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Research paper

The Impact of Technology on Equity Markets: Empirical Evidence from APEC Markets

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Abstract

This paper investigates the dynamic and state-dependent synchronization between the global technology sector and the equity markets of 19 Asia-Pacific Economic Cooperation (APEC) member economies. Moving beyond traditional linear models that capture only average effects, we employ a Quantile-on-Quantile Regression (QQR) approach to analyze how this relationship varies across the full distributions of both technology and equity market returns. Using daily data from May 1, 2015, to September 12, 2024, our findings reveal a profoundly heterogeneous and asymmetric linkage. The results indicate that developed and tech-centric economies, such as the United States and Taiwan, exhibit strong positive co-movement, which intensifies during bull markets. Conversely, many commodity-driven and emerging economies, including Australia and Peru, display their strongest positive synchronization during market downturns, suggesting the technology index acts as a barometer for global risk sentiment. For instance, the marginal effect of technology on the Peruvian market is highest (0.193) in deep bear markets. Furthermore, we uncover significant asymmetries, as seen in Hong Kong, and clear evidence of decoupling in economies like Thailand. These findings demonstrate that market correlations are highly dynamic, challenging the assumptions of static relationships and providing crucial insights for international portfolio diversification and state-contingent risk management strategies.

Keywords: *Equity Market Synchronization; Technology Sector; Quantile-on-Quantile Regression (QQR); APEC; Asymmetric Dependence.*

1. Introduction

The dawn of the 21st century has been characterized by the pervasive and transformative influence of technology. More than just a sector of the economy, technology has become the fundamental substrate upon which modern commerce, communication, and innovation are built. Its relentless advancement has not only reshaped industries but has also profoundly altered the architecture of global financial markets. Technology companies, once niche players, now dominate the world's leading equity indices, with their valuations often serving as a barometer for global economic health and investor sentiment (Gompers & Lerner, 2001). The unprecedented growth and interconnectedness of the technology sector have made it a primary channel for the transmission of economic shocks and financial sentiment across international borders, a phenomenon that has accelerated the trend of global equity market synchronization.

Financial market integration, or the tendency for markets to move in tandem, has been a central theme in international finance for decades. Driven by globalization, the liberalization of capital flows, and advances in information and communication technologies, the world's financial markets have become more interwoven than ever before (Bekaert & Harvey, 2000; Obstfeld & Taylor, 2004). This increased co-movement offers opportunities for efficient capital allocation but also presents significant challenges, most notably the heightened risk of financial contagion, where a crisis in one market can rapidly spill over into others (Forbes & Rigobon, 2002). Classic studies have documented the increase in cross-market correlations, particularly during periods of high volatility, challenging the traditional benefits of international portfolio diversification (Longin & Solnik, 1995).

Within this paradigm of growing integration, the technology sector has emerged as a particularly potent and unique driver of market synchronization. Unlike traditional sectors that are often constrained by geography or physical resources, the technology industry is characterized by global supply chains, international product markets, and cross-border flows of intellectual property and venture capital (Kose, Otrok, & Prasad, 2012). Major technology indices, such as the NASDAQ, are no longer merely domestic benchmarks but are now considered global indicators of innovation and growth prospects. Shocks originating from this sector—be it a major product innovation, a regulatory crackdown, or a shift in investor sentiment—have been shown to have rapid and far-reaching consequences for equity markets worldwide (Engle, Ito, & Lin, 1990; Ehrmann, Fratzscher, & Rigobon, 2011). The dot-com bubble of the late 1990s and its subsequent collapse provided an early, stark illustration of how technology-centric sentiment could drive global market cycles. More recently, the performance of a handful of "mega-cap" tech stocks has demonstrated an outsized influence on the trajectory of global equity returns (Barroso & Maio, 2019).

The Asia-Pacific Economic Cooperation (APEC) forum represents a particularly compelling context for studying this phenomenon. The region is a microcosm of the global economy, comprising highly developed, technology-leading nations (e.g., the United States, Japan, South Korea, Taiwan), major financial centers (e.g., Hong Kong, Singapore), commodity-rich economies (e.g., Australia, Canada, Russia), and dynamic emerging markets (e.g., Vietnam, Indonesia, Philippines). Furthermore, APEC is at the heart of the global technology supply chain, from semiconductor manufacturing in Taiwan and South Korea to software development and assembly in China and Southeast Asia (Baldwin, 2016). This deep integration into the tech ecosystem suggests that APEC economies are likely to be highly sensitive to shocks emanating from the technology sector. However, the sheer diversity within APEC implies that the nature and magnitude of this sensitivity are unlikely to be uniform. While some studies have examined market integration within the Asia-Pacific, they have often focused on regional contagion or the influence of major economies like the U.S. and China, without specifically isolating the unique and evolving role of the technology sector as a common driver (Chiang, Jeon, & Li, 2007; Yang, 2005).

Despite the broad consensus that financial markets are increasingly integrated, a significant gap persists in the literature concerning the precise nature of these linkages. Most existing studies have relied on methodologies—such as correlation analysis, vector autoregression (VAR), and various GARCH models—that primarily capture the average relationship between markets. These approaches, while valuable, implicitly assume that the relationship is stable across different market conditions. This assumption is increasingly challenged by evidence of asymmetries and non-linearities in financial data, particularly during periods of market stress (Ang & Chen, 2002; Hong, Tu, & Zhou, 2007). The impact of a 10% surge in the technology index on an equity market may be fundamentally different from the impact of a 10% decline. Similarly, the effect of a technology shock on a bearish, risk-averse market is likely to differ from its effect on a bullish, exuberant market. Conventional methods are ill-equipped to capture these crucial state-dependent dynamics.

This paper seeks to address this critical gap by employing a Quantile-on-Quantile Regression (QQR) framework, as developed by Sim and Zhou (2015). The QQR methodology provides a powerful lens through which to analyze the relationship between two variables across their entire distributions. By regressing the quantiles of a dependent variable (the returns of an APEC equity market) on the quantiles of an independent variable (the returns of a global technology index), we can estimate a complete spectrum of marginal effects. This allows us to answer nuanced questions such as: What is the impact of a severe downturn (e.g., the 10th percentile) in the technology sector on a similarly distressed APEC market? How does a tech boom (e.g., the 90th percentile) affect an APEC market that is experiencing average returns? This granular approach enables the mapping of asymmetries and the identification of how the relationship strengthens or weakens under different combinations of market stress and exuberance.

Therefore, the central objective of this study is to investigate the heterogeneous and state-dependent nature of equity market synchronization between the global technology sector and the member economies of APEC. By applying the QQR methodology, this paper makes several contributions to the literature. First, it provides a far more detailed and nuanced picture of technology-driven market integration than has been previously offered, moving beyond the limitations of average-based statistical measures. Second, it systematically maps the asymmetries of this relationship, highlighting the varying degrees of contagion and co-movement that exist in bull, bear, and normal market conditions. Third, the findings offer significant practical implications for international investors and portfolio managers by providing a deeper understanding of how cross-market correlations shift, which is essential for effective risk management and dynamic asset allocation strategies within the APEC region. Finally, for policymakers, this research offers crucial insights into the channels of financial contagion and the varying vulnerability of APEC economies to global technology shocks, which is vital for maintaining financial stability in an increasingly interconnected world.

The remainder of this paper is structured as follows: Section 2 will detail the review of literature on existing studies, with a focus on our study. Section 3 will detail the data and methodology, with a focus on the QQR framework. Section 4 will present and discuss the empirical results, including a detailed interpretation of the QQR surface plots. Section 5 will summarize the major findings and conclude with a discussion of the study's implications.

2. Review of Literature

The growing interconnectedness of global financial markets is one of the most defining features of the modern economic landscape. This phenomenon, often referred to as market integration or synchronization, has been the subject of extensive academic inquiry for decades. Concurrently, the rise of the technology sector as a dominant global economic force has introduced new dynamics and channels for the transmission of shocks across borders. This literature review synthesizes three key streams of research relevant to this study: (1) the broad literature on equity market integration and contagion; (2) studies focusing on the specific role of the technology sector in driving global market co-movements; and (3) the methodological evolution from linear models to quantile-based approaches that can capture the complex, state-dependent nature of these relationships.

2.1. Equity market integration and financial contagion

The study of how equity markets move together has a rich history. Early seminal works by Longin and Solnik (1995) challenged the assumption of stable cross-country correlations, finding that correlations between major international markets increased significantly during periods of high volatility. This finding had profound implications for portfolio diversification, suggesting that its benefits diminish precisely when they are most needed—during market downturns. Subsequent research has consistently affirmed this trend of increasing market interdependence, attributing it to factors such as financial liberalization, deregulation, and the reduction of barriers to international capital flows (Bekaert & Harvey, 2000; Henry, 2000). Obstfeld and Taylor (2004) provide a historical perspective, documenting the ebb and flow of global capital market integration and highlighting the unprecedented levels reached in the contemporary era.

A critical strand of this literature distinguishes between fundamental interdependence and "contagion." Forbes and Rigobon (2002) famously argued that what often appears as contagion—an increase in market co-movement after a shock—is merely the continuation of strong linkages that exist in all market states, a phenomenon they termed "interdependence." They proposed a correction for heteroskedasticity that showed correlations were often high and stable. However, other scholars maintain that contagion represents a structural shift in the transmission mechanism during crises (Bae, Karolyi, & Stulz, 2003; Corsetti, Pericoli, & Sbracia, 2005). Using different methodologies, studies have found evidence of contagion during major events like the 1997 Asian Financial Crisis (Chiang, Jeon, & Li, 2007) and the 2008 Global Financial Crisis (Dungey, Kenjegaliev, & Martin, 2014; Longstaff, 2010).

The transmission of information and shocks across markets is central to this process. The "meteor shower" hypothesis of Engle, Ito, and Lin (1990) demonstrated how volatility in one market can spill over into the next as trading opens across time zones, a process greatly accelerated by modern information technology. Similarly, studies have shown that US market movements, particularly the S&P 500, have a significant predictive power for market returns in the Asia-Pacific region, underscoring the dominant role of the US as a source of global financial sentiment (Eun & Shim, 1989; Yang, 2005).

2.2. The technology sector as a unique driver of synchronization

While broad market indices provide a general picture of integration, sector-level analyses reveal that the technology industry acts as a particularly potent channel for global spillovers. Unlike traditional industries, the technology sector is characterized by globally integrated supply chains, borderless product markets, and a high degree of cross-border investment and knowledge sharing (Kose, Otrok, & Prasad, 2012; Di Giovanni & Levchenko, 2010). The dot-com bubble and its collapse in 2000-2001 served as a stark early example of "tech contagion," where sentiment shifts in the US NASDAQ had a dramatic and rapid impact on technology stocks and broader indices worldwide (Brooks & Del Negro, 2004; Ofek & Richardson, 2003).

More recent research has reinforced this view. Phillips and Sertsios (2013) found that technology firms exhibit higher international co-movement in their stock returns compared to non-technology firms. This is often attributed to a common "tech factor" that captures global sentiment toward innovation, growth prospects, and disruptive technologies (Aït-Sahalia, Cacho-Diaz, & Laeven, 2015). The outsized influence of a small number of mega-cap technology firms (e.g., FAANG stocks) has further concentrated this effect, with their performance now driving a significant portion of the variance in global equity indices (Barroso & Maio, 2019; Geman & Gyz, 2021).

The transmission of shocks from the US technology sector to international markets has been a specific focus. Using VAR models, researchers have shown that US technology shocks have significant and persistent effects on both the real economy and financial markets of other countries, including those in the Asia-Pacific (Kim, 2015; Mumtaz & Theodoridis, 2017). The integration is particularly deep within the APEC region due to its central role in the technology supply chain. From semiconductor fabrication in Taiwan and South Korea to assembly in China and Vietnam, the region is highly exposed to the global tech cycle (Baldwin, 2016; Athukorala, 2011). This deep economic linkage provides a strong fundamental basis for the synchronization of their equity markets with the global technology index.

2.3. Methodological limitations and the advance of quantile-based models

A significant limitation of most of the studies is their reliance on methods that model the conditional mean of the data. Techniques such as correlation analysis, OLS, VAR, and standard GARCH models are designed to capture the "average" relationship between variables. However, a large body of literature has shown that financial asset returns are not normally distributed and exhibit characteristics such as skewness, excess kurtosis, and, crucially, asymmetric dependence (Ang & Chen, 2002; Patton, 2006). This means that the relationship between markets can change dramatically depending on whether they are experiencing a downturn, a period of stability, or a rally. Hong, Tu, and Zhou (2007) demonstrated that accounting for these asymmetries is critical for both statistical modeling and economic decision-making.

Quantile Regression (QR), pioneered by Koenker and Bassett (1978), provides a powerful solution to this limitation. Instead of modeling the conditional mean, QR allows for the estimation of the relationship at any given quantile of the dependent variable's distribution. This has made it an invaluable tool in finance for understanding how the determinants of stock returns vary across different market states (Barnes & Hughes, 2002; Baur, 2013). For example, Ciner (2011) used QR to show that the relationship between stock returns and inflation is not uniform but varies significantly between bearish and bullish market conditions. Similarly, Mensi et al. (2014) applied a quantile-based approach to demonstrate that the spillovers between oil and stock markets are much stronger in extreme (both positive and negative) market conditions.

While QR offers a significant improvement by allowing the effect of an independent variable to vary across the distribution of the dependent variable, it still assumes that the impact of the independent variable itself is constant. That is, it does not account for the state of the explanatory variable. To overcome this final limitation, Sim and Zhou (2015) developed the Quantile-on-Quantile Regression (QQR) framework. This methodology estimates the effect of the τ-th quantile of an independent variable on the θ-th quantile of a dependent variable, thereby allowing for a full mapping of the relationship across the entire distributions of both variables.

The QQR approach has been rapidly adopted in various fields to analyze complex, state-dependent relationships. It has been used to examine the asymmetric effects of oil prices on economic growth (Al-hajj, Al-Malki, & Al-Garni, 2018), the link between economic policy uncertainty and stock returns (Sharif, Aloui, & Jammazi, 2017), and the dynamic relationship between cryptocurrencies and other financial assets (Bouri, Lau, & Roubaud, 2019). Its application in studying equity market co-movement is particularly promising, as it can capture the nuances of how a bear market in one region affects a bull or bear market in another (Shahzad et al., 2017). While foundational studies have established the importance of market integration, recent literature has begun to explore the specific role of technology and digitalization. For example, Wu et al. (2024) and Serkbayeva et al. (2024) investigated the impact of fintech adoption on market efficiency in Asia, finding that it accelerated information transmission. Similarly, B. Wu and Wang (2025) and Aslam et al. (2020) used a network model to show that technology stocks have increasingly become central nodes in global financial contagion, particularly after 2020 (Yonghui & Wenlong, 2025). Our study builds directly on these recent insights by employing the QQR methodology to provide a more granular, state-dependent perspective. Unlike the studies, our approach allows us to quantify how the influence of the technology sector changes under different market conditions (e.g., bear vs. bull markets), a gap in the current literature. This allows us to construct a complete 3D surface of the relationship, revealing how the synchronization between technology and APEC markets shifts across all possible market conditions and providing a far more comprehensive and practically relevant understanding of financial integration in the 21st century.

3. Research Methodology

This section outlines the empirical framework adopted to investigate the dynamic and state-dependent relationship between the global technology sector and the equity markets of APEC economies. We begin by describing the data and variables used in the analysis. Subsequently, we detail the econometric methodology, providing a rationale for the selection of the Quantile-on-Quantile Regression (QQR) approach and presenting its underlying mathematical formulation. While the Quantile-on-Quantile Regression (QQR) methodology provides a granular analysis of state-dependent market relationships, we acknowledge its inherent limitations. First, the robustness of the QQR estimates can be sensitive to the choice of the bandwidth parameter used in the non-parametric kernel estimation. Although we employed a standard data-driven approach for bandwidth selection to ensure objectivity, it is important to recognize that alternative specifications could yield slightly different results. our study spans a diverse set of APEC economies, which introduces potential heterogeneity in data quality, market liquidity, and trading protocols. Such structural differences could subtly influence the estimated quantile dependencies. Finally, the QQR framework is fundamentally a bivariate approach. While it offers deep insights into the relationship between pairs of markets, extending it to a multivariate context to control for multiple sources of influence simultaneously remains a complex challenge. These considerations should be borne in mind when interpreting the findings and offer avenues for future research.

3.1. Data and variables

The dataset employed in this study consists of daily closing prices for the major equity market indices of 19 APEC member economies, along with a benchmark global technology index. The sample period, from May 1, 2015, to September 12, 2024, was deliberately chosen to encompass a period of significant structural shifts and economic shocks relevant to technology and equity markets. This timeframe captures critical events, including the escalation of US-China trade tensions, the full economic cycle of the COVID-19 pandemic, Russia Russia-Ukraine War, major global monetary policy shifts, and the rapid acceleration of fintech adoption, thus providing a rich and relevant dataset for examining contemporary market dynamics.

The dependent variables are the national stock market indices for Australia, Canada, Chile, China, Hong Kong, Indonesia, Japan, South Korea, Malaysia, Mexico, New Zealand, Peru, the Philippines, Russia, Singapore, Taiwan, Thailand, the United States, and Vietnam. The primary independent variable, representing the global technology sector, is a broad-based Technology Index. All price series were sourced from a reputable financial data provider to ensure accuracy and consistency.

To analyze the dynamic relationships, the daily price series were transformed into continuously compounded percentage returns. This was achieved by taking the first difference of the natural logarithm of the price indices, as shown in Equation (1):

$$r_t = 100 \times [1\mathrm{n}(\mathrm{P_t}) - 1\mathrm{n}((\mathrm{P_{t-1}})] \quad (1)$$

Where r_t is the log return at time t, and $(\mathrm{P_t})$ is the closing price of the index at time t. $(\mathrm{P_t})$ is the closing price of the index at time $\mathrm{t}-1$. This transformation is standard in financial econometrics as it ensures the stationarity of the time series, a prerequisite for robust regression analysis, and the resulting coefficients can be interpreted as elasticities (Campbell, Lo, & MacKinlay, 1997).

3.2. Econometric framework: quantile-on-quantile regression (QQR)

To capture the full spectrum of the relationship between the technology sector and APEC equity markets under varying market conditions, this study moves beyond conventional methods that focus on the conditional mean (e.g., OLS, VAR). Such models can mask significant asymmetries and non-linearities inherent in financial markets (Ang & Chen, 2002; Baur, 2013). The limitations of mean-based regressions have led to the widespread adoption of Quantile Regression (QR), which allows the examination of relationships at different points of the conditional distribution of the dependent variable.

3.2.1. The QQR model

The QQR model can be viewed as a non-parametric extension of the QR model. We begin by considering a non-parametric QR specification where the conditional quantile of $\mathrm{y_t}$ is a function of x_t

$$\mathrm{y_t} = \beta_\theta(x_\mathrm{t}) + u_\mathrm{t}^\theta \quad (2)$$

Here, β_θ is an unknown function, and $\mathrm{Q_t}(x_\mathrm{t})$ = 0. The QQR approach localizes this relationship by relating the function $\beta_\theta(x_\mathrm{t})$to the specific quantile of the technology index, $\beta_\theta(x_\mathrm{t})$. Sim and Zhou (2015) approximate the unknown function $\beta_\theta(x_\mathrm{t})$using a first-order Taylor expansion around the point x_t = $\mathrm{Q_t}(x_\mathrm{t})$, resulting in the following specification:

$$\mathrm{Q}_\theta(\mathrm{y_t}|x_\mathrm{t}) \approx \beta_0(\theta,\tau) + \beta_1(\theta,\tau)(x_\mathrm{t} - \mathrm{Q_t}(x_\mathrm{t})) \quad (3)$$

In this framework, the coefficients $\beta_0(\theta,\tau)$ and $\beta_1(\theta,\tau)$ vary across both the quantiles of the dependent variable (θ) and the quantiles of the independent variable (τ). The coefficient of primary interest is $\beta_1(\theta,\tau)$, which represents the marginal effect of the τ-th quantile of the technology index returns on the θ-th quantile of a specific APEC country's equity market returns. It captures the local, state-dependent measure of synchronization. For instance, β_1 0.1, 0.9) would be interpreted as the effect of a highly bullish technology market on a deeply bearish local market.

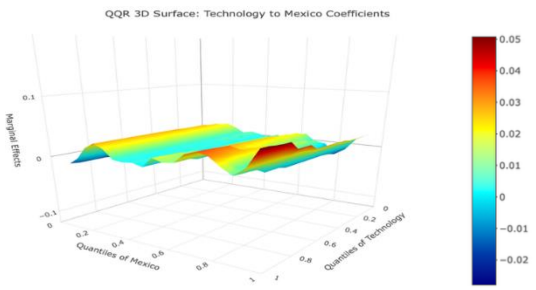
The estimation of $\beta_0(\theta,\tau)$) and $\beta_1(\theta,\tau)$ is conducted via a local linear regression approach. Specifically, for a given (θ, τ) pair, the coefficients are estimated by minimizing the following objective function with respect to β_0 and β_1

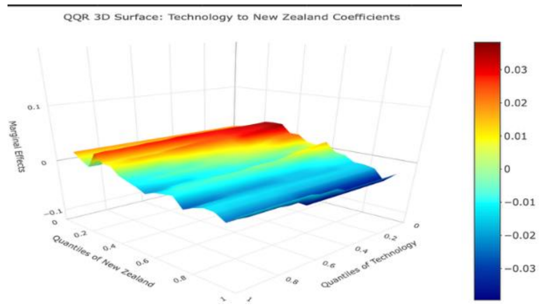
$$\frac{\min}{\beta_0,\beta_1}\sum_{t-1}^{T}\rho_\theta(\mathrm{y_t} - \beta_0 - \beta_1(\hat{x}_\mathrm{t} - \hat{x}_\tau))\mathrm{K}\left(\frac{\hat{x}_\mathrm{t}-\hat{x}_\tau}{\mathrm{h}}\right) \quad (4)$$

Where:

- $\rho_\theta(\mathrm{u}) = \mathrm{u}(\theta - \mathrm{I}(\mathrm{u}<0))$ is the standard quantile loss function, with I(·) being the indicator function.
- $\hat{x}_\mathrm{t}$ is the empirical estimate of the technology index return.
- $\hat{x}_\tau$ is the τ-th empirical quantile of the technology index returns.
- K(·) is a kernel function, for which we use the standard Gaussian kernel to assign weights to observations. Observations of $\hat{x}_\mathrm{t}$ closer to the specific quantile $\hat{x}_\tau$ are given more weight.
- h is the bandwidth parameter, which controls the size of the local neighbourhood around $\hat{x}_\tau$ used for estimation. The selection of an optimal bandwidth is crucial for balancing the bias-variance trade-off, and we follow established practices for its selection (Sim & Zhou, 2015).

By repeating this estimation for a grid of quantiles for both θ and τ (in this study, 19 quantiles from 0.05 to 0.95 in increments of 0.05), we can generate a three-dimensional surface of coefficients. This surface provides a complete and intuitive visualization of how the relationship between technology and equity markets evolves across all market states, thereby offering a far richer narrative than what is possible with traditional econometric models.


QQR 3D Surface: Technology to Mexico Coefficients
Marginal Effects
Quantiles of Mexico
Quantiles of Technology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Marginal Effects
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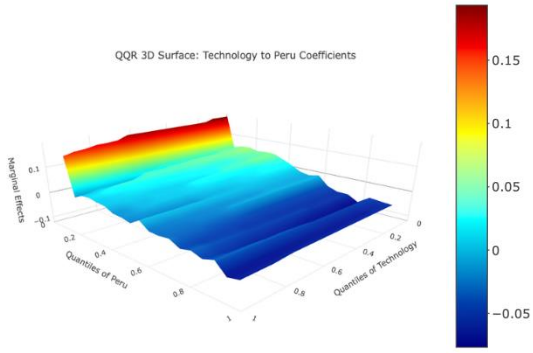
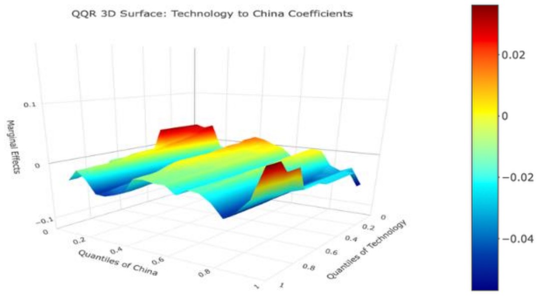

QQR 3D Surface: Technology to Peru Coefficients
Marginal Effects
Quantiles of Peru
Quantiles of Technology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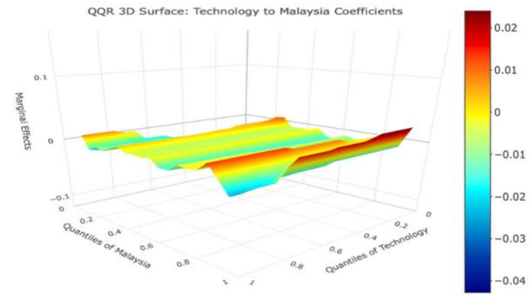
QQR 3D Surface: Technology to Malaysia Coefficients
Marginal Effects
Quantiles of Malaysia
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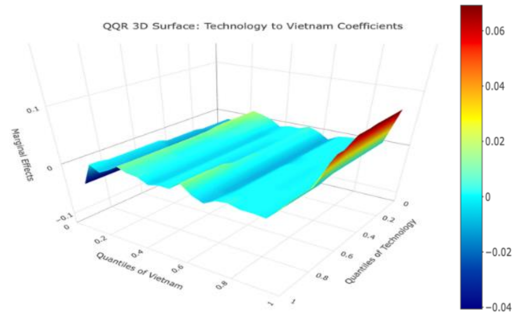
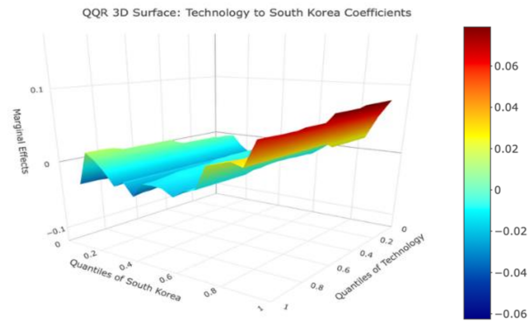
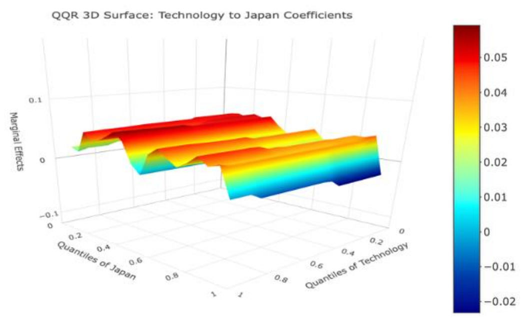
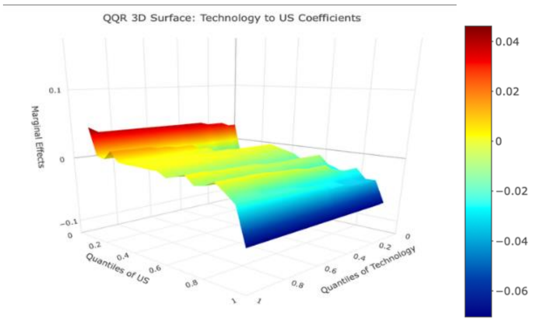
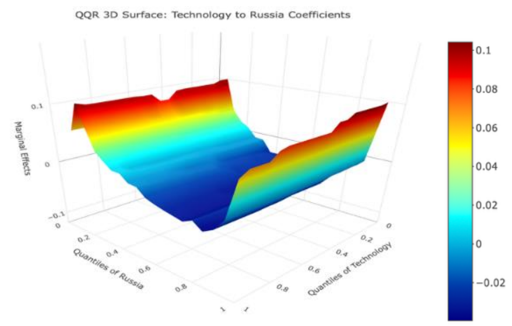

QQR 3D Surface: Technology to Vietnam Coefficients
Marginal Effects
Quantiles of Vietnam
Quantiles of Technology


QQR 3D Surface: Technology to South Korea Coefficients
Marginal Effects
Quantiles of South Korea
Quantiles of Technology


QQR 3D Surface: Technology to Japan Coefficients
Marginal Effects
Quantiles of Japan
Quantiles of Technology


QQR 3D Surface: Technology to US Coefficients
Marginal Effects
Quantiles of US
Quantiles of Technology


QQR 3D Surface: Technology to Russia Coefficients
Marginal Effects
Quantiles of Russia
Quantiles of Technology

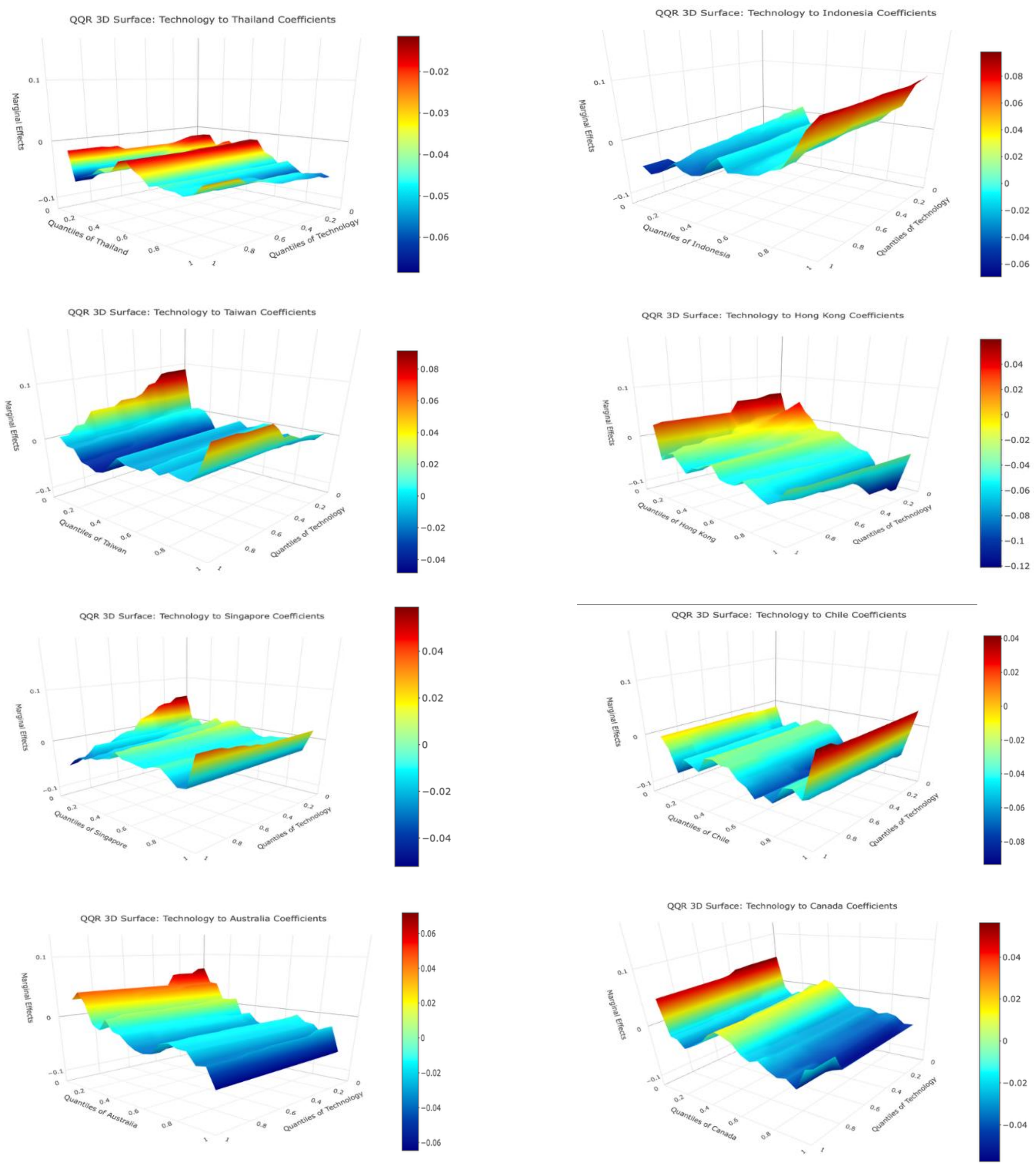


Fig. 1: Quantile-on-Quantile Dependency between Technology Index and APEC Equity Market Returns.

4. Results and Analysis

4.1. Analysis of quantile-on-quantile regression

This section presents a detailed analysis of the relationship between the technology index and the equity markets of various APEC economies using the Quantile-on-Quantile Regression (QQR) methodology. The QQR approach offers a comprehensive framework by estimating the impact of the τ-th quantile of the technology index on the θ-th quantile of each APEC member's equity market returns. This allows for an examination of the relationship under varying market conditions, from bearish (low quantiles) to bullish (high quantiles).

The results are visualized through 3D surface plots where the x-axis and y-axis represent the quantiles of the technology index and the respective country's equity market, ranging from 0.05 to 0.95. The z-axis, represented by both height and a color spectrum, illustrates the QQR coefficient ($\beta(\theta, \tau)$), which quantifies the marginal effect. Warmer colors (reds and yellows) indicate a strong positive relationship (high synchronization), while cooler colors (blues and greens) denote a weak or negative relationship (decoupling or contagion).

4.1.1. Developed economies

This group generally exhibits a high degree of integration with the global technology sector, though with distinct national characteristics. The relationship between the US equity market and the technology index is consistently positive and becomes exceptionally strong when the US market is in a bullish state. The coefficient is positive across nearly all quantiles. For instance, when both markets are in a median state (τ=0.5, θ=0.5), the coefficient is a moderate 0.0005. However, this effect intensifies dramatically in bullish conditions. With the technology index at the 0.95 quantile, its effect on the US market at the 0.95 quantile yields a powerful coefficient of 0.0461. This indicates that positive shocks in the technology sector have a pronounced, amplifying effect on an already booming US market, highlighting the sector's role as a key driver of market highs. The Japanese market displays a complex, wave-like dependence on the technology index. A strong positive effect is evident during bearish market conditions. For example, at the lowest quantiles (τ=0.05, θ=0.05), the coefficient is a high 0.0547. This suggests that in a risk-off environment, the Japanese market is closely tethered to the performance of the technology sector. This positive relationship re-emerges, albeit slightly weaker, during bullish phases, with a coefficient of 0.0495 at the highest quantiles (τ=0.95, θ=0.95). Interestingly, the connection weakens considerably in the middle quantiles, suggesting a partial decoupling when markets are stable. The Australian market shows a highly state-dependent relationship. The strongest positive synchronization occurs when the market is in a bearish or recovering phase. At the lowest quantiles (τ=0.05, θ=0.05), the coefficient is a strong 0.0718. This positive effect persists through the lower-to-mid quantiles of the Australian market. Strikingly, the relationship inverts in bullish market conditions. When both markets are at their highest quantiles (τ=0.95, θ=0.95), the coefficient is -0.0646. This suggests that during strong bull runs, the Australian market, heavily influenced by commodities, decouples from and may even move opposite to the technology sector. The linkage for Canada is positive across most states but shows a clear pattern: the influence of technology is strongest when the Canadian market is bearish and weakest when it is bullish. The coefficient starts at a robust 0.0563 at the lowest quantile of the Canadian market (θ=0.05) and gradually decreases as the market's performance improves, dipping to -0.0109 in the upper quantiles (θ=0.95, τ=0.95). This indicates that the technology sector is a more critical source of influence for the Canadian market during downturns than during periods of strong performance.

4.1.2. East Asian economies

This cluster, known for its significant role in technology and finance, shows strong but varied linkages. The South Korean market, a global technology powerhouse, exhibits a strong and increasingly positive relationship with the technology index as market conditions improve. While the linkage is negative in deep bear markets (coefficient of -0.0625 at τ=0.05, θ=0.05), it turns positive and strengthens significantly, peaking at a coefficient of 0.0789 in a high-quantile environment (τ=0.95, θ=0.95). This "J-curve" effect suggests that while global tech downturns can disproportionately harm the Korean market, it benefits immensely from tech-driven rallies. As a critical node in the global technology supply chain, Taiwan's equity market shows an exceptionally strong and positive correlation with the technology index, particularly during bullish phases. The coefficients are positive across most quantiles, reaching a remarkable peak of 0.0914 at the lowest quantiles (τ=0.05, θ=0.05) and remaining high, for instance at 0.0589 in the middle quantiles. This underscores a deep, structural integration where the fate of the Taiwanese stock market is intrinsically linked to the global technology cycle under almost all conditions. The financial hub of Hong Kong presents a highly volatile and asymmetric relationship. The effect of technology is strongly positive when the Hong Kong market is in a bearish state, with a coefficient of 0.0597 at the lowest quantile (θ=0.05). However, this influence quickly diminishes and turns negative as the market moves into higher quantiles. In a state of extreme bullishness for both markets (τ=0.95, θ=0.95), the coefficient is a deeply negative -0.121. This suggests that while technology can offer support during downturns, the drivers of Hong Kong's bull markets are largely independent of, and potentially contrary to, the technology sector. Singapore's equity market exhibits a clear trend of increasing synchronization as the technology sector's performance improves. The relationship begins as negative during bearish tech phases (coefficient of -0.0521 at τ=0.95, θ=0.05) but becomes strongly positive during tech-driven bull markets, reaching a coefficient of 0.0589 at the highest tech quantile (τ=0.05, θ=0.95). This indicates that Singapore is a significant beneficiary of positive global technology trends, especially when its own market is performing well.

4.1.3. Emerging APEC economies

The emerging markets within APEC show a more heterogeneous and often weaker linkage, reflecting their diverse economic structures. China's relationship is distinctly asymmetric. There is a moderate positive linkage in lower-to-mid quantiles, but this turns negative when the technology sector is bullish and the Chinese market is bearish (coefficient of -0.0477 at τ=0.95, θ=0.25). A strong positive comovement only appears when both markets are in a bullish state (e.g., a coefficient of 0.0362 at τ=0.95, θ=0.95). This complex pattern may reflect the influence of domestic policies and the unique structure of China's state-influenced market. The Indonesian market displays a strengthening positive relationship with the technology index as market conditions for both improve. Starting from a negative coefficient of -0.0694 in bear markets (τ=0.05, θ=0.05), the connection becomes progressively positive, reaching a peak of 0.098 at the highest quantiles (τ=0.05, θ=0.95). This suggests that Indonesia is increasingly integrated into the global tech-driven economy, particularly benefiting during global risk-on periods. The Malaysian market shows a generally weak and often negative correlation. The coefficients are predominantly negative across most market states, such as -0.0264 at the lowest quantiles. The relationship only turns weakly positive in very specific, mixed-quantile scenarios. This indicates a significant decoupling of the Malaysian equity market, likely due to its strong reliance on other sectors like commodities and manufacturing. The Philippines shows a strong positive linkage that is most pronounced at the quantiles' extremes. The effect is positive during normal market conditions but intensifies significantly when both markets are bullish, with a coefficient of 0.0891 (at τ=0.05, θ=0.95). Conversely, the relationship becomes strongly negative during bear markets, with a coefficient of -0.0927 (at τ=0.95, θ=0.1). This indicates high sensitivity to global technology trends, amplifying both gains and losses. The Thai market demonstrates a predominantly negative relationship with the technology index, suggesting a significant disconnect. The coefficients are negative across almost the entire surface, reaching as low as -0.0685 (at τ=0.95, θ=0.1). This implies that the drivers of the Thai equity market are largely independent of the global technology cycle, and in many cases, move in the opposite direction. Vietnam shows an intriguing pattern where the technology index has a negative impact during bearish and normal conditions but turns strongly positive when its market is bullish. For instance, the coefficient is -0.0406 at lower quantiles but rises to 0.0692 at the highest quantile of the Vietnamese market (θ=0.95). This suggests that while generally insulated, Vietnam's market becomes highly receptive to positive technology sentiment during strong domestic bull runs.

4.1.4. Other APEC economies

The Chilean market exhibits a mostly negative and weak correlation with the technology index. The coefficients are negative across a vast majority of the quantiles, reaching lows of -0.0935 (at τ=0.05, θ=0.65). A pocket of positive correlation only appears in the upper right quadrant of the plot, but remains weak. This points to a strong decoupling, likely due to Chile's commodity-exporting economic structure. Mexico's equity market shows a moderately positive relationship that is strongest during normal-to-bullish market conditions. The coefficients are positive across most of the distribution, peaking at 0.0297 (at τ=0.95, θ=0.7). This suggests a stable and beneficial, though not exceptionally strong, linkage to the global technology cycle. The Peruvian market displays a very strong positive correlation, especially when its own market is in a bearish or recovering state. The coefficient is an exceptionally high 0.193 at the lowest quantile (θ=0.05) and remains elevated across the lower half of the market distribution. This indicates that, like other commodity-driven economies like Australia, global risk sentiment channeled through the technology sector has a powerful impact on Peru, particularly during periods of market stress. The Russian market's relationship with the technology index is robustly positive across all quantiles, and it is remarkably strong during downturns. The coefficient reaches a peak of 0.104 when both markets are in their lowest quantiles (τ=0.05, θ=0.1). While the linkage remains positive throughout, its strength diminishes slightly as markets become more bullish. This suggests that the technology index acts as a significant bellwether for the Russian market, especially in risk-off scenarios. The New Zealand market shows a moderately positive but waning relationship as market conditions improve. The strongest positive effect, with a coefficient of 0.0383, is observed when the market is in its middle quantiles. The effect weakens in both extreme bearish and extreme bullish conditions, suggesting that the market is most sensitive to technology news during periods of normal performance.

5. Conclusion

This study set out to investigate the intricate relationship between technology and equity market synchronization across the diverse economies of the APEC region. By employing a Quantile-on-Quantile Regression approach, we have moved beyond traditional linear models to reveal a rich, state-dependent landscape of financial interconnectedness. The application of the Quantile-on-Quantile Regression (QQR) methodology to APEC equity market indices has yielded several key findings that illuminate the complex, state-dependent relationship between technology and equity market synchronization. The study's primary finding is the rejection of a single, uniform relationship between the technology sector and APEC equity markets. The linkage is profoundly heterogeneous across countries and asymmetric across market conditions. For instance, while the United States exhibits a consistently positive relationship that strengthens in bull markets, Thailand shows a predominantly negative correlation, suggesting a structural decoupling. Furthermore, economies like Hong Kong display strong asymmetry, with technology shocks providing a positive influence during market downturns (a coefficient of 0.0597 at the lowest quantiles) but a significant negative influence during market booms (a coefficient of -0.121 at the highest quantiles).
Developed and Tech-Centric Economies (e.g., US, Japan, Taiwan, South Korea) generally show strong positive co-movement with the technology index, particularly in bullish (high-quantile) market regimes. This suggests that their equity markets are deeply integrated with global technology-driven growth and risk sentiment. Commodity-exporting and Industrializing Economies (e.g., Australia, Peru, Chile, Russia) often exhibit their strongest positive linkage during bearish (low-quantile) market conditions. This indicates that the global technology index may serve as a proxy for global risk appetite, which has a pronounced impact on these markets when they are under stress. However, many of these economies show a weakening relationship or even a negative correlation during bull markets, suggesting a diversification of growth drivers away from technology. For a significant subset of economies, including the United States, South Korea, and the Philippines, the synchronization with the technology sector is strongest when both markets are in a bullish phase. The QQR coefficients are at their peak in the upper-right quadrant of the surface plots (e.g., 0.0891 for the Philippines). This indicates that in a global "risk-on" environment fueled by technological optimism, these markets experience an amplified positive effect. Conversely, for another group of countries, including Peru, Russia, and Australia, the technology index has its most significant positive influence during market downturns. Peru, for example, shows an exceptionally high coefficient of 0.193 at the lowest quantiles, the strongest observed in this study. This suggests that during periods of market stress, positive sentiment from the global technology sector can act as a stabilizing force or a leading indicator for recovery in these markets. The analysis confirms that several APEC economies remain largely insulated from or even move counter to the global technology cycle. Thailand is the most prominent example, with consistently negative coefficients across nearly all quantiles. To a lesser extent, Chile and Malaysia also exhibit weak or negative correlations, indicating that their market dynamics are driven by other, more dominant local or sectoral factors (e.g., commodity prices, domestic policy).
The findings conclusively demonstrate that the impact of the technology sector on Asia-Pacific equity markets is not monolithic but is instead contingent on the specific market conditions of both the technology index and the individual national market. We found that developed, tech-oriented economies like the United States and Taiwan are deeply and positively integrated with the global technology cycle. In contrast, many emerging and commodity-driven economies exhibit a more complex relationship, often showing stronger synchronization during market downturns and decoupling during booms. This highlights the dual role of the technology sector as both a driver of growth during risk-on periods and a barometer of global risk sentiment during periods of stress.

5.1. Implications of the study

The results carry significant implications for international portfolio diversification. The assumption of static correlations is challenged by our findings of state-dependent linkages. For example, diversification benefits from investing in markets like Australia or Chile may be most pronounced during a global tech-driven bull market, as these markets tend to decouple. Conversely, during global downturns led by the tech sector, correlations with markets like Peru and Russia may increase, reducing diversification benefits when they are most needed. The evidence of strong synchronization, particularly in economies like South Korea and the Philippines, underscores the potential for contagion from global technology shocks. Financial regulators in these nations must remain vigilant to spillovers from international tech market volatility. For economies that show significant decoupling, such as Thailand, policymakers may have greater autonomy in setting monetary and fiscal policy without immediate concern for spillovers from the global tech sector. APEC financial regulators develop enhanced surveillance systems specifically focused on the technology sector, given its potential to drive market-wide volatility.

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