

Global Liquidity Commonalities: Evidence From Bid-Ask Prices Of Cross-Listed Equity Share Time Series

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ABSTRACT

This study investigates international liquidity spillovers focusing on how liquidity cost shocks propagate within and across geographic regions world-wide. We employ bid-ask spread-based measures of equity share liquidity cost to estimate established vector autoregression (VAR) models and spillover index analyses to quantify the magnitude and direction of cross-border liquidity cost shock information transfers. Our findings reveal significant liquidity cost spillover effects wherein larger more integrated economies tend to be dominant liquidity cost shock information outflow transmitters, while smaller more isolated markets tend to be net receivers of liquidity cost shock information inflows making them more vulnerable to external liquidity conditions. By highlighting the interconnected nature of global liquidity costs, this study underscores the need for coordinated policy responses in order to mitigate systemic risk arising from liquidity cost shocks in increasingly integrated global economy.

Keywords: Liquidity cost; Spillover Outflow and Inflow Information Transfers; Equity Share Bid and Ask Price Spreads; Vector Autoregressive Time Series Models; Forecast Error Variance Decomposition; Spillover Table Analyses; Price Discovery.

JEL: F15

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Introduction

The idea that liquidity cost behavior displays co-movement spanning assets and asset markets is accepted as a stylized fact, most notably within the framework of global market integration. Liquidity is commonly referenced as a property of well-functioning financial markets reflecting the ability of traders to transact quickly, at relatively low cost, and where the bid and ask equity share price spread is commonly employed as a surrogate for liquidity costs.¹ Over recent years, the relevant research literature has accumulated considerable evidence addressing the co-movement of liquidity costs across asset markets (i.e., liquidity commonality), where initial research emphasizes the empirical observation that firm-specific liquidity costs are not idiosyncratic but rather are largely explained by systematic components.² For these reasons, liquidity cost commonality research has risen in prominence as world-wide markets become increasingly integrated largely because liquidity cost shock transmission can concurrently impact liquidity costs across-the-board.

Landmark findings in the relevant research literature suggest that liquidity cost behavior displays systematic co-movement across securities, commonly referred to as liquidity commonality. Seminal research results reported by Chordia, Roll, and Subrahmanyam (2000) indicate that equity share liquidity cost is significantly related to market and industry liquidity cost factors, persisting after controlling for firm-specific factors (e.g., trading volume and price volatility). The Chordia et al. (2000) results suggest that bid-ask equity share price spreads co-move with systematic liquidity costs underscoring the importance of common components in equity share transaction costs. Research following upon Chordia et al. (2000) further indicates that the observed liquidity cost commonalities are driven primarily by factors such as related trading volume, intermediary inventory risk, and macroeconomic conditions that simultaneously affect equity share prices. Furthermore, aggregate liquidity has been shown to display temporal systematic variability, heightening when the market declines and responding accordingly to changes in macroeconomic conditions (Chordia, Roll, and Subrahmanyam (2001)).

At the same time, a considerable body of international finance literature examines the benefits of cross-listing as creating an important channel for information transfers and attenuating market integration as a result.³ However, more recent research results (Goldberg

¹. Within the context of integrated global equity markets, multiple market traded assets provide a singular backdrop to examine liquidity behavior, since they connect home-country equity share markets with other share markets world-wide. This dual-listing institutional mechanism enables one to control for local and cross-market dynamics providing a clear picture of how liquidity shocks are transmitted across markets.

². In the microstructure literature, bid-ask spreads arise from inventory holding costs, order-processing costs, and adverse selection attributable to asymmetric information (Demsetz (1968), Stoll (1978), and Glosten and Milgrom (1985)). These foundational mechanisms suggest that liquidity is not only asset-specific but also influenced by broader market conditions. Systematic factors driving liquidity costs may arise from macroeconomic events or investor sentiment and display tendency to heighten vis-a-viz market tension.

³. Because cross-listed shares trade in U.S. markets but represent home-country ownership claims, the create a direct connection from the U.S. cross-listing market with home-country economic conditions. This type of dual asset trading framework suggests that cross-listed share bid and ask price spreads together reflect home-country equity market frictions as well as world-wide trading dynamics making cross-listed shares particularly appropriate for investigating inter-country liquidity dynamics. A considerable accumulation of current research suggests that home-country equity and share cross-listing attenuates market price discovery processes as well as enhancing share liquidity by mitigating segmentation frictions (Doidge, Karolyi, and Stulz (2004) and Karolyi (2006)). Current research evidence suggests that cross-listed share issuance improves home-country equity share liquidity in addition to creating a feedback channel assisting price discovery providing significant benefits for emerging markets (Ghaffar, Azmat, and Hassan (2022)).

(2023, 2024)) suggest that liquidity commonality is increasingly a world-wide phenomenon resulting primarily as a result increasing market integration, and providing an important channel through which liquidity cost shocks are transferred internationally. Consequently, the relevant research literature has largely developed along two lines (1) cross-listing and market microstructure, and (2) aggregate world-wide liquidity spillovers.⁴

Although a considerable portion of the extant research literature addresses coincidental changes in liquidity costs, liquidity cost spillover research investigates the information transfer aspects of global liquidity shocks, including directional information transfer implications (i.e., identifying a country as being a net transmitter or net receiver of liquidity cost shock information). In order to make directional inferences, the current research utilizes Vector Auto-Regressive (VAR) time-series econometric modeling combined with Forecast Error Variance Decompositions (FEVD) analyses in order to quantify the extent to which liquidity cost shocks originating in one country drive liquidity cost shock variability in other countries. Specifically, the Spillover Index Analysis Framework derived by Diebold and Yilmaz (2009, 2012) is widely accepted since it decomposes liquidity cost shock variability by directional component yielding reliable measures of total and directional interconnectedness of countries world-wide.⁵

While Spillover Analyses have been used to investigate a broad range of interesting economic questions, we are unaware of relevant research investigating the function of multi-market traded shares in attenuating liquidity cost shock transference across countries. Cross-listed firms equity shares provide a natural vehicle for using spillover analyses to investigate international information transfers via liquidity cost variability as a result of their prices and trading costs emanating from U.S. market conditions building upon information derived from the underlying home-country equity shares. Utilizing home-country equity share liquidity cost which incorporates U.S.-share liquidity cost conditions facilitates formation of country portfolios reflecting aggregated liquidity conditions and enabling investigation of the manner by which liquidity shocks emanate from specific countries as well as how they are transmitted throughout markets world-wide.

This research uses home-country equity share bid-ask equity share price spreads of cross-listed firms from thirty-six countries and aggregates these measures to construct country-level average liquidity cost portfolios. We then estimate VAR econometric models using these portfolio-level liquidity cost time-series and compute Generalized FEVDs to quantify the magnitude and direction of liquidity cost spillovers across countries world-wide. The resulting spillover tables provide a global network representation of global liquidity cost shock transmission, identifying countries as net transmitters and net receivers of liquidity cost shocks information. This framework not only captures the extent of liquidity cost interconnectedness but also allows for a detailed decomposition of cross-country dynamics, offering insights into the structure of international financial linkages.

By integrating the extant research literature on liquidity cost commonality with the

⁴. We are unaware of research connecting these lines of research by utilizing cross-listed firms to examine liquidity cost commonality and transmission at the country level, which is noteworthy because cross-listed firms provide a unique measure reflecting both home-country and transnational liquidity cost components via equity share bid and ask prices. In this manner, examining cross-listed firm shares provide a rich mechanism for investigating how liquidity cost shocks originate, transfer, and interconnect across world-wide integrated markets.

⁵. Subsequently, numerous research studies have expanded and adapted the spillover analyses to investigate liquidity cost transmission in foreign exchange and other asset markets, the results of which suggest that spillovers are attenuated by increased uncertainty.

spillover framework of Diebold and Yilmaz, this research provides a more thorough understanding of the manner by which liquidity cost shock information is transferred among equity markets world-wide via multi-market asset trading channels. Our results have important implications for market integration and systemic risk, particularly when market stress and liquidity conditions become highly interdependent.

Literature Review: Liquidity Commonality, Cross-Market Linkages, and Spillover Measurement

Market Liquidity and Bid-Ask Spreads: Conceptual Foundations

A well-known attribute of correctly-functioning competitive markets is the ability of traders to transact quickly, in large or small volume, and at low cost without having impact on quoted market prices.⁶ A commonly employed surrogate for traders' transaction liquidity cost is the difference between the dealer's quoted bid price and ask price, referred to as the bid-ask spread. Dealer's spreads represent round trip-transaction costs where higher spreads indicate greater degree of illiquidity and market friction.

The theoretical development (e.g., Demsetz (1968) and Amihud and Mendelson (1986)) of liquidity costs arises as an element of dealers' cost (e.g., order and inventory costs) in making market in equity shares, as well as compensation for bearing risk (e.g., adverse selection). The subsequent research literature advances the notion of liquidity risk in that liquidity cost reflects a systematic component in addition to firm-specific factors. Consequently, current research frequently includes liquidity costs (i.e., bid-ask spreads) variables as control measures of risk (e.g., liquidity-adjusted measures of Value-at-Risk) since bid-ask spread variability reflects market uncertainty.⁷

Liquidity Commonality: Theoretical Foundation and Empirical Evidence

The notion of liquidity cost commonality suggests that liquidity costs share a common component and vary synchronously across assets and markets, driven, of course, by the common systematic

⁶. Samuelson and Nordhaus (2010) discuss the theoretical model of perfectly competitive markets and their efficiency properties. In theoretical perfectly competitive markets, firms are price takers, all products are identical, and there is free entry and exit, leading to efficient outcomes. The list of assumptions includes the following:

1. **Many Buyers and Sellers:** There are a large number of buyers and sellers in the market. Each participant is small relative to the whole market. No one individual can influence the quoted market price.
2. **Identical Products:** All firms sell exactly the same product. There is no product differentiation (e.g., quality differences). Consumers view all products as perfect substitutes.
3. **Price Takers:** Both buyers and sellers accept the quoted market price and firms must accept the prevailing market price.
4. **Free Entry and Exit:** Firms may easily enter or exit the market wherein there are no barriers to entry or exit (e.g., startup costs, regulations, or patents) assuring normal profits in the long run.
5. **Perfect Information:** All traders have full information where buyers know prices and product quality and sellers know production costs.
6. **Perfect Mobility of Resources:** Labor and capital can move freely without cost. Workers and capital can be deployed rapidly to where they are most productive.
7. **No Transaction Costs:** Buying and selling involve no added costs.
8. **Profit Maximization:** Firms act to maximize their profit by producing to the point where marginal cost equals marginal revenue.

⁷. Particularly noteworthy is the observation that liquidity costs increase in relation to declining market conditions resulting not only in larger bid-ask spreads but also larger degree of interrelationship among assets and markets. Clearly, this observation indicates that liquidity costs are not solely firm-specific but vary synchronously across assets and markets, laying the foundation for research addressing liquidity cost commonality.

factors. Seminal research in this school of thought includes Chordia, Roll, and Subrahmanyam (2000), Hasbrouck and Seppi (2001), Huberman and Halka (2001), Amihud (2002), and Pastor and Stambaugh (2003) where the research indicates that individual equity share liquidity cost reflects a significant market-wide liquidity cost component. Clearly, this finding suggests liquidity risk possesses a non-diversifiable component similar to systematic market risk.⁸

The relevant research literature further suggests that liquidity cost commonality reflects the economic forces working at international levels. That is to say, international financial market research indicates that firm-level liquidity cost is significantly influenced by exchange-level and transnational liquidity cost factors, where both world-wide and home-country macroeconomic information events are associated with synchronized liquidity cost movements. Cross-border financial integration and information transfers suggest that transnational liquidity cost commonality has an important role in determining world-wide liquidity cost dynamics. At the international level, Bekaert, Campbell, and Lundblad (2007) find that financial market integration impacts liquidity costs, suggesting that transnational factors play an important role in determining trading costs.

More recent research literature enhances this framework by examining the factors driving liquidity cost commonality. Variables such as institutional trading and, particularly, degree of foreign institutional investors, have been shown to attenuate liquidity cost commonality through related trading strategies, notably for large and internationally visible firms. Furthermore, high-frequency trading studies suggest that liquidity cost commonality may vary over characteristics like depth, spread, and resilience, suggesting that distinct aspects of liquidity cost react differently to common liquidity cost shocks. Considered together, these research findings collectively support the view that liquidity cost is influenced by both local and world-wide factors, making it a rich topic for the examination of cross-country financial variability.

Firm Cross-Listing and Multiple-Market Liquidity Cost Linkages

Cross-listed firm equity share trading presents researchers with a unique opportunity to investigate international liquidity cost shock transfers. As employed in this research, cross-listed shares primarily regard non-U.S. firms having shares traded on U.S. share exchanges, while simultaneously the corresponding equity shares are traded in the home-country equity share market. This type of multiple-market asset trading institutional structure creates a natural conduit connecting U.S. and home-country liquidity cost status.

The extant research literature addressing multiple-market asset trading clearly indicates that price discovery and liquidity costs are simultaneously determined in both share markets, with price relevant information transferring back and forth between the cross-listed and the underlying equity shares. Considering that cross-listed share trading takes place in the highly liquid and information rich U.S. market environment, liquidity cost shocks to cross-listed shares are likely observed by home-country traders and, as a result, are reflected home-country equity share bid and ask price spreads via share trader arbitrage and institutional informational channels.⁹

⁸. Relevant research also underscores the importance of macroeconomic information in determining liquidity costs. Researchers such as Fleming and Remolona (1999) report results indicating that consequential macroeconomic information events (e.g., U.S. monetary policy changes) result in prompt and synchronized changes in market liquidity costs. Moreover, Hasbrouck and Seppi (2001) conjecture that both domestic and world-wide information flows impact equity share trading costs.

⁹. The clear advantage of employing cross-listed firm share bid and ask price spreads as a surrogate measure for liquidity cost is that their use expedites the construction of home-country liquidity cost measures via aggregating firm-specific bid and ask share price spreads into portfolios representing the home-country equity market liquidity

Measuring Liquidity Spillovers: The VAR and FEVD Methodology Framework

From a methodology perspective, a convenient research design by which to measure the information transferred via liquidity cost shocks across national boundaries is the Vector Auto Regressive (VAR) econometric modeling of time-series, used in conjunction with the Forecast Error Variance Decomposition (FEVD) framework suggested by Diebold and Yilmaz (2009, 2012). The DY research design framework is an especially good fit with the liquidity cost spillover literature since it calculates spillover indices by decomposing the liquidity cost variance of each country time-series into the portion unique to that country and the liquidity cost variability arising from shocks emanating other countries included in the VAR system.¹⁰ Within the DY FEVD analysis framework, the important measures are summarized as follows:

Key Figures Provided by Diebold-Yilmaz Spillover Table Analyses

- 1. Total Spillover Index:** Reflecting the overall degree of connectedness of the variables across home-country markets.
- 2. Directional Spillovers:** Quantifies the extent to which a specific home-country market transmits liquidity cost shocks to or receives liquidity cost shocks from other home-country markets.
- 3. Net Spillovers:** Identifies whether a particular home-country market is a net transmitter or net receiver of liquidity cost shocks.

Spillover Table analysis has been broadly employed in the relevant research literature employing various time-series variables (e.g., market volatility, equity share returns, and increasingly to measures of liquidity cost such as bid-ask spreads and the Amihud (2002) illiquidity ratios). Extant empirical research results consistently report the regular observation of significant spillovers, suggesting that liquidity cost shocks emanate across markets world-wide.¹¹

Similarly, the results of country-level spillover research analyses indicate that liquidity cost shocks are disseminated across national markets, particularly in highly integrated geographic regions such as the European Union (EU). For instance, researchers such as Allen and Gale (2000) advance theoretical underpinnings of spillovers, highlighting the manner by which economic interdependence can impart shocks which traverse national borders. Furthermore, empirical research like Pirrong (2004) demonstrates cross-market liquidity cost spillovers, where liquidity cost shocks in one country affect other regional markets. Specifically addressing the EU Debt Crisis¹², researchers such as Acharya, Drechsler, and Schnabl (2014) report research results

cost. Clearly, this method fits with the extant research literature stressing the importance of multiple-market asset trading in attenuating market integration as well as the information transfers associated with trans-border liquidity shocks.

¹⁰. The Diebold and Yilmaz (2012) generalized FEVD approach has a considerable advantage in that it avoids the ordering dependence problem (i.e., encountered with the Cholesky Decomposition Approach alternative to the DY approach) by using generalized impulse response functions and, thereby, yielding more robust estimates of the time-series degree of connectedness.

¹¹. For instance, liquidity cost spillover research addressing ETFs and foreign exchange markets identify strong cross-country interconnectedness, as well as asymmetric directional dissemination patterns which are attenuated during periods of heightened global market uncertainty.

¹². The European Debt Crisis describes a period of severe financial instability in several European countries following upon the 2008 global financial crash. The Crisis began when several countries (e.g., Greece, Portugal, Ireland, Spain, and Italy) accumulated large amounts of government debt and struggled to repay it. Investors lost confidence, borrowing costs soared, and some countries faced the risk of default. In order to prevent collapse, these countries received financial bailouts from institutions like the European Union, the European Central Bank, and the

indicating that financial sector stress and liquidity cost information is transferred across countries. In the same manner, Cœuré (2013) demonstrates the process by which EU financial integration results in synchronized liquidity cost dynamics and cross-border spillovers.¹³

Implications for Country-Level Portfolio Construction and Spillover Tables

Following upon the relevant research literature discussed previously, building country-level liquidity cost portfolios using cross-listed share home-country bid-ask spreads provides a rich manner by which to examine international liquidity cost interrelationships. Aggregating firm-level spreads into home-country portfolios enables researchers to isolate the average liquidity cost faced by traders in each market world-wide. Employing VAR-FEVD Spillover Table Analysis methods to these home-country portfolio bid-ask spreads enables researcher to isolate and separately identify the following effects:

Strengths Of VAR-FEVD Spillover Table Analysis

- | | |
|--|--|
| 1. Identify Information Transfers: | Inter-national liquidity cost spillover tables which illustrate the manner by which liquidity cost shock information is transferred between and among different countries. |
| 2. Directional Information Transfers: | Inter-national liquidity cost directional spillover tables isolate and identify net transmitters and receivers of liquidity cost shock information. |
| 3. Identify Concentrated Networks: | Inter-national liquidity cost network structures separately identify clusters of highly interrelated markets. |

Spillover Table Analyses are particularly beneficial in acquiring insight into systemic risk and financial contagion types of economic phenomena. Large degrees of interrelationship networks suggest that liquidity cost shocks in one country may quickly spread to other countries impeding the efficacy of world-wide diversification strategies. On the other hand, more segmented countries displaying lower degrees of liquidity cost spillover effects and may serve as more efficacious global diversification vehicles.

Synthesis and Integration of Research Contribution

The current research literature conveys compelling evidence that liquidity cost shocks display both commonality and spillover effect components varying across assets, markets, and countries. Cross-listed home-country bid-ask spreads provide a robust and intuitive surrogate measure of liquidity costs faced by traders. The Diebold-Yilmaz VAR-FEVD framework provides a rich procedure for quantifying liquidity cost shock cross-country interrelationships and enables calculation of direct and directional spillover measures.¹⁴ Considering all of the strengths,

International Monetary Fund. In return, those countries were required to implement strict austerity measures which led to economic hardship and social unrest. In short, the European Debt Crisis was caused by excessive debt, weak economies, and flaws in the euro-system, resulting in bailouts and tough economic reforms across parts of Europe.

¹³. In research more directly addressing liquidity cost correlation, Brenner, Subrahmanyam, and Soussanov (2013) present research results demonstrating the occurrence of international liquidity cost spillovers and commonality across markets. Moreover, Engle, Ghysels, and Nguyen (2012) report research evidence addressing dynamic liquidity cost spillovers employing high-frequency data and suggesting that liquidity cost shock information transfers swiftly across countries.

¹⁴. Particularly noteworthy, however, is the observation that comparatively few research studies have combined these attributes in applying them using cross-listed firms' home-country bid-ask spread proxies for liquidity cost to construct country-specific portfolios. This approach contributes to the relevant literature in the following manner:

weaknesses, and trade-offs inherent within, application of Spillover Table Analysis to examine the behavior of country-specific liquidity cost portfolios enhances our understanding of the manner by which liquidity cost shock information is transferred among countries world-wide including in what manner financial integration influences market liquidity cost behavior.

Research Design and Empirical Methodology

This research examines cross-country liquidity cost commonality and spillovers employing U.S. cross-listed firms and their corresponding home-market equity bid and ask share price spreads. The particular research design and methodology employed has the distinct strength of integrating market microstructure measures of liquidity cost with the multivariate time-series Vector Autoregressive (VAR) and related Generalized Forecast Error Variance Decomposition (GFEVD) framework to measure and quantify the interrelatedness of liquidity costs across countries and geographic regions.

Data and Sample Construction

The empirical analysis employed in this research is based on a sample of 348 U.S. cross-listed firms and their corresponding underlying equity shares traded in their home-country markets over a time period from 2001 and extending through 2022. Multiple-market traded firms provide an intuitive connection between U.S. and international markets and have been widely used in studies of international market integration and global information transfers. For each cross-listed firm, the corresponding home-country equity is identified and daily bid and ask price data are obtained from Datastream database over the period of time 2001-2022 covered in this research.

The countries represented by the cross-listed firms employed are grouped into six geographic regions to better isolate regional liquidity cost spillover information transfers within each geographic as well as across each of the six (6) geographic regions:

Countries Used To Form Regional Portfolios Examining Spillover Transfers Within And Among Six Geographic Regions (36)

North Europe (7)	Denmark, Finland, Ireland, Russia, Norway, Sweden, United Kingdom
Central Europe (8)	Belgium, France, Germany, Luxembourg, Netherlands, Portugal, Spain, Switzerland
South Europe (5)	Greece, Hungary, Israel, Italy, Turkey
North Asia (5)	China, Japan, Korea, Hong Kong, Taiwan
South Asia (5)	Australia, India, Indonesia, New Zealand, Philippines
South and Latin America (6)	Argentina, Brazil, Chile, Columbia, Mexico, Peru

For each country, daily firm-level liquidity costs observations are aggregated to construct country-level liquidity cost portfolios following upon prior research literature investigating

Contribution To Relevant Research Literature

- 1. Comparable Measures:** Measures of liquidity cost shocks which are comparable across country portfolios.
- 2. Investor Perspective:** Reflecting international investor perspectives of trading costs.
- 3. Extends Application:** Advancing the spillover table analysis methodology to cross-country liquidity cost networks.

liquidity cost commonality at the home-country market level instead of the individual equity share (e.g., Chordia, Roll, and Subrahmanyam (2000) and Hasbrouck and Seppi (2001)). Similarly, regional portfolios are formed by aggregating daily liquidity cost measures across all countries within each geographic region. Subsequently, the regional liquidity cost portfolios are used to investigate liquidity cost spillover information transfers (1) within each geographic region as well as (2) across each geographic region.

Measurement of Liquidity Cost

A rich surrogate measure for liquidity cost is the bid and ask price spread which is a commonly employed in the relevant research literature as a standard measure of trading costs and market liquidity. The bid-ask spread reflects the difference between the highest bid and lowest ask prices and captures the cost of immediate execution; wider spreads indicate lower liquidity. Specifically, the relative quoted spread is computed as:

$$PctSpread_{i,t} = \frac{Ask_{i,t} - Bid_{i,t}}{Midpoint_{i,t}}$$

Where, $Midpoint_{i,t}$ is given as $Midpoint_{i,t} = \frac{Ask_{i,t} + Bid_{i,t}}{2}$.

The bid-ask share price spread is widely used in empirical liquidity cost research because it reflects both transaction cost and information asymmetry components of investor trading costs. It has also been employed extensively in studies of liquidity spillovers and systemic liquidity risk.¹⁵ For each home-country represented in the sample, a country-level liquidity cost measure is computed as the daily equally weighted average of firm-level liquidity costs over firms residing in each country employed in this research:¹⁶

¹⁵. A considerable body of literature establishes bid and ask price spread as a robust measure for market liquidity cost and reports its usefulness in investigating liquidity cost spillovers and systemic liquidity risk. Early microstructure research suggests that bid and ask price spreads reflect important dimensions of trading frictions, including transaction costs, inventory risk, and information asymmetry (Roll (1984) and Huang and Stoll (1997)), while asset pricing research links illiquidity to expected returns (Amihud (2002) and Amihud and Mendelson (1986)). Relying on this underlying framework, subsequent research underscores the role of liquidity costs in disseminating information across markets, where frameworks such as Diebold and Yilmaz (2012) advance the measurement of spillovers and studies like Kyle and Xiong (2001) emphasizing the interaction between liquidity cost shocks and systemic risk. More recent empirical research extends these results across asset classes and market conditions, consistently employing bid and ask price spreads as a primary liquidity proxy. For example, Jurksas et al. (2021) report intraday liquidity spillovers in bond markets, while Lim and Choi (2022) show that liquidity transmission across equity sectors strengthens during crisis periods. Similarly, Corbet et al. (2023) provide evidence of cross-market liquidity cost spillovers between cryptocurrency and foreign exchange markets, and Liu and Zhao (2024) demonstrate significant bidirectional liquidity spillovers in exchange-traded funds, particularly during periods of increases uncertainty. Considered together, the extant research literature indicates that bid-ask spreads remain a widely used and robust measure liquidity dynamics, making them particularly appropriate for investigating the liquidity shock information transfers and systemic liquidity risk in modern financial markets.

¹⁶. The **Augmented Dickey-Fuller (ADF)** statistical test is used in time series analysis to check whether a series is stationary or has a unit root (i.e., is non-stationary). A time series is said to be stationary if its statistical properties (mean, variance, autocorrelation) remain constant over time. Stationarity is important because many models (e.g., ARIMA) assume stationarity. The ADF test evaluates whether the Null Hypothesis can be rejected where (1) the Null Hypothesis ($H_{0,c\epsilon C}$) is that the series has a unit root \rightarrow non-stationary, or (2) the Alternative Hypothesis ($H_{A,c\epsilon C}$) that the series is stationary. The null hypothesis is tested using regression of the form $\Delta y_{i,t} = \alpha_i + \beta_i \cdot$

$$L_{c,t} = \frac{1}{N_c} \sum_{i \in C}^{N_c} PctSpread_{i,t}$$

Aggregating the firm-specific liquidity cost measure by employing the cross-sectional daily mean serves to isolate common liquidity costs within a specific country as well as provides the added benefit of mitigating idiosyncratic firm-level noise.¹⁷

Liquidity Cost Commonality

Liquidity cost commonality refers to the co-movement of liquidity costs across assets or markets. Prior literature shows that liquidity costs tend to exhibit systematic components driven by market-wide factors (Chordia et al. (2000) and Karolyi et al. (2012)). In this study, commonality is captured implicitly through the joint dynamics of country-level liquidity series within a multivariate framework. The use of country portfolios allows for identification of systematic liquidity cost factors across regions and facilitates the analysis of cross-border liquidity cost shock transmission mechanisms.

The VAR Econometric Model Specification

Vector Autoregressive time-series models are widely used in liquidity cost commonality and spillover research because they have the advantage of allowing for endogenous feedback effects between the home-country markets being modelled. Let \mathbf{L}_t indicate a $K \times 1$ vector of country-level measure so liquidity cost measures $\mathbf{L}_t \in \mathbf{R}^K$ for countries $k = (1, \dots, K)$ comprising region $\mathbf{r} \in \mathbf{R}$ and $\mathbf{L}_t = (\mathbf{L}_{1,t}, \mathbf{L}_{2,t}, \dots, \mathbf{L}_{K,t})'$, then the VAR(p) econometric model of the interaction of country-specific liquidity costs is given by

$$\mathbf{L}_t = \sum_{j=1}^{j=p} \mathbf{A}_j \cdot \mathbf{L}_{t-j} + \varepsilon_t$$

Where,

$\mathbf{A}_j, \mathbf{A}_j \in \mathbf{R}^K$ are $K \times K$ matrix of VAR Coefficients.

$t + \gamma_i \cdot y_{t-1} + \varepsilon_{i,t}$, where Δy_t is the differenced series and y_{t-1} is the lagged series (i.e., the lag terms account for autocorrelation in the errors). Anytime the null hypothesis is **rejected** the time-series is *considered stationary*. The liquidity cost time-series for all countries employed in this research demonstrate stationarity following upon a first differencing transformation of the country's proportional bid and ask share price spread series. The Null Hypothesis ($H_{0,ccc}$) that the country-specific series has a unit root is rejected at the $\alpha = 0.001$ confidence level for all countries employed in this research. Consequently, we believe that the first differencing transformation of the country-specific average liquidity cost series addresses any unit root issues arising with the data.

¹⁷. The presence of idiosyncratic firm-level noise in data will tend to bias econometric model parameter estimates toward zero and against the detection of liquidity cost shock information transfer spillovers. Aggregating firm-level liquidity measures using the cross-sectional daily mean is a standard approach to extract the common component of liquidity, as liquidity exhibits strong co-movement across assets (Chordia et al. (2000) and Korajczyk and Sadka (2008)). This aggregation also mitigates idiosyncratic firm-level noise inherent in individual liquidity proxies, thereby yielding a more robust measure of market-wide liquidity conditions (Goyenko et al. (2009) and Liao et al. (2021)).

L_t , $L_t \in \mathbf{R}^K$ is a $K \times 1$ vector of country specific liquidity cost measures.
 $\varepsilon_t \sim (0, \Sigma)$, $E[\varepsilon_t] = 0$, and $E[\varepsilon_t \varepsilon_t'] = \Sigma$.
 Σ is the positive definite VAR Variance-Covariance matrix.

Specified in this manner, the VAR model reflects (1) the home-country liquidity cost persistence, (2) cross-country liquidity cost information transfer, and (3) cross-country liquidity cost feedback effects.¹⁸

Forecast Error Variance Decomposition (FEVD)

Following upon the current research literature, this study employs the Pesaran and Shin (1998) and Diebold and Yilmaz (2009, 2012) Generalized Forecast Error Variance Decomposition (GFEVD) derived from the VAR econometric framework discussed previously. As used in this research, the GFEVD decomposes the liquidity cost forecast error variance into portions attributable to liquidity cost shocks arising from the home-country itself and the portion of the liquidity cost shock forecast error variance being driven by the other liquidity cost shocks emanating from other countries.¹⁹ Formally, the contribution of liquidity cost shocks from country j to country i 's H -step-ahead liquidity cost forecast error variance is computed as follows:

$$\Theta_{i,j}^H = \frac{\sigma_{j,j}^{-1} \sum_{h=0}^{H-1} [e_i' A^h \Sigma e_j]^2}{\sum_{h=0}^{H-1} [e_i' A^h \Sigma A^{h'} e_i]}$$

Where,

¹⁸. **Lag Length Selection Criteria:** In this research the optimal lag length for the country-specific daily liquidity cost VAR time-series system is evaluated using two generally accepted information criteria: the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). These criteria balance model fit and parsimony by penalizing excessive parameterization. Generally speaking, we want to increase the lag length until the serial correlation in the errors is sufficiently diminished.

Akaike Information Criterion (AIC): $AIC(p) = \ln |\hat{\Sigma}_p| + \frac{2k_p}{T}$, and

Bayesian Information Criterion (BIC): $BIC(p) = \ln |\hat{\Sigma}_p| + \frac{\ln(T) \cdot k_p}{T}$,

Where, $\hat{\Sigma}_p$ is the estimated covariance matrix of residuals, k_p is the total number of estimated parameters, and T is the sample size.

The AIC imposes a relatively lighter penalty on model complexity, often favoring models with more lags, whereas the BIC applies a stricter penalty, typically selecting more parsimonious specifications. We evaluate the AIC and BIC on a country-by-country basis and find that the lag length minimizing these criteria ranges between 1 and 3, and varies from county-to-county and between the two information criteria employed. Increasing the number of lags further yields no additional benefit, and lag length with the range identified using AIC and BIC criteria produces qualitatively similar Spillover Table Analysis results. We believe our approach yields a systematic and theoretically well-grounded selection of lag length intra-regional and inter-regional liquidity cost shock information transfers. By combining AIC and BIC with diagnostic validation, we believe we balance goodness-of-fit and parsimony, thereby enhancing the reliability of subsequent inference on cross-country liquidity information flow dynamics.

¹⁹. Naturally, the GFEVD approach avoids sensitivity of results arising from variable ordering (i.e., as with the Cholesky Decomposition) and provides a consistent measure of liquidity cost shock interrelatedness across countries.

$\Theta_{i,j}^H$ = contribution of country j shocks to country i forecast error variance.

A^h = moving-average representation of VAR parameter estimates.

Σ = a positive definite variance-covariance matrix.

e_i = the $K \times 1$ i^{th} selection vector having unity in the i^{th} position and zero elsewhere.

$\sigma_{j,j}$ = the standard deviation of shock j.

This GFEVD $\Theta_{i,j}^H$ provides foundation for calculating the country-specific spillover indices and directional measures liquidity cost inflows and outflows. However, following convention established in relevant research, the GFEVD $\Theta_{i,j}^H$ needs to be normalized because the rows of GFEVD $\Theta_{i,j}^H$ do not sum to unity. The established normalization procedure used frequently in the relevant research literature enables this research to make comparisons among countries and geographic regions, and is given by $\overline{\Theta}_{i,j}^H = \frac{\Theta_{i,j}^H}{\sum_{j=1}^K \Theta_{i,j}^H}$.

Spillover Indices and Network Measures

Following Diebold and Yilmaz (2012), this research employs three measures of liquidity cost shock information flows: Total Liquidity Cost Information Spillover Index, Net Liquidity Cost Information Transmitted to other countries, and Net Liquidity Cost Information Received from other countries. Naturally, this research is most interested in whether particular countries may be characterized as being either Net Receivers or Net Transmitters of liquidity cost shock information.

Total Information Spillover Index: The Total Information Spillover Index is average value of the liquidity cost variability attributable to cross-country liquidity cost shocks and measures the overall degree of interconnectedness among countries.

$$TSI = \frac{\sum_{i \neq j} \overline{\Theta}_{i,j}^H}{K} \times 100$$

Directional Information Spillover Indices: The two Directional Information Spillover Indices used in this research are shown below. These indices are measure of the amount of liquidity cost shock information that is transferred to other countries and received from other countries on balance. The subscript $DS_{i \rightarrow \blacksquare}$ indicates the value of the index for the amount of liquidity cost shock information *transferred to* other countries and the subscript $DS_{i \leftarrow \blacksquare}$ indicates the value of the index for the amount of liquidity cost shock information *received from* other countries.

$$DS_{i \rightarrow \blacksquare} = \sum_{i \neq j} \overline{\Theta}_{j,i}^H \quad \text{Liquidity cost shocks transmitted from country i to other countries.}$$

$$DS_{i \leftarrow \blacksquare} = \sum_{i \neq j} \overline{\Theta}_{i,j}^H \quad \text{Liquidity shocks received by country i from other countries.}$$

Net Directional Information Spillover: The Directional Information Spillover Indices $DS_{i \rightarrow \blacksquare}$ and $DS_{i \leftarrow \blacksquare}$ measures used in this research permit the identification of net liquidity cost shock information transmitters (*i. e.*, $NS_i \geq 0$) and net liquidity cost shock information receivers (*i. e.*, $NS_i < 0$) of on a country-by-country as well as a regional basis. The GFEVD-based spillover framework employed herein has become the standard in the relevant research literature for studying interconnectedness

across markets.

$$NS_i = DS_{i \rightarrow \bullet} - DS_{i \leftarrow \bullet}$$

Where, $NS_i \geq 0 \Rightarrow$ Net Spillover Transmitter, and $NS_i < 0 \Rightarrow$ Net Spillover Receiver.

Construction of Inter-Regional and Intra-Regional Spillover Tables

The liquidity cost spillover tables employed in this research are constructed with GFEVD analysis following upon the VAR econometric time-series results, wherein each cell of the spillover table reflects the contribution of liquidity cost shocks from country j to country i. Furthermore, the liquidity cost spillover measures are aggregated at the regional level enabling us to investigate whether liquidity cost shock transmission is stronger within or across the six geographic regions employed in this research. The liquidity cost spillover table analyses enable this research to do the following: (1) identify which countries are dominant sources of liquidity cost shocks, (2) identify regional liquidity cost shock clustering effects, and (3) compare and contrast both intra-regional and inter-regional liquidity cost shock spillovers.

In order to examine inter-regional liquidity cost shock information transfers, countries are grouped into geographic regions to identify geographic patterns in liquidity cost shocks transfers. Regional liquidity cost aggregation is carried out via averaging country-level spillovers within each region as well as across the regions. Aggregate inter-regional liquidity cost spillover analyses enables: (1) comparison of intra-regional vs inter-regional spillovers, (2) identification of regional hubs of liquidity cost risk shock information transfers, and (3) assessment of whether certain regions act as systemic liquidity cost shock information transmitters.

In summary, this study employs cross-listed firms' home-country equity share bid-ask spreads in order to construct country-level liquidity cost measures, which are analyzed established VAR and GFEVD methodology. Using generalized FEVD and the Diebold-Yilmaz spillover table analyses methodology, this study examines both the magnitude and direction of liquidity cost spillovers across countries and regions world-wide. This approach provides a comprehensive framework for enhancing our understanding of global liquidity cost commonality and its transmission mechanisms.

This research contributes and advances the relevant research literature in several important manners. First, and foremost, this research extends the VAR and GFEVD spillover analyses to liquidity costs whereas the existing research literature applies the spillover analyses methodology largely using only security returns and volatility. Second, we use cross-listed firms who have shares traded in multiple asset markets providing as natural setting for international information transfers. Third, we use cross-listed firms' home-country equity bid and ask share price spread as the measure of liquidity cost incorporating a market microstructure perspective into the spillover analysis research design.²⁰

²⁰ The VAR GFEVD spillover table analysis is a highly useful research design and methodology, but it does have limitations that ought to be acknowledged. For example, the VAR GFEVD spillover table analysis assumes the appropriateness of linear VAR econometric modeling having time invariant constant parameters. Nonlinear spillover channels and institutional regime shifts are not explicitly taken into consideration. Furthermore, the high dimensionality of the multivariate VAR models limits the number of countries that can be taken into consideration at one time. These shortcomings are somewhat limited via robustness checks but remain inherent to the otherwise rich research design methodology.

Sample Data Distributional Descriptive Statistics

The data sample employed in this study consists of country-level portfolio daily liquidity cost measures (i.e., proxied by proportional bid–ask spread) across a broad set of developed and emerging countries.²¹ The descriptive statistics reported in Table No.1 summarize the key distributional properties of these aggregated inter-regional country-specific liquidity cost series within each of the six major geographic regions employed in this research - North Asia, South Asia, North Europe, Central Europe, South Europe, and Latin and South America. For each country, the Table No.1 presents the mean, standard deviation, minimum and maximum values, along with higher-moment characteristics including skewness and kurtosis.

Generally speaking, the descriptive statistics shown in Table No.1 suggest that the average daily changes in country-specific portfolio proportional bid–ask spreads are positive across nearly all countries, indicating a slight upward bias in liquidity costs over the time period employed in this research. However, the magnitude of these means values remains economically small relative to their corresponding standard deviations, highlighting substantial day-to-day variability in liquidity cost conditions. This conjecture is further supported by the wide range between minimum and maximum values, indicating the presence of extreme liquidity shocks in both directions.

Table No.1: Descriptive Statistics for Intra-Regional Liquidity Cost Country Portfolios**Panel A: Descriptive Statistics for North Asia Geographic Region Countries**

Country	Mean	Std Dev	p-value ^a	Maximum	Minimum	Skewness ¹	Kurtosis ²
China	0.034882	0.361735	0.000000†	0.999997	-0.999723	0.955590	2.689733 †
Japan	0.078783	0.492184	0.000000†	0.999926	-0.999886	0.565748	-0.314159
Korea	0.028819	0.324654	0.000000†	0.999997	-0.999999	1.219977	4.347479 †
Hong Kong	0.039186	0.359626	0.000000†	0.999996	-0.999026	1.085893	2.618825 †
Taiwan	0.024914	0.294516	0.000000†	0.999952	-0.999483	1.356880	5.637896 †

Panel B: Descriptive Statistics for South Asia Geographic Region Countries

Country	Mean	Std Dev	p-value ^a	Maximum	Minimum	Skewness ¹	Kurtosis ²
Australia	0.067164	0.486793	0.000000†	0.999999	-0.999844	0.551117	-0.094320
India	0.048823	0.469182	0.000000†	0.999997	-0.999912	0.530632	0.416437
Indonesia	0.041297	0.358031	0.000000†	0.999900	-0.999110	1.214258	2.886327†
NZealand	0.057368	0.454912	0.000000†	0.999900	-0.998304	0.746568	0.485553
Philippines	0.031261	0.370201	0.000000†	0.999900	-0.998732	0.899264	2.733165†

Panel C: Descriptive Statistics for North Europe Geographic Region Countries

Country	Mean	Std Dev	p-value ^a	Maximum	Minimum	Skewness ¹	Kurtosis ²
Denmark	0.085691	0.528766	0.000000†	0.999941	-0.998830	0.524906	-0.569215
Finland	0.081696	0.525537	0.000000†	0.999900	-0.999900	0.480255	-0.477381
Ireland	0.055369	0.463427	0.000000†	0.999990	-0.999331	0.581591	0.319975

²¹. A first differencing data transformation applied to the raw proportional bid-ask spread data to induce stationarity in daily changes in bid–ask spreads, and, thereby reflecting short-term fluctuations in country-specific liquidity conditions that are particularly relevant for liquidity cost shock information transfer and inter-country connectedness analysis within the VAR spillover framework.

Russia	0.067030	0.495198	0.000000†	0.999900	-0.998594	0.621362	-0.051691
Norway	0.038745	0.423811	0.000000†	0.999905	-0.999598	0.608511	1.285709
Sweden	0.051788	0.383789	0.000000†	0.999900	-0.999388	1.097138	1.873715
UK	0.064218	0.478792	0.000000†	0.999976	-0.999939	0.619635	0.169771

Panel D: Descriptive Statistics for Central Europe Geographic Region Countries

Country	Mean	Std Dev	p-value ^a	Maximum	Minimum	Skewness ¹	Kurtosis ²
Belgium	0.078886	0.577104	0.000000†	0.999962	-0.999557	0.294008	-0.785907
France	0.066203	0.520072	0.000000†	0.999988	-0.999749	0.457145	-0.290467
Germany	0.048885	0.409811	0.000000†	0.999990	-0.999930	0.704979	0.968082
Luxembourg	0.092131	0.610530	0.000000†	0.999900	-0.999428	0.264604	-1.101227
Netherlands	0.070018	0.528774	0.000000†	0.999952	-0.999916	0.446163	-0.403240
Portugal	0.080937	0.560577	0.000000†	0.999900	-0.996312	0.382269	-0.722721
Spain	0.065338	0.465888	0.000000†	0.999900	-0.998986	0.612561	0.204347
Switzerland	0.047022	0.400074	0.000000†	0.999923	-0.999744	0.937084	1.625948

Table No.1: Descriptive Statistics Continued ...

Panel E: Descriptive Statistics for South Europe Geographic Region Countries

Country	Mean	Std Dev	p-value ¹	Maximum	Minimum	Skewness ²	Kurtosis ³
Greece	0.037045	0.371851	0.000000†	0.999900	-0.998385	0.931269	2.456012†
Hungary	0.071937	0.482358	0.000000†	0.999900	-0.998710	0.568532	-0.148115
Israel	0.059026	0.513387	0.000000†	0.999992	-0.999658	0.445858	-0.135945
Italy	0.049065	0.439711	0.000000†	0.999926	-0.999900	0.640834	0.808122
Turkey	0.041295	0.369665	0.000000†	0.999900	-0.998230	1.029679	2.347346†

Panel F: Descriptive Statistics for Latin and South America Geographic Region Countries

Country	Mean	Std Dev	p-value ¹	Maximum	Minimum	Skewness ²	Kurtosis ³
Argentina	0.053063	0.464145	0.000000†	0.999999	-0.999511	0.579022	0.391302
Brazil	0.052254	0.473425	0.000000†	0.999990	-0.999900	0.531746	0.337800
Chile	0.041269	0.416447	0.000000†	0.999962	-0.999842	0.664629	1.335990
Columbia	0.036464	0.389063	0.000000†	0.999900	-0.999385	0.802669	2.125031
Mexico	0.051387	0.472712	0.000000†	0.999984	-0.999900	0.509314	0.300852
Peru	0.011862	0.233833	0.000123	0.999900	-0.994954	1.409781	11.606836†

†: Indicates that the variable specific null hypothesis is rejected at the $\alpha = 0.05$ confidence level.

1: The null hypothesis that the mean data value is equal to zero under the null is tested using the Student's t-Test. Student's t-Test: $t = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{N}}}$,

where \bar{x} is the sample mean, N is the number of non-missing values for a variable x_i , and s is the sample standard deviation. The critical t-value for the $\alpha = 0.05$ confidence level two-tailed test is 1.962. The p-value reported for the Student's t-test is the probability of obtaining a larger t-statistic and is the null hypothesis is rejected for p-values smaller than $\alpha = 0.05$ confidence level for two-tailed tests.

2: **Sample Skewness:** Skewness is a measure of symmetry or the lack of symmetry of data. A distribution is symmetric if the left and right of the center point appear similar. Skewness = $\frac{\frac{1}{N} \sum_{i=1}^N (x_i - \bar{x})^3}{\left[\frac{1}{N} \sum_{i=1}^N (x_i - \bar{x})^2 \right]^{3/2}} \cdot \frac{N\sqrt{N-1}}{N-2}$, with all variables defined as previously. To test the statistical significance of the computed skewness value, the skewness measure is converted to an appropriate Z statistic by dividing the skewness measure by its standard error, i.e., $Z_S = \left\{ \frac{\sum_{i=1}^N (x_i - \bar{x})^3}{\left[\sum_{i=1}^N (x_i - \bar{x})^2 \right]^{3/2}} \cdot \frac{N\sqrt{N-1}}{N-2} \right\} \cdot \frac{1}{\sqrt{\frac{6N(N-1)}{(N-2)(N+1)(N+3)}}$. The skewness statistic indicates substantial departure from normality for absolute skewness statistic values > 2.00 .

3: **Sample Kurtosis:** Kurtosis measures whether the data are heavy-tailed or light-tailed when compared with the normal distribution. Data having high kurtosis tend to have heavy tails and outliers. Data having low kurtosis have light tails and no outliers. Kurtosis = $\frac{\sum_{i=1}^N (x_i - \bar{x})^4}{\left[\frac{\sum_{i=1}^N (x_i - \bar{x})^2}{N}\right]^2} - 3$, where

all variables are defined as previously. To test the statistical significance of the kurtosis value, the computed kurtosis is converted to an appropriate Z statistic by dividing the skewness measure by its standard error, i.e., $Z_K = \left\{ \frac{(N-1)}{(N-2)(N-3)} \right\} \cdot \left\{ (N+1) \left[\frac{\sum_{i=1}^N (x_i - \bar{x})^4}{\left[\frac{\sum_{i=1}^N (x_i - \bar{x})^2}{N}\right]^2} - 3 \right] + 6 \right\}$.

$\left\{ \frac{2}{\sqrt{\frac{(N^2-1)}{(N-3)(N+5)} \cdot \frac{6N(N-1)}{(N-2)(N+1)(N+3)}}} \right\}$. The kurtosis statistic indicates substantial departure from normality for absolute skewness statistic values > 2.00.

The standard deviation values shown in Table No.1 reflect heterogeneous volatility patterns across geographic regions, where the European markets (i.e., particularly Central and North Europe) exhibiting comparatively larger dispersion in daily liquidity cost changes relative to Asian and Latin American markets. This descriptive result suggests that liquidity cost dynamics in European countries may be more sensitive to world-wide and regional liquidity cost information shocks perhaps resulting from heightened EU economic integration.

The distributional characteristics shown in Table No.1 also suggest substantial departures from normality. Most country-level daily liquidity cost data series exhibit positive skewness suggesting a propensity for large upward movements in daily proportional bid-ask spreads (i.e., periods of liquidity degradation). Furthermore, several countries e.g., Korea, Taiwan, Greece, Turkey, and Peru exhibit large degrees of kurtosis implying fat-tailed distributions and a resultant heightened likelihood of excessive data values. These results are congruous with the occurrence of occasional periods of liquidity stress and support the utilization of VAR-based spillover models which may adapt to non-normal data series.

The reported p-values from the results of the country-specific Student's t-tests confirm that the null hypothesis of zero mean is rejected at the $\alpha = 0.05$ confidence level for virtually all country liquidity cost series, underscoring the statistical relevance of the observed mean liquidity changes. When aggregated at the regional level, similar patterns persist, and all geographic regions exhibit positive mean daily liquidity cost changes, moderate-to-high degree of liquidity cost variability, as well as mild-to-moderate positive skewness with kurtosis values suggesting varying degrees of tail risk across geographic regions.

In summary, the country-specific daily liquidity cost sample provides a comprehensive and high-frequency depiction of world-wide portfolio liquidity cost behavior. The documented statistical observation of non-zero mean changes, high volatility, skewness, and excess kurtosis highlight the importance of modeling cross-country liquidity interdependence using VAR spillover techniques, since these characteristics suggest both attenuated systemic risk dissemination as well as region-specific liquidity cost shocks.²²

²². The following three tests for normality of the underlying daily liquidity cost data are rejected for all countries employed in this research: **Kolmogorov-Smirnov Test Statistic:** A nonparametric test used to compare a sample distribution with the normal distribution when testing for normality. Estimated normal parameters: $\hat{\mu} = \frac{1}{n} \sum_{i=1}^n X_i$,

$\hat{\sigma}^2 = \frac{1}{n} \sum_{i=1}^n (X_i - \hat{\mu})^2$, and Standardize: $Z_{(i)} = \frac{X_{(i)} - \hat{\mu}}{\hat{\sigma}}$. Then $D = \sup_x |F_n(x) - F(x)|$, where D : statistic

(maximum difference), \sup_x is supremum (the maximum over all values of x), $F_n(x)$ is empirical cumulative distribution function, and $F(x)$ is theoretical cumulative distribution function. Null Hypothesis (H_0) is that the data follow a normal distribution and Alternative Hypothesis (H_1) is that the data do not follow a normal distribution.

Presentation and Discussion of Intra-Regional and Inter-Regional Research Results

Discussion of Intra-Regional Spillover Results of Two Asian Geographic Regions

North Asia Intra-Regional Spillover Table Analyses

Table No.2 Panel A reports a Total Spillover Index of 71.147% for liquidity cost shock cross-country information transfers, suggesting a high degree of interrelationship among North Asian financial markets. This particular finding indicates that suggests that more than two-thirds of the liquidity cost shock variability is driven by cross- country shocks, suggesting a manifestation of strong intra-regional financial market integration and, as a result, rapid liquidity cost shock information volatility across financial markets. The magnitude of the North Asia Total Spillover Index is comparable to that for highly integrated regions reflecting the tight economic and financial linkages among these economies.

The directional spillover results suggest a comparatively balanced but interrelated financial system having limited dominance by any single country. Korea stands out as the principal net transmitter of liquidity cost shock information, showing a net spillover value of 6.529% which is the largest to others factor at 79.614%. This specific result suggests that liquidity cost shocks emanating from Korea play an important part in influencing other North Asia financial markets making it a prime source liquidity cost information.

Other hand, Japan and China are net receivers of liquidity cost shock information transfers irrespective of their large economies, with Japan showing net spillover of 3.510% and China showing net spillover of -1.690%. Their larger values for receiving liquidity cost shock information transfers compared with their liquidity cost shock information transfer outflow values indicate that these markets are primarily influenced by intra-regional information shocks instead of information emanating from their own sources. This particular result may be a manifestation of increasing financial openness and sensitivity to North Asia regional Economic developments. Panel A of Table No.1 indicates that Hong Kong (-0.460%) and Taiwan (-0.870%) exhibit near-balanced positions, suggesting that these countries transfer liquidity cost shock information inflows and outflows at approximately similar magnitudes.

The Panel A of Table No.2 diagonal elements reflect North Asia countries own proportion of liquidity cost shock information variability and provides additional evidence regarding the

The resulting Decision Rule is that if Large $D \rightarrow$ reject null (data deviates from normal) and Small $D \rightarrow$ do not reject null (data is close to normal). **The Cramér-von Mises Test Statistic:** Goodness-of-fit test whether a sample has normal distribution by measuring the squared distance between the empirical distribution function and the theoretical cumulative distribution function. Then $U_i = \Phi(Z_{(i)})$ where $\Phi(\cdot)$ is the standard normal CDF. The

Cramér-von Mises statistic is $W^2 = \frac{1}{12n} + \sum_{i=1}^n \left(U_i - \frac{2i-1}{2n} \right)^2$. W^2 measures the squared difference between the empirical CDF and the normal CDF, where smaller values \rightarrow closer to normality and larger values \rightarrow deviation from normality. The Decision Rule is to reject the null hypothesis of normality if W^2 is large and not reject the null if W^2 is small. **Anderson-Darling Test Statistic:** A test statistic $A^2 = -n - \frac{1}{n} \sum_{i=1}^n [(2i-1)(\ln F_i + \ln(1 - F_{n+1-i}))]$. Because mean and variance are estimated, the statistic is adjusted as follows $A_*^2 = A^2 \left(1 + \frac{0.75}{n} + \frac{2.25}{n^2} \right)$. The decision rule is if A_*^2 is large \rightarrow reject normality, and if A_*^2 is small \rightarrow do not reject normality.

existence of strong cross-country financial market relationships. All of the North Asia financial markets exhibit comparatively moderate own-country contributions, ranging from 26.915% for Korea to approximately 30% for Japan and Taiwan. These liquidity cost shock information spillover values are relatively small, suggesting that an important portion of financial market variability is described by outside influences instead of domestic liquidity cost shock information. This specific result is entirely consistent with large total spillover indices reported for these countries and underscores the high degree of liquidity cost shock information relationships among North Asia financial markets.

All things considered, the results of this research depict the North Asia regional markets as being highly integrated and mutually influential regional financial market system, wherein liquidity cost shocks are broadly disseminated via a complex network of economic interrelationships rather than being concentrated in one single dominant financial market. The results clearly depict Korea as a significant transmitter liquidity cost shock information while China and Japan serve as net absorbers of liquidity cost shock information inflows. The somewhat even distribution of spillovers among countries within the region suggests that systemic risk is shared across markets, thereby, reducing the effectiveness of North Asia regional diversification, especially during periods of increased stress and uncertainty when spillovers tend to intensify.

South Asia Geographic Intra-Regional Spillover Table Analyses

Table No.2 Panel B shows a Total Spillover Index of 47.019% for the South Asia Region suggesting a moderate-to-low level of financial market interrelatedness among countries comprising South Asian region. In comparison with the financial markets making up the North Asia region, the lower reported South Asia region Total Spillover Index value suggests that domestic factors serve a much more prominent function and, as a result, inter-market liquidity cost shock spillovers are much less prevalent. This conclusion appears to derive from less than half of the liquidity cost shock variability being explained by inter-country liquidity cost shock information transmitted across financial markets, suggesting that the South Asia region enjoys a relatively weaker degree of financial integration.

The directional spillover analysis shown in Panel B of Table No.2 suggests a comparatively more fragmented and asymmetric interrelatedness structure having clearer distinctions between liquidity cost shock information net transmitters and receivers. The Philippines is clearly shown as the largest liquidity cost shock information net transmitter with a net spillover of 11.623% as well as a high liquidity cost shock information outflow contribution of 68.522%. This result suggests that liquidity cost shocks emanating from the Philippine financial markets have a significant impact upon inter-regional financial markets. Likewise, Indonesia with a net spillover index of 9.627% serves as an important transmitter of liquidity cost shock information, having a substantial outflow spillover index 65.591% highlighting its function as a contributing source of regional liquidity cost shock volatility.

Table 2: Results of Intra-Regional Liquidity Cost Spillover Analysis ^a

Panel A: Generalized Spillover Table (%) North Asia Countries Total Spillover Index 71.147 ^b

Country ^c	China	Japan	Korea	HK	Taiwan	TO Others	FROM	NET
China	29.362	16.735	19.348	17.276	17.279	68.948	70.638	-1.690
Japan	17.097	30.014	19.418	15.700	17.771	66.476	69.986	-3.510
Korea	17.736	17.419	26.915	20.255	17.675	79.614	73.085	6.529
HK	17.005	15.096	21.720	28.872	17.306	70.668	71.128	-0.460
Taiwan	17.110	17.225	19.128	17.437	29.100	70.030	70.900	-0.870

Panel B: Generalized Spillover Table (%) South Asia Countries Total Spillover Index 47.019 ^b

Country ^c	Australia	India	Indonesia	New Zland	Phillipines	TO Others ^d	FROM Others ^e	NET Spillover ^f
Australia	58.311	9.851	13.443	2.442	15.953	32.649	41.689	-9.041
India	8.357	49.105	19.504	2.690	20.344	48.994	50.895	-1.901
Indonesia	9.829	17.488	44.037	7.456	21.191	65.591	55.963	9.627
New Zland	2.885	3.811	11.920	70.350	11.034	19.341	29.650	-10.309
Phillipines	11.577	17.845	20.723	6.753	43.101	68.522	56.899	11.623

Table 2: Intra-Regional Spillover Table Analysis Continued ...

Panel C: Generalized Spillover Table (%) North European Countries Total Spillover Index 73.064 ^b

Country ^c	Denmark	Finland	Ireland	Russia	Norway	Sweden	UK	TO Others ^d	FROM Others ^e	NET Spillover ^f
Denmark	24.769	7.802	11.606	16.655	6.169	16.620	16.379	77.549	75.231	2.318
Finland	10.166	32.129	9.885	11.848	7.061	14.281	14.631	52.882	67.871	-14.989
Ireland	12.560	8.237	26.772	14.512	6.728	14.125	17.065	69.461	73.228	-3.766
Russia	15.648	8.562	12.606	23.276	8.337	14.354	17.217	86.616	76.724	9.892
Norway	9.066	8.008	9.155	13.042	36.421	11.072	13.235	43.333	63.579	-20.246
Sweden	15.661	10.360	12.295	14.396	7.096	23.340	16.851	86.226	76.660	9.565
UK	14.448	9.913	13.913	16.163	7.942	15.773	21.847	95.379	78.153	17.226

Panel D: Generalized Spillover Table (%) Central European Countries Total Spillover Index 55.168^b

Country ^c	Belgium	France	Germa	Luxemb	Nether	Portug	Spain	Switzer	TO Others ^d	FROMther ^e	NETSpillove ^f
Belgium	35.145	12.865	14.830	1.914	11.514	0.015	10.442	13.273	61.244	64.855	-3.610
France	11.740	32.019	16.564	1.637	12.347	0.409	10.567	14.717	70.671	67.981	2.690
Germany	12.958	15.718	30.397	1.803	11.168	0.148	11.575	16.232	76.855	69.603	7.252
Luxembg	3.719	3.450	4.009	67.469	3.802	0.793	5.900	10.858	16.262	32.531	-16.270
Netherlan	10.985	12.848	12.224	1.894	33.402	0.280	11.643	16.724	66.419	66.598	-0.179
Portugal	0.058	0.471	0.058	1.139	0.387	95.155	1.728	1.004	2.778	4.845	-2.067
Spain	10.616	11.794	13.539	3.116	12.411	0.733	35.510	12.281	62.023	64.49	-2.467
Switzerlan	11.168	13.525	15.630	4.758	14.788	0.399	10.169	29.561	85.089	70.439	14.650

Panel E: Generalized Spillover Table (%): South European Countries Total Spillover Index 52.947^b

Country ^c	Greece	Hungary	Israel	Italy	Turkey	TO Others ^d	FROM	NET Spillover ^f
Greece	40.928	17.029	16.249	15.395	10.398	68.813	59.072	9.741
Hungary	18.442	44.346	14.235	17.168	5.810	57.187	55.654	1.533
Israel	18.514	14.989	46.660	13.255	6.581	51.677	53.340	-1.663
Italy	16.950	17.482	12.921	44.661	7.986	56.283	55.339	0.944
Turkey	14.907	7.686	8.272	10.465	58.670	30.775	41.330	-10.555

Table 2: Intra-Regional Spillover Table Analysis Continued ...

Generalized Spillover Table (%): South And Latin America Region Total Spillover Index (%) 50.822^b

Country ^c	Argentin	Brazil	Chile	Columbia	Mexico	Peru	TO Other ^d	FROMthers ^e	NET Spillover
Argentina	35.883	14.936	13.456	21.208	14.515	0.002	70.34	64.117	6.223
Brazil	18.256	43.709	9.862	16.010	12.163	0.001	47.927	56.291	-8.364
Chile	15.276	9.141	40.765	19.882	14.936	0.001	55.107	59.235	-4.127
Columbia	20.493	12.693	16.930	34.689	15.192	0.003	74.736	65.311	9.425
Mexico	16.310	11.147	14.844	17.626	40.068	0.005	56.812	59.932	-3.121
Peru	0.005	0.009	0.016	0.009	0.006	99.955	0.019	0.045	-0.035

- a: The Total Spillover Index indicated degree of inter-region connectedness and is computed as: $TSI = \frac{\sum_{i \neq j} \overline{\Theta}_{i,j}^H}{K} \times 100 = \left[1 - \frac{\sum_{i=1}^{i=K} \overline{\Theta}_{i,i}^H}{K} \right] \times 100$, where K is number of countries in the region, θ_{ij} is contribution of liquidity cost shocks from country j to the liquidity cost shock volatility of country i, diagonal elements (θ_{ii}) are country i portion of liquidity cost shock variability, and off-diagonal elements ($\theta_{ij}, i \neq j$) spillovers across countries. The numerator sums **cross-country spillovers** (off-diagonal elements) and the denominator sums over all countries in the region **total liquidity cost shock variability contributions**. Multiplying by 100 expresses it as a percentage. $TSI = 0\% \rightarrow$ no spillovers (i.e., all liquidity cost shock variability explained by home-country liquidity cost shocks) and $TSI = 100\% \rightarrow$ all liquidity cost shock variability driven by cross-country liquidity cost shocks.
- b: Table No.4 shows the liquidity cost shock spillovers (following the Diebold–Yilmaz spillover index framework). Each entry $\Theta_{ij}(H)$ measures the contribution of country j liquidity cost shocks to the liquidity cost shock variability of country i, obtained from the daily liquidity cost shock $L_t = (L_{1,t}, L_{2,t}, \dots, L_{K,t})'$ VAR time-series model $L_t = \sum_{j=1}^{j=p} A_j \cdot L_{t-j} + \varepsilon_t$. The generalized variance decomposition is defined as $\Theta_{i,j}^H = \frac{\sigma_{j,j}^{-1} \sum_{h=0}^{H-1} [e_i' A^h \Sigma e_j]^2}{\sum_{h=0}^{H-1} [e_i' A^h \Sigma A^h e_i]}$. Row-normalization is applied as $\overline{\Theta}_{i,j}^H = \frac{\Theta_{i,j}^H}{\sum_{j=1}^{j=K} \Theta_{i,j}^H}$, such that each row sums to one i.e., $\sum_{j=1}^{j=N} \overline{\Theta}_{i,j}^H = 1$ (see note a above).
- b: The rows shown in Table No.4 Panels A-G correspond to receiving countries (i.e., sources of liquidity cost shock variability for country i), while the columns of Table No.4 correspond with countries transmitting liquidity cost shocks other countries (i.e., the effect of liquidity cost shocks from country j on all other countries).
- c: The diagonal elements $\overline{\Theta}_{i,i}^H$ represent home-country contributions to its own liquidity cost variability, whereas off-diagonal elements $\overline{\Theta}_{i,j}^H$ for $i \neq j$, reflect the cross-country liquidity cost spillovers.
- d: The “TO” Spillover measure (total liquidity cost spillovers transmitted by country i) is defined as: $DS_{i \rightarrow \blacksquare} = \sum_{j \neq i} \overline{\Theta}_{j,i}^H$ Liquidity cost shocks transmitted from country i to other countries.
- e: The “FROM” Spillover measure (total liquidity cost spillovers received by country i) is defined as: $DS_{i \leftarrow \blacksquare} = \sum_{i \neq j} \overline{\Theta}_{i,j}^H$ Liquidity cost shocks received by country i from other countries.
- f: The net spillover is: $NS_i = DS_{i \rightarrow \blacksquare} - DS_{i \leftarrow \blacksquare}$, where, $NS_i \geq 0 \Rightarrow$ Net Spillover Transmitter, and $NS_i < 0 \Rightarrow$ Net Spillover Receiver.

As net receivers of liquidity cost shock information transfers, New Zealand having a net spillover index of -10.309% and Australia with a net spillover index of -9.041% are the most prominent net receivers of liquidity cost shock information inflows. In comparison to their relatively small spillover index outflow amounts (New Zealand 19.341% and Australia 32.649%, respectively), considered in combination with their spillover index outflow values, the results shown in Table No.1 Panel B suggest that the New Zealand and Australia financial markets are more affected by external liquidity cost shock information than they contribute to the liquidity cost shock volatility of other South Asia region country financial markets. What's more, India shows a net liquidity cost shock spillover index of -1.901% suggesting India is an insignificant net receiver of liquidity cost shock information transfers, although its net inflow position appears more balanced relative that of Australia and New Zealand.

The diagonal elements of Table No.2 Panel B (i.e., own-variance contribution) provide additional insight via showing a liquidity cost shock net spillover index for New Zealand at 70.350%) and liquidity cost shock net spillover index for Australia of 58.311% indicating comparatively large own-market contributions and suggesting that their financial market properties are largely driven by domestic factors. On the other hand, the reported net spillover index for Indonesia (44.037%) and the Philippines (43.101%) show smaller diagonal values, suggesting stronger financial market integration and larger degree of participation in inter-market spillovers.

Overall, the South Asia regional liquidity cost shock spillover network is describes as being smaller degree of financial market integration driven more by local factors, wherein a few emerging markets (i.e., Philippines and Indonesia) serve as vital transmitters of liquidity cost shocks. The more developed financial (i.e., Australia and New Zealand) tend to absorb liquidity cost shock volatility inflows instead of disseminating it among other South Asia region country financial markets. This particular configuration indicates that regional diversification prospects may be stronger relative to more tightly integrated geographic regions, although enhanced risk driven by liquidity cost shocks from more dominant transmitting financial markets remains an important consideration.

Discussion of Spillover Results for Three European Geographic Regions

North Europe Intra-Regional Spillover Table Analyses

Table No.2 Panel C shows a North Europe region Total Spillover Index of 73.064% suggesting a large degree of interrelationship among North European equity market liquidity cost shocks. This result indicates that approximately three-quarters of liquidity cost shock variability is attributable to inter-market liquidity cost shocks instead of arising from country-specific idiosyncratic factors. In other words, liquidity cost shocks originating in one market are rapidly disseminated across the North Europe region underscoring a large degree of financial integration.

Closer examination of the North Europe inter-regional directional spillovers suggests significant asymmetries across countries comprising the region. The UK obviously dominates other North Europe nations as a net transmitter of liquidity cost shock information, showing a net spillover index value of 17.226% comprised of the largest liquidity cost shock information outflow contribution at 95.379%. This result suggests that liquidity cost shocks emanating from the UK market serve an important role in driving North Europe regional dynamic most likely as a result of its position as a major financial center. In the same manner, Russia shows a liquidity cost shock

net spillover index at 9.892% and Sweden has a liquidity cost shock net spillover index value of 9.565% reflecting their status as liquidity shock information net transmitters, contributing more liquidity cost shock information outflows to other markets than they receive as inflows.

On the other hand, the largest net receivers of liquidity cost shock information inflows are Norway with a net spillover index of -20.246% and Finland having a net spillover index of 14.989%. The comparatively small liquidity cost shock information outflow values for Norway and Finland (i.e., 43.333% and 52.882%, respectively), considered in combination with the larger liquidity cost shock information inflow values indicate that Norway and Finland markets are relatively more vulnerable to external liquidity cost shock information and less important in disseminating liquidity cost shock information.

Table No.2 Panel C further indicates that Ireland occupies a more modest position as a net receiver of liquidity cost shock spillovers at -3.766, although its net spillover index position is more balanced relative to Norway and Finland. Similarly, the liquidity cost shock net spillover index value for Denmark is 2.318% and is positioned comparatively more neutral being nearly proportional liquidity cost shock information inflows and outflows. This result indicates that Denmark is both influenced and influencing by other country-specific regional financial markets to a similar degree, resulting in Denmark serving as neither a clear transmitter nor receiver of liquidity cost shock information.

The Table No.2 Panel C diagonal elements (i.e., each regional country-specific own-variability portion of total) highlight the previously discussed findings. North Europe region countries like Norway with 36.421% and Finland having 32.129% display higher home-country market contributions, suggesting proportionally somewhat larger domestic components. On the contrary, smaller Table No.2 Panel C diagonal cell values for countries such as Denmark at 24.769%, Sweden having 23.340%, and UK with 21.847% reflect these countries have large exposure to risk arising from external liquidity cost shocks consistent with their respective positions in highly interrelated region.

On the whole, the research results presented in Table No.2 Panel C illustrate a closely aligned regional financial market and institutional network driven primarily by a few key liquidity cost shock information outflow countries (i.e., predominantly UK) and at the same time smaller financial markets are more likely to absorb liquidity cost shock information inflows. The manner of organization suggested by the results of this research has important implications for diversification plans, since the higher liquidity cost shock spillover strength reduces the underlying motivation for investor regional portfolio diversification during periods of heightened uncertainty.

Central Europe Intra-Regional Spillover Table Analyses

Table No.2 Panel D shows the Central Europe geographic region spillover table results reporting a Total Spillover Index of 55.168 which is significantly smaller in comparison with the North Europe geographic region. This result for the Central Europe geographic region Total Spillover Index indicates a moderate degree of financial interrelatedness among Central European financial markets and institutions, since marginally greater than one-half of the liquidity cost shock information variability is driven by international shocks. Although economic integration remains significant, home-country forces serve a comparably larger role relative to the North Europe region spillover indices.

The liquidity cost shock directional spillover indices shown in Table No.2 Panel D underscore conspicuous differences regarding the function served via individual financial markets with each country's socio-economic institutional structure. For example, Switzerland obviously

emerges as being the largest net transmitter of liquidity cost shock information having a Net Spillover Index of 14.650% as well as a very large liquidity cost shock information outflow value of 85.089%. This result suggests that liquidity cost shocks emanating for Switzerland have an intense and broad-ranged effect across neighboring Central Europe geographic region country financial markets. Germany Net Spillover Index of 7.252% also serves as an important liquidity cost shock information net transmitter, bolstering its position as a significant liquidity cost spillover driver within the Central Europe financial market system. Furthermore, France with a net spillover index of 2.690% moderately adds to liquidity cost information outflows as a net transmitter indicating a largely balanced but somewhat outflowing contribution.

The most prominent net receiver of liquidity cost shock information spillover is Luxembourg showing a Net Spillover Index value of -16.270% and having a comparatively small liquidity cost shock information outflow Spillover Inflow value of 16.262%) which is substantially larger than the inflow spillover index. In a like manner, Belgium showing a Net Spillover Index value of -3.610%, Spain having Net Spillover Index value of -2.467%, and Portugal displaying a Net Spillover Index value of -2.067% are all liquidity cost shock information inflow net receivers but to a smaller degree.

Panel D of Table No.2 shows that the Netherlands is largely balanced in terms of liquidity cost shock information inflows and outflows having a Net Spillover Index of -0.179% (i.e., practically equal liquidity cost shock information inflow and outflow amounts). This result depicts Netherlands as having a somewhat even interaction with the Central Europe region financial market institutional structure wherein it neither absorbs liquidity cost shock information inflows nor generates liquidity cost shock information outflows to greater extent.

The diagonal elements of Table No.2 Panel D convey added intuition into country-specific liquidity cost dynamics. For example, Portugal shows a Total Spillover Index of 95.155% whereas Luxembourg presents a Total Spillover Index value of 67.469% indicating these countries manifest quite large liquidity cost shock own-variance proportions, suggesting that each country's liquidity cost shock movements are mostly the result of domestic factors and, for this reason, these countries are considered to be comparatively shielded from external liquidity cost shocks. What's more, larger Central Europe region markets like Germany show own-variance Spillover Table diagonal cell values of 30.397%, France displaying Spillover Table diagonal cell amounts of 32.019%, and Switzerland having own-variance Spillover Table diagonal cell values of 29.561% which is entirely consistent with their larger degree of financial market integration and, as a result, increased exposure to cross-country liquidity shock information inflows.

Generally speaking, the Central Europe region liquidity cost shock information spillover structure seems less forceful and more unbalanced than is the case with the North Europe region. For the case of Central Europe liquidity information spillover there are a few important markets (i.e., Switzerland and Germany) occupying the role of leading liquidity cost shock information outflow transmitters, while the smaller market economies exhibit a tendency to absorb liquidity cost shock information outflows from those other countries. This type of institutional structure indicates that systemic shocks are emanating from select dominant markets and significantly impacting other regional countries even though regional diversification remains beneficial.

South Europe Intra-Regional Spillover Table Analyses

Panel E of Table No.2 shows the South Europe geographic region having a Total Spillover Index of 52.947%, suggesting a somewhat more moderate degree of interrelatedness among the countries comprising that region. This degree of intra-association is slightly smaller than the

relation among the Central Europe region countries and is significantly less than the degree of correspondence between the North Europe region countries. This observation indicates that domestic economy factors have a relatively significant place in explaining liquidity cost shocks for these countries while intra-regional cross-relationships remain present.

The directional spillover analysis presented in Table No.2 Panel E depicts a somewhat more even institutional organization structure relative to the other geographic regions presented. Most notably, Greece can be identified as the region's largest net transmitter of liquidity cost shock information outflows having a Spillover Index at 9.741% as well as a comparatively large liquidity cost shock outflow Spillover Index of 68.813%. This particular result indicates that Greece's liquidity cost shock information outflows have significant impact upon other regional markets and implying that its own market exhibits exposure to risks arising from economic developing across the region.

Hungary (Net Spillover Index of 1.533%) and Italy (Net Spillover Index at 0.944%) serve the other countries in the region as liquidity cost shock information marginal net transmitters even though on netting the values are small. The nearly equal Spillover outflow and inflow amounts suggest that Hungary and Italy both influence and are influenced by other countries in the South Europe region largely mirroring bidirectional spillover behavior.

Examining the net receivers of liquidity cost shock information transfers for the South Europe region shown in Panel E of Table 2, Turkey shows a Net Spillover Index value of -10.555% and is prominent as the single largest net recipient of spillovers having a relatively small liquidity cost shock information outflow value of 30.775% relative to the somewhat larger liquidity cost shock information inflow amount at 41.330%. The difference in these two indices indicates that Turkey's financial market is comparatively more exposed to liquidity cost shocks emanating from other South Europe region countries and serves a relatively limited position in transmitting liquidity cost shock information to other countries in the region. Israel has a Net Spillover Index value of -1.663% identifying it as an approximately balanced transmitter and receiver of liquidity cost shock information and suggesting Israel enjoys a moderate degree of integration with other markets within the region.

The diagonal elements of Table No.2 Panel E present the own-variance portions of regional liquidity cost shock information behavior. Turkey (58.670%) and Israel (46.660%) display comparatively high degrees of domestic contributions their own-variance decomposition suggesting that each country's home-markets are strongly driven by domestic factors. On the other hand, Greece (40.928%), Hungary (44.346%), and Italy (44.661%) exhibit somewhat smaller diagonal values which is congruous with heightened exposure to inter-market regional influences.

For the most part, the South Europe region liquidity cost spillover interrelationships are best described as being moderate degree of economic integration with relatively symmetric association with other regional economies, wherein no one single market exerts greater impact than the others. Greece appears to serve a principal position as a transmitter of liquidity cost shock information, while Turkey appears positioned as the leading receiver of liquidity cost shock information transfers. The largely even spillover structure shown indicates demonstrates that contagion behavior is displayed but less robust which may provide for somewhat limited diversification benefits within the region in contrast with more extensively integrated markets like those in the North Europe region.

Discussion of Intra-Regional Spillover Results for Latin and South America

Table No.2 Panel F presents the spillover analysis results for the Latin and South America region indicating a Total Spillover Index value for the region of 50.822%, suggesting a moderate level of financial integration among countries in the region. This particular result signifies that more than half of the liquidity cost shock information variability is driven by intra-regional cross-country shocks, while domestic factors persist as important considerations. Relative to more firmly economic integrated regions, the transmission of liquidity cost shock information is present but less acute indicating a somewhat moderately interrelated regional economic system.

The directional spillover measures shown in Panel F of Table No.2 underscore noteworthy asymmetries in the function of home-country financial markets. For instance, Colombia appears as the largest net transmitter of liquidity cost shock information reporting a Net Spillover Index value of 9.425% as well as a liquidity cost shock information outflow index value of 74.736%. This particular result suggests that structural shifts in the Colombian economy apply a strong influence on neighboring country economies. Argentina reporting a Net Spillover Index value of 6.223% also serves as an important net transmitter of liquidity cost shock information contributing substantial variability to regional liquidity cost uncertainty.

On the other hand, Brazil is reported as having the largest liquidity cost shock information net spillover inflow with a value of -8.364% having a higher value for spillover outflows than inflows. Notwithstanding Brazil being one of the largest economies in the Latin and South America region, reporting Brazil as a net receiver of liquidity cost shock information demonstrates that it is more acutely exposed to liquidity cost shocks emanating from other regional countries. In the same manner, Chile reports a Net Spillover Index value of -4.127% and Mexico -3.121% suggesting that they are net receivers of liquidity cost shock information inflows, although their exposures are somewhat more balanced, reflecting the two-directional interactions with other countries in the region.

Table No.2 Panel F indicates that Peru is quite an anomaly with a Net Spillover Value of -0.035% indicating that it is a marginal net receiver of liquidity shock information having negligible spillover contributions to and from other countries in the region, but oddly enough having an unusually large own-variance share (99.955%) of Total Spillover Index (i.e., diagonal elements of spillover table). This result suggests that the Peruvian economy is nearly completely driven by domestic factors and is for the most part isolated from regional liquidity cost shock information transfers.

The Spillover Table diagonal elements for other countries in the region (i.e., own-variance shares) also back these observations. Economies like Brazil having own variance index value of 43.709%, Chile with own variance index amount at 40.765%, and Mexico showing own variance index value of 40.068% and display some modest domestic contributions, consistent with partial economic integration with rest of the region. On the other hand, Argentina with an own variance portion index amount of 35.883% and Colombia having an own variance portion index amount at 34.689% indicate comparatively smaller own share portions, reflecting their greater participation in economic integration cross-country activities as well as their regional service as liquidity cost shock information net transmitters.

Generally speaking, the liquidity cost shock information spillover structure of the Latin and South America region is moderately interconnected but inconsistent, with a few key players (specifically Colombia and Argentina) driving regional liquidity cost shock information transfers, while other countries in the region (i.e., Brazil, Chile, and Mexico) appear to absorb liquidity cost shocks. The behavior of a relatively isolated economy such as Peru further reduces overall regional integration. These empirical results indicate that, although regional diversification benefits may

exist, they are significantly impacted by liquidity cost shocks emanating from the dominant liquidity cost shock information transmitting countries in the region.

Discussion of Spillover Results of Inter-Regional Analyses

Inter-Regional Descriptive Statistics

Table No.3 describes the statistical properties of how liquidity costs evolve day-to-day across geographic regions. The inter-regional liquidity cost shock portfolio descriptive statistics reported in Table No.3 summarize the key distributional properties of these inter-regional country-specific aggregated liquidity cost series within across the six major geographic regions employed in this research - North Asia, South Asia, North Europe, Central Europe, South Europe, and Latin and South America. For each geographic region used in this study, the Table No.3 shows the mean, standard deviation, minimum and maximum values, along with higher-moment characteristics including skewness and kurtosis.

Table No.3: Descriptive Statistics for Inter-Regional Country Portfolio Liquidity Cost

Descriptive Statistics for Inter-Regional Country Portfolio Liquidity Cost

Region	Mean	Std Dev	p-value ¹	Maximum	Minimum	Skewness ²	Kurtosis ³
N Asia	0.043021	0.385846	0.000000†	0.999997	-0.999999	0.903506	1.837660
S Asia	0.054580	0.463735	0.000000†	0.999999	-0.999912	0.591774	0.379467
N Europe	0.061290	0.472239	0.000000†	0.999990	-0.999939	0.621208	0.256447
C Europe	0.061343	0.482078	0.000000†	0.999990	-0.999930	0.545869	0.075508
S Europe	0.049906	0.446199	0.000000†	0.999992	-0.999900	0.631162	0.724151
LSAmerica	0.049343	0.457971	0.000000†	0.999999	-0.999900	0.565271	0.547112

†: Indicates that the variable specific null hypothesis is rejected at the $\alpha = 0.05$ confidence level.

1: The null hypothesis that the mean data value is equal to zero under the null is tested using the Student's t-Test. Student's t-Test : $t = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{N}}}$,

where \bar{x} is the sample mean, N is the number of non-missing values for a variable x_i , and s is the sample standard deviation. The critical t-value for the $\alpha = 0.05$ confidence level two-tailed test is 1.962. The p-value reported for the Student's t-test is the probability of obtaining a larger t-statistic and is the null hypothesis is rejected for p-values smaller than $\alpha = 0.05$ confidence level for two-tailed tests.

2: **Sample Skewness:** Skewness is a measure of symmetry or the lack of symmetry of data. A distribution is symmetric if the left and right of the center point appear similar. Skewness = $\frac{\frac{1}{N} \sum_{i=1}^N (x_i - \bar{x})^3}{\left[\frac{1}{N} \sum_{i=1}^N (x_i - \bar{x})^2 \right]^{3/2}} \cdot \frac{N\sqrt{N-1}}{N-2}$, with all variables defined as previously. To test the statistical

significance of the computed skewness value, the skewness measure is converted to an appropriate Z statistic by dividing the skewness measure by its standard error, i.e., $Z_S = \left\{ \frac{\sum_{i=1}^N (x_i - \bar{x})^3}{\left[\sum_{i=1}^N (x_i - \bar{x})^2 \right]^{3/2}} \cdot \frac{N\sqrt{N-1}}{N-2} \right\} \cdot \frac{1}{\sqrt{\frac{6N(N-1)}{(N-2)(N+1)(N+3)}}$. The skewness statistic indicates substantial departure from normality

for absolute skewness statistic values > 2.00 .

3: **Sample Kurtosis:** Kurtosis measures whether the data are heavy-tailed or light-tailed when compared with the normal distribution. Data

having high kurtosis tend to have heavy tails and outliers. Data having low kurtosis have light tails and no outliers. Kurtosis = $\frac{\sum_{i=1}^N (x_i - \bar{x})^4}{\left[\frac{\sum_{i=1}^N (x_i - \bar{x})^2}{N} \right]^2} - 3$,

where all variables are defined as previously. To test the statistical significance of the kurtosis value, the computed kurtosis is converted to an

appropriate Z statistic by dividing the skewness measure by its standard error, i.e., $Z_K = \left\{ \frac{(N-1)}{(N-2)(N-3)} \right\} \cdot \left\{ (N+1) \left[\frac{\sum_{i=1}^N (x_i - \bar{x})^4}{\left[\frac{\sum_{i=1}^N (x_i - \bar{x})^2}{N} \right]^2} - 3 \right] + 6 \right\}$.

$\left\{ \frac{2}{\sqrt{\frac{(N^2-1)}{(N-3)(N+5)} \cdot \frac{6N(N-1)}{(N-2)(N+1)(N+3)}}} \right\}$. The kurtosis statistic indicates substantial departure from normality for absolute skewness statistic values > 2.00 .

The mean values, while small in magnitude, are uniformly positive across all regions, ranging from about 0.043 in North Asia to just over 0.061 in Northern and Central Europe.

Interpreted as daily changes, this indicates a slight upward drift in liquidity costs over time, suggesting that, on average, trading conditions tend to become marginally more expensive rather than cheaper. The fact that European regions exhibit the highest mean increases points to relatively stronger upward pressure on liquidity costs in those markets, whereas North Asia shows the weakest average increase. Volatility in daily liquidity cost changes is substantial across all regions, as reflected in standard deviations between roughly 0.39 and 0.48. This implies that liquidity conditions are highly unstable in the short run, with frequent and sizable fluctuations. Central Europe and Northern Europe display the greatest variability, indicating more pronounced swings in trading costs, while North Asia again appears somewhat more stable by comparison.

The p-values, effectively zero in all cases, confirm that the average daily changes are statistically different from zero. This suggests that the upward drift in liquidity costs is systematic rather than random noise, and may reflect persistent structural or market-driven factors affecting trading conditions globally. The extreme values further reinforce the instability of liquidity conditions. With maxima close to 1 and minima near -1 in every region, daily changes can shift dramatically in either direction. This highlights the potential for sudden improvements or deteriorations in market liquidity, consistent with episodes of stress or rapid recovery.

All regions exhibit positive skewness, indicating that large increases in liquidity costs occur more frequently than large decreases. This asymmetry suggests that adverse liquidity shocks—periods when trading becomes significantly more expensive—are more common than equally large improvements. North Asia shows the strongest skewness, implying a higher tendency toward sharp cost increases relative to other regions. Kurtosis values are generally modest, though North Asia stands out with relatively higher kurtosis, indicating a somewhat greater likelihood of extreme observations. In contrast, European regions—especially Central and Northern Europe—show lower kurtosis, suggesting fewer extreme tail events despite their higher volatility.

Inter-Regional Spillover Table Analysis

Table No.4 summarizes the Spillover Analysis results for the inter-regional liquidity cost portfolios, evaluating the liquidity cost spillovers between the six (6) world-wide regions employed in this research. Particular has been placed on highlighting the manner by which liquidity cost shocks in one geographic region may impact other geographic regions' liquidity costs. The Generalized Spillover Percentage for all of the geographic regions used in this study combined is 78.423%, suggesting a relatively high degree of interrelationship in liquidity costs shocks across the geographic regions world-wide. Spillover is determined by both the amount of liquidity cost shock information transferred *to* each geographic region, the amount of liquidity cost shock information transferred *from* each geographic region, as well as their net effect, indicating the overall contribution of one region to other regions liquidity cost shocks. Looking at the spillover table values from each geographic region and to each geographic region, we note that geographic regions such as North Asia (NAsia), South Asia (SAsia), and Northern Europe (NEuro) contribute significantly to inter-regional liquidity cost information transfer spillovers. Particularly, NAsia shows a total spillover value of 76.839%, with a substantial outgoing spillover of 78.200%, suggesting that it acts as an important source of liquidity cost shock information to the other regions. Similarly, SAsia shows an outflow of liquidity cost shock information spillover of 75.989% and a total spillover of 66.640%, indicating that liquidity cost changes in SAsia have a broad-ranging impact on other geographic regions, although the information transfer inflow spillovers are slightly smaller than information spillover outflows.

On the other hand, geographic regions like North Europe (NEuro) and Central Europe (CEuro) reflect a comparatively smaller response to liquidity cost shock information inflows from other geographic regions. That is, NEuro displays a liquidity cost shock information inflow value of 84.717%, the largest value among the regions, in conjunction with a net liquidity cost shock spillover of 5.114%. This result indicates that NEuro is not only severely affected by liquidity cost shock information from other geographic regions, but also serves an important part in transferring liquidity cost shock information to others geographic regions. Similarly, CEuro shows an information spillover inflow of 82.780% and a comparatively more modest liquidity cost shock information net spillover of +3.531%, suggesting a similar manner of receiving important liquidity cost shock information spillovers and simultaneously transmitting liquidity cost shocks information to other geographic regions.

Furthermore, the Southern Europe (SEuro) and Latin America (LSAmerica) geographic regions display comparatively more even liquidity cost shock information spillover forces at work, although SEuro's total liquidity cost shock spillover of 77.849% and net spillover of -0.570% indicates that SEuro both receives and transmits liquidity cost shocks in approximately similar amounts. LSAmerica, with a total liquidity cost shock information spillover of 81.713%, is somewhat more disposed to liquidity cost shocks information outflows as suggested by the net spillover of +2.636% indicating a net positive information transfer of liquidity cost shocks to the other geographic regions.

The variability in liquidity cost shock spillover transfers emphasizes the intricate and multifaceted nature of liquidity cost behavior across markets world-wide. In certain instances, regions exhibit net outflows of liquidity cost shock information transfers e.g., North and South Asia. On the other hand, regions like North and Central Europe experience both significant inflows and outflows of liquidity cost shocks with greater stability. These results indicate that

Table 4: Results of Liquidity Cost Spillover Analysis for Inter-Regional Analyses ^a

Generalized Spillover Table (%): All Geographic Regions Inter Regional Total Spillover 78.423 ^b

Region ^c	NAsia	SAsia	NEuro	CEuro	SEuro	LSAmerica	TO ^d	FROM ^e	NET ^f
NAsia	21.800	13.219	17.714	16.017	15.555	15.696	76.839	78.200	-1.361
SAsia	14.564	24.011	15.400	16.838	13.444	15.743	66.640	75.989	-9.349
NEuro	16.572	13.095	20.397	16.858	16.714	16.363	84.717	79.603	5.114
CEuro	15.247	14.547	17.148	20.750	15.526	16.782	82.780	79.250	3.531
SEuro	15.395	12.073	17.675	16.146	21.581	17.130	77.849	78.419	-0.570
LSAmerica	15.061	13.705	16.781	16.921	16.609	20.923	81.713	79.077	2.636

a: The Total Spillover Index indicated degree of inter-region connectedness and is computed as: $TSI = \frac{\sum_{i \neq j} \overline{\Theta}_{i,j}^H}{K} \times 100 = \left[1 - \frac{\sum_{i=1}^{i=K} \overline{\Theta}_{i,i}^H}{K} \right] \times 100$, where K is number of countries in the region, θ_{ij} is contribution of liquidity cost shocks from country j to the liquidity cost shock volatility of country i, diagonal elements (θ_{ii}) are country i portion of liquidity cost shock variability, and off-diagonal elements ($\theta_{ij}, i \neq j$) spillovers across countries. The numerator sums **cross-country spillovers** (off-diagonal elements) and the denominator sums over all countries in the region **total liquidity cost shock variability contributions**. Multiplying by 100 expresses it as a percentage. $TSI = 0\% \rightarrow$ no spillovers (i.e., all liquidity cost shock variability explained by home-country liquidity cost shocks) and $TSI = 100\% \rightarrow$ all liquidity cost shock variability driven by cross-country liquidity cost shocks.

b: Table No.4 shows the liquidity cost shock spillovers (following the Diebold–Yilmaz spillover index framework). Each entry $\Theta_{ij}(H)$ measures the contribution of country j liquidity cost shocks to the liquidity cost shock variability of country i, obtained from the daily liquidity cost shock $L_t = (L_{1,t}, L_{2,t}, \dots, L_{K,t})'$ VAR time-series model $L_t = \sum_{j=1}^{j=p} A_j \cdot L_{t-j} + \varepsilon_t$. The generalized variance decomposition is defined as $\Theta_{i,j}^H = \frac{\sigma_{j,j}^{-1} \sum_{h=0}^{H-1} [e_i' A^h \Sigma e_j]^2}{\sum_{h=0}^{H-1} [e_i' A^h \Sigma A^h e_i]}$. Row-normalization is applied as

$$\overline{\Theta}_{i,j}^H = \frac{\Theta_{i,j}^H}{\sum_{j=1}^{j=K} \Theta_{i,j}^H}, \text{ such that each row sums to one i.e., } \sum_{j=1}^{j=N} \overline{\Theta}_{i,j}^H = 1 \text{ (see note a above).}$$

b: The rows shown in Table No.4 Panels A-G correspond to receiving countries (i.e., sources of liquidity cost shock variability for country i), while the columns of Table No.4 correspond with countries transmitting liquidity cost shocks other countries (i.e., the effect of liquidity cost shocks from country j on all other countries).

c: The diagonal elements $\overline{\Theta}_{i,i}^H$ represent home-country contributions to its own liquidity cost variability, whereas off-diagonal elements $\overline{\Theta}_{i,j}^H$ for $i \neq j$, reflect the cross-country liquidity cost spillovers.

d: The “TO” Spillover measure (total liquidity cost spillovers transmitted by country i) is defined as: $DS_{i \rightarrow \bullet} = \sum_{j \neq i} \overline{\Theta}_{j,i}^H$ Liquidity cost shocks transmitted from country i to other countries.

e: The “FROM” Spillover measure (total liquidity cost spillovers received by country i) is defined as: $DS_{i \leftarrow \bullet} = \sum_{i \neq j} \overline{\Theta}_{i,j}^H$ Liquidity cost shocks received by country i from other countries.

f: The net spillover is: $NS_i = DS_{i \rightarrow \bullet} - DS_{i \leftarrow \bullet}$, where, $NS_i \geq 0 \Rightarrow$ Net Spillover Transmitter, and $NS_i < 0 \Rightarrow$ Net Spillover Receiver.

regions with greater degree of financial integration and interlaced economic activity, e.g., Western and Central Europe, serve as important conduits in the communication of liquidity costs shock information transfers across geographic regions.

All things considered, the spillover table analysis presented in this research complements existing research highlighting the necessity of understanding and being mindful of inter-regional liquidity cost spillovers since they arise as a result of the complex interrelationships inherent with international financial markets and have significant implications for government policy and world-wide bank operating strategy. Particular geographic regions acting as important liquidity cost shock transmitters e.g., North and South Asia perhaps should devise procedures moderating the impact of liquidity cost shock spillovers on their own economic well-being as well as that of their trading allies. On the other hand, geographic regions like North and Central Europe, which exhibit both liquidity cost shock information inflows and outflows perhaps ought to concentrate upon bolstering financial stability in order to better absorb external liquidity cost shocks.

The key findings for the inter-regional spillover table analyses are summarized as follows:

Key Findings of Spillover Table Analyses For Six (6) Geographic Regions	
Geographic Region	Spillover Table Analysis Results
North Asia (NAsia):	Total Spillover: 76.839% (to) and 78.200% (from), with a net spillover of -1.361%. NAsia exhibits a relatively balanced spillover effect, with liquidity costs flowing moderately to and from this region. The negative net spillover suggests that NAsia is a minor net recipient of liquidity shocks, receiving slightly more spillover than it contributes. This may indicate that external liquidity shocks, such as those from neighboring Southeast Asia or North America, have a more significant influence on NAsia's liquidity conditions compared to its own liquidity disturbances impacting others.
South Asia (SAsia):	Total Spillover: 66.640% (to) and 75.989% (from), with a net spillover of -9.349%. SAsia experiences a net negative spillover , with the region receiving more liquidity shock than it contributes to others. Despite its relatively high spillover to other regions, the inflow of liquidity costs is notably greater, especially from regions like NAsia and North America. This suggests that SAsia is more reactive to global liquidity shifts, potentially due to its emerging market status and greater vulnerability to external economic conditions.
North Europe (NEuro):	Total Spillover: 84.717% (to) and 79.603% (from), with a net spillover of +5.114%. NEuro exhibits the highest spillover contribution among all regions, with a positive net spillover indicating it contributes more liquidity shocks to others than it receives. This could reflect the economic strength and stability of Northern European markets, which may act as liquidity providers to other regions, particularly to Central and Southern Europe. The substantial total spillover to other regions indicates a strong interlinkage and possible systemic importance of NEuro in the global liquidity ecosystem.
Central Europe (CEuro):	Total Spillover: 82.780% (to) and 79.250% (from), with a net spillover of +3.531%. Like NEuro, CEuro also shows a positive net spillover , contributing slightly more to other regions than it receives. This is likely due to its economic structure, which is well-integrated into the broader European market and interacts closely with both Western and Eastern Europe. The relatively balanced spillover between inflows and outflows suggests that CEuro's liquidity conditions are somewhat resilient, with spillovers from other regions having a moderate impact.
South Europe (SEuro):	Total Spillover: 77.849% (to) and 78.419% (from), with a net spillover of -

0.570%. SEuro demonstrates a small **negative net spillover**, suggesting that it is a net recipient of liquidity shocks. The spillover between SEuro and other regions is fairly balanced, but the slight net inflow suggests that external economic shocks, particularly from North and Central Europe, might have a slightly stronger impact on Southern European liquidity conditions. This could be indicative of the region's vulnerability to economic disturbances from more stable European regions.

Latin-South America: **Total Spillover:** 81.713 % (to) and 79.077% (from), with a **net spillover** of 2.636%. LSAmerica shows a small **positive net spillover** indicating that it is a moderate net transmitter of liquidity shocks. Its relatively high outward spillover (81.713%) suggests that it contributes in a meaningful fashion to the international dissemination of liquidity cost shocks information. The off-diagonal elements are relatively uniform ranging from 13% to 18% and underscoring the widespread and evenly distributed interrelationships. No single channel overwhelmingly dominates, suggesting that liquidity shocks disseminate through a broad network rather than via isolated regional linkages.

Conclusion and Suggestions for Future Research

The intra-regional liquidity cost spillover results reported in this research reveal a clear pattern of heterogeneous transmission dynamics both within and across global regions, with both the magnitude and direction of spillovers differing substantially. Generally speaking, the findings suggest that more developed and financially integrated regions, such as North Asia and North Europe, exhibit higher spillover intensity, while emerging regions display lower and more uneven spillover patterns. The presence of dominant net transmitters in each region highlights the role of key markets in driving liquidity dynamics, whereas net receivers tend to be more susceptible to external shocks. These results underscore the importance of regional structure and financial maturity in shaping liquidity cost transmission mechanisms.

Summary of Conclusions of Spillover Table Analyses of Six (6) Geographic Regions: Overall Observations:

1. The total inter-regional spillover appears to be relatively high across all regions, with the exception of South Asia, which shows a notably more significant net inflow of liquidity shocks. This suggests that liquidity conditions are highly interconnected across the globe.
2. Developed regions, such as Northern Europe and Central Europe, tend to have a **positive net spillover**, contributing more to the liquidity dynamics of other regions than they are influenced by external shocks. This may indicate their role as liquidity providers in the global financial system.
3. On the other hand, regions like South Asia and North Asia show **negative net spillovers**, implying that they are more reactive to global liquidity conditions rather than driving spillovers to others.
4. Latin America, while a minor net contributor, plays a role in transmitting liquidity shocks, particularly to North America and Europe.

In conclusion, the liquidity cost shock spillover table analyses presented in this research paper indicate that liquidity cost spillovers are a significant consideration in arriving at substantive understanding the interrelatedness of the international financial market system. Geographic regions having stronger economies and more stable financial systems tend to exert greater influence on international liquidity costs while the more emergent geographic regions appear to be more exposed to external liquidity cost shocks. The inter-regional liquidity cost spillover described in this research has significant implications for international financial stability and risk

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management, particularly during financial crises or systemic shock which will tend to attenuate liquidity cost shock volatility.

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