Quantifying the Impact of EU-US "Distressed" Financial Market Integration on European Credit Supply

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Abstract

This paper proposes a new method for quantifying financial integration by adapting Adrian & Brunnermeier (2016)'s $\Delta CoVaR$ to conform with standard asset pricing literature (Lewellen & Nagel 2006, Cochrane 2009). We reconcile $\Delta CoVaR$ with standard microeconomic theory (Waller & Lewarne 1994) and test for causal relationships with respect to the contagion of US acute financial shocks to the EU's loan supply. We do this through three different vector-error-correction models, impulse response functions and forecast error variance decomposition analyses for the equity, debt and FX market respectively. We find that the debt market's $\Delta CoVaR$ exhibits a positive direct long-term relationship with the loan supply while the FX market's a positive indirect one. We only find weak evidence for a long-term relationship of the equity market and the loan supply. In the short run only the FX market showcases any statistically significant relationship. No reverse causality is noted. Finally, we find that financial integration behaves non-homogenously across markets.

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DISCLAMER

All expressions contained herein solely represent my own views and opinions. They do not reflect the perspective of any individual or organisation mentioned or associated with me. This document is provided for informational purposes only and should not be construed as financial or any other form of advice. All mistakes contained are mine and mine alone.

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Chapter 1

Introduction

In financial markets the ability for a shock to propagate from one market to another depends on the degree of financial interconnectedness. Conventional wisdom tells us that the greater the financial interconnectedness is, the greater the shock that will affect the system becomes. The recent demise of SVB has raised concerns about financial interconnectedness between the European Union (henceforth EU) and the the United States (henceforth the US), particularly regarding its impact on credit supply. However, limited research has addressed this direct impact of financial integration on credit supply.

The contribution of this paper to this gap is three fold: 1) we present a new approach to quantifying financial integration, 2) we provide a theoretical framework reconciling our empirical approach with standard economic theory while extending standard credit supply models to incorporate financial integration and 3) we provide novel empirical evidence regarding the causal mechanisms that financial integration at the "ath" percentile has had over time on the credit supply.

We begin by calculating a ΔConditional Value-at-Risk (ΔCoVaR) measurement (see: Adrian & Brunnermeier 2016). $\Delta CoVaR$ captures how much risk is added to system α (the EU in our case) when system β (the US) is in distress (Adrian & Brunnermeier 2016). This approach enables the direct quantification of the "ath" percentile financial integration through a single variable, which we define as "distressed financial integration".

By focusing on this distressed financial integration we improve upon prior literature which focuses on financial integration when the financial systems are at a stable state. Stable state systemic risk safeguards are already established, however, the evidence of acute systemic risk safeguards is lacking.

Even though $\Delta CoVaR$ has seen successful usage in literature (see: Tian et al. 2022, Trabelsi & Naifar 2017, Asgharian et al. 2022, Cai et al. 2018), $\Delta CoVaR$ suffers from a variety of limitations regarding its calculation. The calculation of the time-varying version of the $\Delta CoVaR$ suffers from a priori assumptions about optimal macro state variables (see Adrian & Brunnermeier 2016). While these state variables are meant to capture the time-varying nature of the $\Delta CoVaR$'s statistical moments (Adrian & Brunnermeier 2016), it results in not only human-bias during the selection process but also results in issues when trying to translate and compare $\Delta CoVaRs$ from the US to other countries, decreasing comparability.[1] However, the core underlying issue with the standard $\Delta CoVaR$ construction methodology is its lack of taking into account the available information sets at each point in time.

To overcome these issues we instead look at standard asset pricing literature (see: Lewellen & Nagel 2006, Cochrane 2009) and use non-overlapping short window high-frequency quantile regressions to estimate the time-varying $\Delta CoVaRs$. This approach allows us to estimate time-varying $\Delta CoVaRs$ through a parsimonious method which eliminates a priori state variable assumptions while being consistent with standard asset pricing literature (Lewellen & Nagel 2006, Cochrane 2009) by taking into account available information sets at each point in time.

To understand the impact of distressed financial integration to the credit supply of the EU, we turn towards the total loan supply curve. We first construct a theoretical microeconomic framework (as per: Waller & Lewarne 1994) and model the profit of banks

[1] While Adrian & Brunnermeier (2016) have already identified the most optimal macro state variables for capturing the time-trends of the US economy, their paper lacks an international perspective. This makes it increasingly difficult to select appropriate macro-state variables for non-US regions. That is, should one select macro state variables that reflect what Adrian & Brunnermeier (2016) recommend or should one instead use variables which capture the local economy better. This becomes even murkier when trying to proxy a region like Europe or a political entity like the EU and not a country.

as a function of interest rates, deposits, macroeconomic conditions, and bank-specific factors (as per: Waller & Lewarne 1994, Horst & Neyer 2019, Martin et al. 2016, Lee et al. 2022). We showcase that $\Delta CoVaR$ has strong theoretical underpinnings for its inclusion within credit supply models even in the presence of endogeneity within the model.

Endogeneity is a fundumental issue in credit supply models (see: Waller & Lewarne 1994, Moore 1989, Chen et al. 2014, Attila 2022), however under certain key conditions, we are able to show that equilibriums for supply and demand can be reached even in scenarios where if there was financial independence credit rationing would occur. Specifically, when financial integration is fixed and positive we expect an increase in supply of credit and a decrease when financial integration is negative.

To examine the impact of financial integration empirically and to overcome the issue of endogeneity we employ three vector-error-correction models (VECM), for three different financial market areas, the equity market, the debt market and the foreign exchange market. We begin by first fitting the VECMs to test for long-term relationships, before transforming them into levels and employing orthogonal impulse response functions (IRF) and forecast error variance decompositions (FEVD) to test for short term relationships and to ensure robustness in our results respectively.

Financial integration does not behave homegenously across each asset class. Our results indicate that the EU loan supply (proxied by the total amount of EU loan stock) showcases a direct long term dependence on distressed financial integration with the debt market and an indirect one with the foreign exchange market. The equity market, on the other hand, showcases a weak direct long term dependence. In regards to the short term we find that only the FX market has any impact and that is of an indirect nature.

As the cost to the system increases loan supply increases as well. Given that the other evidence we find corroborates our assumptions of the theoretical model, we hypothesize that this occurs as banks try to remain at the same level of profit as before by issuing a large quantity of loans albeit at a lower profit per loan.

Given the limited research in this area, our research relates closest to Gilje et al. (2016), Leblebicioğlu (2009) and Cornett et al. (2011).

Literature Review

Quantifying financial integration is not a new concept and the literature surrounding such is diverse. This heterogeneity within the literature has resulted in complexity when trying to analyse financial integration. Within financial economic literature the term "contagion" can be broadly seen as a proxy for the term of financial integration. This contagion literature focuses on empirically testing the statistical co-movements and alignment of variables of interest. One of the first papers on such an issue, King & Wadhwani (1990), focuses on the co-movements between different asset returns during the stock market crash of 1987. Later papers too, focus on co-movements of the key statistical moments of different asset-classes, usually focusing on volatility (see: Fry-McKibbin & Hsiao 2015). However, even within this literature strand the definition and approach of quantifying contagion is debatable (see: Forbes & Rigobon 2002).[2]

From a more theoretical economic approach (see: Baltzer et al. 2008) financial integration is usually quantified through three core approaches i) price-based, i.e., testing for asset price discrepancies across markets, ii) news-based, i.e., testing for common co-movements in reaction to events, and iii) quantity-based, i.e., testing for capital outflows against inflows. Nonetheless, most academic literature agrees that the greater the integration the greater the contagion and the greater alignment between statistical moments of the financial proxy variables.

Even though the literature on quantifying financial integration is well established, the literature directly examining the impact of financial integration on credit supply

[2]Fundamentally, financial integration is quantified as the magnitude of co-movements between financial proxies and the most common approaches to doing so can be broadly split into GARCH methods (see: Daugherty & Jithendranathan 2015, Saleem 2009, Fratzscher 2002, Forsberg & Bollerslev 2002), VAR/VECM methods (see: Ahlgren & Antell 2010, Gray 2009, Boschi 2005), Latent factor models (see: Bond et al. 2006, Dungey et al. 2006), Wavelet analysis (see: Castellanos et al. 2011, Gallegati 2012) and finally PCA models (see: Yiu et al. 2010, Calvo & Reinhart 1996).

has seen limited research. Gilje et al. (2016) studies the impact of exogenous liquidity windfalls onto US lending market networks. Specifically, Gilje et al. (2016) finds that after a positive shock to the financial system of a US state, the loan supply increased in another state only if it was financially integrated with the original state. Leblebicioğlu (2009) examines the impact of financial integration and the credit market on consumption smoothing through a theoretical model stress test approach. Both Gilje et al. (2016) and Leblebicioğlu (2009) find that while financial integration increases exposure to financial shocks, inherent financial frictions within credit markets limit the impact of financial integration. Cornett et al. (2011) focusing on the impact that financial shocks have on the credit supply, find that negative shocks to the system result in credit supply to decrease with the exception of banks who mainly relied on equity capital and core deposits as financing.[3]

The key constraint of past literature is the measuring of financial integration indirectly, which hinders their capability to facilitate more comprehensive causal relationships. To remedy this constraint, literature turned towards combining systemic risk measures with standard econometric approaches. The most common systemic risk models are: systemic capital shortfall models (see: Acharya et al. 2016, Brownlees & Engle 2016), distressed insurance premium models (see: Huang et al. 2009) and conditional Value-at-Risk models (Adrian & Brunnermeier 2016).

Most academic literature agrees on the underlying theoretical framework of: greater risk and uncertainty leads to less financing (see: Akerlof 1970, Altavilla et al. 2019). Most empirical research too, corroborates this sentiment (see Zubair et al. 2020, Block & Sandner 2009). Thus, inherently, one can assume that the greater the financial interconnectedness of two systems, the greater the spillover effect and hence the greater the negative impact on the loan supply curve. Regardless of the theoretical and empirical ap-

[3]Other literature strands too study the supply of credit albeit without focusing on financial integration. Key strands include: credit conditions and their impacts on stock returns (see: Patelis 1997, Chava et al. 2015), credit supply and housing (see Favara & Imbs 2015, Justiniano et al. 2019), and credit supply in a financial risk management setting (see: Hirtle 2009). All of which agree on the importance of credit supply within our economic and financial systems.

proaches, literature agrees on key channels that impact the loan supply curve (see Horst & Neyer 2019, Waller & Lewarne 1994, Martin et al. 2016, Lee et al. 2022) and identifies these as: interest rates, deposits, macroeconomic conditions, and bank-specific factors.

Chapter 2

Quantifying "Distressed" Financial Integration

In the following chapter we formally develop our approach to quantifying distressed financial integration and present our sample and descriptive statistics of such.

2.1 Defining "Distressed" Financial Integration

Measuring financial integration by employing standard OLS estimation is identical to setting the quantile level of a quantile regression at $a = 50\%$. As such, employing a standard OLS estimation to measure financial integration one can find the steady state of the relationship of two countries over-time. That is, one can find the "true" financial integration. However, most banking systems have built-in buffers to absorb these financial shocks making testing for steady-state financial integration counterintuitive when the aim is to understand acute financial shocks. Therefore, building on the work of Adrian & Brunnermeier (2016) we propose a distressed financial integration measure that captures the co-movements of two systems, i.e., system a's Value-at-Risk when system b is in distress[4].

[4]The use of Adrian & Brunnermeier (2016)'s measure over employing a quantile regression at the 99th percentile is to measure the excess risk. The $\Delta CoVaR$ measure allows us to eliminate the risk of the steady state (Adrian & Brunnermeier 2016).

We define our distressed financial integration as:

$$\Delta CoVaR_a^{EU|US} = CoVaR_a^{EU|X^{US}=VaR_a^{US}} - CoVaR_a^{EU|X^{US}=VaR_{50}^{US}} \tag{2.1}$$

That is, the difference of the conditional Value-at-Risk of the EU financial system, EU, when the US financial system, US, is in distress and the conditional Value-at-Risk of the EU, when the US is in a normal state.

2.2 Constructing the $\Delta CoVaR$ through Quantile Regressions

To create our time-varying $\Delta CoVaR$ we diverge from Adrian & Brunnermeier (2016)'s methodology and instead follow standard asset pricing literature (Lewellen & Nagel 2006, Cochrane 2009). This is done as follows:

We first find the monthly VaR of the US financial system.

$$L_a^{US} = X_a^{US} + \epsilon_a^{US} \equiv VaR_a^{US} \tag{2.2}$$

L_a^{US} represents the losses of the US financial system at quantile level a, X_a^{US} is a constant variable at quantile level a and the ϵ_a^{US} is the error term. By employing this quantile regression using daily losses over a monthly non-overlapping window we create the US monthly VaR.

We then employ the following quantile regression:

$$L_a^{EU|US} = X_a^{EU|US} + \beta_a^{EU|US} L_a^{US} + \epsilon_{a,t}^{EU|US} \equiv CoVaR_a^{EU|US} \tag{2.3}$$

The predicted values, thus, give us the $CoVaR$ and by taking the differences between the different levels, i.e., between $a = 99\%$ and the $a = 50\%$, we can find the time-varying $\Delta CoVaR$.

2.3 Data Used for Quantifying Financial Integration

In order to calculate the $\Delta CoVaRs$, we need to define a proxy for the US and the EU financial system for each asset class examined respectively. We set our proxies so that there is a one-to-one equivalence between each asset class. The targeted asset class areas for financial integration are: 1) the equity market, 2) the bond market, and 3) the foreign exchange market. These markets are selected given their wide coverage of different industries, their economic importance, as well as their real-time sensitivity to underlying structural changes to the financial systems.

In order to build our dataset we use the largest available amount of information for each available proxy. A summary of the total dataset is give in Table 2.1.

2.3.1 Equity Market

The US financial system is proxied through the $S\&P500$[5]. To proxy the EU we use the popular pan-European index $EUROSTOXX600$[6]. Both indices are not only common and widely-followed but also cover a large percentage of the equity market capitalisation for each respective region.

2.3.2 Debt Market

The debt markets are proxied through the yield of the spread between the 10 year and the 3 year respective governmental bonds. This, allows us to capture the financial integration of the US and the EU in terms of the slope of the yield curve. The US is proxied through the treasury bonds[7], while the EU is proxied through the Euro area changing composition bond yields[8].

[5] Data is taken from Refinitiv.

[6] See footnote 5.

[7] Data is taken from FRED: https://fred.stlouisfed.org

[8] Data is taken from the ECB Statistical data warehouse: https://sdw.ecb.europa.eu

2.3.3 Foreign Exchange Market

The foreign exchange market is proxied through the nominal effective exchange rate for both regions. The US is proxied through the "broad nominal U.S. Dollar Index"[9] and the EU is proxied through the "EER-41/Euro"[10]. The nominal effective exchange rate allows us to capture the interconnectedness in terms of both comparative trade power but also through the foreign exchange market.

Table 2.1: Sample Characteristics of Underlying data for ΔCoVaR

Variable	Equity M.	Debt M.	FX M.
US Proxy	$S\&P500$	T10Y3M	DTWEXBGS
EU Proxy	$EUROSTOXX600$	YC.B.U2.EUR.4F.G_N_C.SV_C_YM.PY_10Y3M	EXR.D.E03.EUR.EN00.A
Obsv.	5814	4759	4269
Sample-Range	04/01/2000-31/03/2023	06/09/2004-31/03/2023	03/01/2006-31/03/2023

Note: 1) "Obsv." refers to the total amount of observations. 2) All Equity M. data was taken from Refinitiv, the US Proxy for Debt M. and FX M. was taken from FRED and the EU Proxy for Debt M. and FX M. was taken from the ECB Statistical Data Warehouse. 3) All data is from trading day data. 4) Given the large official names of the variables, the data code for Debt M. and FX M. is given instead.

[9] See footnote 7

[10] See footnote 8

2.4 Summary Statistics

Table 2.2, below gives the raw descriptive statistics of all the variables of interest.

Table 2.2: Descriptive Statistics of Monthly ΔCoVaR

Variable	Equity M.	Debt M.	FX M.
Min.	-0.034581	-5.460e-05	-0.0208321
1st Qu.	0.003201	-3.778e-07	-0.0039961
Median	0.009448	1.252e-06	-0.0014439
Mean	0.011301	5.973e-06	-0.0019606
3rd Qu.	0.016923	5.382e-06	0.0005239
Max.	0.094942	1.800e-04	0.0114924
Stand. Dev.	0.01413211	2.341784e-05	0.004271513
Obsv.	279	223	207

Note: 1)"Min." refers to the minimum value, "1st Qu." refers to the first quantile at a = 25%, "3rd Qu." is the third quantile at a = 75%, "Max" is the maximum value, "Stand. Dev." refers to the standard deviation and "Obsv." is the total number of observations within our sample.

Looking at Table 2.2 we can see that overall the equity market was the most effective channel of transmitting financial risk to its EU counterpart, followed by the foreign exchange market and then by the debt market. This is expected given the volatility of the equity market compared to the debt market, however, when looking at the effective nominal exchange rate we can see that it contributes more risk to the EU than debt but less than equity. Of importance is to note that the debt market exhibits on average a strong independence from the US debt market.

2.5 Stylised Facts of Financial Integration between the US and the EU

Financial integration between the US and the EU has varied over time. Figure 2.1 showcases our Monthly $\Delta CoVaRs$ across time. Looking at Figure 2.1 we can see that our $\Delta CoVaR$ corroborates how one would expect financial events to impact financial integration. We can see that financial integration between the EU and the US has changed

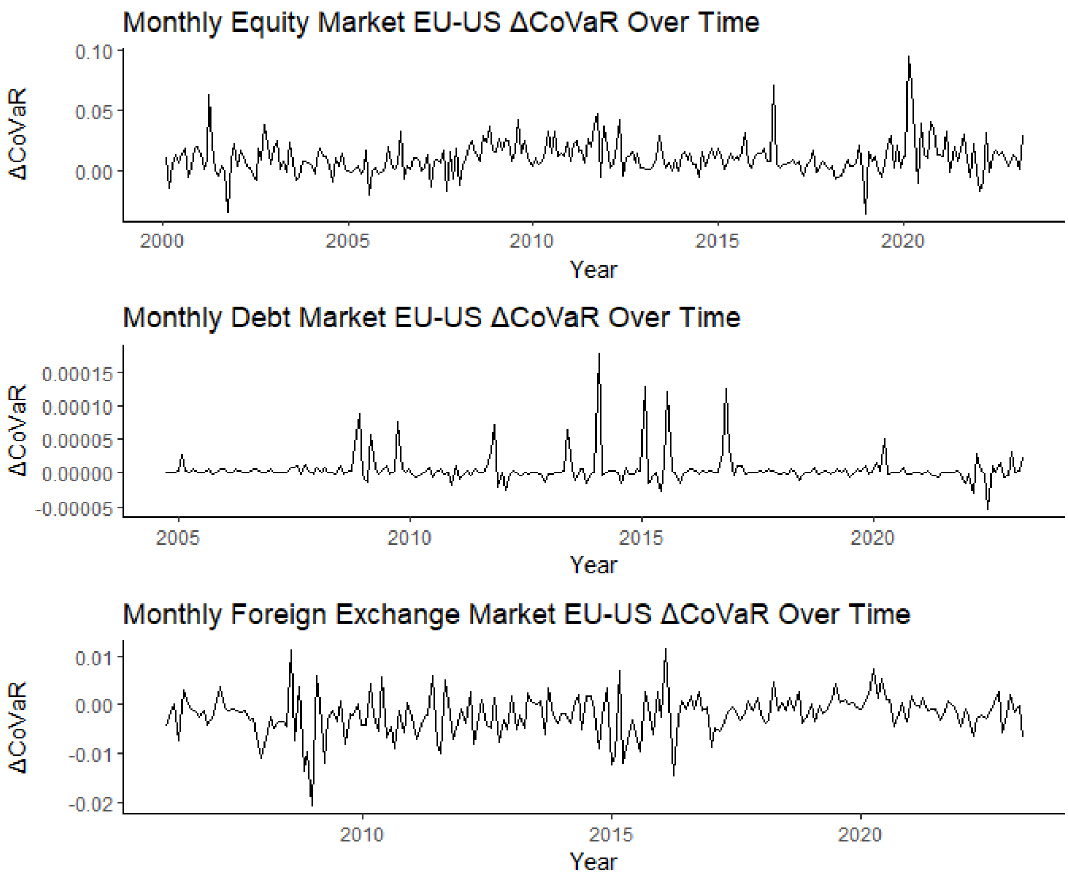

Figure 2.1

trajectory after characteristic global economic and financial events occurred. In the following chapter we present a brief overview of financial integration between the US and the EU across time.[11]

2.5.1 Late 90s-2004

The start of the millennium was characterized by a variety of different critical economic and political events. One of the most notable was the establishment of the Eurozone and the introduction of the Euro as the common currency for the participating member states. While this integration of financial systems had a positive impact on financial integration within the Eurozone, its effects on EU-US financial integration remain ambiguous (Lane

[11]It is important to note that ΔCoVaR is not in it of itself a measure of causality, but rather a measure of co-movement (see: Adrian & Brunnermeier 2016). If one wishes to test for causality they could create a $\Delta CoVaR$ using lagged values of the losses.

2006).

Lane (2006) observed an increase in economic interconnectedness between Europe and the United States after the establishment of the Eurozone, however, argues it is difficult to differentiate the true impact of the creation of the Eurozone from the global trend of increased economic integration. Our analysis, based on the $\Delta CoVaR$ metric, confirms this trend of increased interdependence before a sudden spike coinciding with the Turkish liquidity crisis of November 2000. However, during this same period, both the EU and the US were dealing with the aftermath of the dot-com stock market bubble resulting in further ambiguity.

Despite facing several financial events, the most significant decline in financial integration between the EU and the US was marked by the September 11 terrorist attacks. These attacks led to a sudden contagion effect across countries (see: Mun 2005), as evidenced by the large negative $\Delta CoVaR$. It is likely that investors transferred their capital from the US to the EU as a safe haven, as indicated by Shahzad & Qin (2019). This event not only resulted in the second largest (in absolute terms) equity $\Delta CoVaR$ but also signified the beginning of a downward trend in financial integration between the EU and the US.

2.5.2 2004-2008

The 2004s marked the beginning of large political and economic integration projects. Europe saw both the expansion of NATO as well as of the EU.

In the US, George W. Bush was re-elected president. Under the Bush administration, a series of trans-Atlantic summits took place, with the goal of further integrating the US and the EU together. Two key of these summits took place in 2005 and in 2007 (The White House 2005, 2007). This period set the groundwork for the financial crisis of 2008. Looking at Figure 2.1 only after 2006 does the $\Delta CoVaR$ start to increase again.

2.5.3 2009-2018

As one would expect the start of 2008 financial crisis, and the epitome of it, the start of the European debt crisis, resulted in a continuous downward trend up until 2018. Stracca (2015) investigated the impact of the Euro debt crisis and found that its impact globally was large and in particularly higher to regions with greater interconnected financial systems. Our results, thus, support the fact that financial interconnectedness decreases as investors are trying to shield their investments.

In 2016 the United Kingdom voted to leave the European Union, which would result in a political and economic disentanglement of one the largest economies in Europe. We notice a positive spike in our $\Delta CoVaRs$ signifying the large cost associated with such a move in terms to the EU financial system. Interestingly we once again see a negative spike around 2018 signifying the 2018 US stock market collapse, and once more see evidence of a potential capital flight occurring.

2.5.4 2018-2023

While 2018 was marked by one of the largest drops in equity value in the US, financial integration between the US and the EU was at the forefront with the EU introducing the Capital Markets Union (CMU). The CMU allowed for deeper integration within the EU but as a by-product it would also, thus, increase financial contagion between the member states. This in turn would increase interconnectedness with the US.

The two major events, however, which defined the later period was 1) COVID-19 and 2) the Ukraine conflict. Both major events saw radical changes to financial, social, and economic aspects. COVID-19 saw the shutting down of economies and a constant lockdown-and-opening-up cycle in many economies. The ongoing conflict in Ukraine saw the US and the EU become even more politically interconnected. Joint sanctions, a moving away of the EU and the US from Russian finance and energy, and the expansion of NATO have set the tone for further future integration.

We can see both of these time-periods reflected within our $\Delta CoVaRs$. The pandemic led to isolation and as such our measure starts regressing towards zero (i.e., financial independence), while after the invasion of Ukraine we can see an upward trend of financial interconnectedness.

However, while Covid-19 and the Ukraine conflict have resulted in a burden to both the financial systems of the US and EU, the recent collapse of SVB has added fears to the already existing ones. Interestingly, when looking at our $\Delta CoVaRs$ we can see that while the equity market and the debt market moved in a positive direction signifying an extra risk added to the system by the US, the foreign exchange market moved in the opposite direction signifying an increase in the value of the Euro.

Chapter 3

Quantifying the Impact of Financial Integration on Bank Loan Supply

In the following chapter we set out our empirical approach as well as the theoretical framework underpinning it.

3.1 Theoretical Framework

To measure the impact financial integration has on credit supply we base ourselves primarily on Waller & Lewarne (1994) but also on Horst & Neyer (2019), Martin et al. (2016) and Lee et al. (2022). Under standard economic theory (Waller & Lewarne 1994, Horst & Neyer 2019, Martin et al. 2016, Lee et al. 2022) it is assumed that banking institutions are profit maximizers whose profits are determined by specific factors. These factors have been identified as: i) Interest rates, ii) Deposits, iii) Macroeconomic conditions, iv) Bank-Specific factors (see: Waller & Lewarne 1994, Horst & Neyer 2019, Martin et al. 2016, Lee et al. 2022).

One can, thus, express the profit of the banking institution as a function of said factors as:

$$\Pi = f(\theta, \gamma, \delta, \zeta) \tag{3.1}$$

Where each variable represents each specific factor, i-iv, respectively.

Thus, any credit supply model must be expressed by the aforementioned variables, creating four conditions to be upheld. We provide a simple set-up below to formalize the process and root us within some form of theoretical standing.

3.1.1 A simple set up

Let us begin by following a slightly modified set up of Waller & Lewarne (1994)[12] by assuming a one period perfectly competitive environment in which the bank wants to maximize equation 3.1, as:

$$\Pi_{MAX} = f(\theta, \gamma, \delta, \zeta) \tag{3.2}$$

Assume that the bank chooses to maximize its profits by maximizing the total amount of lending, L, by setting the interest rates on the loans given, to the market rates r_m (as per: Waller & Lewarne 1994). This, gives us the total revenue of the bank as:

$$L * r_m$$

Banks operating must pay some form of variable cost associated with the total amount of loans issued, which we set to q and we express in a quadratic form (as per: Waller & Lewarne 1994, Horst & Neyer 2019):

$$(\frac{q}{2}) * L^2$$

In addition, assume that a central banking unit exists which sets the interest rate paid by the bank on deposits, r_{CB}, and assume that the bank is endowed with deposits,

[12]There exist many different credit supply models and credit related theories. We go with a simple approach to help ground ourselves and avoid pure statistical results in our empirical analysis. We take a microeconomic approach over a macroeconomic one as it allows for a more straightforward approach to modelling the supply of credit with the same fundamental interpretations. See: Horst & Neyer (2019), Martin et al. (2016), Lee et al. (2022), Nichols et al. (2005), Kletzer & Bardhan (1987), Bernanke & Blinder (1988) for alternative approaches.

D (as per: Horst & Neyer 2019, Waller & Lewarne 1994). This, gives us the total amount of money paid on deposits as:

$$D * r_{CB}$$

We also assume that the central bank sets some required reserves RR due to regulations defined by the reserve ratio r (as per: Horst & Neyer 2019, Waller & Lewarne 1994). Thus, deposits would be such that:

$$D = \frac{RR}{r}$$

By assuming a term b which expresses the deposit to loan ratio we can re-write the above equation to be expressed in terms of the loan supply as (as per: Waller & Lewarne 1994, Horst & Neyer 2019):

$$D = bL$$

Putting all of these together we get:

$$\max_{L} = Lr_m - Dr_{CB} - \frac{q}{2}L^2 \qquad s.t.\ D = bL \tag{3.3}$$

By substituting the restraint into the right-hand-side of eq. (3.3) and maximizing the function with respect to L, we get a modified version of Waller & Lewarne (1994)'s optimal loan supply curve as:

$$L^* = (r_m - br_{CB})/q \tag{3.4}$$

The implications of the modiefied Waller & Lewarne (1994) optimal loan supply curve, i.e., e.q. (3.4), are that the loan supply curve is positive so long as the spread between the marginal revenue per loan is greater than the reserve requirement costs (Waller & Lewarne 1994).

3.1.2 Implementing Macroeconomic Conditions

Looking at eq. (3.4) we can see that we have covered factors i), ii), iv). However, the modified Waller & Lewarne (1994) optimal loan supply curve does not take into account macroeconomic conditions.

We remedy this by first assuming that the bank's profit supply curve is subject to an external macroeconomic shock of magnitude M denominated in a unit of account such as the numeraire. The impact of this shock is contingent upon the degree of integration. We define a variable I which measures this level of integration. The range of I is $(-\infty, +\infty)$. This makes the total amount of pass-through shock to the system equal to:

$$M * I$$

with a compounding effect equal to:

$$\text{Compounding Effect} = \begin{cases} \text{Positive} & \text{if } I > 0 \\ \text{Independence} & \text{if } I = 0 \\ \text{Negative} & \text{if } I < 0 \end{cases}$$

When I equals 0 then the bank is independent from the shock. We then assume that each loan issued has the same exposure to the macroeconomic shock, and that the exposure of the bank depends on the total loans supplied.

Adding this to e.q. (3.4), thus, gives us a supply curve which looks like:

$$\max_{L} = Lr_m - Dr_{CB} - \frac{q}{2}L^2 + IML \qquad s.t.\ D = bL \tag{3.5}$$

Once again by substituting the restraint into the right-hand-side of eq.(3.5) and maximizing the function with respect to L, we can derive our optimal loan supply curve as:

$$L^* = (r_m - br_{CB} + IM)/q \tag{3.6}$$

Unlike before, now we have two more parameters impacting the loan supply curve. The magnitude of the shock as well as the level of financial integration. We, thus, satisfy all the conditions that prior literature (Horst & Neyer 2019, Waller & Lewarne 1994, Martin et al. 2016, Lee et al. 2022) has found to be of importance and see directly that these macroeconomic shocks can have varying impacts on the loan supply curve.

3.1.3 Relation to $\Delta CoVaR$

While the aforementioned set-up is a simplistic one, it showcases the direct impact that $\Delta CoVaR$ has on the loan supply curve. We can take this one step further by looking at Adrian & Brunnermeier (2016)'s $\$\Delta CoVaR$. They define the $\$\Delta CoVaR$ as:

$$\Delta CoVaR * Value\ of\ the\ market\ segment \tag{3.7}$$

If we look at our equity case, the value of the market segment would be the market capitalisation of the US stock exchange[13]. Thus, we can see from e.q. (3.5), we can simply replace IM with $\$\Delta CoVaR_i$ giving us:

$$\max_L = Lr_m - Dr_{CB} - \frac{q}{2}L^2 - \$\Delta CoVaR_i L \qquad s.t.\ D = bL \tag{3.8}$$

Where $\$\Delta CoVaR_i$ is the exposure of each individual loan to the external risk. Thus, we can once more substitute the restraint into the main equation and by maximizing the function with respect to L get:

$$L^* = (r_m - br_{CB} - \$\Delta CoVaR_i)/q \tag{3.9}$$

We can thus see the direct impact that $\$\Delta CoVaR_i$ and thus $\Delta CoVaR_i$ has on the optimal loan supply curve.

[13]This is the ingenuity of Adrian & Brunnermeier (2016)'s $\Delta CoVaR$, since it is a Value-at-Risk, measure it not only tells us the total co-movements of the distressed state but also allows for us to see the actual monetary impact the distressed state has on the original system.

3.1.4 Extensions and Endogeneity

We can extend the model by looking back again at Waller & Lewarne (1994) and now assuming that not all loans are repaid. They define p as the probability of loan repayment. By incorporating this into our model we would get the following maximization problem as:

$$\max_{L} = pLr_m - Dr_{CB} - \frac{q}{2}L^2 - p\$\Delta CoVaR_i L \qquad s.t.\ D = bL \tag{3.10}$$

The optimal loan supply curve would then be as follows:

$$L^* = (pr_m - br_{CB} - p\$\Delta CoVaR_i)/q \tag{3.11}$$

The first source of endogeneity comes from the probability of the loan repayment and the rate of the market (as per: Waller & Lewarne 1994). That is, a higher increase in the market rate decreases the probability of loan repayment (see: Waller & Lewarne 1994, Hodgman 1960, Stiglitz & Weiss 1981).

Assuming now that financial integration is no longer exogenous we can see a cyclical relationship form between the probability of loan repayment p and the $\$\Delta CoVaR_i$. The net shock to the system will impact the probability of loan repayment, which will in-turn impact the loan supply, effectively changing the total exposure of the system to the macroeconomic shock. This creates a cyclical effect. Furthermore, the total supply of loans and the exposure that each loan has will also show a circular effect. This becomes of a greater issue if we assume that the shock to the system also impacts the market interest rates. In essence, the greater the shock to the system the greater the effects.[14]

[14]Endogeneity within credit models is a core issue that must be taken into account. While, our model focuses on the total endogeneity of loan repayment and that of the market interest rate and the macroeconomic shock, economic theory has also shown the endogeneity of credit, money, interest rates and deposits (see: Moore 1989, Chen et al. 2014, Attila 2022).

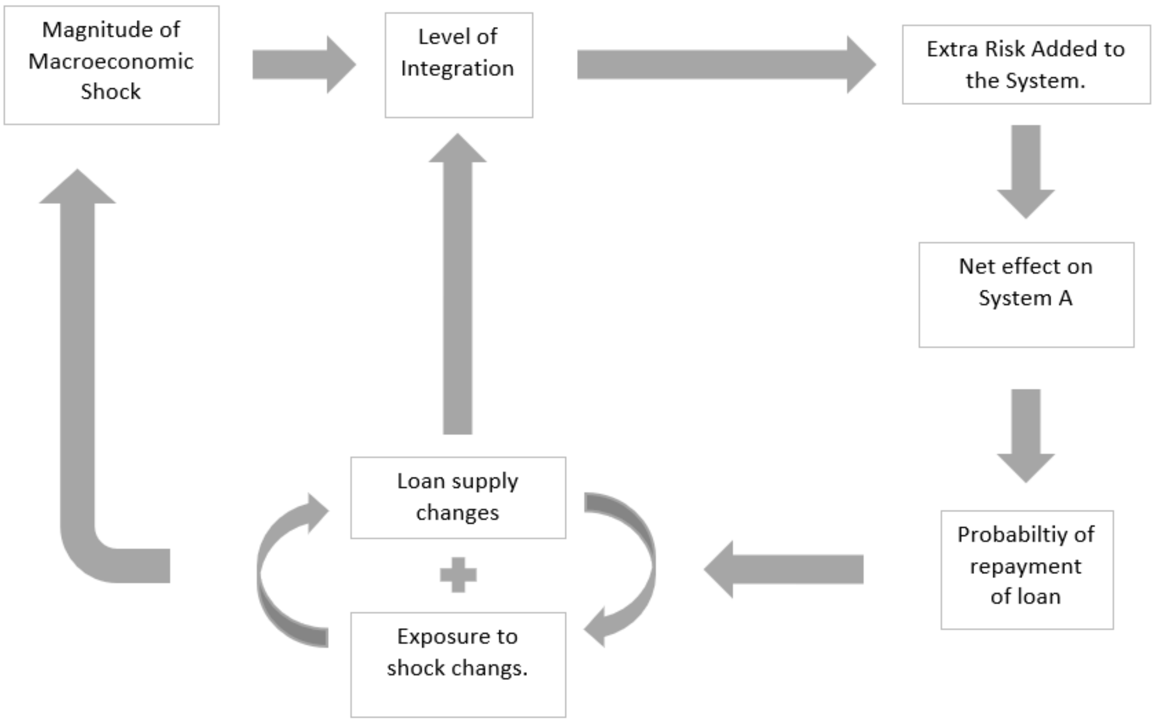

Figure 3.1: Overview of endogeneity issues within credit supply models

3.1.5 Credit Rationing Set-Up

Let us once again fundamentally follow Waller & Lewarne (1994) by explicitly accounting for our two cases of endogeneity. However, unlike Waller & Lewarne (1994) we will assume that probability of loan repayment is a function of both the net shock to the system and market interest rates such that $p = f(r_m, IM)$, with $\partial p/\partial r_m < 0$ and $\partial p/\partial IM$ being unknown. Let us also assume that r_m and IM are independent.

Assume for generality the following modified optimal supply curve:

$$L^* = (pr_m - br_{CB} + pIM)/q \tag{3.12}$$

Let us re-write this equation such that:

$$L^* = (pZ - br_{CB})/q \quad s.t.\ Z = r_m + IM \tag{3.13}$$

Where Z is a measure of the "cost-of-borrowing". We can then maximize e.q. (3.13) with respect to Z and get:

$$\frac{\partial L}{\partial Z} = \frac{p}{q}[1 + \frac{\partial p}{\partial Z}\frac{Z}{p}] \tag{3.14}$$

By taking the inverse, on the assumption that it exists, of e.q. (3.14) and assuming that all other variables are fixed we get:

$$\frac{\partial Z}{\partial L} = \frac{q}{p}[1 + \frac{\partial p}{\partial Z}\frac{Z}{p}]^{-1} = \frac{q}{p}[1 + e_p]^{-1} \tag{3.15}$$

where e_p is the loan rate elasticity of the repayment probability (as per: Waller & Lewarne 1994). If we assume that IM is zero, i.e., financial independence, then our model collapses into Waller & Lewarne (1994)'s with the probability of loan repayment being only a function of the market interest rate. Hence, as per Waller & Lewarne (1994), since by assumption $\partial p/\partial r_m < 0$ we will see a trade-off occur between an increase in interest rates (i.e., leading to greater profits) and a decrease in the probability of repayments of the loans (i.e., leading to less profits). This in turn means that there are two conflicting effects which will determine the supply curve's shape (Waller & Lewarne 1994).

Under such a scenario we can simply follow suit with Waller & Lewarne (1994), and assume that at an initially low market rate, an increase in the market rate will not cause too many borrowers to exit the market hence seeing that the effect of an increase in interest rates dominating the decrease from the elasticity. This in turn will lead to an upward sloping curve, initially, before reaching an optimal market interest rate, r_m^*, which maximizes the total loan supply curve (Waller & Lewarne 1994). After reaching r_m^*, any further increase in interest rates will cause a decrease in the total profit as now the decrease from the elasticity will outweigh that of the increase of interest rates (Waller & Lewarne 1994).

However, assuming that IM is not zero this will also not fundamentally impact this phenomenon, although now $p = f(r_m, IM)$. To see why this is the case, we must first re-write e.q. (3.13) with respect to p such that:

$$p = (Lq + br_{CB})/Z \quad s.t. \quad Z = r + IM \tag{3.16}$$

We can then take the partial derivative of e.q. (3.16) with respect to Z, which will give us the following:

$$\frac{\partial p}{\partial Z} = -(Lq + br_{CB})/(Z^2) \quad s.t. \quad Z = r_m + IM \tag{3.17}$$

From e.q. (3.17), by making the following assumptions: $Lq \geq 0$, $br_{CB} \geq 0$ and $r_m - IM > 0$ when $IM < 0$.[15] We can see that $\frac{\partial p}{\partial Z} < 0$, which allows us to maintain the same inferences as when IM is zero. From here we can see that the smaller Z is the faster p will reach zero.

In reality, financial integration is a lot more static over time (as seen from the slow-reacting trends within our $\Delta CoVaRs$), it is hence possible to assume that financial integration is constant such that IM is constant. As such, we can finally move onto understanding credit rationing and the effect of financial integration onto such.

3.1.6 Credit Rationing and Equilibrium Formation

To understand credit rationing and equilibrium formation we must first begin by assuming a downward sloping demand curve (as per: Waller & Lewarne 1994). Looking at the Figure 3.2, we can see the following three cases: Case 1: $IM = 0$; Case 2: $IM < 0$; Case 3: $IM > 0$.

Under case 1 we assume that IM is zero. We can see an equilibrium form on the backwards end of the supply curve (as per Waller & Lewarne 1994). If demand increases from "Loan Demand 1" to Loan Demand 3" and IM is still zero, a disequilibrium forms (Waller & Lewarne 1994).

[15] If the shock to the system is such that when IM is negative and greater than the market interest rate, then the bank will simply exit the market.

In Case 2, we can see that an extra cost exists on the lender and the lendee. This extra cost will result in the shifting of the supply curve to the left but will also impact how quickly the marginal revenue of the bank decreases. Given that banks must now implement higher interest rate hikes to match the same profit as before, in addition to dealing with the extra burden added to the lendees which in turn will cause them to exit the market even quicker, the loan supply curve will shift to the left and shrink. It is, thus, possible to see that unless demand also decreases to "Loan Demand 2" a disequilibrium forms. This, is in line as well from a mathematical perspective as we can see from e.q. (3.17) that the lower Z is, the faster the rate of change becomes and vice-versa.

Finally, looking at Case 3, we can see that a positive boon exists for giving loans out when the shock is positive. This positive shock means that banks can gain more than before from giving out loans and are such incentivised to do so. Furthermore, individual lendees have a higher chance to pay back their loans as they too are subject to the positiveness of the shock. This will result in a decreased rate of p resulting not only in the shifting of the curve to the right but also its expansion. Of key interest here is the fact that now if demand shifts to "Loan Demand 3" we can see that an equilibrium now forms, unlike cases 1 and 2.

This shows that financial integration can be viewed as a double edged sword in which the underlying effects of the financial system are augmented. Furthermore, our model can also incorporate negative interest rates. If we assume financial integration independence and that interest rates were negative, then the loan supply curve would be zero. However, if financial integration resulted in a positive shock that is greater than the negative interest rates, then the total return on each loan would be greater than zero, effectively still allowing for credit to be supplied.

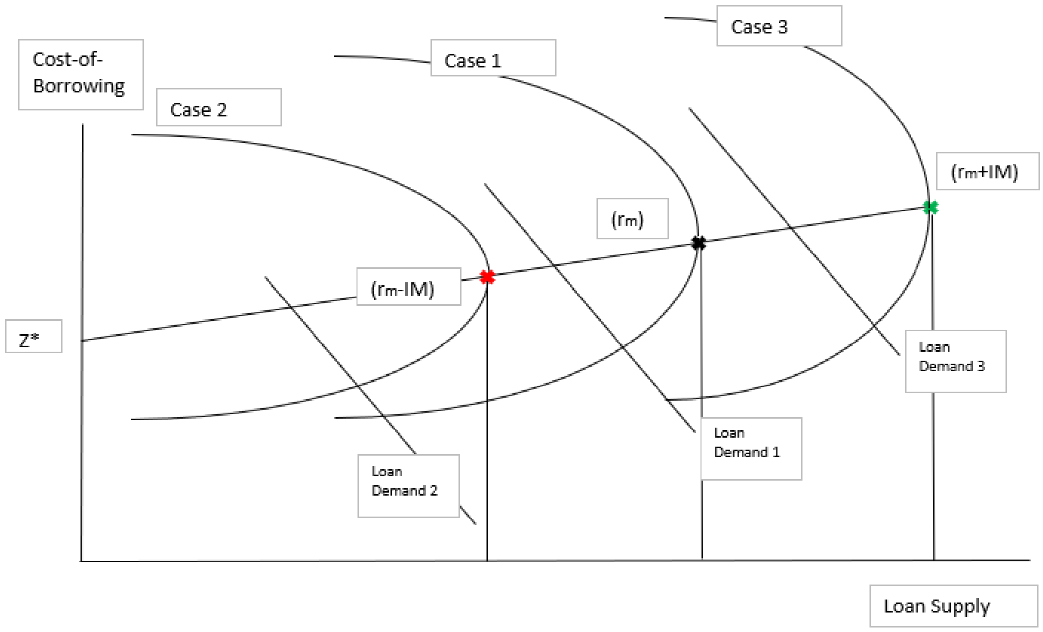

Figure 3.2: Modified Loan Supply with Endogenous Loan Payback

3.2 Empirical Foundations

In section 3.1 we laid out the theoretical background regarding the loan supply curve. Given the presence of endogeneity within our theoretical framework, we overcome this by employing a vector-error correction model (VECM).

3.2.1 Data Used for Quantifying the Impact of Financial Integration on Bank Loan Supply

We estimate a VECM model based on the key areas that impact the loan supply curve as well as the demand for loans[16]. We do not include every type of possible endogenous variable to try and keep our model as parsimonious as possible. Our choice of variables for estimation of the optimal loan supply curve can be seen in Table 3.1 below.

Bank loans supplied are a natural choice for a proxy of credit supply as they represent

[16]We do not explicitly derive the optimal demand function as this is beyond the scope of this paper and in order to keep our model parsimonious we proxy demand and supply of loans through a proxy for the equilibrium between supply and demand nonetheless.

Table 3.1: Proxy Variables used for constructing our VAR System

Variable	Proxy Variable	Series Key	Database	Unit of Measurement
Loan Supply	Loans reported by MFI excluding ESCB (stock) (Euro Area CC)	BSI.M.U2.N.A. A20.A.1.U4. 0000.Z01.E	ECB Statistical Data Warehouse	10^{12} EUR
Interest Rate	Spread between: Cost of borrowing for corporations (Euro Area CC) and Bank Interest Rates on Deposits Redeemable Up to Three Months Notice (Euro Area CC)	MIR.M.U2.B.A2I. AM.R.A. 2240.EUR.N and MIR.M.U2.B.L23. D.R.A.2250. EUR.N	ECB Statistical Data Warehouse	Percent per annum
Deposits	Household Deposits and Liabilities (Euro Area CC)	BSI.M.U2.N.A. L20.A.1.U2. 2250.Z01.E	ECB Statistical Data Warehouse	10^{12} EUR
Macroeconomic Conditions.	$\Delta CoVaR$	N/A	N/A	Percent

Note: 1) Euro Area CC refers to changing composition. 2) All data is monthly data.

a core part of most banking institutions. Bank deposits are also included as they not only provide the funding base of banks and their capacity to supply loans but also are a natural proxy for government regulation. A greater deposit base means a tighter regulatory environment. Interest rates are the key determinants of loan supply as they determine the yield of a loan and thus, the profitability of a bank.

EU loan stock captures the total amount of loans supplied at each period. This allows us to capture the equilibrium supply of loans. The spread between the cost of borrowing for corporations and the interest rates on deposits represents the spread as in e.q. (3.9). Household deposits and liabilities captures the monetary base of the bank. $\Delta CoVaR$ captures the financial integration between EU and the US.[17]

3.2.2 Sample Construction and Data Preparation

We test and identify structural breaks for our two key variables of interest, $\Delta CoVaR$ and *Loan Supply*. We test for this using first a standard F-test (as per: Zeileis 2006) to find the presence of structural breaks and then implement the algorithm developed by Zeileis et al. (2002, 2003), based on Bai & Perron (1998), for simultaneous estimation of multiple breakpoints to identify where these structural breaks occur at.

For the equity market $\Delta CoVaR$ and for the loan supply we find a structural break for both of them in 2019 (See Table 3.2). However, since both the debt market's and foreign exchange market's $\Delta CoVaR$ has no structural breaks, we instead opt to use the structural break of the loan supply curve as the starting date for all the markets to allow for increased comparability. This gives us a sample of: 2019/02/28-2023/02/28 for all our markets. Table 3.2 below gives information regarding said structural breaks.

3.2.3 Model Selection Methodology and Causality testing Approach

We follow standard procedure for model selection within time-series literature (see: Hamilton 1994). We first begin by testing all our variables for stationarity using the Phillips-Perron (Phillips & Perron 1988) test (implemented as per Trapletti et al. 2023), before using the trace version of the Johansen-test for cointegration (Johansen 1991) (implemented as per Pfaff 2008*a*). When deciding the optimal lag-length we follow a case-by-case construction. Table 3.3 below contains all the information of the models used.

We allow for a maximum of 12 months prior for all three of our markets. This is done

[17]\$$\Delta CoVaR$ is not used as we are interested in financial integration, and using \$$\Delta CoVaR$ will muddle the interpretability while not offering much in terms of forecast accuracy and causality identification.

Table 3.2: Sample Construction and Structural Breaks

Variable	Equity M.	Debt M.	FX M.	Loan Supply
No. of Structural Breaks (SB)	3	0	0	5
SB Dates:	2008(2) 2012(4) 2019(6)	N/A	N/A	2001(8) 2005(10) 2009(7) 2014(10) 2019(2)
Selected Sample Range	2019(6)- 2023(2)	2019(2)- 2023(2)	2019(2)- 2023(2)	N/A
Obv.	45	49	49	N/A

Note: 1) Structural tests implemented in accordance to Zeileis (2006), Zeileis et al. (2002, 2003), 2) 2019(2), refers to the year "2019" and the month "2" i.e., February. 3) All data is monthly data. 4) See Appendix A for the full statistical results.

Table 3.3: VECM Specifications

Variable	Equity M.	Debt M.	FX M.
Model	VECM	VECM	VECM
Cointegrating Relationships	3	2	2
Lag Length	9	9	9

Note: 1) Optimal lag length is determined using a VAR model, if the model is a VECM the optimal lag length would be n-1. 2) All data is monthly data.

given the identical sample size as well as to increase comparability across each market. In order for us to find causal relationships we first begin by fitting VECMs and finding the long-term relationships through cointegrating factors (implemented as per Stigler 2019), before formally testing for short-term relationships through orthogonal impulse response functions as well as using forecast variance error decompositions by transforming the VECMs into VAR models in levels (implemented as per Pfaff 2008*b*).

In regards to IRF analysis, since their computation is done through the Cholesky decomposition (see: Rösch et al. 2017, Bruno & Shin 2015), the ordering of the variables matters since it allows us to capture how the shock is transmitted from one variable to the next. That is, variables are affected by the variables preceding them and not variables that succeed them (see: Rösch et al. 2017, Bruno & Shin 2015). As such, we order our variables as per Rösch et al. (2017), with the slowest changing variable to the the fastest and with our variable of interest, i.e., loan supply, at the end. This gives us the following order: $\Delta CoVaR$, Interest Rate Spread, Deposits, and Loan Supply when testing for the impact that $\Delta CoVaR$ will have onto the loan supply. We also test for short-term reverse causality i.e., the impact of the loan supply onto $\Delta CoVaR$. The ordering of the variables now becomes: Loan Supply, Interest Rate Spread, Deposits, $\Delta CoVaR$.

Chapter 4

Financial Integration's Impact on Bank Loans

In the following chapter we present our results for each specific market segment examined. We give a brief overview of our findings in Table 4.1.

Table 4.1: Summary of Results

Variable	Equity M.	Debt M.	FX M.
Long-Term Relationship	Partially[1]	Yes[2]	Yes[3]
Short-Term Relationship	No	No	Yes[4]
Type of integration	LR: < 0 SR: $= 0$	LR: < 0 SR: $= 0$	LR: < 0, SR: > 0

Note: 1) Equity market VECM results showcase that one out of three of the error correction terms is statistically significant, while the FEVD analysis showcases that the Equity market $\Delta CoVaR$ is important in the medium to long run when predicting the loan supply. 2) Long-term relationships with respect to deposits and loan supply. 3) Long-term relationship with respect to interest rate spread. 4) Short-term relationship with respect to interest rate spread. 5) LR refers to long-term and SR to short-term.

4.0.1 VECM Results

We first begin by looking towards the diagnostics of our VECM outputs. Table 4.2 contains an overview of such. We initially see that all our models exhibit the same

Table 4.2: Diagnostic Table Results

Variable	Equity M.	Debt M.	FX M.
Autocorrelation	Yes	Yes	Yes
ARCH effects	No	No	No
Normal Residuals	Yes	Yes	Yes

Note: For further details regarding the statistical tests implemented and results see Appendix F.

characteristics. They all suffer from autocorrelation but exhibit no ARCH effects or no non-normality. This still allows us to draw inferences, albeit in a restricted manner. Furthermore, given the a-priori assumption of endogeneity within the model, the results from the VECM regressions should be looked at with caution. Nonetheless, they give us a good indicator of initial relationships between the endogenous variables.

Loan Equation

Upon first examining the loan supply equation of the VECM we observe that only the debt market exhibits a long-term statistically significant relationship with the system. This suggests that an equilibrium can be formed in the long-run when the shock is from the debt market. Interestingly, the equity market exhibits weak significance for one of the error correction terms but no statistically significant relationship for the other error correction terms.

Looking towards the impact of the lagged values on the loan supply we find that in both the equity and debt market a statistically significant relationship exists between the loan supply and all the other variables of interest. This suggests that a short-run relationship might also exist between the equity and debt market with regards to the loan supply respectively, even in the absence of a strong long-term relationship with the equity market.

In contrast to this, the FX market showcases that the loan supply is independent from both any long-term relationships but also of any short term relationships.

ΔCoVaR Equation

In regards to long term relationships between $\Delta CoVaRs$, none of the markets exhibit long-term relationships nor are indicative of any short term relationships. This observation suggests that financial integration may be exogenous to the factors affecting the loan supply curve.

Interest Spread Equation

When analysing the interest rate spread equations, we notice a divergence in results across the markets. In particularly, while both the equity and debt market indicate no long-term or short-term relationships, in the FX market we notice a long-term relationship form. Furthermore, we see that all the lagged values are statistically significant.

This result provides evidence of the existence of distinct channels of impact that financial integration can have. The FX market's $\Delta CoVaR$ impacts the spread positively implying the greater the risk the greater the spread. This in turn, consistent with our prior results and theoretical framework, indicates that loan supply should increase.

Deposit Equation

Finally examining the deposit equation, we find that only the debt market exhibits a long-term relationship with the system. Furthermore, in particularly with respect to $\Delta CoVaR$, we can see a negative relationship between the risk and the deposits. The negative $\Delta CoVaR$ implies that an increase in the system's value results in a total amount of deposits decrease. This could suggest that as the system becomes richer, individuals prefer to spend over save money. In turn, this could imply that loan supply decreases indirectly as the bank's monetary base decreases.

From our results we can see a conflicting amount of evidence for financial integration homogeneity. This implies that we should not be looking at financial integration as a static concept but rather as a dynamic one. To ensure that our results are robust, we then move onto IRF and FEVD analysis.

4.0.2 IRF Results

Looking at Figure 4.1 and 4.2 we see that we find no short-term statistically significant relationships between ΔCoVaR and the loan supply for both the equity and the debt market respectively. When testing for reverse causality by changing the order of the variables to: Loan Supply, Interest Rate Spread, Deposits, $\Delta CoVaR$ and still find no causal evidence. Furthermore, we find no other form of relationships with respect of the impact that $\Delta CoVaR$ has on the other endogenous variables. This suggests an absence of any short-term relationships.

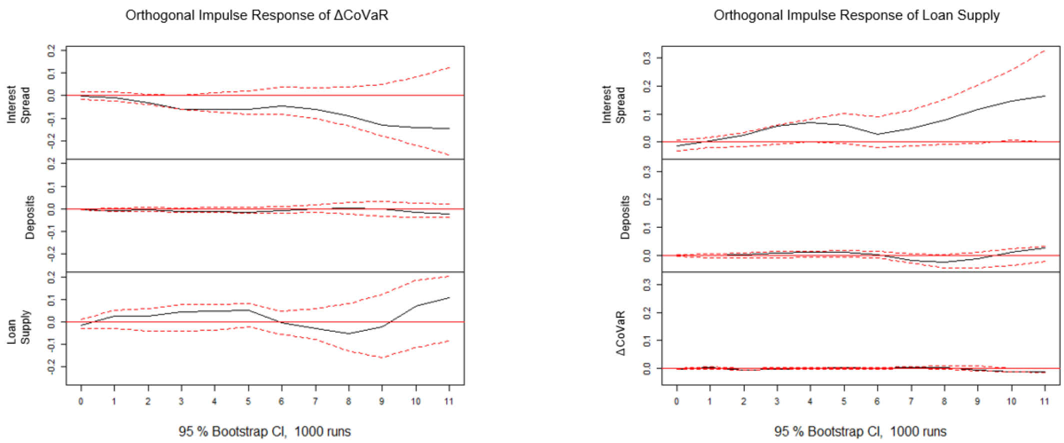

Figure 4.1: Equity Market Impulse Response Function

Note: 1) The black segment is the impulse response function's result on each specified variable. 2) The red dotted lines represent the upper and lower 95% confidence intervals respectively. 3) The confidence intervals and the IRF are bootstrapped a total of 1000 times. 4) All calculations are done as per Pfaff (2008*b*).

When looking towards the FX market we find that while the $\Delta CoVaR$ does not impact the loan supply directly it does in fact negatively impact the interest rate spread and thus impacts the loan supply indirectly. These short-term relationships, as well as the the longer-relationship noticed within the system, give further evidence of the indirect impact that FX $\Delta CoVaR$ has on the loan supply. Interestingly, while the long-term equilibrium relationship seems to be a positive one, the short-term relationship is clearly

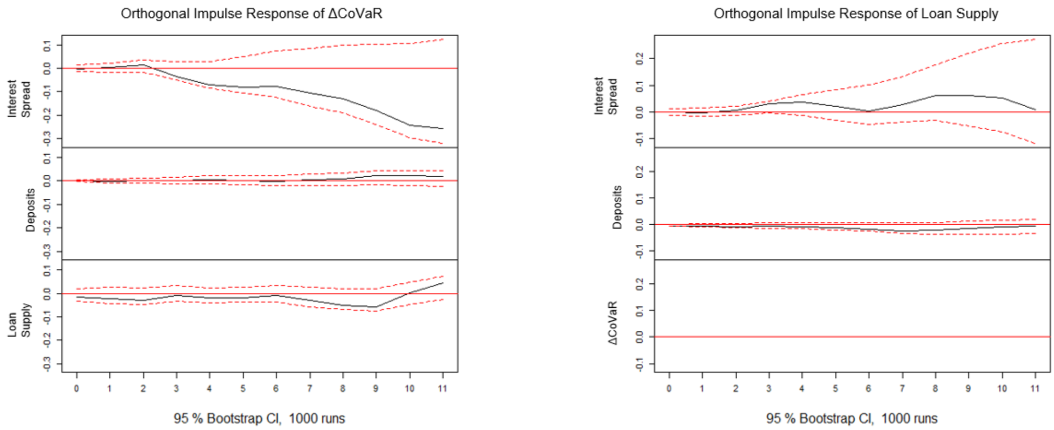

Figure 4.2: Debt Market Impulse Response Function

Note: 1) The black segment is the impulse response function's result on each specified variable. 2) The red dotted lines represent the upper and lower 95% confidence intervals respectively. 3) The confidence intervals and the IRF are bootstrapped a total of 1000 times. 4) All calculations are done as per Pfaff (2008*b*).

negative. This suggests that in the short-term banks drop their interest rate spread and thus profitability to maintain borrowers within the market before gradually increasing their spread across time to make-up for the extra risk added to the system.

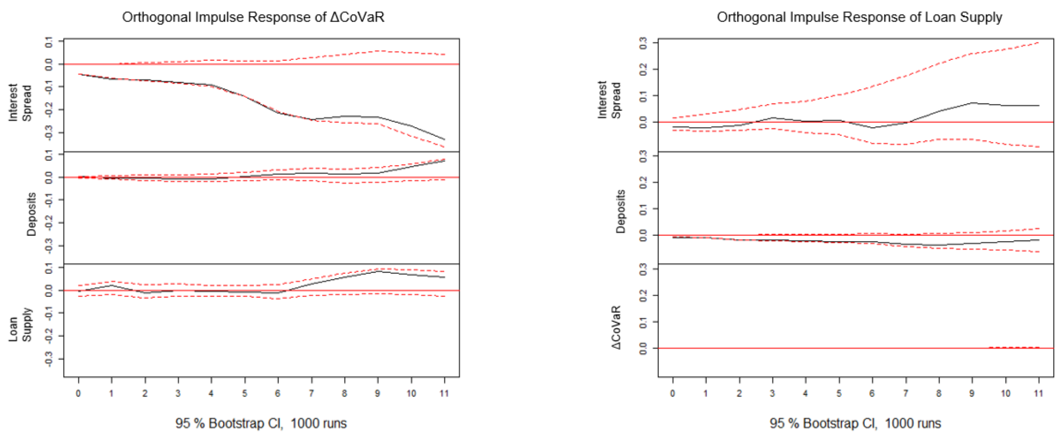

Figure 4.3: FX Market Impulse Response Function

Note: 1) The black segment is the impulse response function's result on each specified variable. 2) The red dotted lines represent the upper and lower 95% confidence intervals respectively. 3) The confidence intervals and the IRF are bootstrapped a total of 1000 times. 4) All calculations are done as per Pfaff (2008*b*).

4.0.3 FEVD Results

In order for us to cement the robustness of our previous findings, we also employ a FEVD analysis. Table 4.3 showcases the aggregate results with respect to the loan supply. Looking towards to the equity market we see that it plays an important role in the prediction of the loan supply curve in particularly with respect to the medium term i.e., the second and third quarter.

The debt market on the other hand showcases an increasing importance relative to the other endogenous variables as the quarters move on. This is consistent with our previous results of a long-term relationship.

The FX market exhibits similar patterns with that of the debt market albeit more extreme. We notice almost no significant contribution in the short to medium term before a sudden spike in the last quarter.

Table 4.3: FEVD Aggregated Results with respect to Loan Supply

Quarter	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
Equity Market				
1	0.24	0.43	0.3	0.03
2	0.37	0.35	0.11	0.16
3	0.34	0.34	0.13	0.19
4	0.24	0.43	0.1	0.23
Debt Market				
1	0.08	0.1	0.46	0.36
2	0.14	0.13	0.45	0.29
3	0.15	0.22	0.38	0.24
4	0.25	0.24	0.32	0.19
FX Market				
1	0.04	0.01	0.67	0.27
2	0.06	0.02	0.68	0.25
3	0.1	0.09	0.59	0.22
4	0.32	0.17	0.35	0.15

Note: 1) FEVD implemented as per Pfaff (2008*b*). 2) "Quarter" refers to three months. 3) The values represent the percentage that each variable explains the variations in the key variable in question. 4)See appendix H for full results.

Table 4.4, showcases our aggregate results with respect to the $\Delta CoVaR$. The equity market showcases that the interest rate spread and the loan supply are the greatest explainers of the variance even though we notice no significant short-term or long-term relationships in our previous results.

The debt and FX market, however, exhibit different results. We can see that for the debt market, $\Delta CoVaR$ itself followed by deposits are the highest contributing variables, while for the FX market this is $\Delta CoVaR$ and the interest rate. This is further evidence for the relationship between FX market and interest rates.

Table 4.4: FEVD Aggregated Results with respect to $\Delta CoVaR$

Quarter	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
Equity Market				
1	0.14	0.39	0.03	0.44
2	0.34	0.36	0.06	0.24
3	0.28	0.38	0.07	0.26
4	0.23	0.4	0.07	0.3
Debt Market				
1	0.82	0.08	0.07	0.03
2	0.52	0.21	0.19	0.08
3	0.36	0.27	0.29	0.08
4	0.37	0.26	0.28	0.09
FX Market				
1	0.86	0.12	0	0.02
2	0.67	0.3	0.01	0.03
3	0.68	0.25	0.02	0.05
4	0.64	0.29	0.03	0.04

Note: 1) FEVD implemented as per Pfaff (2008*b*). 2) "Quarter" refers to three months. 3) The values represent the percentage that each variable explains the variations in the key variable in question. 4)See appendix H for full results.

Looking towards the interest spread we can see that for all the markets the $\Delta CoVaR$ best explains the variance in the market. Followed by the loan supply for the equity and debt market but not for the FX market. Here, we notice that the rest of the contribution is spread out thinly between the lagged interest spread, deposits and the loan supply.

Finally, with regard to deposits we notice a similar pattern for all markets, where the

Table 4.5: FEVD Aggregated Results with respect to Interest Spread

Quarter	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
Equity Market				
1	0.11	0.82	0.02	0.05
2	0.5	0.14	0.02	0.34
3	0.49	0.11	0.05	0.35
4	0.55	0.06	0.04	0.36
Debt Market				
1	0.03	0.95	0	0.02
2	0.47	0.29	0.05	0.19
3	0.61	0.17	0.04	0.18
4	0.74	0.05	0.03	0.18
FX Market				
1	0.54	0.46	0.01	0
2	0.62	0.24	0.09	0.05
3	0.63	0.2	0.11	0.06
4	0.62	0.15	0.14	0.08

Note: 1) FEVD implemented as per Pfaff (2008*b*). 2) "Quarter" refers to three months. 3) The values represent the percentage that each variable explains the variations in the key variable in question. 4)See appendix H for full results.

lagged variables of the deposit best explains itself, however, we notice a divergence in the other endogenous variables.

For the equity market we notice that the $\Delta CoVaR$ offers the second best contribution overall. For the debt market this is the interest rate spread, while for the FX market this is the loan supply.

4.0.4 Empirical Conclusions

Our results and tests showcase mixed results with respect to the impact of financial integration on the EU loan supply. The lack of a long-term relationship with the loan supply with regards to the equity and FX market is in line with Leblebicioğlu (2009) and Gilje et al. (2016) who find that financial frictions cause shocks to eventually die out. However, the long-term relationship noticed in the debt market and the long-term relationship that the FX market has with the interest spread is in contrast to this. Furthermore, the weak

Table 4.6: FEVD Aggregated Results with respect to Deposits

Quarter	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
Equity Market				
1	0.24	0.43	0.3	0.03
2	0.37	0.35	0.11	0.16
3	0.34	0.34	0.13	0.19
4	0.24	0.43	0.1	0.23
Debt Market				
1	0	0.28	0.71	0
2	0.01	0.37	0.6	0.02
3	0.01	0.24	0.66	0.08
4	0.12	0.16	0.58	0.14
FX Market				
1	0.03	0.05	0.89	0.03
2	0.07	0.11	0.73	0.1
3	0.08	0.04	0.72	0.16
4	0.18	0.06	0.6	0.17

Note: 1) FEVD implemented as per Pfaff (2008*b*). 2) "Quarter" refers to three months. 3) The values represent the percentage that each variable explains the variations in the key variable in question. 4)See appendix H for full results.

evidence that the equity market may also have a medium term relationship with the loan supply further adds doubts to the results that shocks may die out completely without having any structural effect.

With regards to the actual impact, we notice that in the long run both the debt and the equity market exhibit a positive relationship between their respective $\Delta CoVaR$ and the loan supply, even if the debt $\Delta CoVaR$ only showcases true significant results. That is, the greater the risk to the system the greater the loan supply. Intuitively, this is simply tied to two core reasons. Firstly, the extra cost to the system should have decreased the marginal revenue of each loan issued and as such banks issue more loans to try and recuperate some revenue back, and secondly, in reality the probability of default is tied to each loan rather than assuming that each loan has the same default probability. By increasing loan supply, banks may be in actuality hedging bad loans.

Furthermore, we also a notice a positive relationship between the FX market's $\Delta CoVaR$

and the interest rate spread, this suggest that banks in the long-run try to increase their profit margin by increasing the marginal revenue per loan. This, might also explain as to why an increase in the system risk causes the loan supply to rise.

In regards to the short-run, we find that only the FX market has any significant impact and that is only attributed to the interest rate spread. Unlike the long-run we see that interest rates decrease in the immediate short-term, most likely in an attempt to try and ensure that borrowers who are also impacted by the market do not exit. In regards to our theoretical framework this is identical to a decrease in p which is off-set by a decrease in r_m.

Looking towards our theoretical framework focusing on the long-term this might initially seem to be in contrast to it, however, if we assume that a shock to the $\Delta CoVaR$ also causes a positive shock to the interest rate spread, then the net effect will determine the total loan-supply. Since we notice that the equilibrium in loan-supply increases, the increase in interest rates dominates the decrease due to $\Delta CoVaR$, ensuring that Z increases. This is thus, consistent with Case 3. While, if we look towards the short run and assume that an increase in the $\Delta CoVaR$ also results in a decrease in the market interest rate then we move towards Case 2, i.e., a shift to the left and downwards.

Finally, we find no evidence of reverse causality between the $\Delta CoVaRs$ and the loan supply.

Chapter 5

Concluding Thoughts

Understanding financial integration remains a central issue in finance, but while several attempts at quantifying financial integration have been proposed, little has changed when trying to quantify distressed financial integration. Furthermore, while financial integration has been studied, its explicit incorporation within theoretical economic models as well as the empirical evidence for these models has seen limited research. We address these gaps in the literature by re-imagining Adrian & Brunnermeier (2016)'s $\Delta CoVaR$, reconciling it with standard asset pricing literature (Lewellen & Nagel 2006, Cochrane 2009) and microeconomic theory (Waller & Lewarne 1994), and employing it in empirical analysis with regards to its impact on the supply of loans within the EU.

We show that the the EU financial system is not financially independent from US acute shocks with regards to the supply of loans. We find that there is a long-term relationship among loan supply and the debt market. Furthermore, we find that the FX market has a long-run relationship with the interest rate spread showcasing its indirect impact on the loan supply. The equity market exhibits weak long-term relationships with the loan-supply, but of similar relationships with the debt market.

In the short-run we find that only the FX market showcases a short-run relationship with only the interest rate spread albeit with an opposite effect to its long-term relationship.

Overall, our results are in support of that of Gilje et al. (2016) who finds that financial integration increases the supply of loans, notwithstanding they do so with positive shocks, as well as with Leblebicioğlu (2009) who finds that financial integration results in greater variability within the market and finally with Cornett et al. (2011) who finds that even in times of financial crisis lending can still continue.

We can see that financial integration is inherently dynamic and not all markets would react accordingly. Recognizing that acute financial shocks are just as important as normal shocks must be a priority for policy-makers who regulate mandatory safeguards for financial institutions.

Our result are of acute financial shocks rather than simple shocks to the system. The fact that the shocks are acute may fundamentally change the underlying assumptions of our theoretical framework resulting in non-optimal behaviour to be expressed. Behavioural models might help better explain the mixed reactions we find. We leave this for future research.

Appendix

A

Table 5.1: Structural Break Chow Test Results

Variable	Equity M.	Debt M.	FX M.	Loan Supply
F-Stat.	15	3.4859	10.591	1412.4
P-Value	0.005***	0.7458	0.04289	< 2.2e-16***
Struc. Break.	Yes	No	No	Yes

Note: 1) Structural tests implemented in accordance to Zeileis (2006), Zeileis et al. (2002, 2003). 2) Given the wide variety of structural break tests, as well as their sensitivities to different parameters, we only reject H0 for P-value<0.01. 3) "***" $p < 0.01$, "**" $p = 0.01$, "*" $p \leq 0.05$, "." $p \leq 0.1$.

B

Table 5.2: Stationarity Tests per Sample Market

Variable	Equity M.	Debt M.	FX M.
$\Delta CoVaR$	-5.0741*** (< 0.01)	-7.9714*** (< 0.01)	-5.5182*** (< 0.01)
Loan Supply	-3.3729 (0.07091)	-3.3729 (0.07091)	-3.3729 (0.07091)
Interest Spread	0.43805 (0.99)	0.43805 (0.99)	0.43805 (0.99)
Deposits	-0.15751 (0.99))	-0.15751 (0.99)	-0.15751 (0.99)

Note: 1) Implemented as per Trapletti et al. (2023). 2) H0: Non-stationary, Alt. H: Stationary. 3) Values refer to the Phillips-Perron coefficients and the values in the parenthesis are the respective p-values. 4) "***" $p < 0.01$, "**" $p = 0.01$, "*" $p \leq 0.05$, "." $p \leq 0.1$.

Table 5.3: First Differences Stationarity Tests per Sample Market

Variable	Equity M.	Debt M.	FX M.
Loan Supply	-5.4227*** (< 0.01)	-5.6969*** (< 0.01)	-5.6969*** (< 0.01)
Interest Spread	-5.4227*** (< 0.01)	-5.6969*** (< 0.01)	-5.6969*** (< 0.01)
Deposits	-5.9628*** (< 0.01)	-6.2444*** (< 0.01)	-6.2444*** (< 0.01)

Note: 1) Implemented as per Trapletti et al. (2023). 2) H0: Non-stationary, Alt. H: Stationary. 3) Values refer to the Phillips-Perron coefficients and the values in the parenthesis are the respective p-values. 4) "***" $p < 0.01$, "**" $p = 0.01$, "*" $p \leq 0.05$, "." $p \leq 0.1$.

C

Table 5.4: Optimal Lag-length

Information Criterion	Equity M.	Debt M.	FX M.
AIC	9	9	9
HQ	9	9	9
SC	9	9	9
FPE	10	10	10

Note: 1) Lag selection was executed and implemented in accordance to Pfaff (2008*b*), 2) lag selection was done based on the most recommended lag length, 3) "AIC" refers to the Akaike information criterion (IC), "HQ" refers to the Hannan-Quinn IC, "SC" refers to the Schwarz IC and "FPE" refers to the forecast prediction error (see: Pfaff 2008*b*).

D

Table 5.5: Johansen Procedure

Variable	Equity M.	Debt M.	FX M.	Test Stat
r≤3	12.26*	7.15	8.87	9.24
r≤2	33.55	25.13*	37.39*	19.96
r≤1	82.85	56.05	86.51	34.91
r≤0	180.70	114.46	163.91	53.12

Note: 1) Implemented as per Pfaff (2008*a*), 2) Variables represent the Johansen test statistic, while the variables in the parenthesis are the 5% critical values, 3) This test was run without a linear trend and constant in cointegration, 4) * marks the level of cointegrating relations.

E

Table 5.6: VECM Results Equity Market.

Variable	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
ECT1	0.1512(2.7226)	5.4399(18.9096)	6.4359(3.3319)	-45.68(16.66).
ECT2	-0.0323(0.3053)	-3.4799(2.1204)	-0.3792(0.3736)	3.5891(1.8679)
ECT3	-0.0221(0.0329)	-0.4525(0.2282)	-0.0475(0.0402)	0.4120(0.2010)
Intercept	0.5762(1.5596)	14.55(10.83)	3.6051(1.9087)	-27.45(9.54)*
Loans -1	0.2134(0.3071)	1.8278(2.1333)	0.7593(0.3759)	-5.8733(1.8793)*
Loans -2	0.0140(0.3487)	2.8783(2.4216)	0.8725(0.4267)	-7.2211(2.1334)*
Loans -3	0.2393(0.3228)	3.1577(2.2418)	0.6051(0.3950)	-5.0718(1.9749).
Loans -4	-0.0885(0.2602)	3.1526(1.8069)	0.3974(0.3184)	-4.5757(1.5918)*
Loans -5	0.0294(0.2211)	1.3512(1.5355)	-0.1457(0.2705)	-0.6904(1.3527)
Loans -6	-0.2832(0.1520)	-0.0277(1.0559)	-0.2796(0.1860)	1.0161(0.9302)
Loans -7	0.0048(0.1737)	-0.8122(1.2066)	-0.5354(0.2126).	2.6778(1.0629).
Loans -8	-0.1446(0.1628)	-0.7868(1.1310)	-0.2639(0.1993)	1.8033(0.9963)
$\Delta CoVaR$ -1	-0.4489(3.0051)	-9.0429(20.8718)	-7.7267(3.6776)	57.3685(18.3873)*
$\Delta CoVaR$ -2	-1.7210(3.2565)	-12.7957(22.6176)	-7.5328(3.9852)	57.2257(19.9252)*
$\Delta CoVaR$ -3	-0.9196(3.0239)	-17.4475(21.0023)	-7.3892(3.7006)	58.0507(18.5022)*
$\Delta CoVaR$ -4	-1.4392(2.7520)	-19.3483(19.1140)	-5.7569(3.3679)	46.7270(16.8387).
$\Delta CoVaR$ -5	-0.4082(2.0922)	-18.1213(14.5310)	-4.2349(2.5604)	35.8059(12.8012)*
$\Delta CoVaR$ -6	-0.4222(1.5296)	-11.8650(10.6240)	-1.9182(1.8720)	18.8890(9.3593)
$\Delta CoVaR$ -7	0.6889(0.8114)	-4.7391(5.6352)	-0.7969(0.9929)	8.5507(4.9644)
$\Delta CoVaR$ -8	-0.0162(0.5415)	-0.7438(3.7608)	-0.0301(0.6627)	1.4451(3.3131)
Interest Spread -1	0.0093(0.3503)	3.1650(2.4331)	0.8652(0.4287)	-6.3431(2.1435)*
Interest Spread -2	0.3036(0.5039)	4.9636(3.5001)	1.0994(0.6167)	-8.5975(3.0835)*
Interest Spread -3	0.1707(0.5258)	5.7698(3.6519)	1.1283(0.6435)	-9.0887(3.2172)*
Interest Spread -4	0.1491(0.5081)	5.9393(3.5292)	0.6426(0.6219)	-6.7449(3.1091).
Interest Spread -5	-0.0814(0.3746)	4.3627(2.6020)	-0.1778(0.4585)	-1.3539(2.2923)
Interest Spread -6	-0.1582(0.4595)	2.0142(3.1913)	-1.0804(0.5623)	5.9334(2.8114)
Interest Spread -7	-0.3403(0.5581)	-0.5520(3.8764)	-1.3354(0.6830)	8.4771(3.4150).
Interest Spread -8	-0.2969(0.3975)	-1.5974(2.7610)	-0.6140(0.4865)	5.2070(2.4323).
Deposits -1	-0.0782(0.5885)	-4.0671(4.0875)	-1.3990(0.7202)	8.8875(3.6010).
Deposits -2	-0.5558(0.3578)	-0.7614(2.4853)	-0.2768(0.4379)	2.8802(2.1894)
Deposits -3	0.6477(0.2954).	0.8008(2.0514)	-0.6474(0.3615)	5.0852(1.8072)*
Deposits -4	-0.4394(0.4152)	1.1049(2.8837)	-0.3459(0.5081)	0.8397(2.5404)
Deposits -5	-0.0275(0.3807)	-1.1622(2.6444)	-0.8783(0.4659)	4.5884(2.3296)
Deposits -6	-0.5952(0.4845)	-1.6603(3.3649)	-0.9691(0.5929)	6.9339(2.9644).
Deposits -7	0.4813(0.5344)	-2.4349(3.7113)	-1.6359(0.6539).	10.4897(3.2695)*
Deposits -8	-0.5921(0.5545)	-2.9555(3.8509)	-0.7174(0.6785)	4.4908(3.3925)

Note: 1) VECMs implemented as per Stigler (2019). 2) Each column represents the VECM regression with respect to each key variable of interest as the dependent variable. 3) "Variable Name -n" refers to the differenced lag variable of time period n. 4) Variables in the parenthesis are the standard errors. 5) "***" $p \leq 0.001$, "**" $p \leq 0.01$, "*" $p \leq 0.05$, "." $p \leq 0.1$.

Table 5.7: VECM Results Debt Market.

Variable	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
ECT1	-0.03(1.069)	2230.131(8415)	3783.758(923.3)**	-17083.751(3910)**
ECT2	1.0e-05(3.3e-05)	-0.093(0.260)	-0.103(0.029)*	0.514(0.121)**
Intercept	0.0006(0.0004)	-1.3116(2.799)	1.409(0.307)**	-2.740(1.30).
Loans -1	0.0001(8.2e-05)	-0.2816(0.6417)	0.3091(0.0704)**	-1.4132(0.2981)**
Loans -2	0.0002(8.4e-05).	0.0944(0.6588)	0.2718(0.0723)*	-1.1382(0.3061)*
Loans -3	0.0001(8.7e-05)	0.4902(0.6875)	0.2758(0.0754)*	-1.1984(0.3194)*
Loans -4	0.0001(7.3e-05)	-0.0459(0.5734)	0.0906(0.0629)	-0.9158(0.2664)*
Loans -5	8.5e-06(6.6e-05)	0.3035(0.5225)	0.0883(0.0573)	-1.9555(0.2427)***
Loans -6	6.0e-06(0.0001)	0.1617(0.8299)	-0.0133(0.0911)	-1.1966(0.3856)*
Loans -7	2.3e-05(7.1e-05)	0.4934(0.5608)	-0.1268(0.0615).	-0.9644(0.2606)*
Loans -8	2.0e-05(9.9e-05)	0.2701(0.7799)	-0.0751(0.0856)	-0.4482(0.3623)
$\Delta CoVaR$ -1	-1.1112(1.156)	-1569(9099.7165)	-4131(998.366)**	16413(4227)*
$\Delta CoVaR$ -2	-1.269(1.179)	2533(9279)	-4192(1018)**	14418(4311)*
$\Delta CoVaR$ -3	-1.485(1.24)	-1467(9726)	-4609(1067)**	17672(4519)*
$\Delta CoVaR$ -4	-1.581(1.239)	-3899(9754)	-4183(1070)*	16425(4531)*
$\Delta CoVaR$ -5	-0.998(1.054)	-3475(8295)	-3304(910)*	15561(3854)**
$\Delta CoVaR$ -6	-0.649(0.843)	-2155(6638)	-2321(728)*	14733(3084)**
$\Delta CoVaR$ -7	0.0275(0.698)	-3319(5496)	-1964(603)*	14833(2553)**
$\Delta CoVaR$ -8	-0.0412(0.479)	-1082(3773)	-1234(414)*	9752(1753)**
Interest Spread -1	-7.0e-06(7.7e-05)	0.2111(0.6047)	0.3507(0.0663)**	-1.1595(0.2809)**
Interest Spread -2	0.0002(9.8e-05)	0.2871(0.7699)	0.2295(0.0845)*	-0.1041(0.3577)
Interest Spread -3	8.4e-05(0.0001)	0.1601(0.8437)	0.2354(0.0926).	-0.3940(0.3920)
Interest Spread -4	6.4e-05(9.5e-05)	-0.3027(0.7509)	0.0404(0.0824)	-0.1362(0.3488)
Interest Spread -5	-9.4e-05(1.0e-04)	0.2914(0.7865)	0.0438(0.0863)	-1.5969(0.3654)**
Interest Spread -6	2.6e-05(0.0001)	0.3445(1.0395)	-0.1068(0.1140)	-1.0267(0.4829).
Interest Spread -7	-5.8e-05(9.9e-05)	0.4696(0.7825)	-0.1312(0.0858)	-1.1025(0.3635)*
Interest Spread -8	-5.5e-05(0.0001)	-0.3159(0.9982)	0.1360(0.1095)	-1.4322(0.4637)*
Deposits -1	-0.0002(0.0003)	-0.7173(2.1560)	-0.1085(0.2365)	-3.6997(1.0016)*
Deposits -2	-5.1e-05(0.0002)	1.1235(1.8146)	0.0338(0.1991)	-0.1382(0.8430)
Deposits -3	0.0002(0.0002)	2.0505(1.5603)	-0.3320(0.1712)	1.5860(0.7249).
Deposits -4	5.1e-05(0.0002)	-0.3406(1.8775)	-0.3271(0.2060)	0.5613(0.8723)
Deposits -5	-0.0003(0.0002)	-1.5187(1.6373)	-0.0895(0.1796)	-0.7620(0.7607)
Deposits -6	-0.0004(0.0003)	0.9998(1.9811)	0.0101(0.2174)	-1.7575(0.9204)
Deposits -7	0.0003(0.0003)	1.1028(2.2477)	-0.6180(0.2466).	-0.2135(1.0442)
Deposits -8	-0.0002(0.0003)	0.2499(2.4389)	-0.4010(0.2676)	-0.0746(1.1331)

Note: 1) VECMs implemented as per Stigler (2019). 2) Each column represents the VECM regression with respect to each key variable of interest as the dependent variable. 3) "Variable Name -n" refers to the differenced lag variable of time period n. 4) Variables in the parenthesis are the standard errors. 5) "***" p $\leq$ 0.001, "**" p $\leq$ 0.01, "*" p $\leq$ 0.05, "." p $\leq$ 0.1.

Table 5.8: VECM Results FX Market.

Variable	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
ECT1	-0.1359(1.58)	-218.34(36.43)**	-6.0135(9.68)	70.6990(75.68)
ECT2	-0.0092(0.03)	-3.3464(0.663)**	0.0104(0.176)	0.6266(1.378)
Intercept	0.0451(0.117)	12.92(2.703)**	-0.1012(0.718)	-1.7647(5.615)
Loans -1	0.0085(0.015)	0.3328(0.34)	-0.1421(0.091)	0.1493(0.713)
Loans -2	-0.0050(0.013)	1.2438(0.2922)**	-0.1952(0.0777).	0.0371(0.6071)
Loans -3	-0.0030(0.0151)	0.9340(0.3466)*	-0.0588(0.0921)	-0.3484(0.7201)
Loans -4	0.0074(0.0134)	0.6602(0.3075).	-0.2326(0.0817)*	-0.0348(0.6389)
Loans -5	-0.0236(0.0167)	1.3463(0.3839)*	-0.2254(0.1020).	-0.7860(0.7975)
Loans -6	-0.0142(0.0226)	-0.3407(0.5200)	-0.2544(0.1382)	0.7707(1.0802)
Loans -7	-0.0182(0.0192)	-0.3788(0.4428)	-0.1765(0.1177)	-0.0837(0.9199)
Loans -8	0.0176(0.0214)	-1.8079(0.4915)*	-0.0327(0.1306)	0.6091(1.0211)
$\Delta CoVaR$ -1	-0.86(1.25)	157.1(28.85)**	2.56(7.67)	-33.31(59.93)
$\Delta CoVaR$ -2	-0.68(0.94)	102.80(21.54)**	4.15(5.72)	-32.90(44.74)
$\Delta CoVaR$ -3	0.54(0.67)	39.44(15.39).	4.40(4.09)	-7.96(31.97)
$\Delta CoVaR$ -4	0.37(0.82)	80.89(18.97)**	3.61(5.04)	-20.15(39.41)
$\Delta CoVaR$ -5	0.17(0.87)	95.26(19.96)**	4.98(5.30)	-20.21(41.46)
$\Delta CoVaR$ -6	-0.39(0.92)	88.06(21.12)**	5.63(5.61)	-37.36(43.87)
$\Delta CoVaR$ -7	-0.17(0.67)	44.29(15.47)*	-1.69(4.11)	-11.12(32.14)
$\Delta CoVaR$ -8	-0.2680(0.3889)	27.8264(8.9505)*	-3.8642(2.3789)	-5.0386(18.5944)
Interest Spread -1	0.0068(0.0262)	2.3507(0.6022)*	0.0517(0.1600)	-0.4733(1.2510)
Interest Spread -2	0.0316(0.0254)	2.3665(0.5842)**	-0.0558(0.1553)	0.2559(1.2137)
Interest Spread -3	0.0315(0.0344)	3.7549(0.7906)**	0.0770(0.2101)	-0.8862(1.6425)
Interest Spread -4	0.0256(0.0420)	5.1208(0.9670)**	-0.2067(0.2570)	-0.4525(2.0089)
Interest Spread -5	-0.0116(0.0474)	6.5255(1.0907)**	-0.2695(0.2899)	-1.3830(2.2660)
Interest Spread -6	-0.0137(0.0433)	5.2556(0.9969)**	-0.1670(0.2649)	-1.2726(2.0710)
Interest Spread -7	-0.0350(0.0375)	4.2175(0.8640)**	-0.1005(0.2296)	-1.7611(1.7949)
Interest Spread -8	-0.0253(0.0270)	1.3446(0.6212).	0.2152(0.1651)	-1.4155(1.2906)
Deposits -1	-0.0202(0.0596)	-2.1262(1.3726)	0.1034(0.3648)	-1.3164(2.8516)
Deposits -2	-0.0092(0.0394)	-1.3419(0.9063)	-0.0673(0.2409)	1.5184(1.8828)
Deposits -3	-0.0020(0.0359)	0.6224(0.8254)	-0.1872(0.2194)	0.2840(1.7148)
Deposits -4	0.0576(0.0333)	-0.7443(0.7672)	0.0193(0.2039)	-0.1200(1.5938)
Deposits -5	-0.0455(0.0398)	3.7605(0.9154)**	0.2016(0.2433)	-3.4443(1.9016)
Deposits -6	-0.0488(0.0402)	1.4474(0.9260)	-0.2710(0.2461)	0.6882(1.9237)
Deposits -7	-0.0428(0.0408)	-0.3606(0.9389)	-0.1913(0.2495)	-0.5821(1.9505)
Deposits -8	0.0343(0.0436)	-5.01(1.01)**	0.2696(0.2670)	-0.2633(2.0869)

Note: 1) VECMs implemented as per Stigler (2019). 2) Each column represents the VECM regression with respect to each key variable of interest as the dependent variable. 3) "Variable Name -n" refers to the differenced lag variable of time period n. 4) Variables in the parenthesis are the standard errors. 5) "***" $p \leq 0.001$, "**" $p \leq 0.01$, "*" $p \leq 0.05$, "." $p \leq 0.1$.

F

Table 5.9: Diagnostic Tests for Equity Market

Test	Autocorrelation	ARCH	Normality
Test-Statistic	230.65	290	9.2072
df	68	1200	8
P-Value	2.2e-16***	1	0.3251

Note: 1) All tests are implemented in accordance to Pfaff (2008*b*). 2) The autocorrelation test is a multivariate-Portmanteau Test for serial autocorrelation. 3) ARCH effects are tested through a multivariate VARCH. 4) Normality is tested through a multivariate Jarque-Bera test. 5) All tests are Chi-squared distributions albeit different distributions. 6) df refers to the degrees of freedom. 7) "***" $p \leq 0.001$, "**" $p \leq 0.01$, "*" $p \leq 0.05$, "." $p \leq 0.1$.

Table 5.10: Diagnostic Tests for Debt Market

Test	Autocorrelation	ARCH	Normality
Test-Statistic	215.65	290	5.8148
df	68	1200	8
P-Value	<2.2e-16***	1	0.3324

Note: 1) All tests are implemented in accordance to Pfaff (2008*b*). 2) The autocorrelation test is a multivariate-Portmanteau Test for serial autocorrelation. 3) ARCH effects are tested through a multivariate VARCH. 4) Normality is tested through a multivariate Jarque-Bera test. 5) All tests are Chi-squared distributions albeit different distributions. 6) df refers to the degrees of freedom. 7) "***" $p \leq 0.001$, "**" $p \leq 0.01$, "*" $p \leq 0.05$, "." $p \leq 0.1$.

Table 5.11: Diagnostic Tests for FX Market

Test	Autocorrelation	ARCH	Normality
Test-Statistic	161.63	290	3.5528
df	68	1200	8
P-Value	1.357e-09***	1	0.8951

Note: 1) All tests are implemented in accordance to Pfaff (2008*b*). 2) The autocorrelation test is a multivariate-Portmanteau Test for serial autocorrelation. 3) ARCH effects are tested through a multivariate VARCH. 4) Normality is tested through a multivariate Jarque-Bera test. 5) All tests are Chi-squared distributions albeit different distributions. 6) df refers to the degrees of freedom. 7) "***" $p \leq 0.001$, "**" $p \leq 0.01$, "*" $p \leq 0.05$, "." $p \leq 0.1$.

G

Table 5.12: Equity Market ΔCoVaR Impulse Response Function

Period	Interest Spread	Deposits	Loan Supply
1	-0.001[-0.018][0.016]	-0.004[-0.005][0.001]	-0.016[-0.029][0.012]
2	-0.008[-0.022][0.015]	-0.007[-0.01][0.004]	0.028[-0.031][0.053]
3	-0.032[-0.037][0.006]	-0.005[-0.01][0.005]	0.025[-0.041][0.058]
4	-0.061[-0.061][0.00]	-0.011[-0.016][0.004]	0.045[-0.039][0.079]
5	-0.06[-0.072][0.011]	-0.011[-0.017][0.007]	0.048[-0.035][0.077]
6	-0.059[-0.081][0.021]	-0.015[-0.02][0.006]	0.051[-0.023][0.08]
7	-0.045[-0.084][0.037]	-0.009[-0.018][0.01]	-0.002[-0.054][0.049]
8	-0.063[-0.102][0.037]	0.00[-0.017][0.019]	-0.027[-0.076][0.06]
9	-0.091[-0.134][0.039]	0.003[-0.024][0.029]	-0.05[-0.127][0.082]
10	-0.129[-0.179][0.048]	-0.001[-0.032][0.034]	-0.023[-0.159][0.122]
11	-0.143[-0.221][0.081]	-0.015[-0.039][0.027]	0.069[-0.113][0.186]
12	-0.146[-0.262][0.122]	-0.021[-0.038][0.021]	0.106 [-0.086][0.202]

Note: 1) Impulse response functions are implemented in accordance to Pfaff (2008*b*). 2) Impulse response functions are orthogonal. 3) The variables in the brackets [ ] represent the bootstrapped lower and upper 95% confidence interval respectively.

Table 5.13: Equity Market Loan Supply Impulse Response Function

Period	Interest Spread	Deposits	ΔCoVaR
1	-0.015[-0.032][0.007]	0.00[-0.003][0.003]	-0.002[-0.004][0.002]
2	0.004[-0.02][0.016]	0.00[-0.009][0.007]	0.003[-0.001][0.006]
3	0.026[-0.018][0.033]	0.002[-0.008][0.008]	-0.005[-0.006][0.001]
4	0.058[-0.007][0.061]	0.007[-0.011][0.014]	-0.001[-0.003][0.003]
5	0.069[0.001][0.083]*	0.01[-0.007][0.015]	0.00[-0.004][0.003]
6	0.061[-0.003][0.102]	0.01[-0.007][0.018]	0.002[-0.002][0.004]
7	0.029[-0.02][0.089]	0.001[-0.01][0.013]	-0.001[-0.004][0.003]
8	0.05 [-0.014][0.114]	-0.017[-0.026][0.005]	0.004[-0.001][0.006]
9	0.078[-0.009][0.151]	-0.026[-0.046][0.003]	0.004[-0.003][0.01]
10	0.116[-0.004][0.012]	-0.013[-0.044][0.008]	-0.004[-0.008][0.008]
11	0.148[0.006][0.023]*	0.011[-0.036][0.001]	-0.011[-0.013][0.001]
12	0.164[0.002][0.032]*	0.027[-0.021][0.001]	-0.01[-0.014][0.001]

Note: 1) Impulse response functions are implemented in accordance to Pfaff (2008*b*). 2) Impulse response functions are orthogonal. 3) The variables in the brackets [ ] represent the bootstrapped lower and upper 95% confidence interval respectively.

Table 5.14: Debt ΔCoVaR Impulse Response Function

Period	Interest Spread	Deposits	Loan Supply
1	-0.0024[-0.02][0.015]	-7.41E-06[-0.0039][0.004]	-0.02[-0.03][0.019]
2	0.0025[-0.017][0.023]	-1.83E-03[-0.008][0.008]	-0.021[-0.04][0.03]
3	0.014[-0.017][0.034]	8.11E-04[-0.009][0.012]	-0.029[-0.047][0.023]
4	-0.034[-0.05][0.027]	2.01E-03[-0.011][0.017]	-0.009[-0.034][0.033]
5	-0.07[-0.084][0.028]	4.49E-03[-0.012][0.021]	-0.02[-0.04][0.025]
6	-0.08[-0.107][0.048]	1.33E-03[-0.015][0.022]	-0.019[-0.037][0.026]
7	-0.076[-0.124][0.08]	-1.32E-03[-0.019][0.023]	-0.007[-0.035][0.034]
8	-0.104[-0.160][0.085]	3.44E-03[-0.020][0.028]	-0.030[-0.058][0.028]
9	-0.131[-0.192][0.097]	9.60E-03[-0.020][0.034]	-0.050[-0.068][0.022]
10	-0.178[-0.239][0.102]	2.22E-02[-0.015][0.043]	-0.059[-0.074][0.020]
11	-0.241[-0.297][0.105]	2.27E-02[-0.019][0.043]	0.004[-0.047][0.047]
12	-0.259[-0.320][0.125]	1.93E-02[-0.022][0.045]	0.046[-0.026][0.073]

Note: 1) Impulse response functions are implemented in accordance to Pfaff (2008*b*). 2) Impulse response functions are orthogonal. 3) The variables in the brackets [ ] represent the bootstrapped lower and upper 95% confidence interval respectively.

Table 5.15: Debt Loan Supply Impulse Response Function

Period	Interest Spread	Deposits	ΔCoVaR
1	-0.0004[-0.014][0.0129]	-0.007[-0.007][0.0004]	-3.33E-07[-3E-06][2.39E-06]
2	-0.004[-0.015][0.014]	-0.006[-0.010][0.005]	1.09E-06[-2E-06][3E-06]
3	0.006[-0.013][0.022]	-0.0086[-0.013][0.005]	4.80E-06[-4E-08][4E-06]
4	0.03[-0.005][0.04]	-0.006[-0.014][0.007]	-2.71E-06[-4E-06][8E-07]
5	0.035[-0.014][0.065]	-0.010[-0.017][0.006]	-1.77E-06[-4E-06][2E-06]
6	0.02[-0.03][0.08]	-0.013[-0.020][0.01]	3.46E-07[-3E-06][3E-06]
7	0.003[-0.049][0.10]	-0.017[-0.025][0.006]	5.19E-06[-6E-07][6E-06]
8	0.028[-0.039][0.132]	-0.025[-0.033][0.01]	1.31E-06[-2E-06][3E-06]
9	0.061[-0.033][0.177]	-0.022[-0.036][0.008]	2E-06[-2E-06][4E-06]
10	0.061[-0.054][0.218]	-0.0163[-0.038][0.012]	1E-06[-3E-06][4E-06]
11	0.051[-0.076][0.256]	-0.01[-0.036][0.015]	2E-06[-2E-06][6E-06]
12	0.008[-0.118][0.274]	-0.006[-0.034][0.018]	1E-06[-3E-06][6E-06]

Note: 1) Impulse response functions are implemented in accordance to Pfaff (2008*b*). 2) Impulse response functions are orthogonal. 3) The variables in the brackets [ ] represent the bootstrapped lower and upper 95% confidence interval respectively.

Table 5.16: FX Market ΔCoVaR Impulse Response Function

Period	Interest Spread	Deposits	Loan Supply
1	-0.044[-0.044][3E-04]	0.001[-0.004][0.005]	-0.007[-0.025][0.019]
2	-0.067[-0.062][-8E-05]*	-0.003[-0.009][0.005]	0.021[-0.017][0.038]
3	-0.068[-0.072][5E-03]	-0.004[-0.014][0.010]	-0.010[-0.033][0.025]
4	-0.082[-0.082][1E-02]	-0.010[-0.018][0.009]	-0.0002[-0.025][0.026]
5	-0.090[-0.099][2E-02]	-0.007[-0.018][0.013]	-0.006[-0.0258][0.022]
6	-0.141[-0.142][2E-02]	0.004[-0.016][0.021]	-0.009[-0.026][0.021]
7	-0.213[-0.206][1E-02]	0.015[-0.013][0.031]	-0.013[-0.035][0.02]
8	-0.242[-0.248][3E-02]	0.019[-0.016][0.037]	0.029[-0.024][0.05]
9	-0.231[-0.256][4E-02]	0.013[-0.025][0.037]	0.058[-0.019][0.08]
10	-0.232[-0.262][6E-02]	0.019[-0.022][0.042]	0.082[-0.017][0.095]
11	-0.272[-0.315][5E-02]	0.046[-0.015][0.057]	0.067[-0.018][0.089]
12	-0.329[-0.364][4E-02]	0.073[-0.012][0.078]	0.056[-0.028][0.083]

Note: 1) Impulse response functions are implemented in accordance to Pfaff (2008*b*). 2) Impulse response functions are orthogonal. 3) The variables in the brackets [ ] represent the bootstrapped lower and upper 95% confidence interval respectively.

Table 5.17: FX Market Loan Supply Impulse Response Function

Period	Interest Spread	Deposits	ΔCoVaR
1	-0.002[-0.025][0.021]	-0.01[-0.008][-0.001]*	-1.06E-04 [0.00][0.00]*
2	0.013[-0.027][0.038]	-0.012[-0.012][0.00]	-6.82E-05[0.00][0.00]*
3	0.027[-0.029][0.055]	-0.022[-0.02][-0.002]*	-1.98E-04[-0.001][0.00]
4	0.067[-0.018][0.083]	-0.021[-0.022][0.003]	-8.13E-05[-0.001][0.00]
5	0.065[-0.037][0.091]	-0.024[-0.025][0.002]	-1.27E-05[-0.001][0.001]
6	0.083[-0.049][0.119]	-0.031[-0.032][0.001]	-2.32E-05[-0.001][0.001]
7	0.086[-0.087][0.148]	-0.038[-0.04][0.002]	3.72E-04[0.00][0.001]*
8	0.129[-0.093][0.197]	-0.054[-0.053][-0.002]*	1.84E-04[-0.001][0.001]
9	0.174[-0.087][0.242]	-0.057[-0.059][0.001]	1.86E-04[-0.001][0.001]
10	0.201[-0.091][0.279]	-0.054[-0.06][0.006]	-2.72E-04[-0.001][0.00]
11	0.191[-0.129][0.302]	-0.053[-0.065][0.014]	-3.48E-04[-0.001][0.001]
12	0.195[-0.156][0.331]	-0.057[-0.076][0.026]	-7.42E-04[-0.002][0.001]

Note: 1) Impulse response functions are implemented in accordance to Pfaff (2008*b*). 2) Impulse response functions are orthogonal. 3) The variables in the brackets [ ] represent the bootstrapped lower and upper 95% confidence interval respectively.

H

Table 5.18: Equity Forecast Variance Error Decomposition with respect to Loan Supply

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	0.1059483	0.1280861	0.01512128	0.7508443
2	0.1357497	0.5383219	0.01735746	0.3085709
3	0.1707209	0.5094498	0.06215567	0.2576736
4	0.2887628	0.4269842	0.06514483	0.2191082
5	0.3562002	0.3585616	0.05966701	0.2255712
6	0.3818849	0.2983798	0.05554761	0.2641877
7	0.3462211	0.3364289	0.07674469	0.2406054
8	0.2858675	0.3684173	0.09066443	0.2550508
9	0.2033739	0.4445825	0.05592193	0.2961216
10	0.1790568	0.4110953	0.06779929	0.3420486
11	0.2234532	0.3806731	0.08867339	0.3072004
12	0.2778956	0.4059015	0.06824671	0.2479562

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.19: Equity Forecast Variance Error Decomposition with respect to ΔCoVaR

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	1	0	0	0
2	0.6818847	0.2057987	0.001356552	0.11096
3	0.6393791	0.1655351	0.001144519	0.1939413
4	0.6027738	0.2056116	0.011830354	0.1797843
5	0.6001097	0.2105733	0.012162357	0.1771547
6	0.5834673	0.210218	0.022634879	0.1836798
7	0.544701	0.2191412	0.059182951	0.1769748
8	0.4900341	0.2202087	0.063855734	0.2259014
9	0.323048	0.4862807	0.046172776	0.1444985
10	0.373665	0.4172014	0.062349386	0.1467841
11	0.385542	0.3736445	0.043426192	0.1973873
12	0.4178311	0.341217	0.036926963	0.2040249

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.20: Equity Forecast Variance Error Decomposition with respect to Interest Spread

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	0.000974312	0.99902569	0	0
2	0.031004091	0.92061475	0.044232749	0.004148406
3	0.296980198	0.53476809	0.024313114	0.143938597
4	0.494771577	0.21175215	0.009298179	0.284178096
5	0.497076493	0.12195782	0.021702492	0.35926319
6	0.500841466	0.08825789	0.035307765	0.375592882
7	0.480533443	0.11254522	0.056672554	0.350248784
8	0.489320807	0.11089008	0.056130401	0.343658716
9	0.513132411	0.09554565	0.047504166	0.343817772
10	0.54292082	0.06969994	0.039821617	0.347557627
11	0.55383453	0.05012527	0.038177338	0.357862862
12	0.544459498	0.04651435	0.045275458	0.363750695

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.21: Equity Forecast Variance Error Decomposition with respect to Deposits

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	0.2665869	0.1420943	0.59131884	0
2	0.2065712	0.6005259	0.15582609	0.03707674
3	0.2332798	0.5579852	0.15093252	0.05780253
4	0.30315	0.4485946	0.10233956	0.14591578
5	0.3715696	0.3559969	0.09928551	0.17314797
6	0.4463801	0.2541266	0.12725783	0.17223545
7	0.4600896	0.2321238	0.15230413	0.15548249
8	0.3480317	0.3201333	0.13907454	0.19276049
9	0.2228461	0.46149	0.09188857	0.22377532
10	0.2002672	0.4618639	0.10295329	0.23491559
11	0.2422949	0.4233319	0.1103643	0.22400891
12	0.2869551	0.3962086	0.08663387	0.23020239

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.22: Debt Forecast Variance Error Decomposition with respect to Loans

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	0.06437065	0.00639187	0.4317174	0.49752
2	0.06959119	0.15892229	0.4707354	0.3007511
3	0.11965538	0.1256212	0.4654935	0.2892299
4	0.11902188	0.12989702	0.4596332	0.2914479
5	0.14240715	0.12559945	0.4447379	0.2872555
6	0.16188898	0.12236022	0.435744	0.2800068
7	0.15110155	0.12381922	0.4341549	0.2909243
8	0.13472561	0.27093555	0.3730124	0.2213264
9	0.17749541	0.27878359	0.3386565	0.2050645
10	0.23969151	0.23898233	0.3326439	0.1886823
11	0.23793571	0.24304985	0.3319994	0.1870151
12	0.26752964	0.24228728	0.3052989	0.1848842

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.23: Debt Forecast Variance Error Decomposition with respect to ΔCoVaR

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	1	0	0	0
2	0.8657022	0.104264	0.01139613	0.01863768
3	0.6088824	0.1292785	0.18846954	0.07336962
4	0.5750453	0.1417606	0.19477403	0.08842003
5	0.5316308	0.1826813	0.20826747	0.07742044
6	0.4625153	0.2940635	0.17154929	0.07187192
7	0.3811696	0.2543909	0.2982778	0.06616172
8	0.3571573	0.284934	0.28625623	0.07165245
9	0.3541724	0.2699332	0.28327073	0.09262368
10	0.3808576	0.2610528	0.26787113	0.0902184
11	0.3703149	0.2612442	0.27910039	0.08934054
12	0.3689333	0.2539132	0.27970807	0.09744541

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.24: Debt Forecast Variance Error Decomposition with respect to Interest Spread

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	0.004379544	0.99562046	0	0
2	0.006452158	0.97053049	0.0018316	0.02118576
3	0.093540165	0.86910668	0.002711371	0.03464179
4	0.308155677	0.46507299	0.021106887	0.20566445
5	0.536072906	0.20361353	0.077439422	0.18287414
6	0.569451356	0.19306041	0.062721137	0.1747671
7	0.570296457	0.20872815	0.043628219	0.17734717
8	0.619992177	0.17418061	0.033137919	0.17268929
9	0.653928578	0.12044753	0.041122553	0.18450134
10	0.693278624	0.07614002	0.034974709	0.19560665
11	0.742414477	0.04837295	0.033186409	0.17602616
12	0.776688442	0.0391262	0.027022487	0.15716287

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.25: Debt Forecast Variance Error Decomposition with respect to Deposits

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	3.82E-07	0.06930854	0.9306911	0
2	7.24E-03	0.38669103	0.6053343	0.000733047
3	4.75E-03	0.37936976	0.606299	0.009577363
4	6.13E-03	0.43909587	0.548183	0.006595649
5	1.63E-02	0.36476849	0.6035452	0.015354315
6	1.33E-02	0.30360365	0.6580115	0.025098313
7	1.03E-02	0.26021372	0.6834809	0.045986486
8	9.75E-03	0.22883656	0.6700712	0.09134063
9	2.19E-02	0.22758125	0.6335589	0.116934582
10	8.04E-02	0.18613606	0.6004881	0.132978072
11	1.25E-01	0.15967291	0.571342	0.144422344
12	1.50E-01	0.14506723	0.5578334	0.14724904

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.26: FX Forecast Variance Error Decomposition with respect to Loan Supply

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	0.008624335	0.01257692	0.6738357	0.304963
2	0.065530101	0.01594699	0.6671628	0.2513602
3	0.059028478	0.01425234	0.6720626	0.2546566
4	0.052649587	0.01866463	0.682225	0.2464608
5	0.054241684	0.02354775	0.6718678	0.2503428
6	0.05936955	0.02317513	0.6754223	0.242033
7	0.057374405	0.04976376	0.6580855	0.2347763
8	0.07732128	0.08384888	0.6185347	0.2202952
9	0.16009262	0.13715112	0.4954613	0.207295
10	0.27238114	0.18173675	0.3847654	0.1611168
11	0.33696112	0.16990758	0.3464666	0.1466647
12	0.36426337	0.17011524	0.3203853	0.1452361

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.27: FX Forecast Variance Error Decomposition with respect to $\Delta CoVaR$

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	1	0	0.00E+00	0
2	0.9212647	0.04741131	4.24E-05	0.03128157
3	0.6680422	0.30097093	4.23E-03	0.02675693
4	0.6330958	0.33583022	3.78E-03	0.02729854
5	0.6956874	0.27231978	9.23E-03	0.02275837
6	0.6806654	0.28024015	1.08E-02	0.02831844
7	0.6898465	0.24740937	1.93E-02	0.04342986
8	0.6817884	0.24801963	1.87E-02	0.05150471
9	0.6758598	0.24599822	2.17E-02	0.05639426
10	0.6214406	0.28964103	2.40E-02	0.06487753
11	0.6402408	0.29397682	3.07E-02	0.03505865
12	0.6646484	0.27451528	3.84E-02	0.02242087

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.28: FX Forecast Variance Error Decomposition with respect to Interest Spread

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	0.43055	0.56945	0	0
2	0.642693	0.3416193	0.0155385	0.000149248
3	0.663507	0.2879115	0.03644488	0.012136628
4	0.6171748	0.2113305	0.11111898	0.060375731
5	0.5842421	0.2116388	0.12704711	0.07707201
6	0.5967891	0.2029977	0.13173794	0.068475224
7	0.6316518	0.2164368	0.10083663	0.051074821
8	0.6490207	0.1929652	0.10595331	0.052060775
9	0.6362824	0.1640251	0.12820546	0.07148695
10	0.6114861	0.147609	0.15130965	0.089595299
11	0.6071138	0.1455391	0.15443267	0.092914403
12	0.6162496	0.146501	0.14772918	0.089520294

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Table 5.29: FX Forecast Variance Error Decomposition with respect to Deposits

Period	$\Delta CoVaR$	Interest Spread	Deposits	Loan Supply
1	0.01303367	0.000204749	0.9867616	0
2	0.03745233	0.075152093	0.8726085	0.01478708
3	0.02885128	0.089205527	0.8081288	0.07381438
4	0.07710099	0.140714389	0.7070129	0.07517171
5	0.07475122	0.106944437	0.7150761	0.10322827
6	0.05600654	0.073583812	0.7563222	0.1140875
7	0.07998963	0.05160044	0.7406234	0.1277865
8	0.09050737	0.033456941	0.7208191	0.15521657
9	0.078444	0.024969609	0.7129241	0.18366233
10	0.08515618	0.025428666	0.6963211	0.19309409
11	0.16424544	0.054146714	0.6109569	0.17065094
12	0.28578394	0.092213727	0.4882853	0.13371702

Note: 1) Forecast variance error decomposition is implemented in accordance to Pfaff (2008*b*).

Bibliography

Acharya, V. V., Pedersen, L. H., Philippon, T. & Richardson, M. (2016), 'Measuring Systemic Risk', *The Review of Financial Studies* **30**(1), 2–47.
URL: *https://doi.org/10.1093/rfs/hhw088*

Adrian, T. & Brunnermeier, M. K. (2016), 'Covar', *American Economic Review* **106**(7), 1705–41.
URL: *https://www.aeaweb.org/articles?id=10.1257/aer.20120555*

Ahlgren, N. & Antell, J. (2010), 'Stock market linkages and financial contagion: A cobreaking analysis', *The Quarterly Review of Economics and Finance* **50**(2), 157–166.
URL: *https://www.sciencedirect.com/science/article/pii/S106297690900132X*

Akerlof, G. A. (1970), 'The market for "lemons": Quality uncertainty and the market mechanism', *The Quarterly Journal of Economics* **84**(3), 488–500.
URL: *http://www.jstor.org/stable/1879431*

Altavilla, C., Pariès, M. D. & Nicoletti, G. (2019), 'Loan supply, credit markets and the euro area financial crisis', *Journal of Banking & Finance* **109**, 105658.
URL: *https://www.sciencedirect.com/science/article/pii/S037842661930233X*

Asgharian, H., Krygier, D. & Vilhelmsson, A. (2022), 'Systemic risk and centrality: The role of interactions', *European Financial Management* **28**(5), 1199–1226.
URL: *https://onlinelibrary.wiley.com/doi/abs/10.1111/eufm.12340*

Attila, J. G. (2022), 'Does bank deposits volatility react to political instability in developing countries?', *Finance Research Letters* **49**, 103126.

URL: *https://www.sciencedirect.com/science/article/pii/S154461232200349X*

Bai, J. & Perron, P. (1998), 'Estimating and testing linear models with multiple structural changes', *Econometrica* pp. 47–78.

URL: *https://doi.org/10.2307/2998540*

Baltzer, M., Cappiello, L., Santis, R. A. D. & Manganelli, S. (2008), 'Measuring financial integration in new eu member states', *ECB OCCASIONAL PAPER SERIES* **81**, 1–38.

URL: *https://www.ecb.europa.eu/pub/pdf/scpops/ecbocp81.pdf*

Bernanke, B. S. & Blinder, A. S. (1988), Credit, money, and aggregate demand, Working Paper 2534, National Bureau of Economic Research.

URL: *http://www.nber.org/papers/w2534*

Block, J. & Sandner, P. (2009), 'What is the effect of the financial crisis on venture capital financing? empirical evidence from us internet start-ups', *Venture Capital* **11**(4), 295–309.

URL: *https://doi.org/10.1080/13691060903184803*

Bond, S. A., Dungey, M. & Fry, R. (2006), 'A web of shocks: crises across asian real estate markets', *The Journal of Real Estate Finance and Economics* **32**, 253–274.

URL: *https://doi.org/10.1007/s11146-006-6800-0*

Boschi, M. (2005), 'International financial contagion: evidence from the argentine crisis of 2001–2002', *Applied Financial Economics* **15**(3), 153–163.

URL: *https://doi.org/10.1080/0960310042000306943*

Brownlees, C. & Engle, R. F. (2016), 'SRISK: A Conditional Capital Shortfall Measure of Systemic Risk', *The Review of Financial Studies* **30**(1), 48–79.

URL: *https://doi.org/10.1093/rfs/hhw060*

Bruno, V. & Shin, H. S. (2015), 'Capital flows and the risk-taking channel of monetary policy', *Journal of Monetary Economics* **71**, 119–132.
URL: *https://www.sciencedirect.com/science/article/pii/S0304393214001688*

Cai, J., Eidam, F., Saunders, A. & Steffen, S. (2018), 'Syndication, interconnectedness, and systemic risk', *Journal of Financial Stability* **34**, 105–120.
URL: *https://www.sciencedirect.com/science/article/pii/S1572308917303698*

Calvo, S. G. & Reinhart, C. (1996), 'Capital flows to latin america: is there evidence of contagion effects?', *Available at SSRN 636120* .
URL: *https://ssrn.com/abstract=636120*

Castellanos, A. M., Vargas, F. S. & RenterÃa, L. G. (2011), 'The contagion from the 2007-09 us stock market crash', *International Journal of Banking and Finance* **8**(4), 67–81.
URL: *journal.uum.edu.my/index.php/ijbf/article/view/8445*

Chava, S., Gallmeyer, M. & Park, H. (2015), 'Credit conditions and stock return predictability', *Journal of Monetary Economics* **74**, 117–132.
URL: *https://www.sciencedirect.com/science/article/pii/S0304393215000653*

Chen, R.-R., Chidambaran, N., Imerman, M. & Sopranzetti, B. (2014), 'Liquidity, leverage and lehman: A structural analysis of financial institutions in crisis', *Journal of Banking and Finance* **45**, 117–139.
URL: *https://doi.org/10.1016/j.jbankfin.2014.04.018*

Cochrane, J. (2009), *Asset pricing: Revised edition*, Princeton university press.

Cornett, M. M., McNutt, J. J., Strahan, P. E. & Tehranian, H. (2011), 'Liquidity risk management and credit supply in the financial crisis', *Journal of Financial Economics* **101**(2), 297–312.
URL: *https://www.sciencedirect.com/science/article/pii/S0304405X11000663*

Daugherty, M. S. & Jithendranathan, T. (2015), 'A study of linkages between frontier markets and the u.s. equity markets using multivariate garch and transfer entropy', *Journal of Multinational Financial Management* **32-33**, 95–115.
URL: *https://www.sciencedirect.com/science/article/pii/S1042444X15300086*

Dungey, M., Fry, R., González-Hermosillo, B. & Martin, V. (2006), 'Contagion in international bond markets during the russian and the ltcm crises', *Journal of Financial Stability* **2**(1), 1–27. Rome Conference on "Derivatives and Financial Stability".
URL: *https://www.sciencedirect.com/science/article/pii/S1572308906000027*

Favara, G. & Imbs, J. (2015), 'Credit supply and the price of housing', *American Economic Review* **105**(3), 958–92.
URL: *https://www.aeaweb.org/articles?id=10.1257/aer.20121416*

Forbes, K. J. & Rigobon, R. (2002), 'No contagion, only interdependence: Measuring stock market comovements', *The Journal of Finance* **57**(5), 2223–2261.
URL: *http://www.jstor.org/stable/3094510*

Forsberg, L. & Bollerslev, T. (2002), 'Bridging the gap between the distribution of realized (ecu) volatility and arch modelling (of the euro): the garch-nig model', *Journal of Applied Econometrics* **17**(5), 535–548.
URL: *https://onlinelibrary.wiley.com/doi/abs/10.1002/jae.685*

Fratzscher, M. (2002), 'Financial market integration in europe: on the effects of emu on stock markets', *International Journal of Finance & Economics* **7**(3), 165–193.
URL: *https://onlinelibrary.wiley.com/doi/abs/10.1002/ijfe.187*

Fry-McKibbin, R. & Hsiao, C. Y.-L. (2015), Extremal dependence tests for contagion, Cama working papers, Centre for Applied Macroeconomic Analysis, Crawford School of Public Policy, The Australian National University.
URL: *https://EconPapers.repec.org/RePEc:een:camaaa:2015-40*

Gallegati, M. (2012), 'A wavelet-based approach to test for financial market contagion', *Computational Statistics & Data Analysis* **56**(11), 3491–3497. 1st issue of the Annals of Computational and Financial Econometrics Sixth Special Issue on Computational Econometrics.
URL: *https://www.sciencedirect.com/science/article/pii/S0167947310004317*

Gilje, E. P., Loutskina, E. & Strahan, P. E. (2016), 'Exporting liquidity: Branch banking and financial integration', *The Journal of Finance* **71**(3), 1159–1184.
URL: *https://onlinelibrary.wiley.com/doi/abs/10.1111/jofi.12387*

Gray, D. (2009), 'Financial contagion among members of the eu-8: A cointegration and granger causality approach', *International Journal of Emerging Markets* **4**(4).

Hamilton, J. D. (1994), *Time series analysis*, Princeton University Press.

Hirtle, B. (2009), 'Credit derivatives and bank credit supply', *Journal of Financial Intermediation* **18**(2), 125–150.
URL: *https://www.sciencedirect.com/science/article/pii/S1042957308000363*

Hodgman, D. R. (1960), 'Credit risk and credit rationing', *The Quarterly Journal of Economics* **74**(2), 258–278.
URL: *https://doi.org/10.2307/1884253*

Horst, M. & Neyer, U. (2019), 'The impact of quantitative easing on bank loan supply and monetary policy implementation in the euro area', *Review of Economics* **70**(3), 229–265.
URL: *https://doi.org/10.1515/roe-2019-0033*

Huang, X., Zhou, H. & Zhu, H. (2009), 'A framework for assessing the systemic risk of major financial institutions', *Journal of Banking & Finance* **33**(11), 2036–2049.
URL: *https://doi.org/10.1016/j.jbankfin.2009.05.017*

Johansen, S. (1991), 'Estimation and hypothesis testing of cointegration vectors in gaussian vector autoregressive models', *Econometrica* **59**(6), 1551–1580.
URL: *http://www.jstor.org/stable/2938278*

Justiniano, A., Primiceri, G. E. & Tambalotti, A. (2019), 'Credit supply and the housing boom', *Journal of Political Economy* **127**(3), 1317–1350.
URL: *https://doi.org/10.1086/701440*

King, M. A. & Wadhwani, S. (1990), 'Transmission of volatility between stock markets', *The Review of Financial Studies* **3**(1), 5–33.
URL: *http://www.jstor.org/stable/2961954*

Kletzer, K. & Bardhan, P. (1987), 'Credit markets and patterns of international trade', *Journal of Development Economics* **27**(1), 57–70.
URL: *https://www.sciencedirect.com/science/article/pii/030438788790006X*

Lane, P. R. (2006), 'The real effects of european monetary union', *Journal of Economic Perspectives* **20**(4), 47–66.
URL: *https://www.aeaweb.org/articles?id=10.1257/jep.20.4.47*

Leblebicioğlu, A. (2009), 'Financial integration, credit market imperfections and consumption smoothing', *Journal of Economic Dynamics and Control* **33**(2), 377–393.
URL: *https://www.sciencedirect.com/science/article/pii/S0165188908001188*

Lee, H., Lee, S. & Paluszynski, R. (2022), 'Capital regulation and shadow finance: A quantitative analysis', *Preliminary Accepted at The Review of Economic Studies* .

Lewellen, J. & Nagel, S. (2006), 'The conditional capm does not explain asset-pricing anomalies', *Journal of financial economics* **82**(2), 289–314.
URL: *https://doi.org/10.1016/j.jfineco.2005.05.012*

Martin, A., McAndrews, J. & Skeie, D. (2016), 'Bank lending in times of large bank

reserves', *International Journal of Central Banking* **12**(4), 193–222.
URL: *https://www.ijcb.org/journal/ijcb16q4a5.htm*

Moore, B. J. (1989), 'The endogeneity of credit money', *Review of Political Economy* **1**(1), 65–93.
URL: *https://doi.org/10.1080/09538258900000005*

Mun, K.-C. (2005), 'Contagion and impulse response of international stock markets around the 9–11 terrorist attacks', *Global Finance Journal* **16**(1), 48–68.
URL: *https://www.sciencedirect.com/science/article/pii/S104402830500013X*

Nichols, J., Pennington-Cross, A. & Yezer, A. (2005), 'Borrower self-selection, underwriting costs, and subprime mortgage credit supply', *The Journal of Real Estate Finance and Economics* **30**, 197–219.
URL: *https://doi.org/10.1007/s11146-004-4879-8*

Patelis, A. D. (1997), 'Stock return predictability and the role of monetary policy', *The Journal of Finance* **52**(5), 1951–1972.
URL: *https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.1997.tb02747.x*

Pfaff, B. (2008*a*), *Analysis of Integrated and Cointegrated Time Series with R*, second edn, Springer, New York. ISBN 0-387-27960-1.
URL: *https://www.pfaffikus.de*

Pfaff, B. (2008*b*), 'Var, svar and svec models: Implementation within r package vars', *Journal of Statistical Software* **27**(4).
URL: *https://www.jstatsoft.org/v27/i04/*

Phillips, P. C. B. & Perron, P. (1988), 'Testing for a unit root in time series regression', *Biometrika* **75**(2), 335–346.
URL: *https://doi.org/10.1093/biomet/75.2.335*

Rösch, D. M., Subrahmanyam, A. & van Dijk, M. A. (2017), 'The dynamics of market efficiency', *The Review of Financial Studies* **30**(4), 1151–1187.
URL: *http://www.jstor.org/stable/26166312*

Saleem, K. (2009), 'International linkage of the russian market and the russian financial crisis: A multivariate garch analysis', *Research in International Business and Finance* **23**(3), 243–256.
URL: *https://www.sciencedirect.com/science/article/pii/S0275531908000421*

Shahzad, U. & Qin, F. (2019), 'New terrorism and capital flight: Pre and post nine eleven analysis for asia.', *Annals of Economics & Finance* **20**(1).

Stigler, M. (2019), Nonlinear time series in r: Threshold cointegration with tsdyn, *in* H. D. Vinod & C. Rao, eds, 'Handbook of Statistics, Volume 41', Vol. 42, Elsevier, pp. 229–264.
URL: *https://www.sciencedirect.com/science/article/pii/S0169716119300355*

Stiglitz, J. E. & Weiss, A. (1981), 'Credit rationing in markets with imperfect information', *The American economic review* **71**(3), 393–410.
URL: *https://www.jstor.org/stable/1802787*

Stracca, L. (2015), 'Our currency, your problem? the global effects of the euro debt crisis', *European Economic Review* **74**, 1–13.
URL: *https://www.sciencedirect.com/science/article/pii/S0014292114001512*

The White House (2005), 'The united states and the european union initiative to enhance transatlantic economic integration and growth', Press release.
URL: *https://georgewbush-whitehouse.archives.gov/news/releases/2005/06/20050620-5.html*

The White House (2007), 'Framework for advancing transatlantic economic integration between the united states of america and the european union', Press release.

URL: *https://georgewbush-whitehouse.archives.gov/news/releases/2007/04/20070430-4.html*

Tian, M., Alshater, M. M. & Yoon, S.-M. (2022), 'Dynamic risk spillovers from oil to stock markets: Fresh evidence from garch copula quantile regression-based covar model', *Energy Economics* **115**, 106341.
URL: *https://www.sciencedirect.com/science/article/pii/S0140988322004704*

Trabelsi, N. & Naifar, N. (2017), 'Are islamic stock indexes exposed to systemic risk? multivariate garch estimation of covar', *Research in International Business and Finance* **42**, 727–744.
URL: *https://www.sciencedirect.com/science/article/pii/S0275531916303567*

Trapletti, A., Hornik, K. & LeBaron, B. (2023), 'Package 'tseries'', *CRAN* .
URL: *https://cran.uib.no/web/packages/tseries/tseries.pdf*

Waller, C. J. & Lewarne, S. (1994), 'An expository model of credit rationing', *Journal of Macroeconomics* **16**(3), 539–545.
URL: *https://www.sciencedirect.com/science/article/pii/0164070494900221*

Yiu, M. S., Ho, W.-Y. A. & Choi, D. F. (2010), 'Dynamic correlation analysis of financial contagion in asian markets in global financial turmoil', *Applied Financial Economics* **20**(4), 345–354.
URL: *https://doi.org/10.1080/09603100903494946*

Zeileis, A. (2006), 'Implementing a class of structural change tests: An econometric computing approach', *Computational Statistics & Data Analysis* **50**(11), 2987–3008.
URL: *https://www.sciencedirect.com/science/article/pii/S0167947305001477*

Zeileis, A., Kleiber, C., Krämer, W. & Hornik, K. (2003), 'Testing and dating of structural changes in practice', *Computational Statistics & Data Analysis* **44**(1–2), 109–123.
URL: *https://doi.org/10.1016/S0167-9473(03)00030-6*

Zeileis, A., Leisch, F., Hornik, K. & Kleiber, C. (2002), 'strucchange: An r package for testing for structural change in linear regression models', *Journal of Statistical Software* **7**(2), 1–38.
URL: *https://www.jstatsoft.org/index.php/jss/article/view/v007i02*

Zubair, S., Kabir, R. & Huang, X. (2020), 'Does the financial crisis change the effect of financing on investment? evidence from private smes', *Journal of Business Research* **110**, 456–463.
URL: *https://www.sciencedirect.com/science/article/pii/S0148296320300758*