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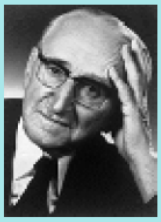



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The BRI: Trade Integration and Stock Market Synchronization: A Review of Empirical Findings

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Abstract
In the context of the Belt and Road Initiative (BRI), we review selected studies that explicitly or implicitly address the question of whether there occurs synchronization of stock markets between China and the BRI economies. Following this, we examine the extent to which this synchronization of stock markets may be driven by bilateral trade. This question is of particular interest to investors who wish to profit from the BRI while minimizing their risk through portfolio diversification. Our results show that there is plenty of supporting evidence that the stock markets of China and the BRI economies are synchronized, and that synchronization appears to be increasing since the launch of the BRI. We also find that bilateral trade is an important determinant for explaining stock market integration between China and the BRI countries. Based on these results, interregional diversification appears to be less efficient. Further research is needed to determine whether other forms of diversification, such as inter-industry diversification, would be more beneficial.

Keywords: BRI, Belt and Road Initiative, Belt and Road Countries, China, Stock Market Synchronization, Stock Market Co-Movement, Stock Market Integration, Trade Integration, Trade Volume, Bilateral Trade, Portfolio Diversification, Investing

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The BRI: Trade Integration and Stock Market Synchronization:

A Review of Empirical Findings

Introduction

The President of China and General Secretary of the Chinese Communist Party (CCP) Xi Jinping first publicly announced the Belt and Road Initiative (BRI) in September 2013. Since its launch, the BRI has sparked interest in bilateral and multilateral economic and trade agreements, followed by a wave of investments (Chitpattanapaibul & Wu, 2019). This initiative has been described as a "call for an open and inclusive (mutually beneficial) model of cooperative economic, political, and cultural exchange" (Liu & Dunford, 2016, p. 323).

By now, the BRI has already led to a significant increase in cross-border trade volumes across participating countries in Asia. Yu et al. (2020, p. 1) find according to their index that bilateral trade "[b]etween China and the Belt-Road countries has grown approximately 8% faster than has that with the non-Belt-Road countries". Thus, the initiative has been affecting trade and has most likely contributed to further economic integration. According to Zhai (2018, p. 85), by 2030 global trade is to "[b]e boosted by the BRI, with an expansion of 5.6% in 2030 in comparison" to a scenario without BRI investments.

We suppose that such an episode of immense economic integration is very likely to be accompanied by, or even evokes, changes in financial markets. Obviously, the question of such changes in the stock markets is of particular interest to investors, especially to those who want to profit from the developments surrounding the BRI. Since it is not yet clear which economies and equity markets will benefit most from these developments, investors may want to spread their investments and diversify their portfolios by choosing to invest in several, if not all, of these equity markets. This strategy of portfolio diversification is commonly used by investors to minimize potential risk. However, such a risk minimization strategy only works if the markets move independently of each other to a certain extent.

In this paper, we review selected studies that explicitly or implicitly address the question of whether the stock markets between China and BRI economies do synchronize. Following this, In the second part of this paper, we introduce the concept of stock market synchronization, explain why it might be relevant for investors, and provide an overview of selected studies and their empirical results on the above question. In section three, we further examine the extent to which this synchronization of stock markets may be due to bilateral trade. We first discuss theoretical considerations on such a relationship and thereafter review empirical findings. In

the final section four, we make some concluding remarks, discuss implications for investors, and briefly give some avenues for further research.

In a nutshell, there are numerous studies supporting the hypothesis that the stock markets of China and the BRI countries are synchronized, which implies that interregional diversification seems to be less efficient in terms of risk aversion. Further, a couple of studies provide evidence that bilateral trade is an important factor in explaining stock market synchronization.

Stock Market Synchronization among China and BRI Economies

Stock market synchronization (or stock market co-movement) refers to situations where different stock markets rise or fall at the same time (Huang et al., 2019).[1] From an investor's perspective, the degree of stock market co-movements matters for optimal portfolio decisions and, thus, for the optimal degree of inter-regional portfolio diversification.

Referring to Grubel (1968), the benefits of international portfolio diversification on risk has been pointed out in the light of correlations between different stock markets. Investors can lower their portfolio risk as they invest in uncorrelated stock markets. In statistical terms, this means that "the variance of a diversified portfolio is smaller the smaller the correlations of returns" (Grubel, 1968, pp. 1301-1302). In case of co-moving or correlated stock markets (which means that stock markets show a high degree of co-movement on the same day (or week or month); Bracker et al., 1999), the benefits of portfolio diversification vanish. In fully synchronized stock markets, the portfolio variance of investing in one market equals the variance of investing in several markets. This would imply that diversification among several markets loses its benefits since portfolio risk reduction will not take place. Based on these theoretical considerations, the degree of market synchronization affects the portfolio decisions of investors. Thus, it is not surprising that there is plenty of research on the co-movement of international stock prices (Levy & Sarnat, 1970; Solnik, 1974; Karolyi & Stulz, 1996; Bracker et al., 1999; Forbes & Rigobon, 2002; Brooks & Del Negro, 2004; see Raju & Pavto (2019) for a review), in recent times also with focus on Asia or economies along the BRI. Given our focus of interest, we review studies published since 2010 that analyze the co-movements of the Chinese stock

[1] The term stock market synchronization is related but different to the term financial contagion. According to Forbes and Rigobon (2001, p. 44), financial contagion describes "a significant increase in cross-market linkages after a shock to an individual country (or group of countries)." Dungey et al. (2005, p. 10) define financial contagion as "contemporaneous transmission of local shocks to another country or market after conditioning on common factors that exist over a non-crises period". In comparison to the term financial contagion, we understand the term stock market synchronization in a broader sense. Stock market synchronization (or stock market co-movement) are not necessarily linked to an economic shock or an economic crisis. Stock market synchronization may also occur in 'normal' market times.

market with the stock markets of BRI economies or BRI-related economies.[2] We exclude studies that are related to the BRI but do not consider China (Kumar & Dhankar, 2017; Kolesnik et al., 2020; Chipattanapaibul & Wu, 2019).[3] Table 1 gives an overview.

Table 1: Stock Market Synchronization of BRI Countries

Study	Countries Included (#countries)	Time Period (#years)	Data Frequency	Method	Findings/Conclusions
Karim & Majid (2010)	Malaysia, China, USA, Japan, Singapore, Thailand (6)	1992 – 2008 (16)	weekly	ARDL and VAR	• Stock markets of Malaysia and major trading partners are integrated. • China's stock market is only significantly positively (negatively) correlated with Malaysian (US) stock market.
Chow et al. (2013)	China, Korea, Hong Kong, Taiwan, Singapore, USA (6)	1980 (1992) – 2011 (31)	weekly	Time-varying coefficients regression	• There is an increasing trend for the stock market dependence among Hong Kong, Thaiwan, South Korea, and Singapore. • Chinas shows an increasing dependence on other East Asian economies and USA.
Tiwari et al. (2013)	China, India, Japan, Malaysia, Hong Kong, Singapore, Korea, Indonesia, Taiwan (9)	2005 – 2012 (7)	daily	Wavelet correlations	• In the long run, Asian stock markets are nearly perfectly integrated. • Asian stock market dependencies are higher in the long-run than in the short-run.
Chien et al. (2015)	China, Malaysia, Singapore, Thailand, Indonesia, Philippines (6)	1992 – 2013 (15)	weekly	Cointegration tests with structural breaks and recursive cointegration	• Regional financial integration among China and the ASEAN-5 has been increasing but remains limited. • Among the East Asian economies studied, China and Indonesia are the main drivers economic and financial integration.
Nguyen & Elisabeta (2016)	China, Indonesia, Malaysia, Philippines, Thailand (5)	2004 – 2014 (11)	weekly	Wavelet correlations	• Stock market integration across China and ASEAN4 economies are at moderate level before and after the financial crisis and at a higher level during the financial crisis.

[2] As proxy for a country's stock market, scholars typically use the most representative stock index of the country. For example, in case of China, they use the Shanghai Composite index; in case of Russia, they use the Russian Trading System (RTS).

[3] For example, Kumar and Dhankar (2017) find a significant integration of the stock markets of India, Pakistan, Sri Lanka, and Bangladesh. Kolesnik et al. (2020) focus on the impact of the BRI on the Russian stock market. Chipattanapaibul & Wu (2019) focus on several countries that are related to the BRI (Italy, South Korea, Russia, and Indonesia), but exclude China.

Paramati et al. (2016)	Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Thailand (11)	1999 – 2013 (14)	weekly	Conditional correlations	• Due to the increasing economic integration, stock market correlations have increased and converge towards a long-run equilibrium.
Zhang et al. (2018)	China, India, Russia, Turkey (4)	2000 – 2017 (17)	daily	MF-X-DMA method	• In the mid-term and in the long-run, stock markets of the four economies studied are positively correlated. • The cross-correlations of China's and the other stock markets become more complex.
Caporale et al. (2019)	China, Hong Kong, India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand (12)	1998 – 2018 (20)	monthly	Panel and club convergence	• After the proposal of the BRI, the stock market linkage risk increased. • There exists a full panel convergence of stock markets (regionally and globally). • The results indicate a marginally faster regional convergence (in Asia) than global convergence (with the US). • Also, China is integrated with the full panel but also with a group of selected economies. • Three sectors out of ten (oil & gas, healthcare, and technology) do not contribute to full panel convergence, i.e. they hold stock market integration back. • After the financial crises, the speed of convergence has declined.
Huang et al. (2019)	11 BRI countries and 15 developed countries (26)	2007 – 2017 (11)	daily	Conditional Copula Model	• The probabilities of stock market co-movements are higher between the Chinese stock market and stock markets of BRI countries than co-movements of the Chinese stock market and the stock markets of developed markets.
Lu et al. (2019)	32 BRI countries (32)	2005 – 2016 (12)	daily	Metric of Volatility	• The stock markets of China and of BRI countries show bilateral linkages of volatility. • Due to the financial crisis, China's stock market exhibits a stronger contagion to the stock markets of BRI countries. • The stock markets of the BRI became sensitive to negative shocks from China.
Patel (2019)	China, India, US, Germany, Switzerland, Russia, Hong Kong, Saudi Arab, UAE (9)	2001 – 2018 (18)	daily	Correlations, unit root test, Granger causality, Johnsen cointegration test, generalized method of moments (GMM)	• After the financial crises, an increase in bilateral trade made the Indian stock market more integrated with the other stock markets. • There is a bidirectional causality between the Chinese and the Russian stock market index.

Burdekin & Tao (2021)	China, Australia (2)	2005 – 2017 (12)	weekly	Markov-switching dynamic regression (MSDR)	• In times of low volatility, China's stock market has a significant positive relationship with the Australian stock market. • In times of extreme volatility (such as booms and crashes), no positive relationship between the Chinese stock market and the Australian stock market can be found.
Manu et al. (2022)	China, India, Malaysia, Hong Kong, Singapore, South Korea, Taiwan, Japan, China (8)	2011 – 2018 (8)	daily	Multiple linear regressions, Johansen cointegration tests, VAR Granger causality	• All stock markets are positively correlated but only low or moderate in magnitude. • The Chinese stock market affects the stock markets of India, South Korea, and Singapore. • The stock markets of Hong Kong and Taiwan affects the stock market of China.
Saji (2022)	China, Japan, Singapore, South Korea, India (5)	1999 – 2019 (20)	monthly	Johansen cointegration and Vector Error Correction Model (VECM)	• There is a weak convergence among Asian stock markets. • The Chinese stock market affects the price changes of Indian and Singapore stock markets. • Stock markets of the other Asian economies do not influence the Chinese stock market prices.

Karim and Majid (2010) examine stock market co-movements between the Malaysian stock market and its main trading partners (China, USA, Japan, Singapore, and Thailand) in the period of 1992 and 2008 using weekly data. They find that the Malaysian stock market and the stock markets of China, USA, Japan, Singapore, and Thailand are integrated. However, China's stock market is only significantly positively (negatively) correlated with Malaysian (US) stock market, but uncorrelated to the stock markets of the remaining countries (Japan, Singapore, and Thailand). The authors suggest that intra-regional trade is one of the main drivers of a higher degree of stock market co-movements. *Chow et al. (2013)* focus on the stock market integration of several East Asian economies (China, Korea, Hong Kong, Taiwan, and Singapore) with the USA and among each other during 1980 and 2011 using weekly close prices of the stock market indices. The authors conclude that there is stock market dependence between South Korea, Hong Kong, Taiwan, and Singapore. When it comes to China, its stock market shows an increasing co-movement with the other East Asian economies and with the USA. Also, *Tiwari et al. (2013)* focus on stock market synchronization among Asian stock markets (China, India, Japan, Malaysia, Hong Kong, Singapore, Korea, Indonesia, and Taiwan) using daily data in the period of 2005 to 2012. Using different data frequencies, they conclude that “Asian stock markets are nearly perfects integrated in the long-run” (Tiwari et al.,

2013, p. 449), but less integrated when analyzing short-run frequencies.[4] *Nguyen and Elisabeta (2016)* examine the level of stock market integration between China and four ASEAN economies (Indonesia, Malaysia, Philippines, and Thailand) using weekly data in the period of 2004 to 2014. In short, they find that the stock markets of China and the ASEAN economies were moderately integrated before and after the financial crises. During the financial crises, they report a higher degree of stock market integration. *Paramati et al. (2016)* focus on stock market co-movements in the Australasian region (Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, and Thailand) between 1999 and 2013. Based on weekly stock market prices, they (Paramati et al., 2016, p. 4224) conclude that "the increasing economic integration in the region has contributed to the long-run equilibrium relationship of the stock markets and increased the stock market correlations". *Zhang et al. (2018)* analyze the interplay between the Chinese stock market the three stock markets of the Belt and Road Initiative (India, Russia, and Turkey) using daily data between 2000 and 2017. According to their results, all markets are positively related, but show a different degree of correlation for different time horizons. The correlations seem to be lower in the short-term than in the mid-term or long-term perspective.[5] Further, they (Zhang et al., 2018, p. 11) find that cross-correlations between China, India, Russia, and Turkey became more complex "and the linkage risk of these stock markets increases after 'The Belt and Road Initiative' was proposed". *Caporale et al. (2019)* analyze stock market integration of several Asian countries (China, Hong Kong, India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, and Thailand) between 1998 and 2018 based on monthly data. They found that Asian stock market show stock market convergence at the aggregate level but find at the industry level that convergence is mainly driven by seven out of ten industries.[6] In particular, the industries oil and gas, healthcare and technology hold back stock market co-movement at the aggregate level back. The speed of stock market convergence also decreased since the financial crisis in 2008. *Huang et al. (2019)* focus on the question whether China's stock market co-movement probability is larger with the stock markets of eleven BRI countries or fifteen developed countries using daily data between 2007

[4] Based on wavelet correlations, Tiwari et al. (2013) distinguish between short-term, medium-term, and long-term co-movements of Asian stock markets. In short, they find that co-movements are higher in the long run (which means applying monthly, quarterly, or biannually stock market data) that co-movements in the short run (which means applying intra-weekly, weekly, or fortnightly stock market data).

[5] Based on the MF-X-DMA method (multifractal detrended moving-average cross-correlation analysis), Zhang et al. (2018) find that stock markets are significantly correlated in the mid-term and long-term. They (2018) define mid-term as the window size of 30 to 250 days. If the window size is lower (larger) than 30 (250) days, they consider it to be short-term (long-term).

[6] Stock market synchronization is mainly driven by the industries 'basic materials', 'industrials', 'consumer goods', 'consumer services', 'telecommunications', 'utilities' and 'financials. The industries 'oil and gas', 'healthcare', and 'technology' do not influence stock market synchronization on the aggregate level.

and 2017.[7] In short, they (Huang et al., 2019, p. 3249) find that "extreme co-movements probabilities between Chinese market and B.R.I. markets are higher than developed markets at both tails". The authors further find that stock markets react asymmetric in this sense that there is a larger probability for a joint crash than for a joint boom. Also, *Lu et al. (2019)* deal with stock market co-movement between China and the economies along the BRI. In total, they include 32 BRI countries and analyze daily stock market data between 2005 and 2016. The results show that there are stock market linkages between the stock market of China and all the BRI economies. In greater detail, they (Lu et al., 2019, p. 3300) find that "the financial crises intensified the spillover effects", "a stronger contagion exhibited from China's market to B&R equity markets" and that "most of the B&R markets have become more sensitive to the negative signals released by China's market". *Patel (2019)* studies the Indian stock market and its co-movements with some BRI economies but also developed economies (China, India, US, Germany, Switzerland, Russia, Hong Kong, Saudi Arab, and UAE) during 2001 and 2018. Using daily stock market data, he (Patel, 2019, p. 106) shows that the "Indian stock market became closer and more integrated with all other markets after the financial crisis due to an increase in bilateral trade after the financial crisis". With respect to the BRI, he also states that the Indian stock market had bidirectional causality with Russian stock index and Chinese stock index. *Burdekin (2021)* analyzes stock market integration between China and Australia in the period of 2005 and 2017 using weekly stock market data. He concludes that stock market co-movement between China and Australia is positively significant when volatility is low but is not significant when stock market volatility is high (e.g., the financial crisis). *Manu et al. (2022)* focus on the co-movement of eight leading Asian stock markets (China, India, Malaysia, Hong Kong, Singapore, South Korea, Taiwan, and Japan) during 2011 and 2018. Applying daily stock market data, they (Manu et al., 2022, p. 190) find that "all the indices are positively correlated with each other, but the degree/magnitude of their correlation is either low or moderate". Regarding the Chinese stock market, they find that it affects the stock markets of India, South Korea, and Singapore and it is affected by the stock markets of Hong Kong and Taiwan. *Saji (2022)* uses monthly data to analyze stock market integration of five Asian economies (China, Japan, Singapore, South Korea, and India) in the period of 1999 to 2019. In short, the results show weak stock market convergence among the selected Asian economies. Further, he (Saji, 2022, p. 221) provides evidence that the "Chinese market is

[7] Huang et al. (2019) consider eleven BRI countries (India, Israel, Indonesia, Malaysia, Philippines, Russia, Singapore, South Africa, South Korea, Thailand, and Ukraine) and fifteen developed countries (Australia, Canada, France, Germany, Ireland, Israel, Italia, Japan, Netherlands, Singapore, South Korea, Spain, Sweden, United Kingdom, and United States). Note that three countries are part of the subset of BRI countries and of the subset of developed countries at the same time (Israel, Singapore, and South Korea).

significantly affecting price changes in Indian and Singapore stock markets" and that "none of the Asian stock markets can influence Chinese stock prices".

A variety of studies already dealt – directly or indirectly – with stock market co-movement between China and BRI countries. In general, the studies provide a strong tendency that stock markets of China and other BRI economies co-move (or are integrated) (Chow et al., 2013; Tiwari et al., 2013; Chien et al., 2015; Paramati et al., 2016; Zhang et al., 2018; Huang et al., 2019; Lu et al.,2019; Patel, 2019; Burdekin, 2021). Some studies name the relationship 'low' or 'moderate' (Manu et al., 2022; Saji, 2022), or 'fluctuating' or 'limited' (Nguyen & Elisabeta, 2016; Chien et al., 2015; Caporale et al., 2019). Karim and Majid (2010) find no evidence for stock market integration between China and BRI countries. Despite the strong evidence, one should be careful with drawing a conclusion. The reason is that the studies reviewed are different with respect to several aspects. We present these aspects in the following:

Number of countries. Although all studies reviewed contain Chinas stock market, the number of selected countries range from two (Burdekin, 2021) to 32 (Lu et al., 2019).

Regional scope. Studies are different with respect to their regional scope. Some studies focus on BRI countries (Zhang et al., 2018; Huang et al., 2019; Lu et al., 2019), whereas other studies focus on the Asian (Tiwari et al., 2013; Chien et al., 2013; Nguyen & Elisabeta, 2016; Caporale et al., 2019; Manu et al., 2022; Saji, 2022) or Australasian (Paramati et al., 2016; Burdekin, 2021) region. Some studies also include developed countries across the globe (Karim & Majid, 2010; Chow et al., 2013; Huang et al., 2019; Patel, 2019).

Explicitly referring to the BRI. Although all studies deal with China and economies related to the BRI, only three studies explicitly focus in their scope on the BRI (Zhang et al., 2018; Huang et al., 2019; Lu et al., 2019).

Time horizons. The results should also be interpreted in the light of the period of data. Since the BRI project was launched in 2013, studies that deal with data periods before 2013 do not reflect the impact of the BRI on stock market co-movement (for example, Karim & Majid, 2010). Since the time horizons of most studies included the period of financial crises, they mostly investigated the impact of the crisis on stock market co-movements (for example, Nguyen & Elisabeta, 2016; Lu et al., 2019).

Data frequencies. Although all studies use stock market data, the chosen data frequencies differ. Some studies use daily (Tiwari et al., 2013; Zhang et al.; 2018; Huang et al., 2019; Lu et al., 2019; Patel, 2019; Manu et al., 2022) data, whereas other apply weekly (Karim & Majid, 2010; Chow et al., 2013; Chien et al., 2015; Nguyen & Elisabeta, 2016; Paramati et al., 2016; Burdekin, 2021) or monthly (Caporale et al., 2019; Saji (2022) data. Which data frequency suits best, is a matter for discussion. Burdekin and Tao (2021, p. 3), for example, use weekly

data “to avoid overlapping and non-synchronicity problems associated with global financial markets not being open over the exact same trading hours”, but also note that “daily data may be more appropriate for assessing market efficiency and trading strategies”. Khalifa et al. (2014, p. 516) further recommend using weekly data (instead of daily data) to ensure “proper time for regime-switching to occur.” Interestingly, data frequencies also affect the results of stock market integration (Tiwari et al., 2013; Zhang et al., 2018). For example, Tiwari et al. (2013) find that stock market linkages among the Asian economies are stronger with lower data frequencies. This means that the likelihood of stock market co-movement is lower when analyzing daily data than the likelihood of observing stock market co-movements when using monthly or even biannual data. Zhang et al. (2018, p. 8) report similar results in their study noting that the stock markets of China, India, Russia, and Turkey “are significantly correlated in the mid-term […] and the long-term […], rather than in the short term”.

Industry levels. In addition to leading stock market indices, we find only one study that analyze stock market co-movements on the industry level. In short, Caporale et al. (2019) find that, out of ten industries, seven industries contributed to stock market integration and three industries (oil & gas, healthcare, and technology) hold back stock market integration.

Asymmetry. Some studies also investigate whether negative or positive news have a larger effect on stock market co-movements using, for example, asymmetric GARCH models (Chipattanapaibul & Wu, 2019). Lu et al. (2019, p. 3311) note that “most of B&R and China’s markets are sensitive to positive news” and that “B&R markets as risk absorbers exhibit significant sensitivities to the negative news from Chinese market during the [financial] crisis period”.

Causality. Some studies not only analyze correlations between stock markets but also analyze whether there are causal relations between different stock markets using Granger causality tests or similar methods (Chien et al, 2015; Patel, 2019; Manu et al., 2022; Saji, 2022). For example, with respect to the BRI, Patel (2019) states that the Indian stock market had bidirectional causality with Russian stock index and Chinese stock index. Manu et al. (2022) find that the Chinese stock market affects the stock markets of India, South Korea, and Singapore, but is affected by the stock markets of Hong Kong and Taiwan. As mentioned earlier, Saji (2022) finds that the Chinese stock market affects the Indian and Singaporean stock markets and is not affected by any of the Asian stock markets considered in his study. A potential argument for these findings is that China is the “dominant trade and investment partner for most of the Asian countries in the region” (Saji, 2022, p. 223).

Trade Integration and Stock Market Synchronization

Since the literature provides evidence for stock market synchronization among China and BRI countries, we now focus on the question as to what extend bilateral trade can explain co-varying stock markets. Generally, according to Dornbusch et al. (2000), factors that influence stock market co-movements can be separated into *fundamental-based* and *non-fundamental-based* factors. *Fundamental-based* factors refer to "spillovers resulting from the normal interdependence among market economies" (Dornbusch et al., 2000, p. 179). This means that shocks in one country – good or bad ones – will affect other countries due to their financial and real linkages (e.g. common shocks, trade links, or financial links; Huang et al., 2019). In contrast, *non-fundamental* factors refer to co-movements of stock markets that cannot be explained by fundamental factors. Typically, "irrational" changes in the behavior of investors (such as risk aversion, herd behavior, or loss of confidence) caused by news, market uncertainty, or economic policy are examples for non-fundamental factors that can lead to "irrational" volatile stock markets (Dornbusch et al., 2000; Huang et al., 2019). Although a variety of different factors exist that may explain stock market co-movements, we focus on bilateral trade as one important fundamental determinant of stock market synchronization among BRI economies.

From a theoretical point of view, bilateral trade among countries may have positive or negative effects on the degree of stock market synchronization. For example, Bracker et al. (1999, p. 15) note that "import and export dependence may exert divergent influences on how two stock markets interact". In short, Bracker et al. (1999) argue that higher export dependence should be positively related to stock market synchronization but import dependence may have either a positive or negative effect on the co-movements of stock markets.[8] Another argument is provided by Tavares (2009, p. 65), who note that trade integration "may lead to lower correlation of asset returns if, for instance, it is associated with higher sectoral specialization". In the same vein, Kose et al. (2003, p. 57) note that "if stronger trade linkages are associated with increased interindustry specialization across countries, and industry-specific shocks are important in driving business cycles, then international business-cycle comovement [and, thus, stock market synchronization] might be expected to decrease".[9] Although the effect of trade integration on stock market synchronization is not unambiguous from a theoretical perspective, there are several reasons to believe that stronger bilateral trade relations are associated with a higher likelihood of stock market co-movements – in general, but also for China and BRI economies in specific.

[8] See Bracker et al. (1999, pp. 18-19) for a detailed description of why export and import dependence may have different effects on stock market synchronization.

[9] See also Frankel and Rose (1998).

On a more general perspective, empirical studies provide evidence that bilateral trade contributes in explaining the contagion of currency crises (Eichengreen et al., 1996; Glick & Rose, 1999), the synchronization of business cycles (Bordo & Helbling, 2003; Kose et al., 2003), and output growth (Otto et al., 2001), and the co-movement of stock markets (Forbes & Chinn, 2004; Wälti, 2005).[10] When focusing on stock market synchronization, Forbes and Chinn (2004) analyze – among other scopes – cross-country correlations of the stock markets of France, Germany, Japan, United Kingdom, and the United States between 1985 and 2000. In short, they (Forbes & Chinn, 2004, p. 720) find that "bilateral trade flows appear to be the most important determinant of cross-country linkages in bond markets as well as stock markets". Wälti (2005) analyzes three fundamental determinants (trade intensity, financial integration, and the exchange rate regime) of stock market synchronization considering fifteen developed countries between 1973 and 1997. His (2005, p. 22) findings suggest "trade and financial integration contribute positively to stock market synchronization".[11] Fixed exchange rate regimes also foster stock market synchronization. In contrast to these results, only a few studies find mixed results (Bracker et al., 1999; Narayan et al., 2014) or even find that trade has no impact on stock market synchronization (Didier et al., 2012). For example, focusing on stock market co-movements of nine countries (Australia, Japan, Hong Kong, Singapore, Switzerland, Germany, United Kingdom, United States, and Canada) between 1972 and 1993, Bracker et al. (1999) analyze four measures of bilateral trade dependence (two measures import dependence and two measures of export dependence) controlling for a variety of macroeconomic factors. In short, they (1999, p. 22) note that the measures of "import dependence may tend to either increase or decrease the degree of co-movement across markets".[12] Similarly, Narayan et al. (2014) find diverging results regarding bilateral trade. For stock market correlations of four pairs of countries, they find a negative effect of trade. In case of one pair of countries, they find a positive effect of trade on stock market co-movement. Lastly, during the financial crises, Didier et al. (2012) conclude that bilateral trade had no impact on stock market co-movements.

[10] Bilateral trade does impact not only on stock market correlations but also on other form of contagion such as currency crises. For example, analyzing twenty industrial countries based on data between 1959 and 1993, Eichengreen et al. (1996, p. 35) conclude that "contagious currency crises tend to spread across countries mainly as a function of international trade links". In the same vein, Glick and Rose (1999) find that trade linkages are responsible for the spread of currency crises. Bordo and Helbing (2003) find that bilateral trade has "a modest role" in explaining business cycle synchronization.

[11] Interestingly, Wälti (2005, p. 18) comments the finding that stronger trade linkages lead to greater stock market co-movements as follows: "This result is not surprising since studies in business cycle comovements conclude that enhanced trade linkages bring about more correlated business cycles."

[12] In addition to measures of bilateral trade, Bracker et al. (1999, p. 25) find further factors of stock market synchronization which are geographic proximity, a time trend, dummy variables representing "different blocks of countries whose trading hours overlap", and the size differential across markets.

Despite the evidence, it remains the question whether bilateral trade also drives stock market synchronization in the context of China and the BRI or BRI related countries. In fact, a lot of authors *argue* that stronger bilateral trade ties between two economies lead to a higher degree of stock market co-movements (Karim & Majid, 2010; Lu et al., 2019; Patel, 2019). For example, Karim and Majid (2010, p. 61) note that an increase in stock market synchronization "might be due to a remarkable rise in the proportion of bilateral trade among the countries in the region". Patel (2019, p. 106) writes that "the Indian stock market became closer and more integrated with all other markets after the financial crisis due to an increase in bilateral trade after the financial crisis." Finally, Saji (2022) note that the dominant role of Chinas stock market on other Asian stock markets may be due to its dominant role as trading partner. The argument that bilateral trade is an important determinant of stock market synchronization in the BRI context, however, does not provide statistical support. Fortunately, a few authors (Tavares, 2009; Paramati et al., 2016; Huang et al., 2019; Caporale et al., 2019) provide *econometrical evidence* for the question whether trade impacts stock market synchronization among China and BRI countries. Again, we exclude studies that deal with the BRI (or Asian countries) but do not incorporate China (Nguyen & Lam, 2017). Table 2 provides an overview.

Table 2: Effect of Trade Integration on Stock Market Integration

Study	Regional Scope	Time period	Measure(s) of Trade	Effect	Remarks
Tavares (2009)	40 developed economies	1970-1990	Bilateral trade intensity	+ (++)	• Trade intensity increases correlations between stock markets (both with including control variables (++) and without control variables (+)).
Paramati et al. (2016)	Australia and Asia	1999 – 2013	Bilateral trade intensity	+++	• Bilateral trade intensity is highly significant when analyzing Asia as a group. • The impact of bilateral trade intensity differs (significant or insignificant) when analyzing correlations between Australia and individual Asian markets separately.
Huang, Huang & Wang (2019)	11 BRI economies	2007 – 2017 (11)	Bilateral trade openness between China and BRI countries	+	• The extent of bilateral trade openness between BRI countries and China has a significant positive effect on stock market co-movements.
Caporale et al. (2019)	10 Asian economies	2000 - 2016	Bilateral trade relations with Asian region (and with the US) of different sectors	+++	• Bilateral trade has a positive effect on stock market synchronization.

+++ (++/+) positively correlated with stock market synchronization/co-movement; $p < .01$ ($p < .05$ / $p < .10$)

Tavares (2009) analyzes the determinants of stock market synchronization among 40 developed and developing countries in the period of 1970 and 1990. Based on a panel regression model, he (Tavares, 2009, p. 67) finds that bilateral trade intensity – defined as "the average of the two bilateral-export-to-GDP rations for each pair of countries" – has a significant effect on stock market correlations. The impact of bilateral trade intensity on stock market correlations remains statistically significant even when controlling for a variety of control variables such as asymmetry of output growth, export structure, real exchange volatility, and further controls.[13] *Paramati et al. (2016)* use a time-series regression model to analyze the impact of trade on stock market co-movements between Australia and Asian economies in the period of 1999 and 2013. Depending on the model specification, they define bilateral trade as the percentage of Australia's total bilateral trade (imports and exports) with ten main Asian economies or as the percentage of Australia's total bilateral trade (imports and exports) with one Asian economy. The results show that bilateral trade is highly significant when focusing on Australia and Asia as a group even when controlling for inflation differentials, interest rate differentials, and a dummy variable for the financial crises. However, when focusing on bilateral trade of Australia with each Asian economy separately, they find that only trade between Australia and Indonesia, Japan, Malaysia, or South Korea has a significant effect stock market co-movement. In the case of China, the authors find that bilateral trade has no statistical effect of stock market correlations. A potential reason is that "most of the Chinese firms are owned by the government and or partially listed on the stock exchange" (Paramati et al., 2016, p. 4223). *Huang et al. (2019)* also investigate whether bilateral trade impacts stock market synchronization between either China and developed markets or China and BRI countries applying a time-varying symmetrized Joe-Clayton Copula model.[14] In the period from 2007 to 2017, they (Huang et al. 2019, p. 3243) find that bilateral trade is has a significant effect on stock market co-movements for both BRI countries and developed markets, noting that "bilateral trade openness is an important factor for the extreme co-movement at both tail between Chinese and global markets, including not only developed markets but also B.R.I. markets". Applying a fixed effect model, *Caporale et al. (2019)* test for the impact of bilateral trade on both global and regional stock market integration. According to their results, bilateral trade is highly significant in explaining stock market synchronization, especially when focusing

[13] Besides output growth, export structure, and real exchange volatility, Tavares (2009) also controls for the following variables in some regressions: Size of the economies, distance between economies (geographical proximity), average GDP per capita, language, colonial history, being an island, rule of law, and civil liberties.

[14] As mentioned above, Huang et al. (2019) separate the stock markets into two groups, namely developed economies and BRI economies. The subset of BRI countries consists of India, Israel, Indonesia, Malaysia, Philippines, Russia, Singapore, South Africa, South Korea, Thailand, and Ukraine; the subset of developed countries consists of Australia, Canada, France, Germany, Ireland, Israel, Italia, Japan, Netherlands, Singapore, South Korea, Spain, Sweden, United Kingdom and United States).

on regional rather than global integration. In short, they (Caporale et al., 2019, p. 1) conclude that “trade linkages and stock market development promote Asia’s regional stock market integration but not its global integration”.

Despite evidence on the general level, the sound arguments, and four studies with an explicit scope to the BRI, one should be cautious in concluding that bilateral trade between China and (partially) BRI countries *causes* – among other factors – stock market synchronization. This has several reasons:

Varying regional scope. Although all studies consider China, only the study of Huang et al. (2019) explicitly addresses BRI countries. The other studies focus more on Asia (Caporale et al., 2019), Australia and Asia (Paramati et al., 2016) or even developed countries (Tavares, 2009).

Different periods. Since the BRI has been launched in 2013, it is of our major interest to extract the effect of the BRI on trade, and, thus, on stock market co-movement among China and BRI economies. However, the studies we reviewed show a great variation regarding the analyzed periods. Tavares (2009) and Paramati et al. (2016) analyze data before the BRI was even launched. In this sense, the studies by Huang et al. (2019) and Caporale et al. (2019) are of higher interest since the data they used at least partially fit to our research interest.

Different definitions of trade or bilateral trade. Although all studies analyze the effect of trade on stock market co-movement, they use different measures of trade. Tavares (2009, p. 67) defines the trade variable as “the average of the two bilateral-export-to GDP ratio for each pair of countries i and j”. In contrast, Paramati et al. (2016, p. 4216) define bilateral trade as the “percentage of Australia’s total bilateral trade with 10 major Asian countries”. Caporale et al. (2019, p. 17) define bilateral trade relations as “[e]xports of country i to country j as a percentage of total exports of country i”.[15] Lastly, Huang et al. (2019, p. 3250) define bilateral trade as the “strength of bilateral trade relationship between China” and another country. In more mathematical terms, bilateral trade intensity is calculated by the sum of China’s exports to and China’s imports from another country divided the sum of China’s GDP and the GDP of the other country (see also Frankel and Rose, 1998).[16] Table 3 gives an overview and states the mathematical formulas.

[15]A similar measurement of bilateral trade is used by Narayan et al. (2014).

[16] Frankel and Rose (1998) define bilateral trade intensity as the sum of exports and imports between two countries i and j divided by the sum of GDP of countries i and j.

Table 3: Measures of Bilateral Trade

Study	Formula of Bilateral Trade Intensity	Explanation
Tavares (2009)	$\frac{\frac{X_{ij}}{GDP_i} + \frac{X_{ji}}{GDP_j}}{2}$	• Average of bilateral export to GDP ratios of two countries i and j
Paramati et al. (2016)	$\frac{X_{ij} + IM_{ij}}{\sum_{j=1}^{10} X_{ij} + IM_{ij}}$	• Australia's (i) exports plus imports with country j relative to the sum of Australia's exports plus imports with its ten largest Asian trading partners (j=1, …, 10)
Caporale et al. (2019)	$\frac{X_{ij}}{X_i}$	• Exports of country i to country j as a percentage of total exports of country i
Huang et al. (2019)	$\frac{X_{ij} + IM_{ij}}{GDP_i + GDP_j}$	• Sum of Chinas (i) exports to and imports from another country j as a percentage of the sum Chinas GDP and the other country's GPD

Legend: X_{ij} – Exports from country i to country j; IM_{ij} – Imports from country I to country j; GDP_i – GDP of a country i.

Varying control variables. In addition to bilateral trade, also "other macroeconomic factors may indirectly impact the extent of stock market integration through their influence on bilateral trade conditions" (Bracker et al., 1999, p. 15). To consider control variables is also important from an econometric point of view to avoid, for example, omitted variables bias. To account for this, empirical studies should incorporate a set of control variables when testing for the isolated effect of trade integration on stock market co-movements.[17] Referring to the four studies we reviewed in the context of the BRI, not all studies contain the same control variables in their econometric setting. For example, Paramati et al. (2016) consider three control variables (inflation differentials, interest rate differentials, and for the financial crisis). In contrast, Tavares (2009) controls for nine variables. Table 4 shows an overview of the control variables each study applied.

[17] For example, Bracker et al. (1999) control in their seminal paper for a variety of variables of economic integration such as purchasing power parity, the interest rate, inflation differentials, bilateral exchange rates, geographical proximity, firm size effects, time trends, and regional blocks of countries.

Table 4: Control Variables

Study	Control Variables	
Tavares (2009)	• asymmetry of output growth • export structure • real exchange rate volatility • size of the economy • geographical proximity • GDP per capita	• common language indicator • common colonizer indicator • island indicator • rule of law • civil liberties
Paramati et al. (2016)	• inflation differentials • interest rate differentials • global financial crisis	
Huang, Huang & Wang (2019)	• financial integration • credit markets integration • economic policy uncertainty • inflation differential • nominal GDP growth rate	• nominal exchange rates • price of crude oil
Caporale et al. (2019)	• trade openess • real interest rate differentials • exchange rate risk	• local stock market development • dividend yields • global financial crises dummy

Varying measures of stock market integration and different econometric methods. The four studies also show differences regarding their econometric methodology. On the one hand, all studies apply different ways to measure stock market synchronization. Tavares (2009) uses (simple) correlations of pairwise stock market returns, Paramati et al. (2016) calculate conditional correlations of stock market returns of country pairs, Caporale et al. (2019) use adjusted relative transition parameters based on the Philips and Sul panel convergence tests, and Huang et al. (2019) use time-varying upper and lower tail dependence probabilities (which are based on a conditional symmetrized Joe-Clayton copula model). On the other hand, there are also slight differences in the econometric models applied. Although all studies apply regression models, three studies use pooled regressions models (Tavares, 2009; Paramati et al., 2016; Huang et al., 2019), whereas one study applies a fixed effect model (Caporale et al., 2019).[18]

[18] For example, Bracker et al. (1999) also use a pooled time series regression model in their study.

Conclusion

Based on the perspective of investors who want to optimize their portfolio decisions with respect to risk, the degree of stock market synchronization among China and BRI countries matters for investment decisions in this geographic area. In theory, in case of a perfect co-movement of stock markets, inter-regional diversification does not lower portfolio risk. In contrast, in case of uncorrelated stock markets, investors can benefit from portfolio diversification across several markets or economies. Thus, especially for investors who want to invest in countries that are affected by the BRI, the effect of the BRI – channeled through bilateral trade – on stock market correlations are of particular interest.

Thus, we first review a variety of studies that analyze whether stock market synchronization takes place among in China and BRI countries. In summary, most studies find that stock markets of China and BRI economies co-move (Chow et al., 2013; Tiwari et al., 2013; Chien et al., 2015; Paramati et al., 2016; Zhang et al., 2018; Huang et al., 2019; Lu et al., 2019; Patel, 2019; Burdekin, 2021). Some studies find at least limited evidence for stock market synchronization in this area (Nguyen & Elisabeta, 2016; Chien et al., 2015; Caporale et al., 2019; Manu et al., 2022; Saji, 2022). Only Karim and Majid (2010) find no evidence for stock market integration between China and BRI countries; but this study was done before the BRI was even launched.

In a second step, we review whether stock market synchronization in the BRI region can be explained by bilateral trade among BRI economies. Based on four studies, we find econometric evidence that an increase in bilateral trade between BRI economies also leads to a higher degree of stock market synchronization (Caporale et al., 2019; Tavares, 2009; Paramati et al., 2016; Huang et al., 2019). However, due to several reasons, these studies are only comparable to a limited extend. In fact, only the study of Huang et al. (2019) explicitly addresses the question whether bilateral trade among BRI countries impacts stock market correlations among BRI countries. Moreover, their study incorporates only eleven BRI economies.

Although the literature provides a good starting point, there are a variety of open questions regarding the BRI and the impact of bilateral trade on stock market integration. The following topics should be considered:

Stock market correlations before and after the launch of the BRI. We expect stock market correlations (or any other measure of stock market synchronization) to increase due to increased bilateral trade caused by the BRI. Thus, we would expect that stock market correlations are on average lower in the periods before 2013 in comparison to the period since 2013. We further expect that stock market correlations should steadily increase over time since the launch of the BRI.

Stock market correlations and data frequencies. We expect stock market correlations to be higher when we use low frequency (biannual, quarterly, or monthly) data in comparison to high frequency (daily or weekly) data. However, since the BRI should foster economic integration, also stock market correlations of high frequency data are expected to increase over time.

The regional scope of the BRI. Although most authors simply speak about BRI countries, one may question what is meant by BRI countries. For example, scholars argue that BRI economies can be divided into several corridors or different parts. For example, Lu et al. (2019) name six parts of the BRI which are Southeast Asia, South Asia, Western Asia and North Africa, Central and Eastern Europe, Central Asia, and Commonwealth of Independent States (CIS). Similarly, Liu and Dunford (2016, p. 14) refer to six major corridors which are "a new Eurasian Land Bridge and China–Mongolia–Russia, China–Central Asia–West Asia, China–Pakistan, Bangladesh–China–India–Myanmar, and China–Indochina". Based on these parts or corridors, it may be interesting whether stock market synchronization differs among the six corridors and whether bilateral trade has the same effect in all parts or not.

Methodological questions. Based on our review, several different measures of stock market synchronization and of bilateral trade have been used. Thus, it remains the question, which measure fits best for our purpose. The same thought applies to the econometric model.

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