Stock Market Networks and Multinational Corporate Strategies

Madhmathi R., Professor, Department of Management Studies, Indian Institute of Technology Madras, India.

Ranganatham N., Guest Faculty, Department of Humanities and Social Sciences, Indian Institute of Technology Madras, India.

Abstract

International firms identify varied relationships in international stock markets. Certain stock markets are identified as having large participation, while others with large probability in connectedness. Stock markets exhibit varied degree of accessibility with specific markets being considered important across economic borders and yet others are considered important only within its group. Such distinguishing heterogeneity in stock market relations are influenced significantly by economic policy changes. Energy price levels impact increases stock exchange outflows of the economies especially those that have strong relationship with each other. Market eccentricity (importance within networks) is influenced significantly positively by short term interest rate forecasts, long term interest rates and housing growth rates for almost all economies. Interest rate changes influence inflows and outflows in the cluster groups. Short term forecasts have positive effect on market heterogeneity characteristics. Higher the short term interest rate forecast of nodal economies in a cluster, higher will be its activities in relationship to others connected with it.

A positive or negative impact changes the market relationship and firms hence revise their business tactics to address the impact of policy changes on market heterogeneity. Firms change productivity in an economy to address interest rate shifts in economies. Since markets are connected, the productivity shift is addressed only in the market which is a node centre. The centrality of exchanges hence is pertinent for the corporates. Besides productivity changes, firms also utilize FDI inward and outward activities as a management tactic, and to a certain extent merger values to address the impact of macroeconomic policy changes on stock market heterogeneity. Risk hedging necessity may motivate the firms to increase their flow of funds across international stock exchanges.

Key Words: Stock Market Network, Macroeconomic Policy Measures, Foreign Direct Investment, Mergers.

Stock Market Heterogeneity and Multinational Corporate Strategies

Corporate entities are fast assuming the role of super structures to accentuate the economic welfare of nations. Business entities' inter-organizational relations exceed boundaries to establish links that are not truly transaction based. Many non-contractual obligations such as product liability, environmental damage, infringement of intellectual property rights, intangible asset acquisitions are long lasting but informal, tacit commitments to continue business based on conventional relationships (Macaulay 1963). Such non-contractual relationships are popular not only for large corporate houses but also upcoming smaller startup and tech firms for several reasons. Corporate participation across international markets seeks effective non-contractual methods through business norms (Fromentin, 2022), manager-specific investments (Shleifer, and Vishny, 1989), economics of social structures (Granovetter 1985), corporate reputation (Barnea et al. 1985), reputation and cost-benefit evaluation (Klein and Leffler 1981), and the prospect of contract commitments (Alexrod, 1984). A subtle way of addressing the strengths and pitfalls of such business relationships is the global valuation of firms in distinct markets. This intricate valuation process lays bare the risk of interconnectedness between markets. Market interactions thus are ruthless in transmitting the economic crisis through its stakeholder relationship based connectedness. Corporate entities hence are aware of these shock vibrations and plan their business investments to optimize productivity and enhance market valuation.

Theoretically, economies tweet their indicators through policies to enhance the market interactions since economies tend to benefit from corporate participation in its development (Karanasos et al., 2021). Literature abounds in linking stock market predictability with economic indicators (Caballero and Simsek, 2022).. Engle et.al., (2013) demonstrates that interest rates, inflation, unemployment rates, production growth rates are certain crucial indicators that impact stock market returns. Market diversification concept of the capital market theory propounds that general economic state variables will influence the pricing of large stock market aggregates (Chen et.al., 1986). The basic characteristic of a stock market is in providing liquidity (Cottle et.al., 1962), and emphasises the significant linkage between the real and financial sectors for economic growth (Tobin, 1969). Romer (1993), Boyle and Peterson (1995), and Chami et al. (2006) have argued that the stock market plays the crucial role for monetary policy transmission. Corporate entities representing the stock market thus act as private participants to support the economic development of nations. Policy makers hence are keen to introduce economic incentives to foster the stock market participation towards economic development. Corporates, on the other hand exercise their linkages across markets through contractual and non-contractual relationships to reduce corporate risk and optimize market valuation. Corporates employ innumerable tactics to manage their contractual and non-contractual relations. Agency theory supports the contractual structures being in tune with the corporate entities and the economic agents towards risk reduction (Barnea, Haugen, and Senbet 1985). Stock market interrelationships imply a non-contractual tactic of corporates to reduce costs and achieve superior valuation. Intra-organizational relations through mergers and acquisitions is an illustration of a tactic to achieve economies of cost across nations. Intra-organizational relations through foreign direct investments can positively replace inter-organizational relations across economic boundaries to offset competitive costs. Resource dependency theory postulates that corporates engage in board room links, stock market connections, mergers, joint ventures, acquisitions, foreign direct investments and non-contractual relations with international participants to sustain long-term economic ties. The ability of corporate entities to achieve superior valuation through such tactics and relationships raises the question on the effectiveness of economic measures by a nation leading to corporate participation.

Intra and inter-corporate relationships arise in the context of specific patterns of inter-organizational dependencies and constraints. Locational advantages of natural resources are pivots to connect with international stock markets while the economic policies and politics can hinder the relationship as a constraint. A corporate's financial and trade association through its debt or equity market financing integrates its corporate resource requirement with stock market commitments seamlessly. Stock markets through their fiduciary role provide the corporates with several non-contractual strategies to steer them towards business efficiency and effectiveness. A most often applied non-contractual relationship is through investment bankers (Hayes et al. 1983). Historically investor bankers dominated the corporates by providing services for all activities of a firm. However, corporates currently are in a state to strategically use the stock market relationships to their advantage by associating with multiple investment bankers. Corporate strategies also explore relations beyond the basic financial core by integrating with multiple entities for their long-term and short-term resource requirements. Such non-contractual and contractual relationships among international participants point out the crucial role played by stock markets across the world in integrating the resource requirements. Stock market interconnectedness as network structures helped in identifying the taxonomy that classified exchanges based on their economic activity (Mantegna, 2000) and explained the stock market crashes (Onnela et.al., 2003). Exploring the international market connectedness as a centrality of value flows, exchange significance, accessibility, centrality significance, market with linkages, number of linkages, market transitivity, and probability of relations and importance of an exchange within its network pinpoints the heterogeneous characteristic of financial markets. Examining the stock market interconnectedness further by exploring the impact of specific economic indicators on stock market network measures would address corporate expectations and help firms to formulate strategic business decisions, especially cross border corporate mergers, foreign direct investments to augment corporate productivity.

Stock markets across the world have taken the brunt of epidemic crisis, arguably emphasizing the credibility of economic linkages to stock market integrations. Research interest and evidence point out the scope of examining the connectedness of stock markets across economies for varied reasons. Probing the interconnectedness highlights the role of value distribution across the globe as well as supports the possibility of the markets to redistribute the economic benefits towards a universal goal. Integration across stock markets does have its well-known side effects such as the domino effect of market risk. Asset markets are complex networks for the reasons of economic governance and to amplify corporate value. With internationalization, corporates have recognized the need to shift across global markets and thus further strengthen the network of asset markets. The linkages across asset markets could be high or low indicating the degree of connectedness; the number of markets with which they are connected (hubs); closeness of connectivity defined as asset clusters; average closeness of one asset class with other asset groups defined as harmonic closeness; the asset class that acts as a bridge between other asset classes (betweenness centrality) weakly or strongly connected asset market; the ratio of connectivity to total possible connectivity (density); connectedness inside a cluster defined as modularity; diameter of the market indicating the shortest distance between the two asset markets with longest connectivity; the influence a specific asset market has on the market network named as eigenvector centrality; the probability of being associated with a specific asset market (page rank) are certain heterogeneous structures that can be inferred through network analysis. Examining stock market network heterogeneity explains the asset market behavior in depth, targeting a macroeconomic influence further for the heterogeneity explains the co-movement of stock returns across varied time zones and economic policy changes.

Asset market heterogeneous structures could be explained through macroeconomic indicators. The information content of macroeconomic indicators influencing the stock market return heterogeneity

implicitly could lead to better policy decisions. Further, corporates can address the impact of internationalization by examining specific economic indicators such as gross domestic product across economies, the purchase power parity in each market, the housing market, inflationary trends and interest rate behavior. A visible impact of stock market heterogeneity is associated with the profit opportunities for the corporate sector. Though the cyclicality of the link between stock markets and macroeconomic fundamentals are theoretically established, focus on impact of macroeconomic indicators on stock market networks enhances the forecast accuracy for corporate investment decisions. Corporates' core dependence on the accuracy of forecasts make or kill projects and hence it is essential to examine more closely the influence on the stock market heterogeneity. Establishing the reasons behind the rise or fall in valuation of asset prices motivates economies in regulating the asset market.

The core objective of the research examines the impact of economic measures on the stock market heterogeneity as network structures. The outcome of the research identifies the corporate tactics response to specific economic policy changes affecting their stock market connectedness. The present paper examines the varied literature backdrop leading to the research objectives in section 1. While several interesting efforts on the stock market networks are available, the linkages between economic fundamentals and network heterogeneity are limited. Country level examination of the relationship is dominant in prior works. Section 2 defines the scope of the research and discusses the research methodology to support the hypotheses raised. The choice of data source is restricted to a specific source in order to examine the concept more closely and structurally. Section 3 provides the descriptive statistics of the data and elaborates the market networks. Stock market heterogeneity is analyzed in depth for the time zone 2015 to 2022. Analysis of the influence of macroeconomic indicators on stock market network heterogeneity further clarifies the relationship between global equity asset markets. The research inference and implications of the findings along with discussions of work yet to be accomplished are presented in section 4. Section 5 summarizes the findings and provides recommendations for future research.

1.1 Stock Market network and corporate tactics

Financial markets as networks are based on the resource dependence of entities across asset markets (Pfeffer, 1987). Flow of funds from a surplus to a deficit market, product value flow from low to high demand markets, financial value flow from low to high yield markets represent the linkages in global markets. Economic power and transaction efficiencies are often cited as core criteria triggering the flow of information across financial markets. Economic power provides a hierarchical structure that allows asset markets to dominate and establish long-term relationships (Macaulay, 1963). Political support also is perceived as an information flow across financial markets triggering the research solution of economic governance for enhancing the capital flows in the financial markets. Economic efficiency as a motive in asset markets to link the participants essentially the corporates is to achieve the cost efficiency of transactions (Telser, 1980). Large business houses essentially create international networks to accomplish performance efficiency. Besides, international flow of capital as portfolio investments also is an adequate reason to link varied asset markets to achieve efficient cost of capital. Financial intermediaries as the enablers of market network provide support to the argument that conflicting relationships in financial asset markets exist. The relationship between agents in the financial markets also is viewed as a network behavior supported by agency theory (Williamson, 1985). Literature abounds in representing the network structure of financial markets in varied dimensions. Financial market networks were explored as optimizing networks in line with the Markowitz model by depicting the flow of investment with size of the financial asset to be invested as the nodal point (Gulpinar et.al., 2003). Boyles and Waller (2010) apply network analysis to identify the minimum risk

portfolio by considering the expected flow cost and its variance. Examination of the stock market as a complex network model further supported the theoretical premise of resource dependency as a force behind strong financial networks (Bautin et.al., 2013). Network model applications for investments and protection from network vulnerability towards cyber-attacks substantiates the ever growing research interest (Nagurney and Shukla 2017).

The most often used method of constructing financial market networks is with Pearson correlation coefficients. Correlations are simple structures yet powerful to indicate the strength of movements between two assets. Financial theories such as the CAPM model rely heavily on studying the stock market return movements through the correlation coefficients. Low but positive correlations are identified for risk hedging though a negative high correlation is considered as the perfect risk balancing asset group in a portfolio. Mantegna (1999) examined the taxonomy of stock markets networks to group them on their economic activities. Highly correlated networks were found to exhibit larger links where lower correlation link networks contribution to overall network connectivity was much higher than larger correlation network links. Examining the correlations and the resultant network relations across global stock indices helped identify information flow across international equity markets (Bonanno, 2000). A scrutiny of the leverage structure further explains the connectivity across these markets. High correlations are associated with larger cluster behaviour in the financial markets. Cluster linkages were examined with correlation coefficients for forming complex networks (Jiang and Cai, 2008). The resultant discussions highlight the linkages within large and smaller clusters and the flow of funds across clusters. Agency based financial market models applied correlations to study the information flow in the networks (Kim et.al., 2008). Besides Pearson correlation, efforts on representing the network through Kendall's rank correlation (Pozzi and Aste, 2012) addressed the connectivity across financial market assets to establish the strength of their association. Networks are represented as complex graphs and hence the inference of the flow across financial networks is restrained by the method used to capture the flow pattern. Correlations are not indicators of a two-way flow pattern as exhibited in the financial markets across the globe. Examining the connectedness with correlations limits the inference of similarity in flow from one asset to the other since the examination of A,B and B,A result in one correlation coefficient. However, correlations with the application filtered graphs present the network with its true heterogeneity of influences in the flow relationships.

Variations such as cross correlations are more informative since they are found to be very helpful in addressing the financial market flows especially in downward trending markets and at crisis. The premise for the selection of cross correlation as a tool for graphing the financial market networks stems from the herding behavior of market participants. Herding behavior is evident in the markets when a downtrend leads to a market crash. Such co-movements over time can be best depicted through the cross correlation matrix of asset prices. Lagged correlations (Podobnik et.al.,(2010), de-trended cross correlations (Rafal et.al., 2015) and anti-correlation (Jiang and Zheng (2012) represent the underlying synchronizing co-movements in the financial markets over time. Financial literature also addresses the relationship between asset risk and subsequent asset return as leverage effect in depicting market networks (Bian, 2019). The presence of large trade data in the financial markets encourages the application of cross correlation tool to address the topological characteristics of networks. Reigneron et al. (2011) analysed the link of index correlation with a negative leverage effect. Cross correlation structures may not have a consistent lag or lead structure within the network indicating that complex and dynamic networks can handle critical probes much better than simple network models. Further, financial markets are considered as multi-layered linked systems implying the stability of models may not hold over time. Linking the individual network assets to an external component further fine tunes the explanation of relationships existing in the financial markets. Varied externalities thus being

incorporated in a network relationship enhances the understanding of flow of information within and across clusters in the financial markets.

A partial correlation coefficient can be a better estimate of the two way flow of assets since it accounts for an adjustment factor in terms of the third variable that could cause disruptive signals in the flow of funds between two assets. Further, spurious correlation relationships elimination is possible when partial correlations are measured. The relationship of assets A,B are now examined with a third asset C by linking A to C and B to C and subsequently removing the effect of C from the examined relationship. If the partial correlation is higher than the Pearson correlation the strength of the relationship between A,B is well established, else the Pearson correlation estimate is spurious and the strength of relationship is from their independent relationship with C. Partial correlations are applied to test the network relationship between market indices (Shapiro et.al., 2009). Partial correlations suggest a two way flow of information content between markets that is best captured as inflow and outflow effects in network models. Literature has well documented the inference of partial correlation directed relationships in financial market networks. Kenett et.al., (2010) investigate large capitalized stocks in the New York market through partial correlation. Partial correlation is used to filter out the essential information flow in the market. By considering a threshold parameter, the networks are further filtered to create the market networks. They report a significant dominance of financial sector stocks especially investment banks in the market. Partial correlations have a specific strength in addressing the market relationships, however they are not indicators of a causal relationship. Though examination of the casual relationship implies better explanations of network structures, the measure of causation is a broad area and is difficult to pinpoint the precise causation relationship in a network. Considering this, the partial correlate can work as an approximate tool to impart a meaningful understanding of network relationships.

Examining the causation enhances the identifying of temporality, strength, specificity, consistency and plausibility of relationships in the financial markets. Financial markets with varied information content across time are subject to the temporal causal relations. This time-series nature of the market is studied as the Granger causality relationship. However, Granger causality is measured as a probability of occurrence than as a measure of strength such as correlation coefficients. The probability of Granger causality however is inferred as low or high co-integrated networks and hence can provide a measure of two-way flow of information content across assets. It is essential to statistically test the effect of one on another. Literature applying the Granger causality to construct financial networks prove that stock markets react to market volatility. Tu (2014) report the strong impact of financial stocks in the Chinese market network examined through the Granger causality data. Since the weight measure for constructing the network is a probability value, the networks may not reflect the causal relationship fully. Another alternative applied by researchers is the entropy function to construct market networks (Wang and Sun, 2021). The context of representing market relationship varies based on the purpose of investigation. Examining the impact of economic fundamentals on the network structure is aptly supported by literature defining markets or correlated networks than causal networks.

1.2 Stock market link to economic fundamentals

Asset market valuations especially the financial stock market, by representing the corporate financial flows are crucial to strengthen the economy. Stock market valuations theoretically are expected to represent both macroeconomic, industry and firm level information. Literature points out the influencing role of macroeconomic factors on market valuations (Wang et.al., 2023). Identifying the influence of macroeconomic factors on the heterogeneity of markets is needed to plan the corporate decision strategies for specific economic policy impacts (Morck et al., 2000); (Karanasos et al., 2021). Besides the specific application of predicting the market valuation movements by economic factors

such as interest rate changes, inflation trend, monetary policy impact, the establishment of relationships helps corporates to strategically position their competitiveness in the economy. Research problems that are encountered in addressing the impact of economic variables on stock market valuations stem from the inter-relationships within the economic variables. Besides, the impacts are not stationary across the numerous variables that represent the economy. Chen et.al., (1986) reports the spill over effect of several economic variables on financial market values globally. Peiro, (2016) establishes the notion that financial markets anticipate the changes in economic indicators since they are the discounted value of future projections. Fromentin, (2021) investigates the ability of financial markets in predicting the future economic outlook since increased returns from the stock market are a major indicator of economic growth. The examination of such bi-directional relationships over time helps in an integrated economic and market growth, though the non-linearity of the relationships implies the inherent methodological difficulties in establishing the impacts. The research focuses on capturing the impact of economic factors such as interest rates, economic growth, inflation and other asset market growths such as housing, energy and food on stock market value flow heterogeneity. Further by establishing the heterogenic stock market value impact from anticipated economic changes would address the strategies required by corporates to increase their market valuation especially during market crashes.

Literature reports the negative relationship between interest rates and stock market returns (Karamelikli and Karimi, 2020). The negative relationship has a pertinent implication since the market crashes can be associated with drastic interest rate increases. The empirical examination of market crashes and its strong relationship with interest rates across economies is well documented and proves the negative effect with varied methodologies. Liu and Fang (2020) provide evidence of increased market values with reduced interest rates in the economy. Taveeapiradeecharoen and Aunsri (2020) examined the impact of market prices on several indicators of interest rate structures in the economy such as bank deposit and lending rates and long term Treasury bond rates. Though in certain economies interest rates have not established a significant impact on market returns, the variations in results are attributed to the impact of short vs. long term rate structures.

Commodity markets are hypothesized to have a significant impact on stock market returns. Kumar et al., (2020) studied the oil price impact on stock markets to conclude that economies exhibit sensitive relationships to extreme changes (increase or decrease) in oil prices. Raza et al., (2016) reported the impact of oil and gold prices on stock market valuation, however they reported a negative significant relationship. Commodity markets exhibit diverse interactions in varied economies; further the supremacy of economies in specific commodities also is diverse. This has resulted in varied results from the examination of the relationship between commodity and equity markets. Mensi et al., (2021) identified a positive relationship between oil and stock markets during the financial crisis years across economies. Singhal and Ghosh (2016) report an insignificant relationship between oil and stock prices. Mohalhal, (2015) reports an insignificant relationship with sector indices. While energy is a crucial factor for economies, there is a theoretical link between stock market valuation movements and commodity market value changes. However, these anticipated changes are well hedged by the corporate sector leading to insignificant valuations in a broad context. There is a possibility of establishing the specific relationships in both energy and non-energy price changes impact on the stock market. As commodity markets are viewed as a hedge against stock markets, the inflation or deflation in an economy is projected as a likely cause of market crashes when commodities do not act as a hedge. The complicated structure of the relationship between inflation and stock market values hence requires further examination from the context of the stock market heterogeneity.

Similar to commodity markets, housing markets are well established to significantly influence the stock market valuation. Diebold and Yilmaz (2012) reports the significant relationship between financial and housing markets based on correlation coefficients. The basic premise in the relationship is founded on the rational expectations permanent income hypothesis that postulates a positive relationship between consumer confidence and consumer spending. Using the wavelet coherency procedure, the degree of co-movement and causality between housing, stock markets, and macroeconomic uncertainty are investigated (Alqaralleh et.al., 2023). The results highlight that the clustering of global business acts as global hubs that expose the housing markets to international shocks and volatility spill over. Real estate markets along with stock markets are crucial indicators of economic growth and both are affected by several macroeconomic indicators. The valuation in these markets hence are subject to similar dependencies, hence are considered as cross assets by global investors. The interaction between these markets is stronger in the long run than short or medium term, with the two asset markets being bilaterally causally linked and have stronger return and volatility transmission effects (Zhou, 2010). The variation over time horizon is due to the different types of investors with speculative objectives or strategic investment goals. Short term investors view sensitive frequently changing information much more than long term investors whose outlook is based on external and intrinsic factors influencing the markets. The relationship between the markets is examined through co-integration techniques, linear causality tests, correlation analysis and GARCH related models at varied time intervals. The non-linear movement pattern between these assets though theoretically established is yet to be tested in international asset markets.

Market networks either stock market or commodity, real estate, or economic markets exhibit a co-movement in terms of value inflows and outflows. Network analysis links the relationships by identifying their heterogeneous effects. Resource dependency and agency theories underlie the need for studying the heterogeneous relationships between markets. Based on the resource dependency theory, the stock markets interrelationships across nations is sought by a firm through its internationalization process to reduce the dependency and to dominate in the industry. However, the commodity and real estate of economic markets function together in order to increase efficiency in process and minimize transaction costs (Williamson 1985). Theoretically hence there seems to be a contrast in the motives of the stock market relationships across economies verses the real sector international relationships (Eccles and White 1988). The pertinent question then is to identify the motives of international relationships or co-movements in fund flows across stock markets considering the economic policies and cost efficiencies in varied economies.

1.3 Corporate tactics

Corporate tactics to increase investment commitment or identify strategic connectivity in an international setting are dominated by the stock market efficiency and business opportunities in an economy. For an international investment, corporates need to analyse several factors across international stock exchanges. Corporates on this ground focus on major linkages among stock exchanges and the sensitivity of each security in these exchanges. A balanced portfolio of investments for a firm in both domestic and international economies is likely to result in a stable performance over time. International diversification by increasing the number of economies and the assets in such economies paves the way for minimizing risk and optimizing returns for the firm. International markets exhibit connectedness, for instance the European markets are linked through their currency policies. Similarly the Pacific markets (Singapore, Hong kong, Korea) tend to move together since market players and participants interactions are ample among these economies. North American markets (USA, Canada and Mexico) also correlate well with each other due to border proximity and resource dependencies.

Roll (1992) suggests that the significant correlations among international stock market movements are partly due to similarity in exchange procedures such as stock index determination methodologies. Though each market exhibits distinct styles of representation such as selection of either large number of firms or smaller number of firms in their core market index construction, diversification representation provides for the subtle differences across international stock market indices despite co-movement patterns. Alternative viewpoints are provided by Heston and Rouwenhorst (1994) who finds evidence for low correlation across international indices that are due to country specific policies and politics and not due to diversification concepts as explained by Roll (1992). The linkages are also found to be time variant with the linkages being very highly influential during major upheavals and low during normal economic conditions. Solnik (1974) was the first to quantify the risk reduction benefits of international equity diversification. International diversification thus provides firms with lower risk at almost nil additional opportunity cost. Rowland and Tesar (2001) find that multinational corporations may have provided diversification benefits for investors in Canada, Germany and the United States. They however report that the addition of foreign market indices to a domestic portfolio provides substantial diversification benefits in all international economies involved in the diversification process. Corporate concern over choice of international stock markets is basically influenced by the level of liquidity; taxation structures; market benchmarks such as market capitalization size; transaction volume; concentration of large firms and bid ask spreads. The crucial differences among markets encourages corporates to hold contractual or non-contractual commitments that meet the firm level commitments. The choice of an international market hence is based more on the interconnectedness with other exchanges.

Major strategies applied by corporates to explore the international market linkages is through foreign direct investments and merger deals. Capital flows across boarders are through foreign direct investments (Chayawisan 2015). FDI flows are associated with ownership considerations, location advantage and internationalization limits set by the firm (Faeth 2009). Blonigen (2005) proposes that the technology dependencies of firms motivates them to hold intangible assets such as knowhow and managerial talent that are applicable to specific economies. Factors motivating firms to seek international markets are thus theoretically optimizing their market value, resource cost and process efficiency. Seetanah and Rojid (2011) identify the macroeconomic variables associated with a firm's decision towards internationalization. They postulate the direction and effects of macroeconomic measures on foreign direct investment flows. Merger as a preferred mode of foreign direct investment provides firms with a control effectively leading to their desired corporate expectations. Host economies policy interventions along with technology transfer cost, market structure and industry supremacy play a key role in the internationalization entry mode of firms (Matto et al. 2004). Literature also establishes the key economic incentives that lead to an inflow or outflow of capital to and from economies. Research evidence also points out that mergers may not have a positive effect on the local economy, however firms tactically benefit from merger deals by addressing market competition effectively (Alfaro, Chanda, Kalemli-Ozcan, & Sayek 2004). Besides capital flows, firms also address international market presence through changes in production process made possible by the universal adaptation of technological competences. Such tactical business decisions increase corporate productivity. Domestic economies hence address their economic policies towards fostering the corporate productivity that is crucial for the growth rate of its economy.

2.1 Research Methodology

The objectives of the research to establish the relationship between stock market connectedness and economic markets is by linking the stock market network heterogeneity indicators of centrality and probability estimates with global macroeconomic indicators. Towards this end the global financial

indices' partial correlates are measured from the OECD database. OECD indices are estimated with 2015 as the base year. Yearly data from 2015 to 2022 and from 2007 to 2014 are considered as two epochs for noting the market network heterogeneity over varied time zones. The International Monetary Fund identifies the importance of China as an important global economic player with the Chinese currency devaluation in 2015 and included Chinese currency in the IMF currency basket in 2016. Years 2017 to 2019 is recorded as halting growth rates of the world economy followed by the pandemic in 2020. The Russian collapse also fuelled the fall in markets with the escalation of the Russia-Ukraine war after the pandemic. Comparatively the period 2007 to 2014 could be classified as a stable market duration although the European debt crisis during this time continued beyond 2014. The partial correlates from the international market indices are used to measure the heterogeneity of the stock index network.

Centrality measures establish the relevance of each market in creating international value chains. The most often applied measure of centrality is node degree. Degree centrality is indicated by the number of relations connected to each market. The relation between international markets is represented both as inflows and outflows between each other. Hence the degree centrality of in-degree and out-degree, corresponding to the number of in-going and out -going relations respectively. The larger the degree with respect to a market, the more central it is in terms of its value flow. The links are weighted by the strength of measured relations such as partial correlations.

$$C_D^w(k) = \sum_i^N w_{ki} \quad (1)$$

Betweenness centrality is an index measure of the number of markets to which it is a shortest path in the network for a specified market node. The markets with highest betweenness centrality are most important since their deletion from the network would imply several other relationships in the network will be affected. It can be inferred that movement of prices in markets with high betweenness centrality would connect different parts of the network closely in terms of the fund flow.

$$C_B(k) = \sum_i^N \frac{g_{ij(k)}}{g_{ij}} \; i \neq j \neq k \quad (2)$$

where g_{ij} is the shortest path connecting the two nodes i and j and $g_{ij}(k)$ the shortest path connecting the two nodes that also passes through node k, based on the sum of the weights.

The closeness centrality index is the average length of the shortest path of a market with all other markets in the network. The markets that have higher closeness centrality index in the network are more dominant and play a central role. In addition, these markets are more accessible for all other markets.

$$C_C(k) = d(i,k)^{-1} \quad (3)$$

where d(i, k) is the shortest path between the two nodes i and k based on the sum of the weights

A market's influence measured as eigenvector centrality is similar to degree centrality measure. However, eigenvector is based on the degree of importance. The implication is a market with a smaller number of more important neighbours has a higher eigenvector centrality compared to a market with more neighbours of less importance. The measurement is based on the weighted adjacency matrix (A) and λ the constant.

$$C_E(k) = \frac{1}{\lambda} A_{ik} C_E(i) \quad (4)$$

Centrality is also represented by the hubs and authorities in each network. A hub would be a market that has large flows and has linkages with other markets. Authority centrality on the hand gives the

value of the market based on the number of relations linked to it. Measures of authority and hub provide information content on the markets as users and suppliers of fund flows respectively.

$$C_H(k) = y(n) \sum_j^N w_i \, C_{AT}(k) \tag{5}$$

$$C_{AT}(k) = x(n) \sum_j^N w_j C_H\,(k) \tag{6}$$

y is a vector that holds the value of the hub while x is a vector that holds the value of authority.

The relation between markets represented as transitivity is given as the clustering coefficient in a network. For each market the proportion of its neighbours that are connected to each other represents the strength of relationships with the group in the network. Clustering coefficients state the probability of a market's neighbours influencing each other. A higher clustering coefficient would imply the presence of a market in a competitive setting.

$$C_{cf}(k) = \frac{\sum_{ij}^N w_{ij} + \sum_{ih}^N w_{ih}}{d(i)(n-2)\times 2} \tag{7}$$

Measure of modularity in a network also represents the probability of a market's distance with the probability of a random relationship between the markets. Higher modularity implies higher probability of relationships with the market in the network.

$$C_M(k) = \frac{1}{4m} \sum_{ij}^N \left(A_{ij} - \frac{k_i k_j}{2m} \right) \tag{8}$$

Where m is the number of edges. A is the matrix of adjacent nodes and k is the random edge.

Eccentricity in a network is a measure of the maximum distance from a market to other markets in the network. Eccentricity indicates the importance of a market within its network. Eccentricity centrality is a reciprocal of the eccentricity of a market.

$$C_T(k) = max(w) \in Vd(v, w) \tag{9}$$

Specific macroeconomic variables considered are interest rate (short and long term), economic growth represented by demand growth rates and GDP growth rates; housing sector growth rate, inflation rate in energy and food sectors. Impact of macroeconomic variables on the stock market heterogeneity is established through three stage least squares. Three stage least squares is an estimation technique that considers several models together. Economic measures are highly correlated information and hence when the heterogeneity of stock indices is associated with such highly correlated data sets, the estimation method will not be able to highlight the influence of relevant variables. The error terms of the economic estimates of several variables with high correlation ought to consider the correlation between error terms of these equations. The three stage least squares is the best way of considering the correlation in error terms as information while estimating the regressors. The error terms of the set of equations estimating the heterogeneity of stock markets are highly correlated, however, the error terms of each estimating equation do not exhibit an autocorrelation. The first stage of estimation is similar to a single equation estimate where economic measures as endogenous independent variables are used to estimate each measure of stock market network heterogeneity examined as dependent variable. The second stage applies the estimated values of endogenous variables as instruments. These estimated simultaneous equations for all the stock market heterogeneous independent variables are then used for the next stage. This second step is the 2SLS model. The third stage applies the generalized least squares to transform the estimates with the variance and covariance of error terms so that the correlation between the different model error terms is accounted for.

The objective of identifying the impact on corporate decisions of a growth factor in macroeconomic fundamentals is analysed through difference-in-difference method. Here, economic measures are the treatment variables since for example by increasing or decreasing the interest rate, an economy can encourage its stock market relationship that would lead to the firm's change in business tactics such as increase or decrease their presence in the host economy through a merger or foreign direct investment or production value changes. The economic measures are the treatment subject to by the corporate entities. The market network heterogeneity is the factor during which the impact of the treatment is examined. Business tactics such as mergers are the outcome in the estimated model. Difference-in-difference methods are popular analysis tools to measure the impact of economic policy changes across time. The method has also been successfully deployed to measure the impact of economic policies on varied business scenarios so that significant differences in corporate decisions to changes in economic policies are established.

3.1 Data Description

Economic measure as an incentive towards stock market centrality structures and its impact on corporate decisions requires three sets of data viz., international stock market index data, economic measures of nations and corporate decisions and performance in these economies. The data source for the market indices and economic measures and corporate parameters such as foreign direct investment and corporate productivity are elicited from OECD data sets (htpps://data.oecd.org). The merger and acquisition statistics by countries (Institute for Mergers and Acquisitions and Alliances: https://imaa-institute.org) portal provided details of merger value and number of merger deals in each economy.

3.1.1 Stock Market Network

International stock index data across 16 years made available by OECD provides the backdrop for analysis. OECD recognizes the economic structural change in data sets by referring the economic indicators such as price levels and inflation every five years. The base year change occurrence during 2015 is considered to represent the trend for the period 2015 to 2022. Index values prior to the base year change for 8 years (2007 to 2014) are compared to identify the structural change in stock market network. Network plots are drawn by employing Fruchterman-Reingold algorithm which is a force-directed layout algorithm. The algorithm simulates a physical system in which the nodes are the exchange indices with electrical charges and the edges of the graph are treated as springs to map the attractive and repulsive properties. The nodes that are connected by an edge are pulled closer together, while the nodes that are not connected are pushed apart.

Stock market index network centrality measures eigenvector, clustering coefficient, modularity, hub, eccentricity, betweenness centrality, closeness centrality, weighted and degree measures (Figure 1 to 9) represent the dispersal of market network structures. Market degree and weighted degree frequency distribution exhibits higher number of economies with larger centrality measures and the percentage of firms with smaller measures of centrality though present are very less. Clustering coefficients, modularity, betweenness and closeness centralities and eccentricity are almost similar across economies. Hub and eigenvectors are widely dispersed across the economies.

All measures of network centrality exhibited sparse connectedness prior to 2015 when compared to the connectedness from 2015 to 2022 (Figure A1 to A10). Prior to 2015, there is a distinct strong connectivity within Euro and Pacific economies. Prior to 2015, Switzerland, Canada, Finland, Luxemburg and New Zealand are close to each other but far apart from the rest of the economies. The period after 2015 depicts a strong link with Russia, New Zealand and Turkey. Hungary, Columbia, Chile,

Latvia, Iceland, Israel and Brazil are farther apart and seem to have little or almost weak relationships with other stock market indices. Rest of the economies have strong stock market connectivity.

An analysis of network characteristics for the stock exchanges for the time period after 2015 throws interesting financial linkages that exists among economies. The market inward flow of value from the stock markets are strong among Russia, New Zealand and Turkey (10%); Britain, Columbia and Chile market inward flow (7%); followed by the connectivity of the euro economies along with Korea (7%). The outward flow among the stock markets is strong with Spain, Norway, Portugal, Luxemburg, Greece, Poland and Czech (10%). Outward flow of stock markets between Russia, New Zealand and Turkey is 7%.

Significance of the stock markets is prominent between Russia, New Zealand and Turkey (17%). Rest of the economies have very weak market significance measured by betweenness centrality. On the contrary, the probability of relationships measured by modularity is strong among several economies (Mexico, Belgium, Britain, India, France, Luxembourg, Greece, Canada, USA, Italy, South Africa, Poland, Czech, Austria, Portugal, Slovenia, Norway, Estonia, Japan and Indonesia (44%)). The second cluster of market exchanges are USA, France, Netherlands, Canada, Italy, Japan, Poland, Germany, Sweden, Korea, Finland, Denmark, Ireland, Poland, Slovenia, China, India, Australia, Spain, South Africa, Austria, Luxembourg, Greece, Czech, Estonia (36%) in terms of network modularity. The linkage between Russia, New Zealand and Turkey is measured at 12%.

Measure of market transitivity is high (12%) between Russia, New Zealand and Turkey. Britain, France, Belgium and Spain also have moderate transitivity measured as cluster coefficients. Importance within networks is very high (68%) among all economies except China, Latvia, Israel. Turkey, Chile, Columbia, New Zealand, Hungary, Brazil and Russia.

Chinese stock market exhibits high accessibility with Switzerland, Denmark and Sweden (10%). The accessibility of USA stock market with Germany, Netherlands, France, Canada, Poland and Greece at 7% (closeness centrality) establishes a moderate accessibility between these exchanges.

Importance of centrality of stock exchanges (eigenvector centrality), market with linkages (hub) are negligible (2%). The highest is between Russia, New Zealand and Turkey (7%). Market network measures distinctly point out the clustering of nations through the financial markets.

3.1.2 Economic measures and corporate tactics

Economic variables for the 42 economies included interest rate indicators (short and long term), demand, capital formation, GDP, inflation and commodity price levels. Stock market valuations are expected values, hence economic forecasts are hypothesized to predict market centralities. Variations across economies are prominent in almost all measures of economic indicators (Table 1). Corporate tactics for the 42 nations show a high coefficient of variation for foreign direct investment outflows. Average FDI outflows are higher than the average FDI inflows (Table 2).

4.1 Impact of economic measures on the heterogeneity of stock markets

This section elaborates first the ability of economic measures in explaining the heterogeneity of stock markets. The discussion of the impact of corporate tactics on the movement of economic measure across stock market centralities is explored next.

4.1.1 Predicting stock market heterogeneity

Nine simultaneous equations were analysed to predict each heterogeneity measure in the stock market. The root mean square error of the equation predicting betweenness centrality alone did not

have significant predictive power (Table 3). All the other heterogeneity measures' (Degree centrality, Weighted degree centrality, Closeness centrality, Modularity, Eccentricity, Hub, Clustering coefficient and Eigenvector centrality) explanatory power are nearly 40% (R square). The measure of importance of stock exchanges within the network (eccentricity) has a predictive power of 34%. The statistical significance of the equations were at 1% (5% for market accessibility (closeness centrality)).

Degree and weighted degree that measures the centrality of stock exchange value flows is significantly influenced by changes in price level index growth rate and energy CPI growth rate. Value flows across markets decline as price level growth rates increase. Higher price level increases the profitability of firms and the additional cash flows from product markets may have deterred the firms from utilizing the financial stock exchanges to generate the additional cash flows. However, with increased energy prices stock markets, firms seek the increased flow of value in international stock exchanges to offset the cost concern. Risk hedging necessity may motivate the firms to increase their flow of funds across international stock exchanges.

Importance of stock exchanges within the network is significantly influenced by short term interest rate forecasts, long term interest rates, housing sector growth rate and average CPI growth rate. Increased interest rates indicate increased cost of borrowing and hence stock market plays a significant role in identifying investment providers through the exchanges. The short term interest rate forecast is a better indicator of importance of stock exchange than the long term interest rate forecast. In addition, the stock market importance also increases for long term interest rates prevalent in the economy. Housing growth rate influences the importance of stock market (stock market network eccentricity) positively. Housing sector is an indicator of asset valuation in an economy, thus has a tendency to increase the importance of the stock exchanges within its network. Average CPI price levels is expected to have a negative impact on the importance of stock exchange in an economy since asset values provide the cushioning effect for the investment requirements of firms and corporates may not consider the stock exchanges as important connectivity points.

Probability of relationships between international markets is significantly affected by changes in short term and long term interest rate forecasts and CPI energy growth rates. Short term forecasts increase the probability of relationships while long term forecasts reduce the probability of relationships. Increased energy price levels reduce the probability of centrality relationships of international indices. The intuitive argument could be, reducing the forecast of long term interest rate economies would offset the unemployment problems. Corporates would plan investment proposals based on long-term forecasts and thus increase the probability of international market relationships. The negative probability of relationships reducing with increased energy price levels may imply that corporates are simultaneously focusing on domestic self-sufficiency advocated by economies' energy requirements in the long run. This explains the negative explanatory power of energy price level changes, especially the subsidies and cuts and promotion of alternate energy resource utilizations generated within the economy over a period of 10 to 30 years.

The linkages of stock markets are further explored by the independent variable hub. International stock market linkages increases when economies increase the price levels though the impact of the coefficients are very less (2% to 3%). Inflationary pressures when controlled by the economy thus induces the firms to reduce international stock market linkages and focus only on major financial market relationship. That may also explain the tendency of firms to reduce their international stock market exposure risk and costs associated with such linkages. Energy price level increase as a policy measure is expected to increase the stock market linkages since this is a crucial resource requirement for the corporate sector.

Stock market accessibility measured as closeness centrality does not react to several policy changes by the economies. Price level rates however significantly exhibit a negative relationship with stock market accessibility. Firms focus on accessibility cost to reduce the stock market relationships when CPT rates increases in an economy. Transitivity measure of stock market networks (cluster coefficients) negatively impacts CPI forecast rates. Transitivity in stock markets implies the switching of relationships across boundaries when new connections are established over time. Transitivity also implies contagious risk transfer across international markets. Increased price levels hence reduce the transitivity among international stock markets. Stock market network heterogeneity factors of betweenness centrality (stock exchange significance) and eigenvector centrality (centrality importance) do not have significant impact due to economic policy changes. Neither of these heterogeneous factors are large and the dominant percentages across international markets are just 2%. The only strong relationship is between Russia, New Zealand and Turkey.

Stock market inflows (Russia, New Zealand and Turkey), outflows (Spain, Norway, Portugal, Luxemburg, Greece, Poland and Czechia) are significantly influenced negatively by growth rate of consumer price index in these economies. Stock market value inflows decline with increase in price index growth rates and increase with energy price level rates. Energy price levels impact increases stock exchange outflows of the economies especially those that have strong relationship with each other. Market eccentricity (importance within networks) is influenced significantly positively by short term interest rate forecasts, long term interest rates and housing growth rates for almost all economies. A moderate relationship of the eccentricity impact is identified for China, Russia, New Zealand and Turkey.

Network modularity (probability of relationship) is very high and has a positive impact from short term interest rate forecasts and negative impact from long term interest rate forecast and energy rates for several economies. A high impact for USA, France, Netherlands, Canada, Italy, Japan, Poland, Germany, Sweden, Korea, Finland, Denmark, Ireland, Poland, Slovenia, China, India, Australia, Spain, South Africa, Austria, Luxembourg, Greece, Czech, Estonia as a group points out the changing financial relationship structure across economies. A moderate probability of relationship is observed from changes in these economic variables for Russia, New Zealand and Turkey.

4.1.2 Corporate tactics differences due to Impact of economic policies on stock market heteroscedasticity.

Corporate productivity increases as a result of policy change impact (short and long term interest rate forecasts, long term interest rates, price level growth rate, average price levels, and food prices) on degree centrality (centrality of cash flows). Long term interest rates and housing growth rates impact on degree centrality increases foreign direct investment outward business tactic of firms. Impact of price level growth rates and energy rates on degree centrality increases FDI inward business activity significantly. Housing growth rate impacts degree centrality to increase merger value strategy of firms (Table 5).

Productivity declines after impact of economic measures (long term interest rate forecast, long term interest rate, average price index and food prices) on weighted node centrality (Figure B1 to B3). FDI outward indicate a reduction on the impact of long term interest rate forecast and long term interest rate on weighted node centrality. FDI inward reduction is on the impact of price level growth rates and energy rates on weighted node centrality. The weights assigned are based on the smallest sum of the weights between two nodes. This also is expressed as the shortest path between two nodes.

Productivity increases after impact of long term interest rates and forecasts and average price index on closeness centrality. Outward FDI reduces after impact of long term interest rates and forecasts and

food prices on closeness centrality of international stock indices. FDI inwards increases with impact of price index growth and energy rates on closeness centrality.

5 Research Implications and scope for future research

European, Pacific, Asian, African and North American economies' yearly stock market index data, economic data pertaining to productivity, interest rate structures, price levels, FDI and capital values form the data set for the research. The eight year period data also collated the merger value and number of deals taken up under merger by the nations. The international data set made available from OECD data set is representative of the world across varied periods of policy initiatives. The research addressed the market heterogeneity based on the relationships among stock market indices. Such relations are explored as varied measures of market importance and market linkages. The heterogenic characteristics of market importance helps firms to foster business relationships towards corporate excellence. A comparison of network heterogeneity with two epochs identify the new network structures.

Before 2015, the stock market relationships were dominated by USA, Britain, Germany, Latvia, Indonesia, Mexico and Spain with other economics linking to either or all these nations. Israel and India had a weak association with this dominant cluster. A second group of economies that had strong relationship apart from the earlier cluster were headed by Canada, New Zealand, Luxemburg and Finland. After 2014, a major shift in the relationships is visible. Russia, New Zealand and Turkey segregated into a small minor cluster of stock indices. Rest of the economies had a strong dominant interconnectivity with each other, i.e., the cluster of relationships has increased dramatically. A visible outlier in this dominant cluster are China, Colombia, Chile and Latvia. This structural split in stock markets indicates the market value movements across global economies. A strong cluster is an indicator of strength of stock market integration due to varied measures of relationships. Heavy cash inflow clusters are the group of Russia, New Zealand and Turkey. Heavy cash outflow clusters are Spain, Norway, Portugal, Luxemburg, Greece, Poland and Czech economies.

Testing the determinants of the relationships through economic indicators of interest rates and price levels reveal certain interesting inferences. Stock market significance and probability of stock market relationships are influenced strongly by interest rates. Interest rate changes impact three clusters of economies (betweenness centrality). The first cluster is Russia, New Zealand and Turkey. The second cluster is Israel, Japan and Sweden. The third cluster is China, USA, Finland, Denmark and Czech. Interest policy changes are bound to impact market return within these economies more than with other countries that are not clustered with them. The stock market measure of modularity (probability of the stock market relationships strength) is strong in three cluster groups. The first cluster is similar to the betweenness cluster. However the interest rate impact of second and third clusters equally divides the participants in opposite poles of network position.

Commodity price levels as economic signals impact the importance of exchanges, value flow with these market index and accessibility of the exchanges. Market accessibility is high with the cluster group China, Czech, Sweden and New Zealand. Such strong relationship enable financial market role at times when price levels are re-set in an economy. If price levels are not re-set immediately by firms in the economic growth, theoretically market valuation will be undermined in these economies. Interest rate changes influence inflows and outflows in the cluster groups and significance and importance of relationships changes accordingly. However, short term forecasts have positive effect on market heterogeneity characteristics. Higher the short term interest rate forecast of nodal economies in a cluster, higher will be its activities in relationship to others connected with it.

The research also addressed the specific corporate decisions that would be consequence of a policy change in economic measures. Corporate productivity is the most preferred tactic to address the impact of interest and commodity price level changes in varied heterogenetic stock market scenarios. FDI inward shifts are the consequence of impact of energy rate changes in the stock market connectedness. FDI outflows become a corporate tactic to address the impact of food price and interest rate changes to different market relationships.

Though only a few of the macroeconomic indicators have an empirical impact on stock market relationships, the examination of business related indicators such as consumer confidence index will address the mode of productivity changes to be accomplished by the firms. There is a lot of scope for including the business tactics through intangibles that are shifted from one economy to another. Besides technical and human strengths brand equity can be a business tactic that can play a subtle role in countering external policy impacts on the firm's financial market relationships. Future work to identify the effectiveness of corporate tactics to address the policy changes would further help firms to optimize their market value.

Table 1 Average Values of Economic Measures of 42 Nations (Rates (%))

Economic Measures	Mean	CV	Min	Max	Skewness	Kurtosis
Short term interest forecast	2.10	3.87	-0.06	14.80	2.53	10.70
Long term interest forecast	2.47	3.03	0.19	13.88	2.28	9.00
Long term interest	2.15	2.63	-0.11	9.38	1.46	4.31
Demand growth	1.90	0.84	0.41	4.25	0.10	1.95
Gross fixed capital formation growth	2.87	3.52	-3.52	17.60	2.14	12.41
Net GDP forecast	6.98	5.48	1.14	43.33	4.96	29.88
Real GDP forecast	2.27	0.96	0.40	7.90	1.76	6.68
Average CPI	3.02	3.41	0.37	20.29	3.92	21.29
CPI forecast	4.29	4.02	1.01	29.05	5.18	31.55
PPP growth rate	3.53	6.38	0.58	29.95	4.19	24.14
Housing growth rate	1.00	0.00	0.86	1.02	-3.21	11.61
Price level index growth	1.00	0.00	0.99	1.01	-0.23	3.88
Energy CPI	4.48	4.42	-0.61	25.04	2.38	11.90
Food CPI	3.04	4.83	-0.38	23.86	3.93	22.00

Table 2 Average Value of Corporate Tactics (Rates (%))

Corporate Tactics	Mean	CV	Min	Max	Skewness	Kurtosis
FDI inward	2.63	3.68	-0.57	20.29	4.48	26.11
FDI outward	4.09	49.95	-0.88	93.60	6.06	38.50
Productivity	1.61	4.30	-2.23	15.47	3.92	21.74
Mergers (Number)	0.05	0.03	0.01	0.23	3.99	19.03
Mergers (Value)	0.08	0.21	0.00	0.58	3.59	14.17

Table 3 Predicting stock market heterogeneity

Equation	Heterogeneity Measure	RMSE	R Square	Chi 2	Probability
Degree	Value Flows	6.61	0.43	40.91	0.00
Weighted	Value Flows	5.81	0.43	38.67	0.00
Eccentricity	Importance within network	0.66	0.45	33.88	0.00
Closeness	Accessibility	0.15	0.33	24.58	0.04
Betweenness	Exchange significance	14.28	0.16	8.63	0.85
Hub	Market with linkages	0.06	0.43	44.08	0.00
Modularity	Probability of relationship	0.98	0.40	26.81	0.02
Clustering	Transitivity	0.19	0.42	31.14	0.01
Eigenvectors	Centrality importance	0.27	0.44	34.51	0.00

Table 4 Stock Market Heterogeneity Predictors

Economic Measure	Degree	Weighted Degree	Eccent-ricity	Close-ness	Between-ness	Hub	Modu-larity	Cluster Coeffi-cient	Eigen-vector
stintfor			0.28				0.35		
ltintfor							-0.36		
ltint			0.10						
demgr									
gfcfgr									
ngdpfr									
rgdpgr									
cpiavgtot			-0.25	0.06					
cpifortot									
pppgr									
housinggr			8.23						
pligr	-93.92	-85.61				0.03			
cpiener	1.63	1.40			1.46	0.02	-0.19		0.06
cpifoof									
Constant	111.89	101.16							

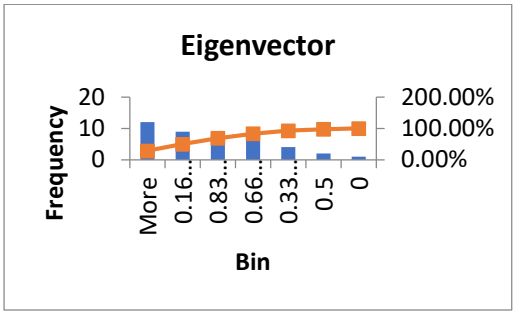
Note: stintfor: Short term interest forecast; ltintfor: Long term interest forecast; ltint: Long term interest demagr: Demand growth; gfcfgr: Gross fixed capital formation growth rate; ngdpfr: Net GDP forecast; rgdpgr: Real GDP forecast; cpiavgtot: Average CPI; cpifortot: CPI forecast; pppgr: PPP growth rate; housinggr: Housing growth rate; pligr: Price level index growth rate; cpiener: Energy CPT; cpifoof: Food CPI. Significant coefficients are reported (Significance level: 5%).

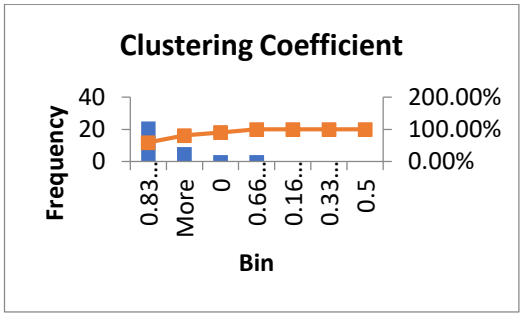
Table 5 Differences in corporate tactics due to impact of economic policy changes on stock market heterogeneity

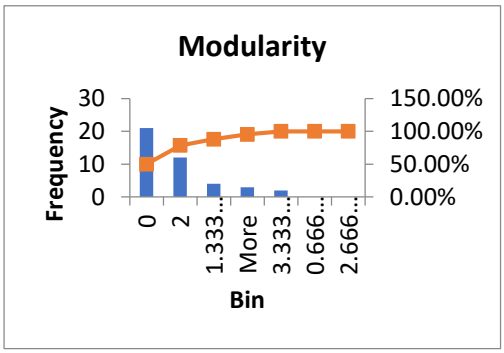
Economic Measure	Degree	Weighted	Eccentricity	Closeness	Betweenness
stintfor			0.28		
ltintfor					
ltint			0.10		
demandgr					
gfcfgr					
ngdpfr					
rgdpgr					
cpiavgtot			-0.25	0.06	
cpifortot					
pppgr					
housinggr			8.23		
pligr	-93.92	-85.61			
cpiener	1.63	1.40			1.46
cpifoof					
Constant	111.89	101.16			

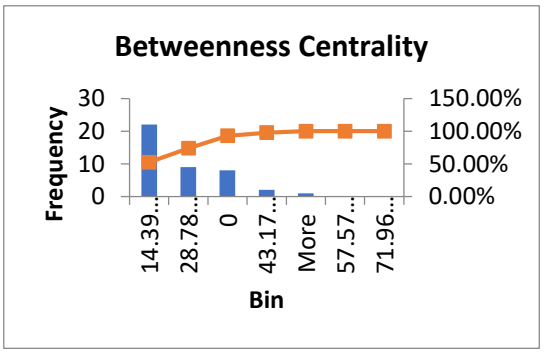
Economic Measure	Hub	Modularity	Clustering Coefficient	Eigenvectors
stintfor		0.35		
ltintfor		-0.36		
ltint				
demandgr				
gfcfgr				
ngdpfr				
rgdpgr				
cpiavgtot				
cpifortot			-0.17	
pppgr				
housinggr				
pligr	0.03			
cpiener	0.02	-0.19		0.06
cpifoof				
Constant				

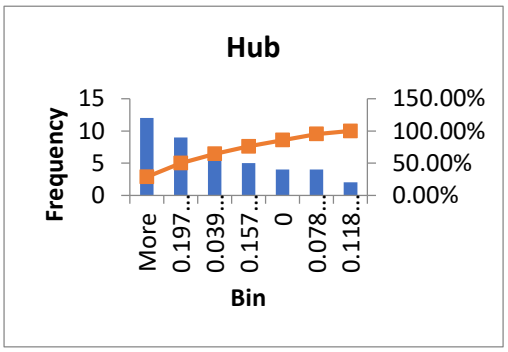
Figures 1 to 9

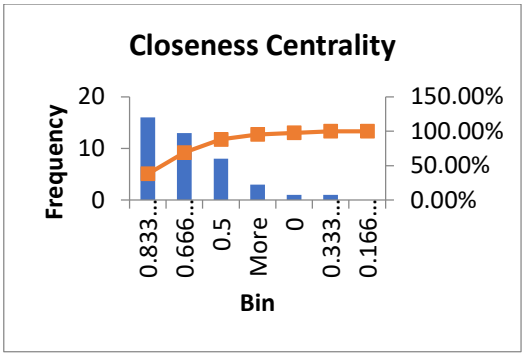


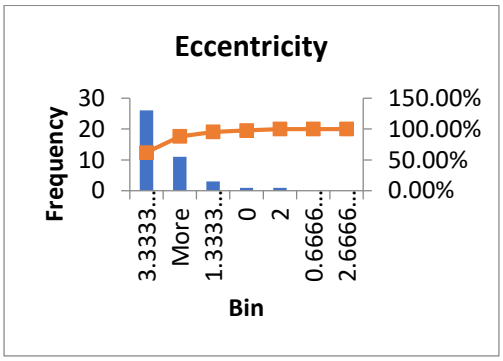


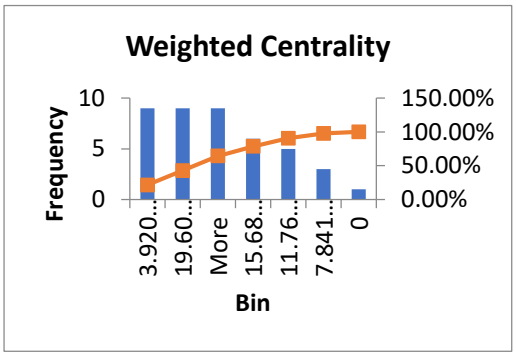












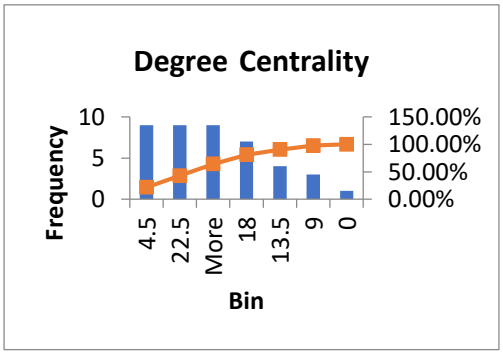
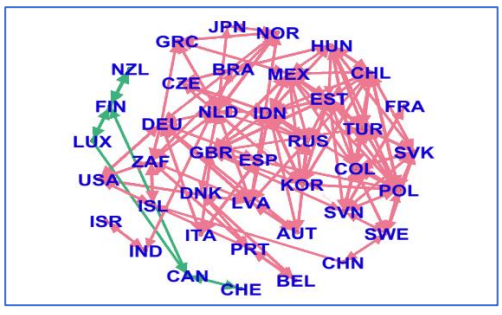


Figure A1: Strongly connected



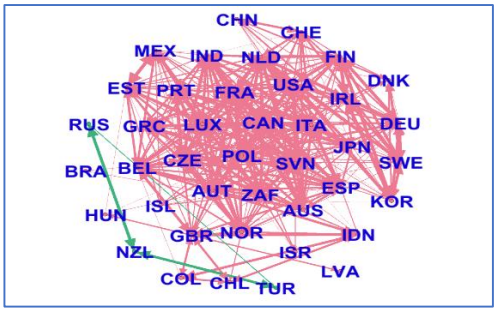
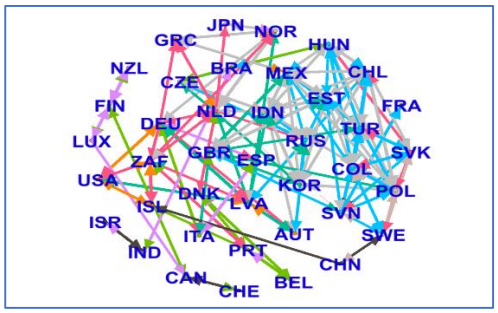


Figure A2: In-degree Centrality



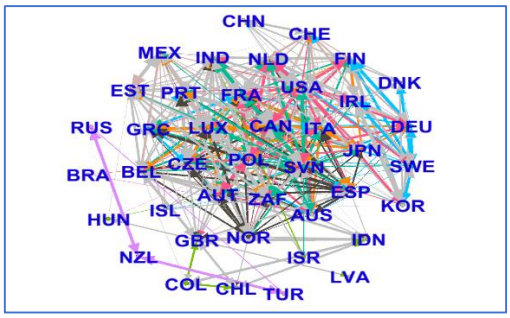
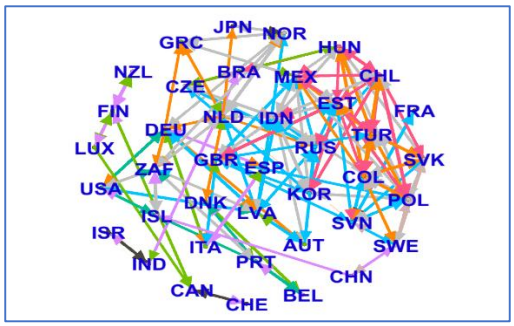


Figure A3: Outdegree Centrality



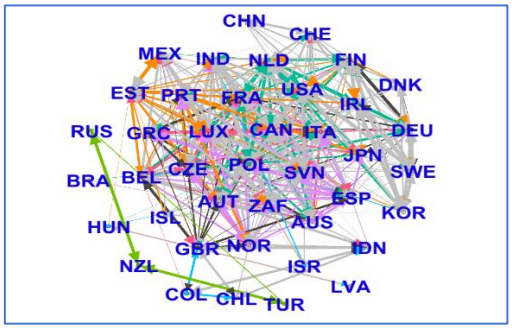
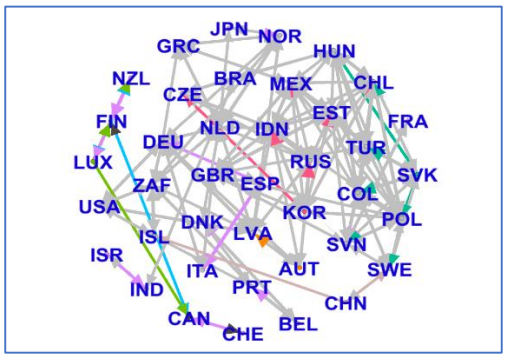


Figure A4: Betweenness Centrality



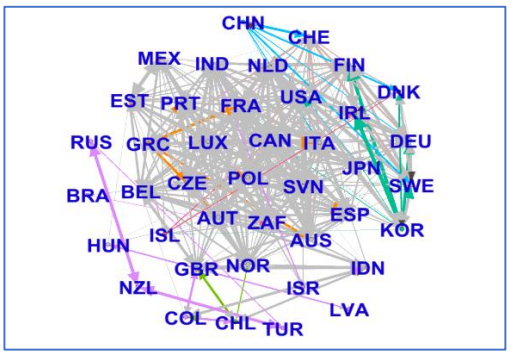
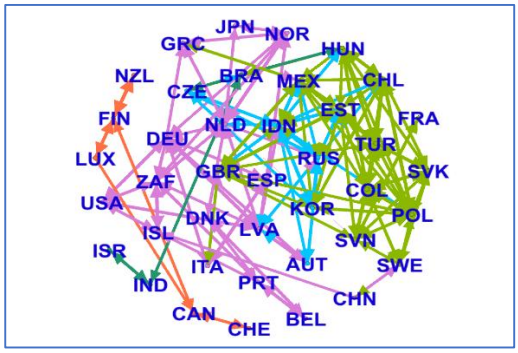


Figure A5: Modularity



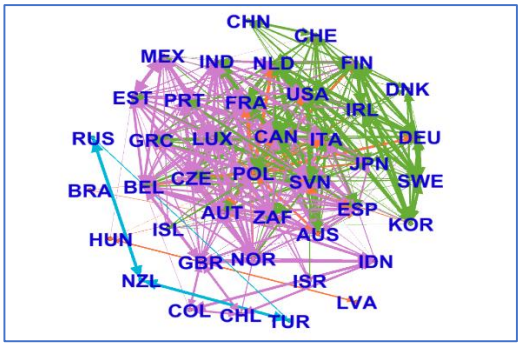
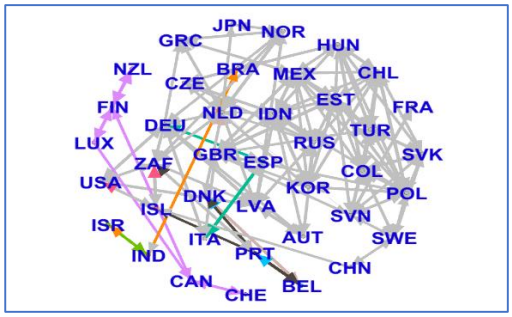


Figure A6: Authority



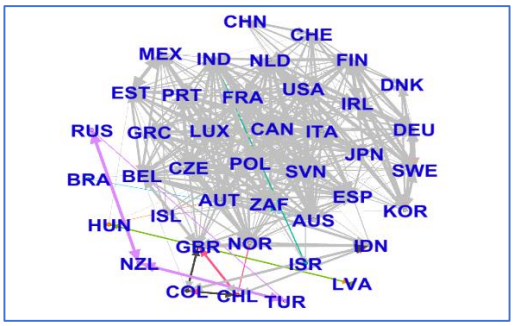
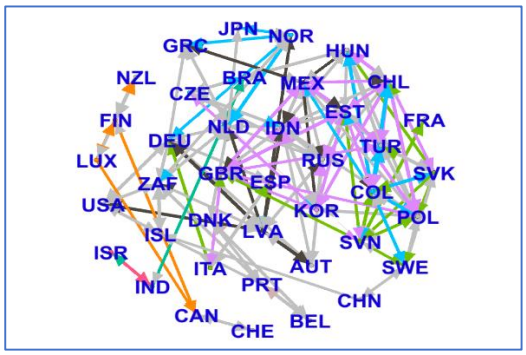


Figure A7 : Clustering Coefficient



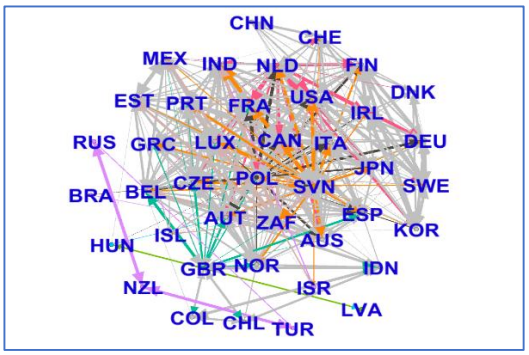
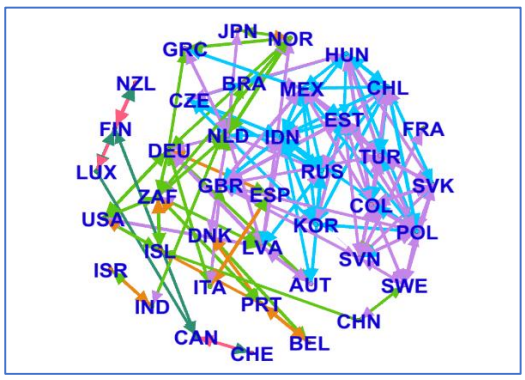


Figure A8 : Eccentricity



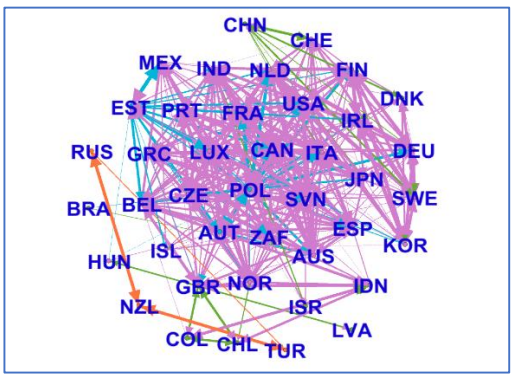
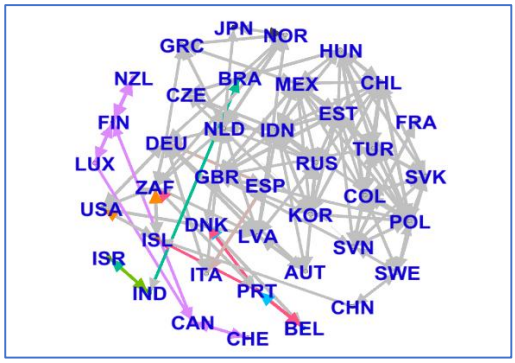


Figure A9: Hub



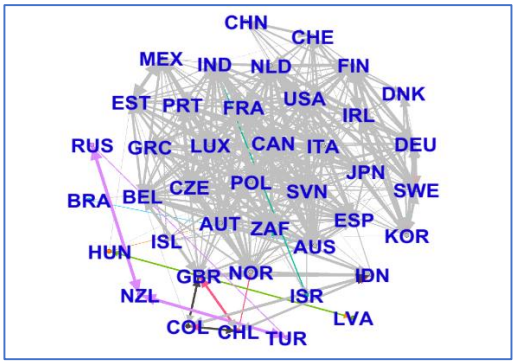


Figure A10: Closeness Centrality

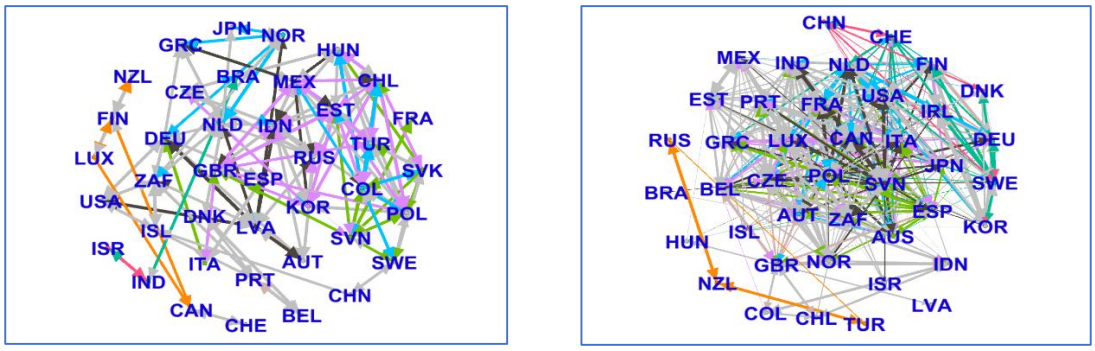


Figure A11: Eigenvector centrality

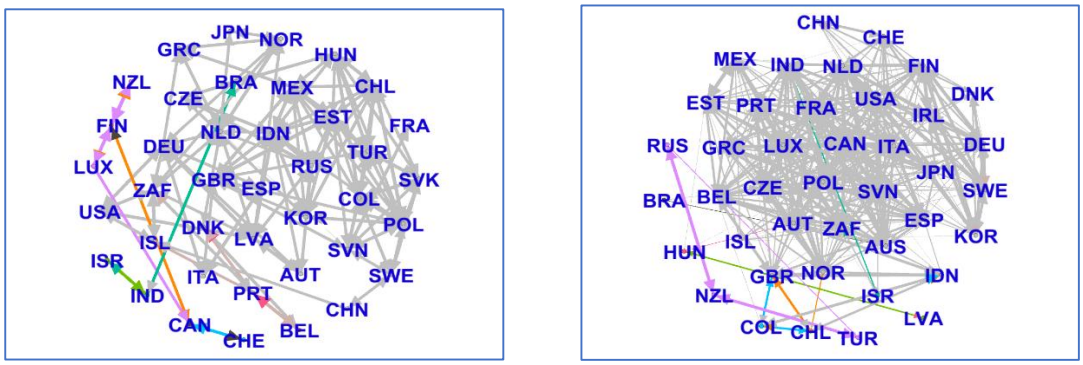
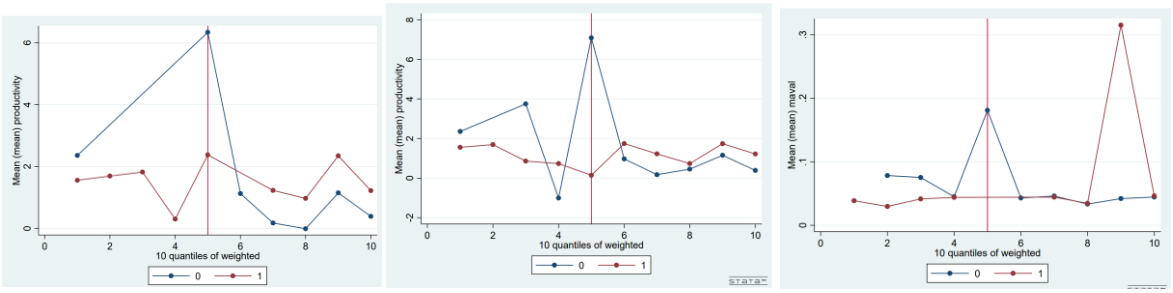


Figure B1, B2, B3



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