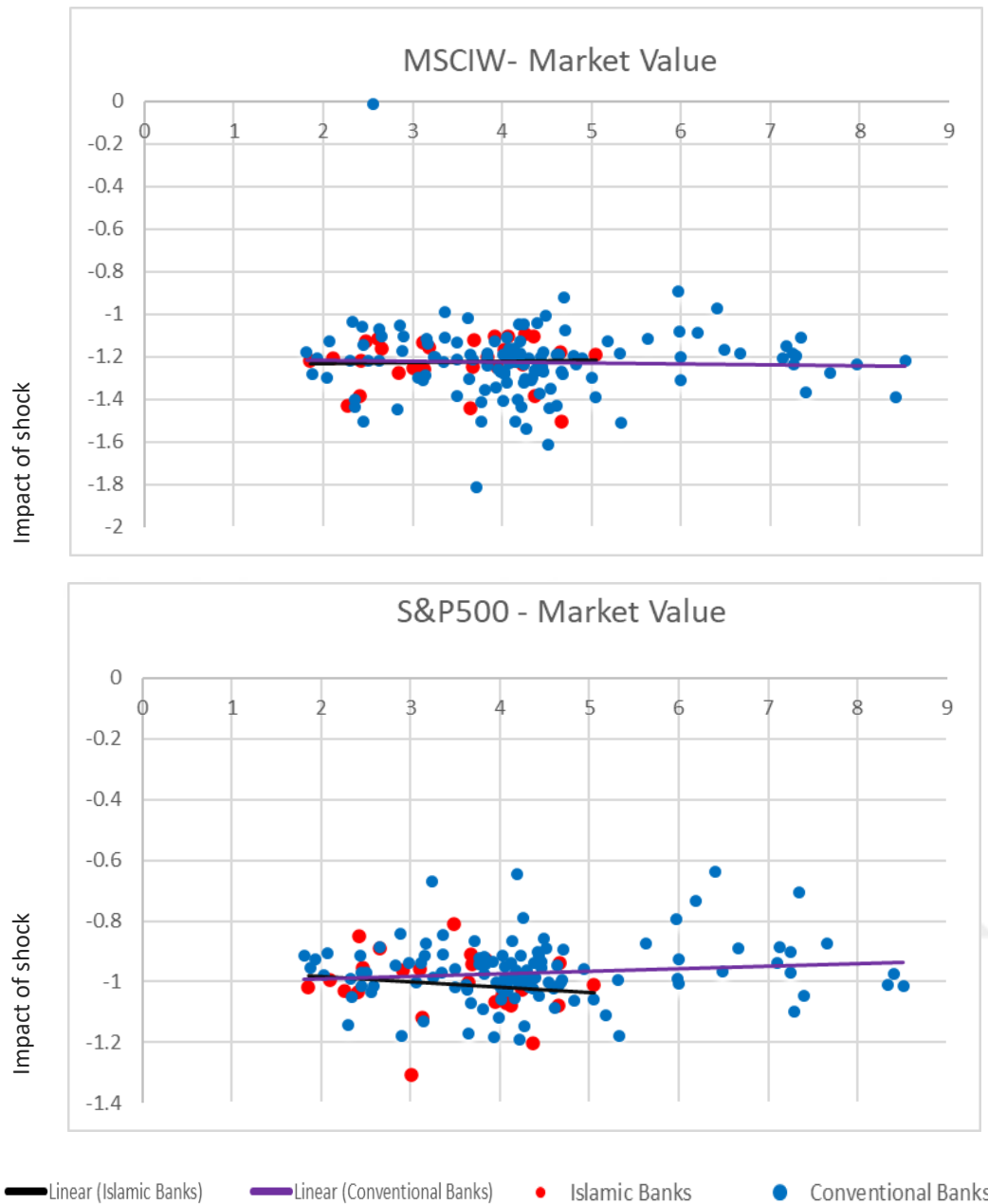


Figure 3.3 (Continued) : Market Size (Bank Size).

While the evidence is mixed in the literature, our findings suggest that bank size may have a varying impact on conventional bank resilience according to different factors as we have discussed in section 3.4. (Sun et al. 2016). However, Islamic banks seem to become more vulnerable to financial shocks as their market value increases. Small Islamic banks outperform major Islamic banks in terms of bankruptcy risks and financial efficiency, according to previous research. (Cihak and Hesse, 2010; Abedifar et. al., 2013). This result may be due to the fact that dealing with credit risk for a large Islamic banks is more challenging than for a small Islamic bank. As the size of the banking activity increases in Islamic banks, this may trigger further harsh credit risk

management restrictions for different PLS transactions, causing moral hazard and adverse selection issues. Due to higher share of PLS contracts, large Islamic banks have a higher risk of impaired financing than small Islamic banks. Small Islamic banks, on the other hand, focus on low-risk investments and fee revenue, whereas major Islamic banks invest in contracts with higher risk, such as Mudharaba. (Cihak and Hesse, 2010; Korbi and Bougatef, 2017; Windarjoro et. al., 2020)

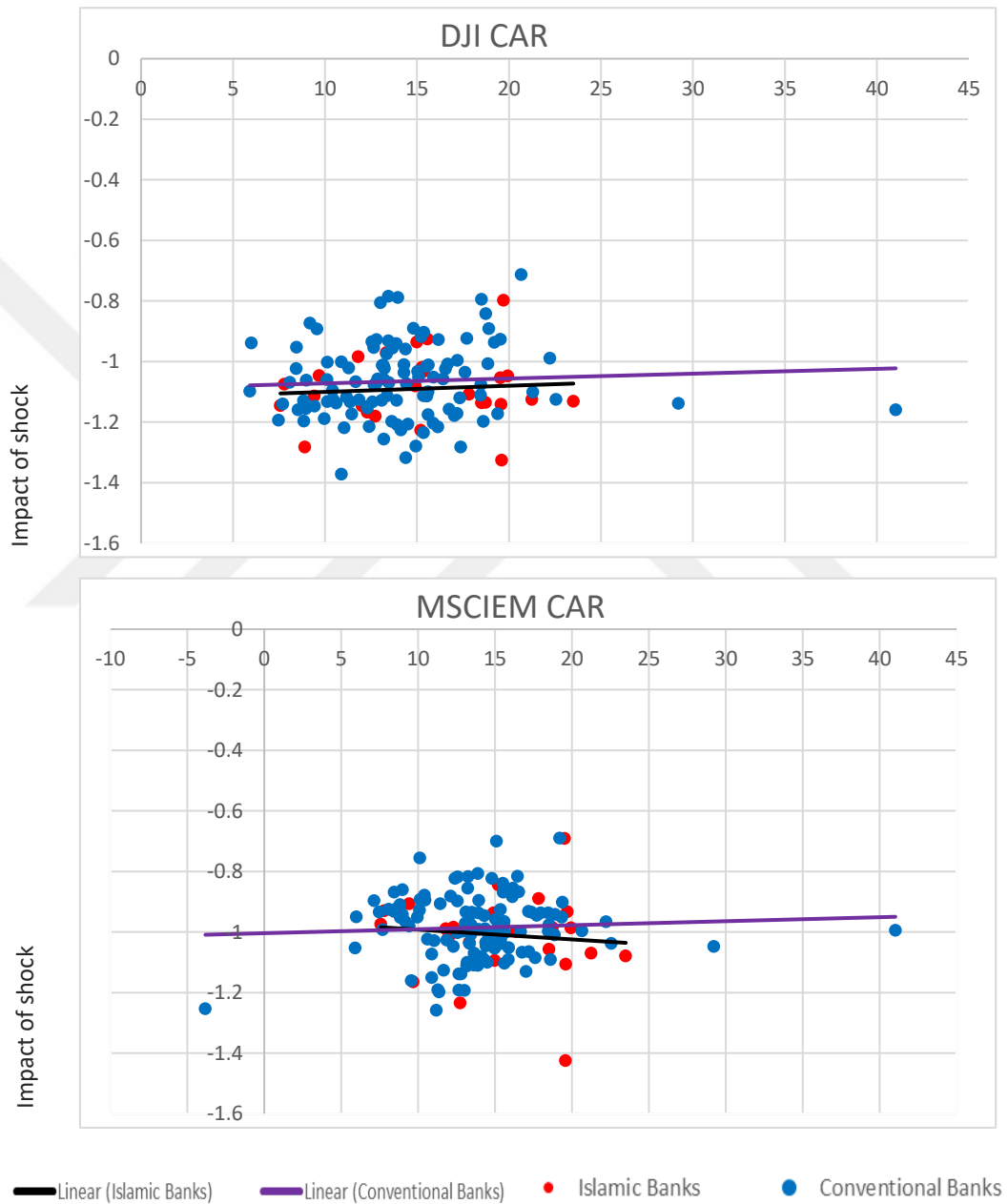


Figure 3.4 : Capital Adequacy Ratio.

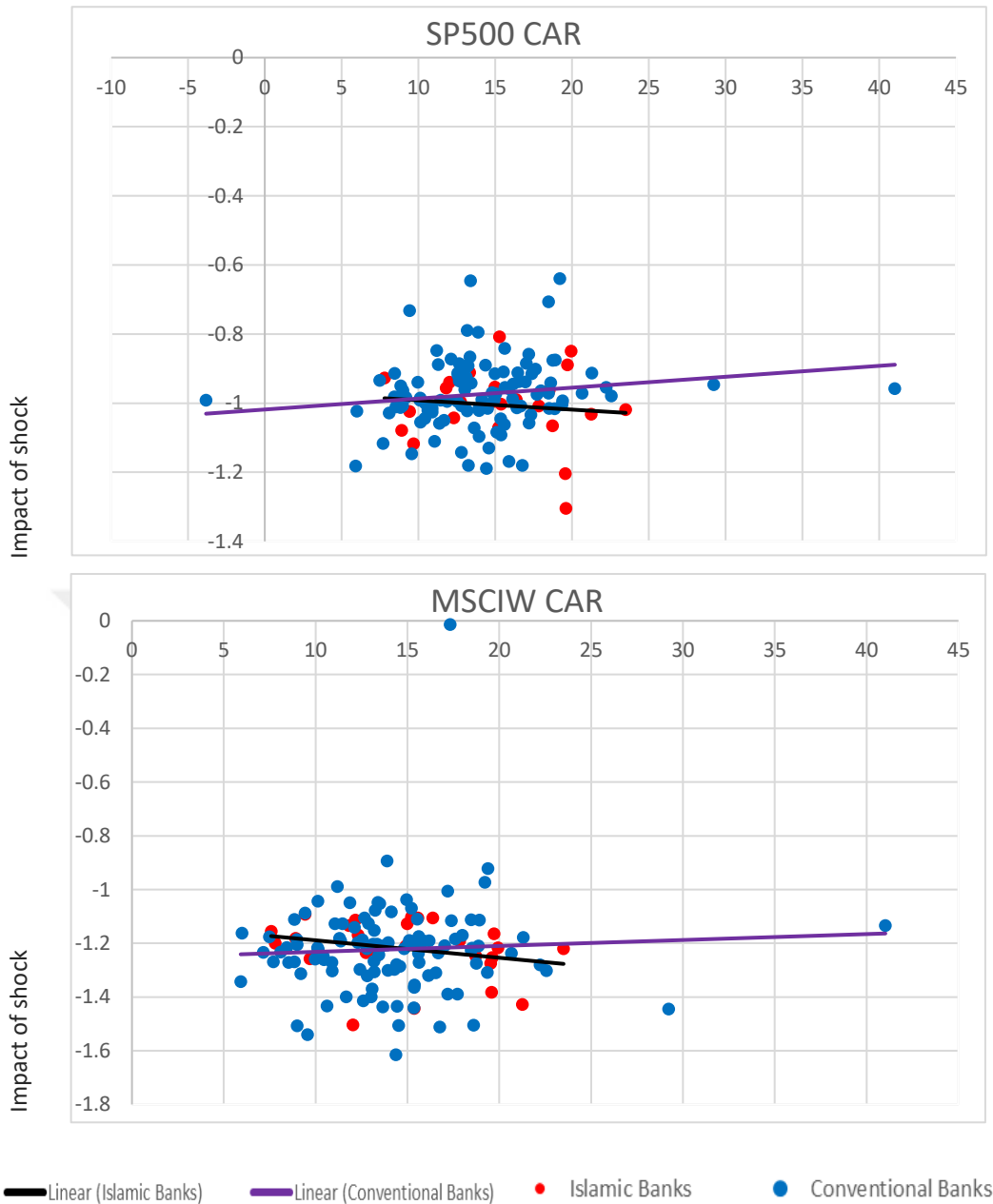


Figure 3.4 : (Continue) : Capital Adequacy Ratio.

Second, we discover that, with the exception of the MSCI World and Emerging Market indexes, Islamic banks appear to be more vulnerable to financial shocks than conventional banks as we see figures associated with the S&P 500 and DJI. Third, again the MSCI World Index is the most important financial index affecting banks in our sample relative to other indices when we examine the impact of bank size.

Results associated with capital adequacy ratio are illustrated in Figure 4. Our findings for conventional banks imply that when the capital adequacy ratio falls, conventional banks become more vulnerable to financial shocks. To put it another way, conventional banks with highly capitalized (Tier 1 and Tier 2) and lower risk weighted assets are

more robust to financial shocks than conventional ones with less capital and higher risk-weighted assets.

However, a shock to financial indices have greater impact on Islamic banks with higher capital adequacy ratio, except the case related to the Dow Jones Industrial Index, in Figure 4. Low capitalized Islamic banks' equity price performance are more resilient than high capitalized Islamic banks' equity price performance due to a shock in S&P 500, MSCI World and MSCI Emerging market indices. Several factors might explain the inverse relationship between capital adequacy ratio and Islamic bank share prices. First, imposing the same capital adequacy framework of conventional banking system may not be suitable for Islamic banks. Some reports of Islamic financial system point out there is a clear distinction among dual banking system both on the liabilities and assets sides. According to Islamic banking profit and loss sharing system the risk of investment deposits should be borne equally by depositors and investors. Hence, Islamic bank deposits are exposed to certain risks that conventional bank deposits are not. Furthermore, due to Sharia-based principles Islamic banking faces other concerns such as rate of return risk and fiduciary risk that are not addressed by the Basel rules. (Smolo and Hassan, 2010) Also, our findings are in line with the recent studies that capital adequacy ratio adversely affect profitability and stability of Islamic banks. (Ibrahim, 2019; Alnajjar and Othman, 2021) Authors attribute these results to the low return on assets over the sample period of their analysis. Last, some authors find that higher capital adequacy ratio may lead to a significant decline in bank credit supply for MENA countries which results in credit crunch phenomenon (Awdeh and Moussawi, 2021). This may also adversely affect the Islamic banking system. Hence, as there are disparities between the dual banking systems, our findings suggest that capital requirements for Islamic banks should be revised to deal with the issues mentioned above. Second, except for low CAR values (10% for MSCIM and S&P 500; 15% for MSCIW), we also observe that Islamic banks are relatively less resilient to shocks compared to conventional banks when we study capital adequacy ratio. Third, similar to previous cases, the MSCI World Index seems to be the most critical financial index among the four affecting banks in our sample.

3.6 Conclusion

We conducted an empirical analysis between Islamic and conventional banking system in which we estimated a multivariate quantile autoregressive model using returns of bank equity prices in emerging markets. Our results reveal that there are similarities and differences between Islamic and conventional banks with respect to spillovers in the value at risk between bank equity prices and major global financial indices. We observe that bank equity prices tend to be more sensitive to shocks in major financial indices as bank's leverage ratio increases. This result is important especially for Islamic banks as recent reports claim that recently developed instruments in Islamic financial system which have led to increases in the debt and leverage ratio, endangers stability of the Islamic banks as they are relatively more affected to financial risk spillovers. (Lewis, 2015; Nienhaus, 2014; Islamic Financial Services Board, 2017)

As for differences between dual banking system, the impact of financial shocks over bank equities increases with bank size for Islamic banks. The fundamental reason could be that as Islamic banks grow in size, managing credit risk becomes more complicated, due to certain risk management constraints for different PLS transactions resulting in moral hazard and adverse selection issues. (Cihak and Hesse, 2010; Widarjono et al. 2020) Moreover, we observe the impact of the financial shocks does not vary according to different bank sizes for conventional banks. Last, our findings show that the risk weights determined by Basel standards may be insufficient to correctly assess the capitalization of Islamic banks, as interest-free banking faces risks that are quite different from those encountered by conventional banks. Consequently, high capital adequacy ratio on its own might not be enough to measure the Islamic financial system's stability and productivity. (Ibrahim, 2019; Ariss and Sarriddine, 2007; Basher et al. 2017)

Our results for regulators, policy makers and bank practitioners on Islamic banking as they have similarities and differences over different bank specific variables. For Islamic banks, they should avoid high level of costs, indebtedness and leverage ratio which is mainly caused due to PLS monitoring system and financial instruments like tawarruq and commodity murabaha. Finally, due to structural variations in the assets of the dual banking system, the risk weights determined by the capital adequacy ratio must be modified to reflect variances for Islamic banks.

4. DETERMINANTS OF CAPITAL ADEQUACY RATIO FOR DUAL BANKING SYSTEM: A STRESS TEST APPROACH

4.1 Introduction

Despite the fact that the relevance of stress testing has grown since the unpredictably devastating global economic crisis of 2008, new methods have begun to be discussed in the literature on the inadequacies of the methodologies. In this regard, analyses of numerous extraordinary crisis scenarios, as well as the degree of resilience of banks, have begun to be carried out meticulously. To put it another way, stress tests are no longer based on prior observations and professional expertise, but rather on catastrophic scenarios that would push banks or financial organizations into insolvency. Financial institutions must have a robust capital structure that can withstand unanticipated and severe shocks as a blow to the financial sector has catastrophic consequences on the whole economy through influencing macroeconomic activity. As a result, the problem of forecasting crises and avoiding them by early intervention has featured prominently.

In light of historical negative and economically destructive experiences, it is reasonable to conclude that financial sector crises are caused not only by their own internal dynamics, but also by changes and shocks in the macroeconomic and financial fields, and that they have more severe consequences. As a result, it's vital to monitor the entire system as well as the current state of affairs.

The fact that stress tests using more comprehensive and newer techniques can help mitigate the effects of potential crises, and that they should be used not only by banks to manage risk, but also by regulatory and supervisory authorities to set financial and economic stability goals, has led to the conclusion that a method is required.

Another critical issue is the relationship between banking sector variables and macroeconomic variables. If the relationship structure cannot be determined correctly, the probability of making mistakes in terms of both catching risks and policy recommendations increases.

In light of all of these, the dynamics of capital adequacy ratios in conventional and Islamic banks are examined in this section. Furthermore, the paper investigates which banking type is affected more by the macroeconomic conditions, by distinguishing the banking sector as conventional and participation banks.

The primary aim of the article is to use current econometric methodologies to conduct a stress test of Turkish conventional and Islamic banks using both macro (aggregated) and micro (bank specific) data. For this purpose, we employ two different models for our analysis: Additive semi-parametric quantile regression model (Koenker, 2010, 2011) and semi-parametric quantile panel model (Cai et. al., 2018). Finally, probability analysis supports the forecasts which is generated by the quantile regression estimates. With probability analyses, the likelihood of capital adequacy ratio being lower or greater than a given value is calculated based on the values of explanatory factors in the context of various scenarios.

Overall, results in this chapter indicate that capital adequacy ratio determinants of participation and conventional banks differ from each other. Regarding, the public debt ratio for conventional banks and the exchange rate for Islamic banks are variables that affect the capital adequacy ratio, according to the findings from the additive semi-parametric quantile model. Although unemployment has a positive effect on the capital adequacy ratio in both types of banks, which imply that this positive impact is unaffected by the fluctuations in the unemployment rate. The semi-parametric panel quantile technique is used only for conventional banks, and the determinants of capital adequacy ratio are explored while taking bank size into account. Banks tend to improve their capital adequacy ratios according to increases in the public debt ratio and interest rate as their bank size and capital adequacy ratio grow.

The rest of the chapter is organized in the following manner. The literature on stress testing is presented in Section 2. Sections 3 and 4 describe the data and model, respectively. Then, Section 5 summarizes the findings, with the first half of the fourth section devoted to time series-based analysis and the second portion containing the results of panel-based analysis. Section 6 brings the article to a close by discussing policy implications.

4.2 Literature Review

Our chapter focus the research on macro stress tests as well as comparative studies amongst dual banking systems. For this aim, we segregate the literature review into several sections as follows.

4.2.1 Macro stress tests

4.2.1.1 Macro stress test history

Wilson (1998), one of the pioneering articles in the stress test literature, "What is the risk of a given portfolio?", "How do different macroeconomic scenarios, both regional and sector-based, affect the portfolio's risk profile?" in the dynamic model he created to answer questions such as, he basically examines the link between macroeconomic variables and bankruptcy risk. One of the main studies on macro stress tests following Wilson's model is Elsinger et al. (2006). The authors emphasize that the study is the most comprehensive study of the banking system in a country in terms of risk at the time of writing. The paper examines banking system in Austria based on the monthly data obtained from Datastream between 1989 and 2002. Results find that the probability of the occurrence of systemic risk is low and its impact is high for Austria banks.

Sorge and Virolainen (2006) divide stress testing into two categories: value-at-risk and balance sheet models, and empirically test both methods in Finland banks. Balance sheet models simply estimate the bank's profitability, capital adequacy and liquidity conditions with using the data of banks' T-account. On the other hand, value-at-risk models employ statistical elements to forecast future loss with a high degree of certainty. The authors argue that value-at-risk models provide more significant results than balance sheet models as they focus on different levels of confidence.

Despite the fact that it is designed to discover possible difficulties during times of crisis, its inability to detect the effect of the 2008 global recession encouraged the quest for new stress test models and methodologies. In the light of this fact, Cihak and Ong (2010) investigate failure of stress tests to detect financial risks during the global recession of 2008. Authors point out that the basic solution is to keep stress test scenarios simple, and that well-designed stress tests can help identify key areas where risks can be concentrated. Based on this suggestion, Vazquez et al. (2012) design a

three-stage credit stress test to capture the correlations between selected macroeconomic and financial factors. These three processes are summarized as follows: constructing a model to capture the relationships between the specified macroeconomic and financial factors, calculating banks' debt payment power via the construction of parameter vectors that connect macroeconomic and financial variables to define credit performance criteria, and calculating banks' debt payment power through credit quality.

The European Central Bank produce a paper in 2013 that provided a methodology to evaluate projected bank solvency, making stress testing more stable in this regard. The article discusses the risk models in three stages: credit risk, market risk and profit models. In the report, the model states that the estimation methods used in the stress tests available in the relevant period could not detect the interactions between the variables and the nonlinear properties of the variables. Based on this result, authors recommend that stress test models should be developed over nonlinear models.

Borio et al. (2012) points out that stress tests totally failed during the 2008 financial crisis, when they are most needed, and any of these tests helped to realize weak parts in the banking system prior to the 2008 financial recession. To overcome these challenges, the authors suggest that the efficacy of stress test scenarios may be strengthened by using indications from financial contraction indicators (such as unusually strong cumulative increases in loan and asset prices) and that they should be evaluated universally.

Schectman and Gaglianore (2012) focus on credit risk, who challenge parametric approaches and employ macro stress testing using quantile regression methodology.

Criticizing parametric methods, Schectman and Gaglianore (2012) employ macro stress tests with quantile regression analysis to focus on credit risk. From 1995 to the third quarter of 2009, non-performing loans in Brazil are evaluated with macro variables including economic growth, unemployment, inflation, short term interest rate and loan volume. Last, Kanas and Molyneux (2017) focus on importance of non-linear models in stress tests using the additive semi-parametric quantile regression technique developed by Koenker (2010, 2011). In this study, the authors analyze US banks between 1984 and 2013 with both parametric and non-parametric stress test models. Authors find that results are not statistically significant for the stress testing with linear estimation techniques. Finally, they illustrate that quasi-parametric econometric

techniques provide more flexible and accurate way for analyzing banking vulnerability.

4.2.1.2 Macro stress test studies on Turkey

There are very few research regarding stress test scenarios for Turkey in the literature, especially for Islamic banks. The primary aim of these studies for Turkey is to focus on non-performing loans and capital adequacy ratio. Using the vector autoregressive approach (VAR), Evrim Beşe (2007), one of the first to apply stress testing to Turkey banks, finds that exchange rate shocks and inflation expectations affect financial soundness.

Iskender (2012), employing VAR technique in his study, conducts a stress test on four different models and finds that the Turkish banking system is resistant to various risk spillovers. Onder et al. (2015) analyze non-performing loans and corporate loans with the GMM model for Turkish banks. Authors find that real GDP and interest rates have a significant effect on corporate loans, while unemployment rate is effective on individual loans. Furthermore, the study contends that the Turkish banking sector's strong financial basis is an important factor in the sector's capital adequate resistance to financial shocks. Furthermore, in one of the few research on Islamic banks in Turkey, Akkuş (2017) applies Wilson's loan portfolio technique to Islamic banks. The study focuses on three Islamic banks in Turkey for 2005 Q1 to 2016 Q2 period. The report suggests that Islamic banks in Turkey's banking sector have adequate capital adequacy ratios to prevent them from any financial risk spillovers which ensures their resilience.

4.2.2 Comparative stress test studies on dual banking system

There are very few studies that compares participation and conventional banks with stress tests. Examining the Qatari banking sector, Elsiefy (2012) defines shocks through credit risk, interest rate risk and currency risk. The study, which evaluates the capital adequacy ratio as the main variable, accepts the 2008 financial crisis as a base year and evaluates the period 2006-2010 in two stages, as pre-shock and post-shock era employing z-score technique. When comparing on participating banks and conventional banks, he finds that both banks are strong in terms of capital adequacy ratio, but the changes in participation banks are more affected than their conventional counterparts. Moreover, findings indicate that after 2008 recession, conventional

banks recovered faster than Islamic banks on several aspects such as profitability. Last, author posits that the solvency of the banking sector for Qatar was very durable in all scenarios during 2008 crisis.

Chattha (2013) specifies the general problems of Islamic banks only theoretically without an empirical study on the subject. Chattha (2016) conducted a stress test with a technique developed by the IFSB using the capital adequacy ratio.

For Turkey, Hassan et al. (2016) applied a stress test with capital adequacy ratio for participation and conventional banks. Authors employ non-performing loans and exchange rate data of the BDDK and the Central Bank of Turkey during the period January 2006-October 2014. As a consequence, the paper finds that Islamic banks are more sensitive to stress than their counterparts, but sensitivity is not in terms of profitability but of capital. The reason for participation banks' sensitivity is that they are more subject to credit risk scenarios such as rises in non-performing loans and decreases in collateral value.

Kurniadi et al. (2018) conduct profitability, capital and liquidity stress tests only for Islamic banks in Indonesia. They explain the expected profit-loss difference for the profitability risk, the non-payment risk used in capital risk, the non-performing loans, and the profitability risk using the value-at-risk method over the prices of assets and funds. As a result, they reveal that Islamic banks are not profitable enough due to their low profit margins, however, they will not be affected by a possible liquidity crisis.

4.3 Methodology

In accordance with the chapter's objectives, a time series-based additive semi-parametric quantile regression technique (Koenker, 2010, 2011) and a semi-parametric panel quantile regression technique (Cai vd., 2018) are used together to eliminate the shortcomings of existing stress tests, and probability analyses are performed based on the regression estimates. The most common issue in stress testing is that if there is a non-linear relationship between the stress variable and the explanatory variables based on their parameters, the linear regression models employed cannot capture this relationship. Semi-parametric regression approaches are more adaptable than linear regression models, which involve several limiting assumptions, and they may predict

linear and non-linear relationship between dependent and independent variables based on their parameters.

In this study, semi-parametric quantile regression based on both time series and panel data is used for numerous reasons. To begin with, as stated in the introduction part of this article, stress tests utilizing time series aggregate the variables at the bank level, making it impossible to make independent judgments about the susceptibility of individual banks to risks. Panel data approaches include more information and are statistically more efficient than time series techniques because they employ both cross-section and time series data. Furthermore, time series models that do not consider individual heterogeneity into account may provide skewed results.

Despite the benefits indicated above, panel data approaches have certain disadvantages. One of them is that the standard errors of their coefficients will tend to drift higher since the variance of the variables that fluctuate in the temporal dimension but not in the cross-sectional dimension is low. In this instance, the coefficients will fail the significance tests. The most prominent examples are macroeconomic indicators (exchange rate, inflation rate, growth rate, etc.) utilized in the context of stress testing. In this regard, Mester (1997), Kashyap and Stein (2000), and Canakci (2008) suggested that utilizing bank-level data instead of aggregated data in stress tests may result in biased conclusions. As a consequence, employing both time-series-based semi-parametric quantile regression and panel data-based semi-parametric quantile regression and comparing the results from both techniques would boost the validity of the results. The time series-based additive semi-parametric quantile regression model will be explained briefly below, followed by its extension into the panel data model.

4.3.1 Additive semi-parametric quantile regression model

The additive semi-parametric quantile regression technique developed by Koenker (2010, 2011) can be expressed as:

$$Q_{Y|x_t, z_t}(\theta|x_t, z_t) = x_t' \beta + \sum_{i=1}^p \xi_i(z_{ti}) \quad (4.1)$$

In this equation, the conditional quantile model of Y depending on x and z with the corresponding quantile parameter $\theta \in (0,1)$. $x_t' \beta$ and $\sum_{i=1}^p \xi_i(z_{ti})$ represents the parametric and nonparametric components of the model, respectively. In this instance,

x and z are sets of independent explanatory factors, and the variables they contain are usually determined empirically. In equation, $\xi = (\xi_1, \xi_2, \dots, \xi_p)$ values are non-parametric continuous functions. Equation 4.1 depicts the conditional tail distribution of the dependent variable (Y).

The coefficients vector (β) of k explanatory variables in the set of explanatory variables x is calculated by minimizing the objective function as follows:

$$\min_{\beta, \xi} \sum \rho_{\theta}(Y_t - x_t' \beta - \sum \xi_i(z_{ti})) + \lambda \|\beta\|_1 + \sum_{i=1}^p \lambda_i V(\nabla \xi_i) \quad (4.2)$$

$$\|\beta\|_1 = \sum_{k=1}^K |\beta_k| \quad (4.3)$$

$$\rho_{\theta}(q) = q(\theta - I(q < 0)) \quad (4.4)$$

In equation 4.4, ρ_{θ} indicates a function with a weight of θ when the errors are positive and $(1 - \theta)$ when they are negative. Furthermore, λ the smoothing parameter and $V(\nabla \xi_i)$ displays the change in the derivative of the function ξ_i . Assuming that the ξ_i derivative of the function ξ_i' is absolutely continuous, the total change in $R \rightarrow R$ can be expressed as

$$V(\xi'(z)) = \int |\xi''(z)| dz \quad (4.5)$$

and for the ξ function, the total change in the derivative expressed as $R^2 \rightarrow R^2$:

$$V(\nabla \xi) = \|\int \nabla^2 \xi(z)\| dz \quad (4.6)$$

In equation 4.6, $\nabla^2 \xi(z)$ shows the second derivatives matrix, namely Hessian, and $\|\cdot\|$ represents the Hilbert–Schmidt norm for matrices.

Depending upon the value of λ in model 1 above will result in alternative model selections. In this scenario, the Schwarz (1978) criterion can be used to identify the best appropriate model.

$$SIC(\lambda) = T \ln \hat{\sigma}(\lambda) + 0.5 h(\lambda) \ln(T) \quad (4.7)$$

$$\hat{\sigma} = \frac{1}{T} \sum_{t=1}^T \rho_{\theta}(Y_T - \hat{\xi}(x, z)) \quad (4.8)$$

$$h(\lambda) = \frac{\sum_{t=1}^T \partial \hat{\xi}(x, z)}{\partial Y_t} \quad (4.9)$$

$$\hat{\xi}(x, z) = x' \beta + \sum_{i=1}^p \hat{\xi}_i(z) \quad (4.10)$$

4.3.2 Semi-parametric panel quantile regression model

We employ partially varying-coefficient quantile panel data model with correlated random effects model (Cai vd., 2018) in this study. The model is known as a semi-parametric panel quantile model with partially variable coefficients since it has both constant and variable coefficients. The model may be expressed mathematically as follows:

$$Q_{\theta}(Y_{it}|X_{it}, H_{it}, \alpha_i) = X_{it,1} \beta_{\theta} + X_{it,2} \delta_{\theta}(H_{it}) + \alpha_i \quad (4.11)$$

In this case, $Q_{\theta}(Y_{it}|X_{it}, H_{it}, \alpha_i)$ represents the conditional quantile value of θ to individual effects (α_i) with variables X_{it} and H_{it} . The explanatory variables matrix is $X_{it} = (X'_{it,1}, X'_{it,2})'$, and the dimensions of the explanatory variables $X'_{it,1}, X'_{it,2}$ are $K_1 \times 1$ and $K_2 \times 1$, respectively. β depicts the vector of constant coefficients in size $K_1 \times 1$ and $\delta_{\theta}(H_{it})$ represents the vector of functional coefficients in size $K_2 \times 1$. H_{it} is an abbreviation for the observable smoothing variables. Both coefficients change depending on the quantile value. Cai et al. (2018) assume that the aforementioned causes resulting from bank management (total more deposits, granting more loans, etc.). Assuming that the individual effects are connected to the explanatory factors, the individual effects may be written as a nonlinear function of the independent variables as follows:

$$\alpha_i = \alpha(X_i, H_{i1}, \dots, H_{iT}) + \epsilon_i \quad (4.12)$$

According to Cai et al. (2018) and Kanas and Molyneux (2018), fully parametric models may generate size issues for large samples. Furthermore, numerical optimization strategies frequently fail to provide a solution in applications. As a result, rather than using complete parametric models, more flexible additive semi-parametric models are employed as follows.

$$Q_{\theta}(Y_{it}|X_{it}, H_i, \epsilon_i) = X'_{it,1}\beta_{\theta} + X'_{it,2}\delta_{\theta}(H_i) + \sum_{t=1}^T X'_{it}\varphi_{\theta}(H_i) + \epsilon_i \quad (4.13)$$

In the preceding model, it is assumed that the smoothing variable H_{it} in the $K = K_1 + K_2$ dimensional unknown coefficients vector $\varphi_{\theta}(H_i)$ is expected to fluctuate over time and does not change between cross-sections. In the context of stress testing, H_i will represent macroeconomic factors (exchange rate, inflation, economic growth, and so on) that do not vary from one bank to the next but do fluctuate over time.

The pooling approach is used to estimate the semi-parametric panel quantile regression described by equation 11. The impact of Y_{it} on X_{it} in the preceding equation occurs in two ways: direct effect of constant coefficients(β_{θ}) and variable coefficients($\delta_{\theta}(H_i)$), and indirect effect on random effects ($\varphi_{\theta}(H_{it})$). Assuming that the time dimension has a length of $T \geq 2$, the following two conditional quantile models must be calculated in order to identify the direct impacts.

$$Q_{\theta}(Y_{it}|X_i, H_i, \epsilon_i) = X'_{it,1}[\beta_{\theta} + \varphi_{1t}(H_i)] + X'_{it,2}[\delta_{\theta}(H_i) + \varphi_{2t}(H_i)] + \sum_{l \neq t} X'_{il} \varphi_l(H_i) + \epsilon_i \quad (4.14)$$

$$Q_{\theta}(Y_{is}|X_i, H_i, \epsilon_i) = X'_{it,1}\varphi_{1t}(H_i) + X'_{it,2}\varphi_{2t}(H_i) + X'_{is,1}\beta_{\theta} + X'_{is,2}\delta_{\theta}(H_i) + \sum_{l \neq t} X'_{il} \varphi_l(H_i) + \epsilon_i \quad (4.15)$$

Equation 4.14 may be approximated numerically using the integrated quasi maximum likelihood method as follows:

$$\hat{v} = \operatorname{argmax}_v L_{l,\theta}(\hat{v}) \quad (4.16)$$

$$L_{l,\theta}(\hat{v}) = \max \sum_{i=1}^N \sum_{t=1}^T \ln l_{1,\theta}(Y_{it}, q_{1,\theta}(W_{it}, v_i)) \quad (4.17)$$

In the above expression, $l_{1,\theta}(Y_{it}, q_{1,\theta}(W_{it}, v_i))$, represents θ quantile value and i . horizontal section while t . represents the integrated maximum likelihood-like function for the period.

4.4 Data

Our data consists of 21 conventional deposit banks operating in Turkey (Ziraat Bank, Burgan Bank, QNB Finansbank, Arap Türk Bankası, Yapı ve Kredi Bankası,

Anadolubank, Halk Bank, HSBC Bank, Vakıflar Bank, Akbank, ICBC Turkey Bank, Fibabanka, Turkish Bank, Türk Ekonomi Bankası, Şekerbank, İş Bankası, Alternatifbank, Denizbank, ING Bank, Odea Bank, Garanti Bank) and 3 Islamic banks (Albaraka Türk, Türkiye Finans, Kuveyt Türk). Capital adequacy ratio (CAR) for conventional and Islamic banks are gathered from the BDDK (Banking Regulation and Supervision Agency) on a monthly basis from June 2005 to December 2018.

We select the macro factors that impact the connection between financial stability and capital adequacy ratio based on information from the literature. (Vatansever and Hepşen, 2013; Yüksel and Özşarı, 2017) On the basis of the literature, we pick four explanatory variables for quantile regression model as unemployment rate, public debt stock ratio, interest rate (both repo and 2-year) and exchange rate (dollar/Turkish lira).

We obtain unemployment rate, inflation rate for macroeconomic variables which are compiled from the information pages of TURKSTAT and The Central Bank of the Republic of Turkey (TCMB/Türkiye Cumhuriyet Merkez Bankası) on a monthly basis from June 2005 to December 2018. The ratio of public debt net stock to GDP variable (Public debt/GDP), which is used as the debt ratio indicator, is obtained from the Ministry of Treasury and Finance page. The yields of repo is compiled from TCMB reports on a daily basis. Then, we convert daily data into the monthly data for consistency. Table 1 represents the descriptive statistics for all variables.

Table 4.1 : Descriptive Statistics of All Variables.

Conventional Banks	Mean	Median	Max.	Min.	Std. Dev.
Capital Adequacy Ratio	16.822	16.181	23	14.08	1.942
Islamic Banks	Mean	Median	Max.	Min.	Std. Dev.
Capital AdequacyRatio	14.848	14.8	18.42	10.79	1.434
Explanatory Variables	Mean	Median	Max.	Min.	Std. Dev.
Unemployment	10.124	9.9	13.9	8	1.305
Public Debt Stock Ratio	19.922	20.099	42.897	5.969	10.808
Repo Interest Rate	10.282	8	24	4.5	4.937
2-year Interest Rate	12.832	10.718	26.042	5.166	5.180
Dollar	5.065	5.137	5.854	3.261	4.143

4.5 Results

First, we summarize the quantile time series estimate findings in this section. Our results show that the non-parametric technique gives statistically more significant results than the semi-parametric and fully parametric methods, particularly for Islamic banks. For purpose of brevity, we report only results of fully parametric quantile estimation results in this section. Semi-parametric and fully parametric results are given in Appendix. After non-parametric quantile results, one-step prediction results and probability analysis are represented in scenario construction session. Finally, we conclude our results with semi-parametric panel quantile estimation results.

4.5.1 Non-parametric quantile regression analysis

The model estimate findings for $\theta = 0.05, 0.90, \text{ and } 0.95$ are produced by calculating the degree of smoothness (λ) values, which allows us to obtain both statistically and economically significant results by using the Koenker (2010, 2011) technique. The influence of explanatory variable capital adequacy ratio is graphically depicted with their percent 95 confidence ranges in order to see the effect of non-parametric factors on the explanatory variables.

Table 4.2 and Table 4.3 represents illustrates strongly statistically significant effects of all independent variables on the 0.05, 0.90, and 0.95 quantile of CAR for both conventional and Islamic banks.

Figures 4.1 and 4.2 depict the impact of financial and macroeconomic variables with 95% confidence band on capital adequacy ratio for conventional and Islamic banks, respectively. For quantile values of $\theta = 0.05, 0.9$ and 0.95, we obtain statistically significant results for the impulse response functions. In these figures, we observe that marginal effect of all explanatory variables are positive for each variable regardless of bank types.

When we observe the quantile effects on CAR for conventional banks in Figure 1, exchange rate impact changes according to different quantile levels of CAR. For lower quantiles ($\theta = 0.05$) exchange rate has “V” shape that means the positive marginal effect of dollar is decreasing between 1 to 3 values as this effect is increasing between 3 to 7 values of dollar. For higher quantiles ($\theta = 0.9$ and 0.95), however, exchange rate has an increasing impact between for values between 1 and 3 and marginal effect

decreasing 3 to 7 values of CAR for conventional banks. In literature, recent studies find that exchange rate has no statistically significant effect over capital adequacy ratio using linear methods on deposit banks in Turkey. (Yüksel and Özsarı, 2017) Our findings illustrate that the effect of foreign currency on capital adequacy ratio differs between quantiles which is impossible to measure with linear models.

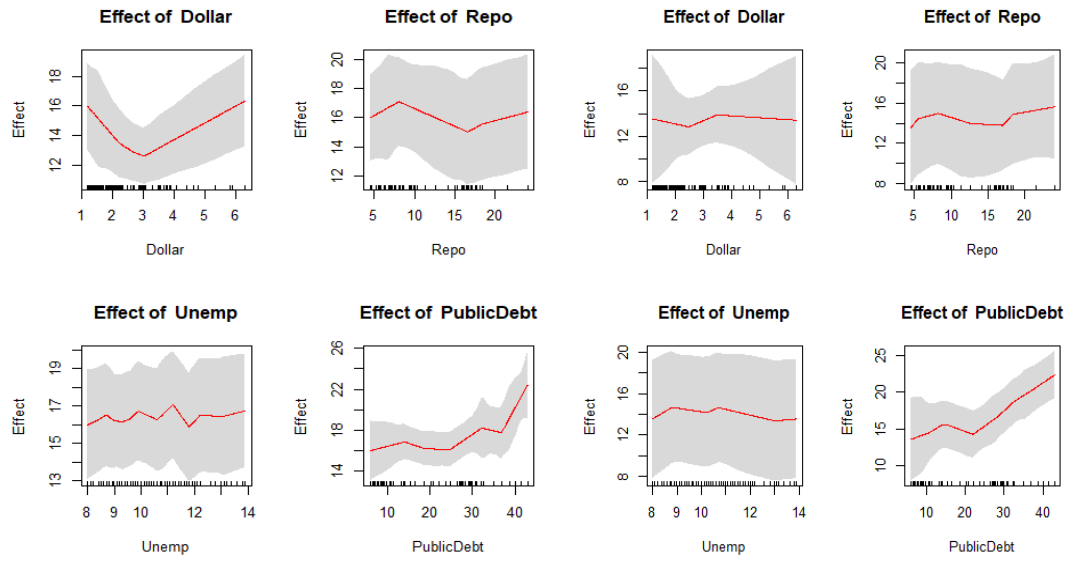
Table 4.2 : Non-Parametric Analysis for Conventional Banks (CAR).

: 0.05				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	15.98	1.494	10.7	<2e-16***
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	3	0.4	11.993	5.40E-07***
Repo	3	0.5	9.92E+00	6.08E-06***
Unemployment	11	0.07	1.996	3.35E-02*
Public Debt Stock/GDP	9	1	7.55	7.17E-09***
: 0.90				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	13.543	2.871	4.718	5.82E-06***
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	2	0.4	1.03E+01	6.88E-05***
Repo	7	0.5	4.271	0.000268**
Unemployment	5	0.3	3.182	0.009482***
Public Debt Stock/GDP	7	1	14.489	5.06E-14***
: 0.95				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	12.242	2.366	5.174	8.16E-07***
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	2	0.4	11.392	2.70E-05***
Repo	7	0.5	5.227	2.72E-05***
Unemployment	6	0.3	3.798	0.00159**
Public Debt Stock/GDP	9	1	19.762	<2.00E-16***
EDF represents the degree of freedom. Signif. codes: '***' 0.001; '**' 0.01; '*' 0.05; '.' 0.1				

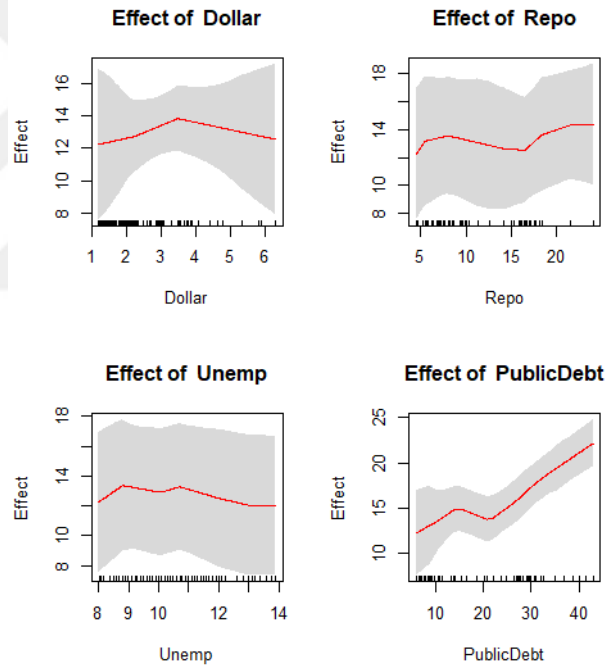
Table 4.3 : Non-Parametric Analysis for Islamic Banks (CAR).

: 0.05				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	13.237	2.203	6.01	1.78E-08***
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	5	0.09	9.477	1.02E-07***
Repo	6	0.5	8.764	5.21E-08***
Unemployment	11	0.05	2.731	0.00333**
Public Debt Stock/ GDP	7	1	2.619	0.01461*
: 0.90				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	11.937	3.453	3.457	0.000736***
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	4	0.3	11.278	6.67E-08***
Repo	6	0.5	1.39E+00	0.225
Unemployment	6	0.3	1.33	0.248
Public Debt Stock/ GDP	11	1	8.496	3.35E-11***
: 0.95				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	12.844	3.018	4.255	3.82E-05***
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	2	0.4	32.497	2.64E-12***
Repo	5	0.5	1.34E+00	0.2516
Unemployment	5	0.2	3.075	0.0115*
Public Debt Stock/ GDP	7	1	10.924	6.06E-11***

EDF represents the degree of freedom. Signif. codes: '***' 0.001; '**' 0.01; '*' 0.05; '.' 0.1



0.05 Quantile 0.9 Quantile



0.95 Quantile

Figure 4.1 : Non-Parametric Quantile Effects on Conventional Banks' CAR.

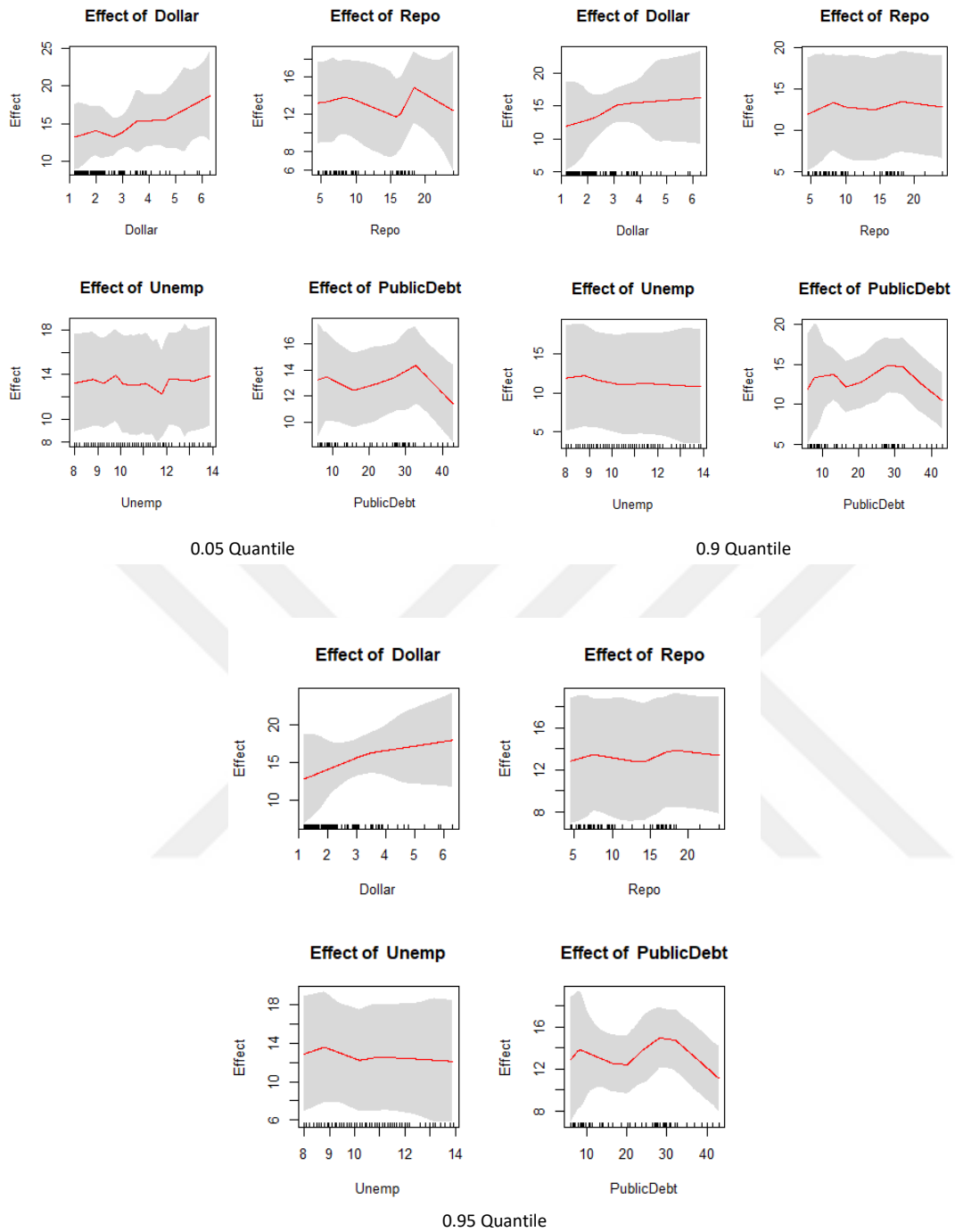


Figure 4.2 : Non-Parametric Quantile Effects on Islamic Banks' CAR.

For Islamic banks, the exchange rate is a significant determinant for all $\theta = 0.05, 0.9$ and 0.95 . In Figure 2, our results reveal that CAR of Islamic banks increases with exchange rate which documents dollar rate has an increasing positive marginal effect on capital adequacy ratio. Recently, some authors posit that widespread use of the “murabaha” contract leads higher level of capital ratios for Islamic banks with the increase in foreign exchange. (Mansour and Dooukanly, 2019)

The effect of public debt ratio over capitalization ratio also differs between Islamic and conventional banks. For conventional banks, results illustrate that public debt ratio has positive effect on CAR for all $\theta = 0.05, 0.9$ and 0.95 . Although there are studies investigating the effect of different macroeconomic variables on the capital adequacy ratio in the literature, there is no study yet that reveals the net effect of public debt or the ratio of public debt stock to GDP on the capitalization ratio. This study reveals that the increase in public debt increases the capital adequacy ratio for conventional banks in Turkey. This may be explained by the fact that banks feel comfortable during periods of economic growth and decrease their capital adequacy requirements. Various studies have shown that the effect of growth rate on the capital adequacy ratio is negative for Turkish banks. (Yahaya et al., 2016), Yüksel and Özsarı, 2017). As a result of the increased public debt ratio, conventional banks may require additional capital as they expect riskier macroeconomic circumstances in Turkey. The effect of the public debt ratio, on the other hand, differs depending on the different quantiles for Islamic banks.

In terms of the unemployment rate, Figures 1 and 2 show that the effect of unemployment on CAR remains flat for both conventional and Islamic banks for $0.05, 0.9$, and 0.95 quantile levels. Some researchers identify a positive relationship between the capital adequacy ratio and unemployment, despite the fact that, when compared to other factors, unemployment is not a macro variable with a high degree of importance in explaining the capital adequacy ratio. (Yüksel and Özsarı, 2017) Our findings, which corroborate earlier research, reveal that the unemployment rate has a significant impact on CAR, but not as effective as the other variables.

Last, the marginal effect of repo interest rate for conventional banks decreasing between certain values (approximately 7% to 17%) and increasing especially at the values (less than 7% and greater than 17%) where the interest rate rises above a certain level for $\theta = 0.05, 0.9$ and 0.95 . It has been emphasized in the literature that banks can

increase their capital in the face of interest rate hikes by displaying a more cautious stance, as rising interest rates negatively affects capital adequacy ratios by reducing loan repayment opportunities. (Demirguc-Kunt and Detragiache, 1998)

For Islamic banks, we observe CAR follows different pattern than conventional banks in our analysis. For higher capitalized banks ($\theta = 0.9$ and 0.95), we see that effect of repo interest rate remains flat over CAR. On the other hand, for $\theta = 0.05$, the effect of repo interest rate is similar with conventional banks. Our results illustrate that repo interest rate affects Islamic banks only when they have less CAR.

4.5.2 Scenario construction and stress testing

The next step in our macro stress assessments is to create adverse macroeconomic circumstances. In this section we conduct one-step predictions and probability analysis for stress tests. As a result, one-step forecasts for the capital adequacy ratio is produced for each independent variable, utilizing the extreme quantile values and models discovered in our non-parametric analyses, while taking the last observation values of the other variables.

Table 4.4 represents the one-step prediction values are given for the Capital adequacy ratio for selected macroeconomic variables. The horizontal axis quantile values show the quantile values of non-performing loans. We pick three quantile values 0.95, 0.90, and 0.05, respectively, which similar with the previous section. On the vertical axis, the quantile values show which quantiles of the independent variables are employed.

For conventional banks, we observe the impact of exchange rate varies according to different quantile values of capital adequacy ratio. In other words, capital adequacy ratio fluctuates between quantile levels which the marginal impact changes depending on various quantile levels. On the other hand, for the Islamic banks, however, the capital adequacy ratio of the exchange rate has an increasing effect on all quantile values. The capital adequacy ratio, which is approximately 12-13 percent for the lower quantiles of the exchange rate, increases to 16-17 percent when the exchange rate is in the high quantiles. These findings indicate the existence of a positive and increasing impact of the exchange rate on the capital adequacy ratio of Islamic banks in our previous findings.

Table 4.4 : CAR Values Estimated According to the Tail Values of the Independent Variables.

Variables	Tau	CAR of Con. Banks			CAR of Islamic Banks		
		0.95	0.90	0.05	0.95	0.90	0.05
Dollar	0.01	16.77	17.42	17.67	12.93	13.46	12.17
	0.05	16.80	17.39	17.52	13.03	13.53	12.23
	0.95	18.05	17.66	15.64	16.83	17.15	14.38
	0.99	17.28	17.38	17.55	17.83	17.67	16.81
Unemployment	0.01	17.80	17.70	16.52	18.17	18.47	15.55
	0.05	18.29	18.19	16.77	18.49	18.61	15.70
	0.95	17.50	17.44	16.92	17.49	17.49	15.76
	0.99	17.42	17.52	17.15	17.33	17.34	16.06
Repo	0.01	15.43	15.41	16.54	16.96	16.64	16.58
	0.05	15.94	15.88	16.70	17.07	16.84	16.63
	0.95	16.80	16.73	16.10	17.98	18.14	18.23
	0.99	17.53	17.47	16.92	17.50	17.50	15.77
Public Debt Stock	0.01	--	--	--	--	--	--
	0.05	15.26	15.77	16.18	17.76	16.53	16.38
	0.95	23.42	22.88	19.31	17.06	16.01	15.69
	0.99	24.42	23.89	21.47	16.11	15.00	14.87

In terms of the impact of unemployment rate on capital adequacy ratio, our results reveal that the marginal effect is positive but does not vary according to different levels of unemployment for both bank types in the previous section. However, this negative effect is not an effective variable in explaining the capital adequacy ratio. In table 4.4, we see that capital adequacy ratio reduces with increasing quantile levels of unemployment rate. However, results reveal that the quantile values of the unemployment rate changes the estimated capital adequacy ratios by less than 1%. This table confirms that the unemployment rate has an effect on the capital adequacy ratio, but it is not a very decisive explanatory variable. When the bank types are compared regarding the effect of unemployment rate, it is seen that the capital adequacy ratios of both types of banks are close to each other, regardless of the unemployment rate and the quantile levels of the capital adequacy ratio. Especially for

the critically low quantile level of the capital adequacy ratio of 0.05, the capital adequacy ratio estimates of conventional banks and Islamic banks are close at all unemployment levels.

Regarding the public debt ratio, there is no significant result for the 0.01 quantile value both for Islamic and conventional banks. When the values of 0.05 and 0.99 quantile levels of conventional banks' debt ratio are examined, the difference between the predicted capital adequacy ratios greater than any other explanatory variables for conventional banks. In table 4.4, the increasing values of capital adequacy with the high values of public debt stock is in line with the positive and increasing effect obtained in previous section. On the other hand, the capital adequacy ratio gives different results in different quantiles for Islamic banks, as it is seen in the table 4.4.

Previous section concluded that the marginal effect of repo interest rate may be both positive and negative effect on both conventional and Islamic banks depending on different quantiles. In table 4.4, it can be observed that the projected capital adequacy ratios are quite similar to one another on the repo rate. Hence, this result also confirms the previous analysis in our study.

Finally, we use probability analysis to determine the likelihood of stress factors going below or exceeding specified threshold levels. The mean and variance were calculated using the maximum likelihood approach, using the current values of the stress variables and explanatory factors, and the distributions assumed to be normal, logistic, mean and variance t distribution (t location scale), and extreme value distribution.

163 observed stress factors and independent variables were obtained using the estimated mean and variance by running the simulation five thousand times with the assistance of Monte Carlo simulation, and sample distributions are created using four alternative distributions.

The regressions we estimate and the values of the independent variables obtained in accordance with a uniform distribution in a particular range are used in probability analysis. The other independent variables are held at their previous observed value for each independent variable, and each new derived value is assigned as the new observation value, after which the stress variables are performed. The probability of stress variables being greater or lower than specific threshold values may be determined using these predicted stress variables. Half of the maximum and minimum

values observed in the data for the relevant variable are calculated when determining the lower and upper threshold values of the independent variables, and half of the minimum value is subtracted for the lower threshold and half is added to the maximum value for the upper threshold. The lower and upper threshold values in this direction are 1 TL and 9 TL for the dollar, 2.25% to 36% for repo interest, 4% and 20.85% for the unemployment rate, and lastly 3 percent to 62 percent for the public debt ratio. The threshold number for the capital adequacy ratio is set at 8% (Basel criteria) and 12% (BDDK).

In table 4.5 and 4.6, we represent the probability analysis for conventional and Islamic banks respectively. In this analysis, we focus on situations where the capital adequacy ratio, which is accepted as the Basel criterion for banks, falls below 8% will be included. In table 4.5 for conventional banks, we observe that depending on the changes in the unemployment rate, the probability of the capital adequacy ratio to be below or above the threshold values is almost zero. The probability of reducing the capital adequacy ratio of the repo rate to lower the capital adequacy ratio below 8% in all quantiles is quite low. On the other hand, the probability of changes in the exchange rate to lower the capital adequacy ratio below the threshold value of 8 percent at a high quantile level is close to zero for all values. In low quantiles of capital adequacy ratio, this probability is around 5% in normal, logistics and t distributions, while it rises to 15% in extreme value distributions. Therefore, in a quantile of 0.05 where the capital adequacy ratio is low, there is a possibility that foreign currency shocks may reduce the capital adequacy ratio below the 8% level. In the analyzes regarding the public debt ratio, it is seen that the relevant probabilities for all quantile values of the capital adequacy ratio are high. Especially in 0.95 and 0.90 quantiles where the capital adequacy ratio is high, the probability of capital adequacy ratios below 8 percent, excluding logistic distribution, is more than 40 percent. Therefore, from the results, it is seen that the public debt ratio is an important variable for the conventional banks and the volatilities in the public debt may negatively affect the capital adequacy ratios of the banks.

For Islamic banks, the results are given in table 4.6. According to the findings, the chance of the capital adequacy ratio falling below 8% as a result of unemployment and repo rate shocks is zero or close to zero in the bad case scenario. When the quantile value of the capital adequacy ratio in the repo rate is 0.05, there is an 8.5% probability

for the extreme distribution. When we look at public debt ratio, unlike conventional banks, the probability of the capital adequacy ratio falling below the 8% threshold is always below 10 percent, except for extreme value distributions. Therefore, it can be concluded that the changes in the public debt ratio are not as important as in conventional banks in terms of affecting the capital adequacy ratio in Islamic banks. The fluctuations in the dollar exchange rate cause the probability of the capital adequacy ratio to decrease below 8% to be between 10-25% at the tau 0.95 and 0.90 levels, and between 30-40% at the tau 0.05 level. These findings show that increase in foreign exchange affects Islamic banks, and that this effect is stronger when the capital adequacy ratio quantile value is 0.05.

As a result, our results reveal that unemployment rate and repo rate do not affect the capital adequacy ratio much. As emphasized in our previous findings, there is a positive relationship between the capital adequacy ratio and unemployment, but unemployment is not as critical a variable as other macro variables in explaining the capital adequacy ratio. (Yahaya et al.,2016) Therefore, the findings obtained are consistent with previous results in the literature and our findings in the additive quantile regression analysis.

Table 4.5 : Probability Analysis for Conventional Banks' CAR.

	Public Debt Ratio Stock			Dollar			Unemployment			Repo		
Distribution	Tau=0.05											
	CAR<8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8<CAR<12
Normal	0.144	0.231	0.625	0.093	0.228	0.679	0.000	0.000	1.000	0.001	0.086	0.913
Logistik	0.087	0.190	0.723	0.074	0.183	0.743	0.000	0.001	0.999	0.004	0.074	0.922
Extreme Value	0.163	0.229	0.608	0.191	0.203	0.606	0.000	0.020	0.980	0.035	0.153	0.812
T Distribution	0.091	0.193	0.716	0.093	0.228	0.679	0.000	0.000	1.000	0.001	0.086	0.913
	Tau=0.90											
	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	SYO<8	CAR >12	8<CAR<12
Normal	0.341	0.175	0.484	0.000	0.001	0.999	0.000	0.005	0.995	0.002	0.126	0.872
Logistik	0.227	0.164	0.610	0.000	0.003	0.997	0.000	0.011	0.989	0.007	0.104	0.889
Extreme Value	0.407	0.153	0.441	0.001	0.031	0.968	0.005	0.056	0.940	0.046	0.182	0.772
T Distribution	0.341	0.175	0.484	0.000	0.001	0.999	0.000	0.005	0.995	0.002	0.126	0.872
	Tau=0.95											
	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	SYO<8	CAR >12	8<CAR<12
Normal	0.379	0.164	0.457	0.000	0.018	0.982	0.000	0.008	0.992	0.003	0.135	0.862
Logistik	0.252	0.156	0.591	0.000	0.024	0.976	0.000	0.014	0.986	0.008	0.110	0.882
Extreme Value	0.438	0.145	0.417	0.010	0.085	0.906	0.007	0.063	0.930	0.052	0.186	0.762
T Distribution	0.379	0.164	0.457	0.000	0.018	0.982	0.000	0.008	0.992	0.003	0.135	0.862

Table 4.6 : Probability Analysis for Islamic Banks' CAR.

	Public Debt/GDP			Dollar			Unemployment			Repo		
Distribution	Tau=0.05											
	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8<CAR<12
Normal	0.144	0.231	0.625	0.311	0.207	0.482	0.000	0.058	0.942	0.014	0.170	0.816
Logistik	0.087	0.190	0.723	0.219	0.195	0.587	0.000	0.051	0.949	0.018	0.132	0.850
Extreme Value	0.163	0.229	0.608	0.384	0.180	0.437	0.007	0.120	0.874	0.085	0.195	0.720
T Distribution	0.091	0.193	0.716	0.311	0.207	0.482	0.000	0.053	0.946	0.014	0.170	0.816
	Tau=0.90											
	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	SYO<8	CAR >12	8< CAR <12	CAR <8	CAR >12	8<CAR<12
Normal	0.080	0.238	0.682	0.156	0.215	0.629	0.000	0.011	0.989	0.000	0.006	0.994
Logistik	0.062	0.191	0.747	0.106	0.176	0.718	0.000	0.016	0.984	0.000	0.011	0.989
Extreme Value	0.180	0.216	0.603	0.253	0.185	0.562	0.007	0.071	0.922	0.003	0.059	0.938
T Distribution	0.080	0.238	0.682	0.156	0.215	0.629	0.000	0.011	0.989	0.000	0.006	0.994
	Tau=0.95											
	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8< CAR <12	CAR <8	CAR >12	8<CAR<12
Normal	0.033	0.192	0.775	0.196	0.210	0.594	0.000	0.012	0.988	0.000	0.003	0.997
Logistik	0.032	0.147	0.820	0.133	0.178	0.689	0.000	0.017	0.983	0.000	0.009	0.991
Extreme Value	0.120	0.196	0.684	0.288	0.180	0.532	0.007	0.075	0.918	0.002	0.050	0.947
T Distribution	0.033	0.192	0.775	0.196	0.210	0.594	0.000	0.012	0.988	0.000	0.003	0.997

On the other hand, it is seen that public debt is a more effective variable for conventional banks and the exchange rate is more effective variable for Islamic banks. Finally, it is seen that the issue of which quantile value of the stress variables is calculated is decisive in the probability analysis of capital adequacy ratios. Banks are more likely to cross the critical threshold at low quantile values of capital adequacy ratios for exchange rates and repo rates. Therefore, banks with low capital adequacy ratios are more affected by foreign exchange and interest rate shocks than banks with high capital adequacy ratios.

4.5.3 Semi-parametric quantile panel regression results

The findings of the panel semi parametric analysis will be examined in this section of the paper. The logarithmic value of bank total assets (bank size) for the variable are shown on the horizontal axis in the graphs below. The objective is to determine how the explanatory factors of bank size influenced the potential impacts on selected variables. The beta coefficient on the vertical axis measures how the marginal impact on the relevant stress variable of the explanatory variable employed in the study is assessed based on different values of the marginal effect on the bank size. The capital adequacy rate, which contains stress factors, is illustrated in the visuals to the study findings for three distinct types of quantiles associated to active profitability and follow-up loans. At this point, the appropriate banking variables were assumed to represent pantile values of 0.15, 0.50, and 0.75.

The red lines in the graphs represent the banks' low tail, when the amount of the following loans is 0.05. Similarly, the blue lines reflect a value of 0.95 with a significant tail value. Our trust range is comprised of these two values. Lines in black The independent variable for the associated cantifies depicts the influence of the total assets on stress factors.

There are no statistically significant outcomes in the study for Islamic banks in the thesis. The fact that the results we got for the overall sector may not be significant of participation and conventional banks of the banking variables might be caused by different outcomes. Only three banks in the Islamic Banks sample provided statistically significant findings since it is not possible to decompose on factors which we utilize as a variable on the horizontal and vertical axes.

4.5.3.1 Public debt effect on capital adequacy ratio

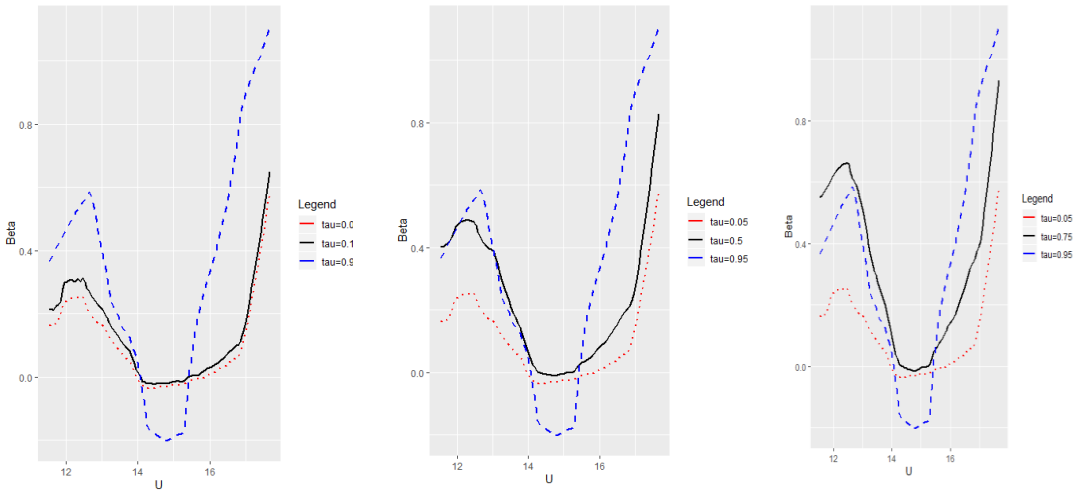


Figure 4.3 : The Effect of Public Debt Stock Ratio on Capital Adequacy Ratio.

The effect of the public debt stock ratio on the capital adequacy ratio is strongly related to the size of the bank. We observe for large banks, capital adequacy ratio increases with the higher level of public debt ratio according to Figure 4.3. When capital adequacy rates are compared across quantile levels, it becomes clear that banks with higher capital rates may be able to improve their capital ratio more than banks with lower capital rates. In other words, when we look at banks with the same total assets but different quantile levels, we find that high quantile levels(i.e. banks with higher CAR) have greater beta values. The effect of public debt in the 0.15 and 0.5 quantile levels, where the capital adequacy ratio is low and medium size, it is shown to follow a decreasing effect from the value of the logarithm of total assets of about 13 to the value of 14. For the same bank size for high quantile levels, our results indicate there is no statistically significant result. This circumstance demonstrates that when small and medium-sized banks' capital adequacy ratios are inadequate, they are unable to enhance their capital adequacy when public debt ratios rise. As a result, it can be claimed that only large banks boosted their capital adequacy ratios in response to the rise in the public debt ratio and this effect is greater for the large banks with high capital adequacy ratio.

4.5.3.2 Exchange rate effect on capital adequacy ratio

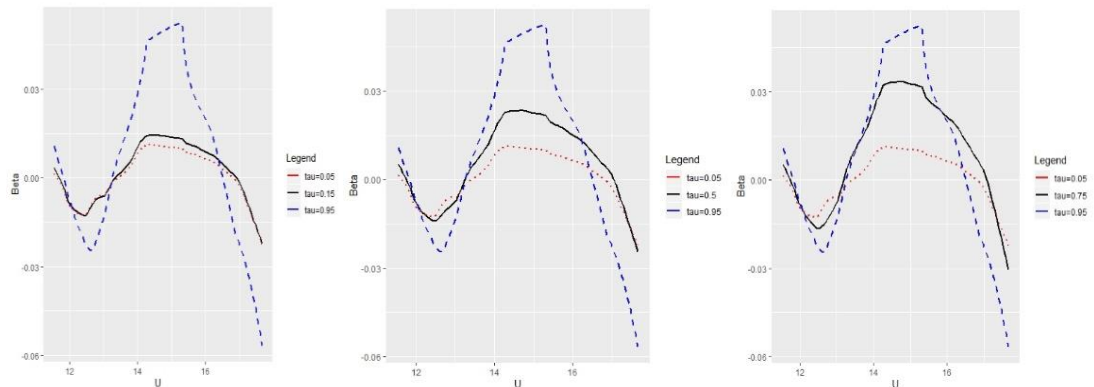


Figure 4.4 : The Effect of Exchange Rate on Capital Adequacy Ratio.

According to the findings, the marginal effect of exchange rate on capital adequacy ratio is not statistically significant for small and large banks. For medium-sized banks, the impact of public debt ratio increases till the logarithm of bank size equals to 15, then decreases. Moreover, this impact is more than higher quantile of capital adequacy ratio. Namely, banks with more capital ratio are more sensitive the changes in capital adequacy ratio. As a result, the size of the bank is a deciding factor in the influence of the foreign currency on the capital adequacy ratio from the perspective of medium-sized banks. Our previous findings indicate that the exchange rate has a positive impact on the capital adequacy ratio, according to the time series analysis, and this effect varies according to different quantiles. To conclude, in the panel data analysis, the marginal effect of public debt ratio changes proportional to the size of the bank.

4.5.3.3 Interest rate effect on capital adequacy ratio

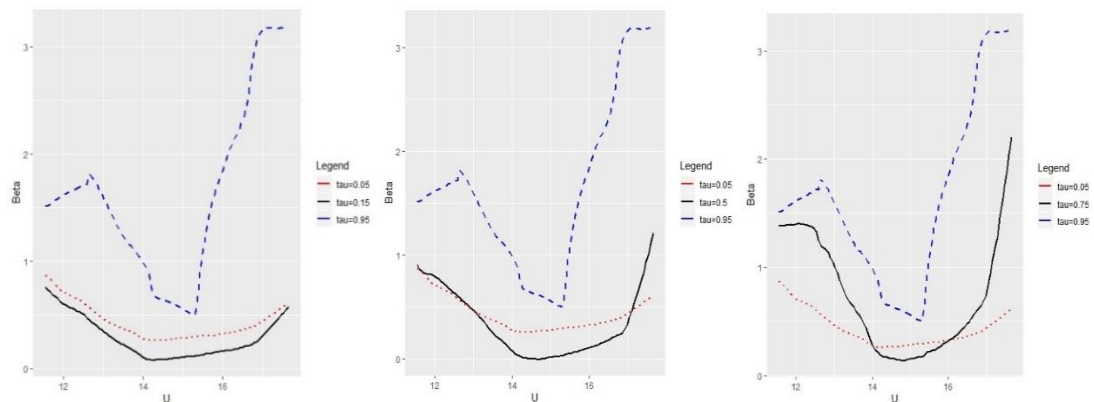


Figure 4.5 : The Effect of Interest Rate on Capital Adequacy Ratio.

We have no statistically significant result for 0.15 quantile level. For 0.5 and 0.75 quantile levels, public debt has a decreasing effect on small banks. On the other hand, results indicate that the impact of public debt increasing for large banks. Moreover, these effects are greater for banks with higher capital adequacy ratio. Previously, our results reveal that the positive marginal effect of interest rate on capital adequacy ratios increased in certain interest rate intervals and decreases in others, according to the time series results. The results achieve here are comparable to those obtained through time series analysis. Interest rate has a declining effect for small banks in quantiles with high capital adequacy ratios, but a positive and growing effect for large banks, according to panel data analysis findings. In other words, as interest rates rise, large banks tend to improve their capital adequacy ratios more than small banks.

4.6 Conclusion

The banking sector has endured low interest rates, slow loan growth, and rising regulatory expenses since the 2008 financial crisis, but there have also been substantial improvements in the recent decade. New service providers, such as FinTech and BigTech, have joined numerous financial service categories. Although sophisticated technologies improve quality and lower costs, they exacerbate existing poor profitability levels owing to rivalry for new technology acquisition and downward wage, price, and margin pressures. In addition, the fact that European and Japanese banks are barely covering their capital expenses will suffice to indicate that the sector's profitability is in jeopardy in general (OECD, 2020).

As a result, it's critical to identify the risks and vulnerabilities to which the banking sector and the overall system may be vulnerable, as well as to assess and forecast the possible hazards that these may represent. Stress tests are a valuable technique at this point. Tests may highlight the weak and strong aspects of banks and industries, as well as the actions that need to be made.

In this article, we attempt to use the most up-to-date approaches in order to give accurate analysis and relationships. However, because the analyses and findings need to be reliable, a bilateral strategy is used, with both time series-based and panel data-based quantile regression models being considered. Conventional banks and Islamic banks are also assessed within themselves, keeping in mind that the dynamics and risk sources may change depending on the form of banking.

Our results reveal that the public debt ratio for conventional banks and the exchange rate for participation banks are the major determinants in determining the capital adequacy ratio. Although the effect of unemployment on the capital adequacy ratio is positive in both types of banking, findings suggest that it is not sensitive to changes in the unemployment rate.

The semi-parametric panel quantile approach, which is the second half of the project, is employed solely for conventional banks, and determinants of capital adequacy ratio is investigated considering bank size. As the scale of banks and the level of capital adequacy increase, banks tend to increase their capital adequacy ratios more against the increase in public debt ratio and interest rate.

Our research yielded significant policy consequences. For capital adequacy ratio, our research reveal that at high levels of public debt stock, the dollar exchange rate, and unemployment rate, banks raise their capital adequacy ratios to protect themselves from the economy's growing fragility. As a result, given the efforts taken to combat the pandemic and the financial system's sensitivity to negative shocks, it is critical that they begin building capital buffers as soon as feasible.,



5. CONCLUSION

This thesis, which is based on a comparison between Islamic and conventional banks, is divided into three chapters. In this regard, our investigations have made numerous contributions to the literature.

In the first chapter, we use multivariate quantile regression model to assess the Islamic banking system's stability to financial risk spillovers and compare it to the conventional banking system. We examine financial risk spillovers from financial indices such as bank share prices for this purpose. On a global and regional scale, Islamic and conventional banks are compared against one other as well as within themselves. In comparison to conventional banks, the data show that there is no difference in risk sensitivity participation banks in both global and regional level. Findings reveal that the claim in the literature that Islamic banks are more stable than conventional banks, which is predicated on the 2008 crisis, may have changed in subsequent years. Furthermore, when the data is examined across regions such as the Middle East, the Gulf, and Asia; it is shown that Islamic banks do not differ in terms of financial stability. The recent improvements in Islamic finance principles and standards published by AAOIFI and IFSB, whose efficacy has improved in the previous 10 years, bringing Islamic banks internationally closer together in terms of performance, might explain these outcomes.

The impact of bank-specific characteristics on the dual banking system is investigated in the second chapter, using the same model as in the first chapter but with a larger data set. The purpose of this chapter is to investigate how leverage ratio, capital adequacy requirements and bank size impact the resilience of conventional and Islamic banks in response to financial shocks. Our findings show that there are parallels and differences in the value at risk between bank equity prices and important global financial indices across Islamic and conventional banks. In this respect, high leverage ratios have a detrimental impact on both types of banks' risk sensitivity. When it comes to bank size, smaller banks are less impacted by shocks for Islamic banks, however the impact of bank size on conventional banks varies according to different shocks in

financial indices. When it comes to capital adequacy ratios, whereas traditional banks with high capital adequacy ratios are less influenced by financial risk spillovers. However, for Islamic banks, a high capital adequacy ratio means that financial shocks have a greater impact on bank equity returns. Hence, these findings suggest that the risk weights established by Basel standards may be insufficient to accurately assess the capitalization of Islamic banks, as interest-free banking involves risks that are distinct from those faced by conventional banks.

In the third chapter, we empirically examine the determinants of capital adequacy ratios of Turkish banking sector with employing novel stress test methods. For this purpose, we use additive semi-parametric quantile regression model and a semi-parametric quantile panel model for analysis. Moreover, quantile estimation results are supported by scenario analysis. The semi-parametric quantile regression results in this chapter show that capital adequacy ratio have different determinants due to bank types. The exchange rate has a positive and increasing impact on capital adequacy ratio of Islamic banks, although it has mixed outcomes for regular banks' capital ratio. Public net debt stock has a positive and growing effect for conventional banks' capital adequacy ratio, whereas it has a mixed effect for Islamic banks. The unemployment rate, on the other hand, has a positive effect on capital adequacy ratio for both bank types, although it is not as effective as the other variables in the analysis. Last, panel quantile results reveal that as the bank size and capital adequacy level of conventional banks increase, they tend to increase their capital adequacy ratios more against the increase in the public debt ratio and interest rate.

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APPENDICES

APPENDIX A: Tables

APPENDIX B: Figures



APPENDIX A: Tables

Table A.1 : Semi-Parametric Quantile Estimation Results for Conventional Banks.

: 0.95				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	14.1444	2.9319	4.824	3.58e-06***
Unemployment Rate	-0.1303	0.1372	-0.950	0.344
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	1	1	13.745	0.000299***
GDP Growth Rate	9	1	25.612	2e-16***
Unemployment	4	1	3.810	0.005663**
Public Debt Stock/ GDP	2	1	5.359	0.005703**
: 0.90				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	13.40145	3.46968	3.862	0.000173***
Unemployment Rate	-0.07422	0.16621	-0.447	0.655908
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	1	1	3.805	0.0532.
Repo	9	1	17.769	<2e-16***
Unemployment	6	1	2.426	0.0293*
Public Debt Stock/ GDP	5	1	1.459	0.2073
: 0.05				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	13.9508	3.8660	3.609	0.000427***
Unemployment Rate	0.1487	0.2525	0.589	0.556887
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	3	0.4	7.706	8.36e-05***
Repo	7	1.0	9.065	3.25e-09***
Unemployment	4	1.0	3.392	0.0111*
Public Debt Stock/ GDP	3	1.0	0.255	0.8578
EDF represents the degree of freedom. Signif. codes: '***' 0.001; '**' 0.01; '*' 0.05; '.' 0.1				

Table A.2 : Semi-Parametric Quantile Estimation Results for Islamic Banks.

: 0.95				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	12.32623	3.17142	3.887	0.000157***
Unemployment Rate	0.06556	0.19543	0.335	0.737777
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	4	0.3	15.367	2.03e-10***
GDP Growth Rate	9	1.0	11.089	6.65e-13***
Unemployment	3	1.0	2.253	0.085.
Public Debt Stock/ GDP	3	1.0	1.590	0.195
: 0.90				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	12.64072	3.13467	4.033	9.09E-05***
Unemployment Rate	-0.07915	0.17818	-0.444	0.658
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	2	1	19.009	5.11E-08***
Repo	10	1	12.741	1.55E-15***
Unemployment	2	1	3.533	0.0319*
Public Debt Stock/ GDP	5	1	0.901	0.4827
: 0.05				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	14.73305	5.5943	2.634	0.00939**
Unemployment Rate	-0.02951	0.30565	-0.097	0.92323
App. sign. of qss terms	EDF	Lambda	F value	Prob (> F)
Dollar	1	0.3	15.31	0.000141***
Repo	7	1	5.358	1.84E-05***
Unemployment	3	1	19.872	8.21E-11***
Public Debt Stock/ GDP	4	1	3.44	0.010231*
EDF represents the degree of freedom. Signif. codes: '***' 0.001; '**' 0.01; '*' 0.05; '.' 0.1				

Table A.3 : Parametric Quantile Estimation Results for Conventional Banks.

: 0.05				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	-0.31062	0.368546	-0.843	0.4006
Dollar	0.004413	0.056331	0.078	0.93765
GDP Growth Rate	0.310471	0.038673	8.028	2.12E-13***
Unemployment	-0.03153	0.013461	-2.342	0.02043*
Public Debt Stock/ GDP	0.030767	0.009403	3.272	0.00131**
: 0.90				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	-0.89153	0.426052	-2.093	0.037989*
Dollar	0.338813	0.093459	3.625	0.000389***
Repo	0.283842	0.053957	5.261	4.61E-07***
Unemployment	-0.06923	0.012392	-5.587	9.89E-08***
Public Debt Stock/ GDP	0.104112	0.007485	13.91	2.00E-16***
: 0.05				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	-0.28962	0.41079	-0.705	0.482
Dollar	0.43714	0.08997	4.859	2.82E-06***
Repo	0.22054	0.04974	4.433	1.73E-05***
Unemployment	-0.08541	0.01233	-6.927	1.03E-10***
Public Debt Stock/ GDP	0.10952	0.007	15.645	2.00E-16***
EDF represents the degree of freedom. Signif. codes: '***' 0.001; '**' 0.01; '*' 0.05; '.' 0.1				

Table A.4 : Parametric Quantile Estimation Results for Islamic Banks.

: 0.05				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	-0.60387	0.369096	-1.636	0.1038
Dollar	-0.13245	0.073374	-1.805	0.073 .
GDP Growth Rate	0.404605	0.043993	9.197	2.22E-16***
Unemployment	0.021882	0.008786	2.49	0.0138*
Public Debt Stock/ GDP	0.008528	0.012651	0.674	0.5012
: 0.90				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	-3.931	3.5374	-1.111	0.26814
Dollar	1.68113	1.56066	1.077	0.283035
Repo	0.37181	0.08539	4.354	2.39E-05***
Unemployment	0.18075	0.04773	3.787	0.000216***
Public Debt Stock/ GDP	0.0274	0.0618	0.443	0.658079
: 0.05				
Parametric Coeff.				
	Coeff.	Std. Error	t-Value	Prob (> t)
Intercept	-7.61095	2.49322	-3.053	0.00266**
Dollar	3.60726	1.07818	3.346	0.00103**
Repo	0.27698	0.06547	4.231	3.94E-05***
Unemployment	0.14352	0.03025	4.744	4.65E-06***
Public Debt Stock/ GDP	0.10755	0.03697	2.909	0.00415**

EDF represents the degree of freedom. Signif. codes: '*' 0.001; '**' 0.01; '*' 0.05; '.' 0.1**

APPENDIX B: Figures

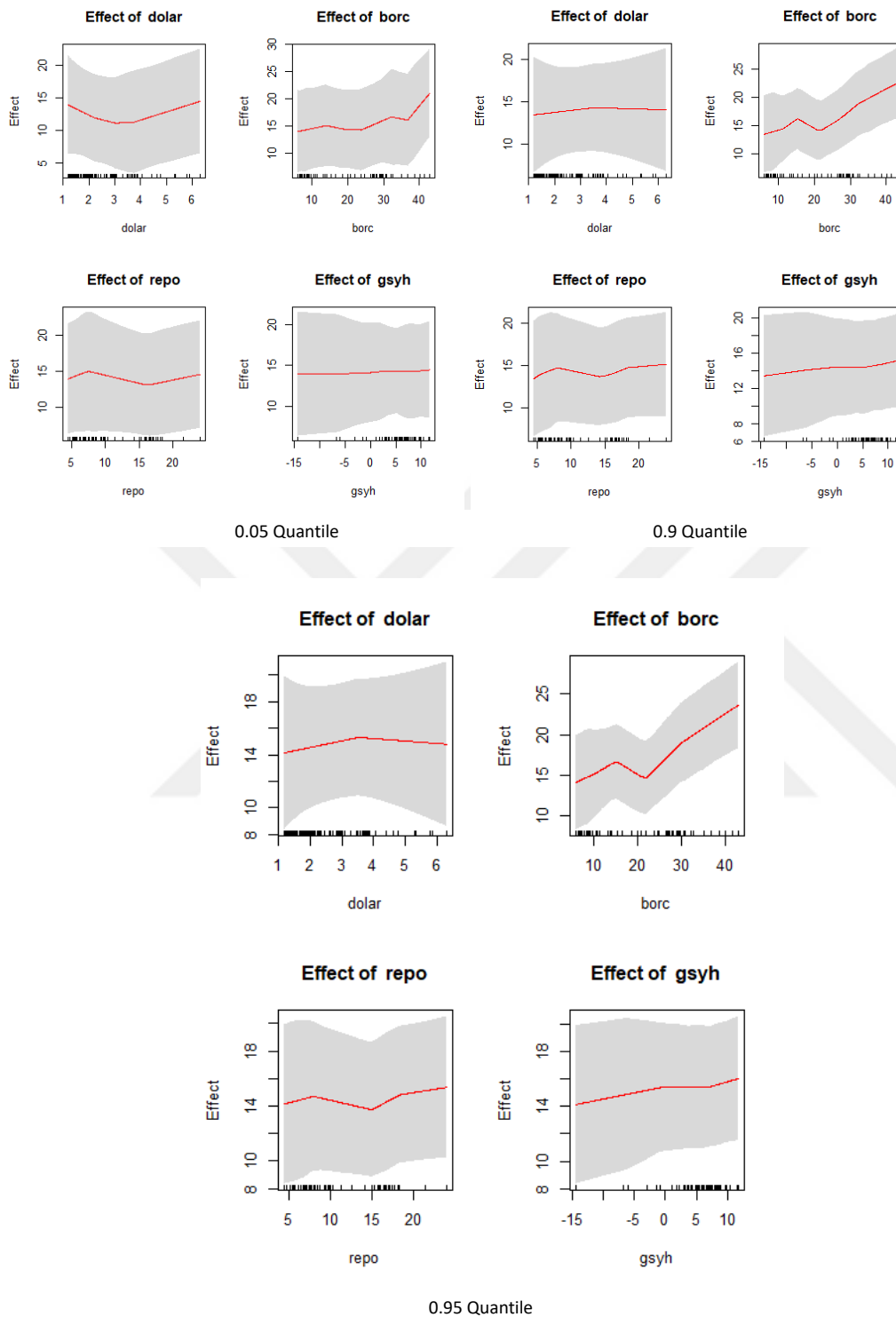


Figure B.1 : Semi-Parametric Quantile Effects on Conventional Banks' CAR.

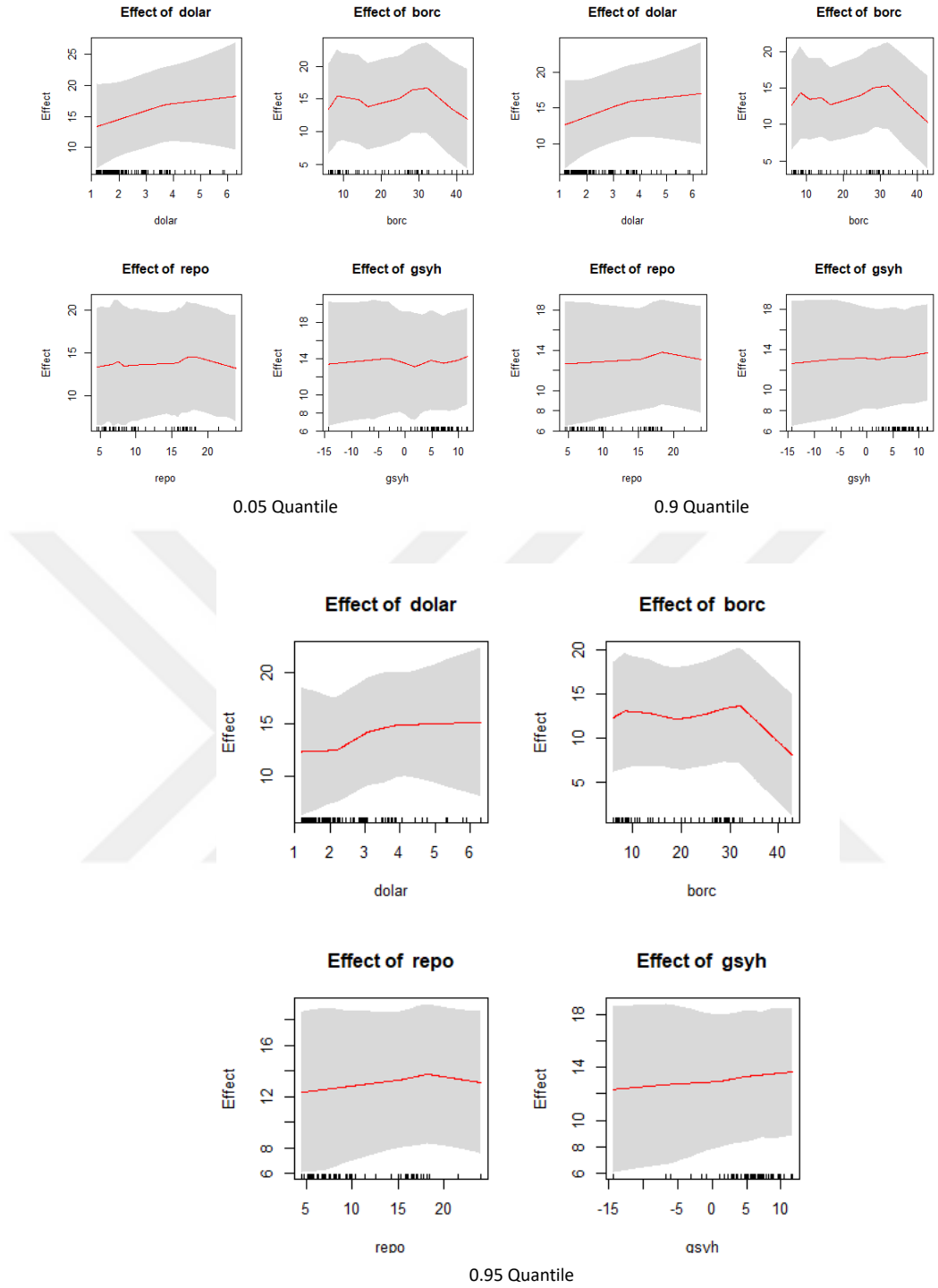


Figure B.2 : Semi-Parametric Quantile Effects on Islamic Banks' CAR.

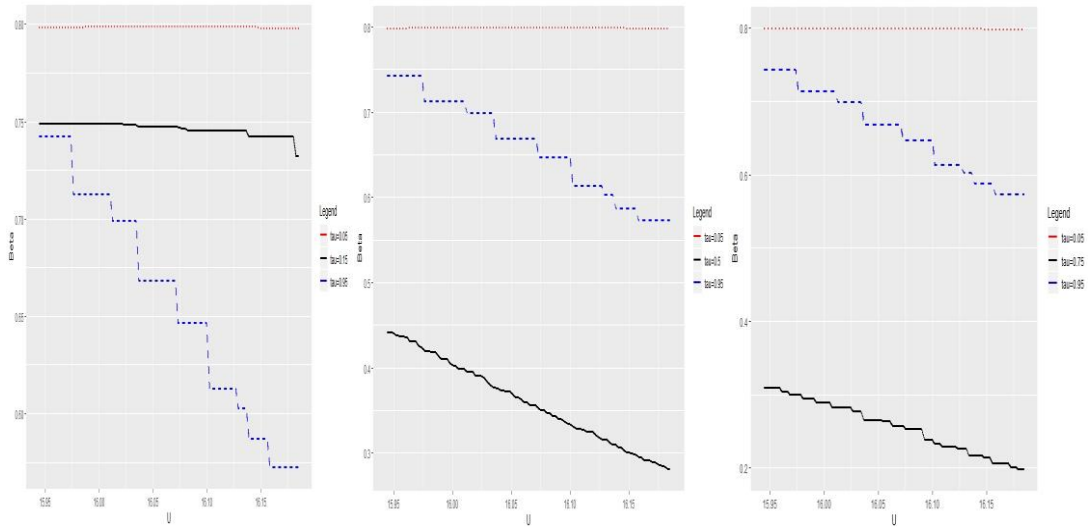


Figure B.3 : Semi-Parametric Quantile Effects on Islamic Banks' CAR Example.

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