UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

FACULTY OF BUSINESS ADMINISTRATION AND ECONOMICS

Working Paper Series

Working Paper No. 2023-13

The world's largest free trade agreement RCEP and its financial markets – A perspective on volatility and risk.

Marc Atkins and Christian Peitz

August 2023

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Abstract

We analyse the largest financial markets as well as the most affected industries of the Regional Comprehensive Economic Partnership (RCEP) zone and examine them for their respective market risk and stability. Trade decisions with RCEP member countries are influenced by the stability of financial markets within the RCEP free trade area. To this end, we examine the largest financial markets in terms of volatility and risk using various GARCH models. Our focus is on the financial markets of the largest of the 15 RCEP member countries, namely China, Japan, South Korea, Australia, Indonesia and Thailand. We consider whether RCEP's expected entry into force as well as this event itself have an impact on the respective financial markets by means of an event analysis.

We further derive the most effected industries by the agreement and extend our analysis to the sector-level. We examine the largest companies of the automotive industry, the computer, electronic and electrical equipment sector as well as the chemical industry and analyse their performance and volatility over time.

Keywords: GARCH models, trade policy, RCEP, event analysis, financial risk.

JEL Codes: C51, F13, G14, G32

1 Introduction

The development of financial markets and economic growth are inter-related, a linkage dating back to the conceptualisation that skill and knowledge need borrowed capital for they can be put to effective use by their economic agents (Bagehot, 1873). Hence, well-developed financial markets play a key role for rising economic growth, capital accumulation and technological innovation, a concept emphasised already by Schumpeter more than a century ago (Alfaro et al., 2004). The basic argumentation of financial market development causing economic growth argues that well-developed financial markets lower the costs of transactions, thereby enabling an efficient allocation of funds, while competition of economic agents causes efficient specialisation of activities resulting in economic growth (Greenwood and Smith, 1997).

Because of RCEP's significant (economic) implications as well as its distribution of effects with a concentration of additional international trade occurring primarily within the RCEP economies, an analysis of the financial markets in the RCEP region is of great interest. By 2030, an incremental increase of $465 billion U.S. dollars ($465 bn) in exports is estimated from RCEP members to other RCEP members as well as $49 bn to other countries due to RCEP provisions (Park et al., 2021). In line with theory on free trade agreements (FTAs), Park et al. (2021) project a significant decrease in trade outside RCEP. The additional trade for the region is accompanied by increases in income as well as overall positive labour market implications (Park et al., 2021). Several findings from the literature support a strong positive correlation of financial market development, for instance in the form of the stock or bond market, and economic growth, some of which show this to be a causal relationship. Our subsequent analysis focusses on the stock market.

Although the incrementally added economic growth of RCEP is not preceded and caused by financial market growth but a consequence of the provisions of the agreement, the aspects mentioned together with the significance of RCEP's effect call for a detailed financial market analysis of the RCEP region.

1.1 Literature Review

In accordance with the conceptualisation by Bagehot (1873) as well as Schumpeter (1912), Shaw (1973) and McKinnon (1973) emphasise a positive connection between financial sector expansion and progression of the real economy. Together with Goldsmith (1969) they are among the early protagonists of this view on financial markets and economic growth, analysed extensively over the years. Because their research was based on traditional growth theory of the time, however, it lacked the analytical foundations emerged later that prove financial market development to stimulate the level of economic development and to potentially induce growth effects (Pagano, 1993). Previously, financial intermediation was found to be correlated with the level of capital stock per labour unit or the productivity level, not however to the growth rate. Endogenous growth models led to advances from this perspective and to increased interest in the financial market and economic growth nexus (Pagano, 1993). These models allow an explicit modelling of financial intermediaries' services such as liquidity provision, information collection and analysis as well as risk sharing (Kahn and Senhadji, 2003). The rationale behind the causality can be explained by two factors. Firstly, in a solid financial market, the costs of transactions are such that funds are allocated efficiently to their most advantageous use. Secondly, consumption is stabilised as investors can diversify investments effectively, enhancing economic growth (Colombage, 2009). Greenwood and Smith (1997) show this twofold argumentation of causality by means of two models of intermediated activity. To show the role of bank and stock markets in allocating funds to those activities in the economic system yielding the highest returns they use the Diamond and Dybvig (1983) liquidity provision model (Greenwood and Smith, 1997). This is also the focus of Shaw (1973) and McKinnon (1973). Using the model of intermediated transactions by Townsend (1978), their analysis proves that competition of economic agents causes efficient specialisation of activities.

As pointed out by Kahn and Senhadji (2003), the literature on this topic is quite extensive and entails other studies, such as Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), Roubini and Sala-i-Martin (1992), Obstfeld (1994) and Bencivenga et al. (1995). On the basis of these theoretical foundations from the literature numerous studies set out to empirically analyse the nexus of financial market and economic growth, its development as well as causality, each with a different focus, for instance, regarding

the financial market segment of bank, bond or stock market. A selection of the extensive research is discussed in the following.

King and Levine (1993) find that the banking sector is strongly positively associated with economic growth as well as the growth rate of technology and physical capital (by means of both cross-section and panel analysis for 80 countries of different development levels). Kahn and Senhadji (2000) find a strong positive and significant relationship between financial development and economic growth for the banking, bond as well as stock market, in their analysis of 159 countries of different development levels. The result is confirmed for the stock market by several studies, including Levine and Zervos (1998) and Beck and Levine (2001, 2002) with a focus on large country samples, by Bassani et al. (2001) and Leahy et al. (2001) with a focus on highly developed economies as well as by Platek (2022) focussing on less developed economies (Fink et al., 2005). Other studies find ambiguous results including Fink and Haiss (1999), Hahn (2002) and Fink et al. (2004). Fink et al. (2005) find strong evidence for short-run growth effects for emerging economies, while the effect is weak for industrialised countries. Regarding investment, Alfaro et al. (2004) find that while FDI itself has ambiguous effects on economic growth, economies with highly developed financial markets observe significant benefits from FDI. In their empirical analysis of the connections between financial markets, FDI and economic growth they use cross-country data from 1975 to 1995 for numerous members and non-members of the Organisation for Economic Co-operation and Development (OECD). Financial integration of several markets in a region can lead to enhanced access to capital, thereby contributing to the discussed effect of financial markets on economic growth. Guiso et al. (2004) find that financial integration in the European Union (EU) does not lead to financial development in the local markets but improves firms' access to the international financial markets of the region. This is supportive of the development of both more and less economically developed countries in a region experiencing financial integration. Colombage (2009) supports the discussed hypothesis on causality, finding that the development of financial markets stimulates economic growth. In his analysis of the five highly developed economies Canada, Japan, Switzerland, the United Kingdom (UK) and the United States of America (USA) from 1995 to 2006, Colombage finds uni-directional causality from financial market development to economic growth (except for Canada, for which the opposite causality is found), using Granger causality testing based on vector error-correction models. Moreover, his analysis incorporates the three major financial seg-

ments of bond markets, stock markets and credit markets, which are inter-related. Using a different method, Cave et al. (2020) find a robust negative relation of the banking sector and economic growth, while the relationship of stock market development and growth is positive (up to a threshold). Analysing 101 countries from 1990 to 2014 their analysis makes use of a multiple-indicators-multiple-causes model that treats the two indicators of financial development, namely banking sector and stock market, as two latent indicators (Cave et al., 2020).

Also concerning the stock market in particular its positive relationship with economic growth is an empirical fact (Capasso, 2008). Several studies examined this relation for specific countries. The following provides an overview of the results found for different countries using different analysis methods. Wong and Zhou (2011) find that the stock market development and economic growth exhibit a strong positive correlation. Using cross-country panel data for China, USA, UK, Japan and Hong Kong, their empirical analysis shows independently strong positive correlations of stock market development and economic growth (Wong and Zhou, 2011). Despite unproven causality, this result supports the theory that financial market development is a driver for economic growth for different types of financial and economic systems. Guru and Yadav (2019) are among those filling the gap of analysing this relationship on emerging economies in particular. For Brazil, Russia, India, China and South Africa, they find that both banking sector and stock market indicators stimulate economic growth, while the different indicators of financial market development are complimentary. Banking sector indicators of their analysis include financial intermediaries' size, domestic credit to private sector (CPS) as well as credit to deposit ratio (CDR), while the value of shares traded and the turnover ratio comprise the stock market development indicators (Guru and Yadav, 2019). Furthermore, Ngare et al. (2014) find a positive effect of stock market development on economic growth analysing 36 African countries from 1980 to 2010. While economies with stock markets generally grow faster, relatively less developed economies with a stock market are found to grow faster than relatively more developed economies (Ngare et al., 2014). Enisan and Olufisayo (2009) add to this, analysing seven economies in sub-Saharan Africa. Using vector error-correction models in Granger causality testing, analogous to Colombage (2009), they find a causal relationship of stock market development on economic growth for Egypt and South Africa. Bi-directional causes are found for Kenya, Ivory Coast and Zimbabwe (Enisan and Olufisayo, 2009). Using a similar approach with a vector error-

correction model and Granger causality testing, Vazakidis and Adamopoulos (2009) find opposite causality in their analysis of the French economy from 1965 to 2007. Lazarov et al. (2016) find robust positive relationship in this context for Macedonia using both panel regression models (fixed and random effects) as well as the dynamic panel model of Generalised Method of Moments analysing the period of 2002 to 2012. Nyasha and Odhiambo (2017) confirm this for the Kenyan economy in their analysis of stock market and banking sector development and economic growth from 1980 to 2012, applying the autoregressive distributed lag bounds testing approach. They find a positive effect of the former on growth, whereas banking sector development is found to have a negative influence. Their results are robust both in the short and long run (Nyasha and Odhiambo, 2017). Azam et al. (2016) analyse Bangladesh, India, China and Singapore and find significant positive short-run relation of stock market development and growth for India and China as well as significant long-run effects for China and Singapore. Pan and Mishra (2018) find no evidence of a close relationship between stock market development and short-run economic growth for China. Borteye and Peprah (2022) find supporting evidence for Ghana using bivariate and regression analysis for the years 2014 to 2018. The stock market dimension of market liquidity and economic growth exhibit a strong positive relationship, while market capitalisation shows a moderately positive and market size a moderately negative correlation (Borteye and Peprah, 2022).

2 RCEP: the agreement, its members, and expected economic impact

RCEP was agreed between the ASEAN countries Brunei, Cambodia, Indonesia, Lao, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam, the ASEAN+3 countries China, Japan, South Korea as well as the ASEAN+6 countries Australia and New Zealand except for India[1]. It was signed in November 2020 after 30 rounds of negotiations

[1]India left the negotiations a year before the agreement was signed. Beside some domestic political issues, the decision was made mainly because of economic factors including trade deficits with 11 of the 15 RCEP members as well as the fear of Chinese competition in sectors such as manufacturing (Petri and Plummer, 2020). As RCEP decreases trade barriers, imports from other countries are likely to increase, posing a risk to some domestic production. Besides manufacturing India was worries about the domestic agricultural sector in view of rising imports from Southeast Asia as well as Australia and New Zealand (Hilpert, 2021).

during eight years and entered into force for the first 10 of the 15 countries on January 1st, 2022, namely Australia, Brunei, Cambodia, China, Japan, Lao, New Zealand, Singapore, Thailand as well as Vietnam (RCEP, 2022a). For South Korea (February 1st) and Malaysia (March 18th) entry into force came in the subsequent two months, for Indonesia on January 2nd, 2023, and for the Philippines on June 2nd, 2023 (Australian Department of Foreign Affairs and Trade, 2022). Myanmar remains the single country for which RCEP has not entered into force entirely, despite having ratified the agreement already in 2021, which is due to political tensions and non-acceptance of some of the agreement's members[2]. Together with Myanmar's small share of RCEP trade and gross domestic product (GDP) of less than one percent and China being its largest trading partner, the RCEP agreement can be seen as implemented (OECD, 2023). Some members states, like China, South Korea and Japan, are among the most developed and wealthiest economies globally while others, like Laos or Cambodia belong to the relative least developed and poorest economies. Despite causing challenges for RCEP regarding its depth as well as its implementation, this diversity among member states enables a more efficient fragmentation of tasks and thus more efficient supply and value chains while at the same time RCEP will eliminate approximately 90 percent of tariffs on goods for intra-RCEP trade over 20 years (Park et al., 2021). The CPTPP exhibits a higher density of relatively more developed economies, supporting the agreement in eliminating 96 percent of tariffs on products traded among member countries.

RCEP is the world's largest FTA before the EU, the United States-Mexico-Canada Agreement (USMCA, formerly NAFTA) as well as the CPTPP. Its member countries generate around 30 percent of global economic output, approximately $26 trillion (Plummer and Petri, 2021). This can rise to more than half of the world's GDP by 2030 (Neumann and Rajanayagam, 2020). Besides the CPTPP and the ASEAN organisation itself, with its trade barrier reductions, ASEAN's 10 member states had bilateral FTAs in place with the five non-ASEAN states that form part of RCEP, namely China, Japan, South Korea, Australia and New Zealand. In addition, Australia and New Zealand already had bilat-

[2]The ratification of the agreement is seen with concern and doubt by some of RCEP's members in the wake of the 2021 military coup in Myanmar and RCEP's ASEAN members in July 2022 agreed that the decision whether to accept Myanmar's ratification is to be made by each country itself who then inform the ASEAN secretariat and the other RCEP members (Japan External Trade Organisation, 2022). Thailand, Singapore and China have started applying the RCEP provisions also to Myanmar (Singapore Ministry of Trade and Industry, 2023; General Administration of Customs of the People's Republic of China, 2022)

eral trade agreement in place. The three largest RCEP members China, Japan and South Korea, however, had not made such agreements as China and Japan as well as Japan and South Korea had been lacking bilateral FTAs entirely. Hence, these are the countries with the highest tariffs still in place, which is in large parts due to cultural reasons, and for which the largest tariff reduction is expected (Flach et al., 2021). RCEP comprises 20 chapters, among others dealing with trade in goods, rules of origin, customs procedures, trade in services, investments, intellectual property rights, as well as e-commerce. The agreement's main goal is forming an economic partnership that eliminates tariffs, thereby raising regional flows of trade and investment (RCEP, 2022b). The harmonisation of the rules of origin is considered the greatest achievement (Flach et al., 2021). Every trade agreement comprises a set of rules referred to as the rules of origin. Exporters ought to prove a certain share of domestic production to avoid paying tariffs and receiving preferential entry into a market. In order to avoid a 20 percent tariff for the entry into Lao, for example, Chinese automobile producers have had to provide proof that at least 40 percent of the product comes from China itself or another ASEAN country (Flach et al., 2021). The main issue is that the rules of origin differ for every bilateral FTA as well as for every country and sector, making the rules to comply with for preferential treatment very complex. Fragmented value chains, in which intermediate inputs cross multiple borders, make it more difficult. By essentially counting all intermediate inputs from the 15 member states as domestic production, RCEP consolidates and harmonises the rules of origin. This promotes GVC trade as it becomes less costly for goods to cross borders, also multiple times. In effect, the Chinese automobile producer is going to need merely one certificate of origin for its exported goods. Especially small and medium enterprises (SMEs) are expected to benefit from the reduced regulatory burden by harmonised rules of origin, enabling them to reach a larger number of customers more easily.

Table 1: Incremental export changes in 2030 due to RCEP (in $ bn)[3]

Importer-Exporter	CHN	JPN	KOR	BRN	IDN	MYS	PHL	SGP	THA	VNM	CLM	AUS	NZL	RCEP	Not RCEP	Total
China (CHN)	0.0	89.5	9.0	0.2	4.9	21.1	6.9	0.2	12.8	16.3	2.3	5.3	1.0	169.5	64.9	234.4
Japan (JPN)	161.2	0.0	32.9	-0.1	1.9	-5.5	-1.2	-2.7	4.4	-4.6	0.2	-6.0	-0.5	180.0	-47.3	132.7
South Korea (KOR)	17.4	19.0	0.0	0.0	1.4	2.9	0.4	-0.1	2.6	9.8	0.9	5.5	0.9	60.7	4.8	65.4
Brunei (BRN)	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.2	-0.1	0.1
Indonesia (IDN)	6.5	0.5	1.6	0.0	0.0	0.0	-0.2	0.0	1.5	-0.1	0.0	1.1	0.1	10.8	1.8	12.6
Malaysia (MYS)	9.3	-1.1	1.0	0.0	-0.2	0.0	-0.3	0.0	1.3	-0.8	-0.1	0.0	0.0	9.1	3.2	12.3
Philippines (PHL)	3.3	-0.3	0.7	0.0	0.0	0.1	0.0	0.0	1.5	0.0	0.0	0.0	0.0	5.2	1.6	6.8
Singapore (SGP)	1.2	0.1	0.5	-0.1	1.0	-3.0	-0.1	0.0	0.8	-1.6	0.0	-0.1	0.0	-1.3	-1.2	-2.5
Thailand (THA)	9.5	1.9	1.8	0.1	0.5	0.5	0.1	0.3	0.0	0.4	0.7	0.5	0.3	16.7	11.1	27.8
Vietnam (VNM)	3.8	-1.3	3.1	0.0	0.1	-0.2	0.5	0.1	0.9	0.0	0.5	0.1	0.0	7.5	8.2	15.7
Cambodia, Lao, Myanmar (CLM)	0.8	-0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	1.5	2.7	4.2
Australia (AUS)	-0.2	0.9	3.2	0.0	0.7	-0.2	0.0	0.0	0.2	-0.4	0.0	0.0	-0.3	3.9	-0.6	3.3
New Zealand (NZL)	0.1	0.6	0.9	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0	-0.2	0.0	1.3	-0.3	1.0
RCEP	212.9	109.7	55.3	0.1	10.3	15.6	6.0	-2.2	26.6	18.8	4.6	6.0	1.4	**465.2**	**48.6**	**513.8**
Not RCEP	13.6	18.8	8.9	0.0	1.5	-4.0	0.3	0.9	0.0	-4.1	-0.7	-3.1	-0.5	**31.8**	**-49.4**	**-17.6**
Total	226.5	128.5	64.2	0.1	11.9	11.7	6.3	-1.3	26.6	14.8	3.9	2.9	0.9	**497.0**	**-0.8**	**496.2**

Table 1 shows the incremental changes in goods and services traded in 2030 because of RCEP, estimated with the Computable General Equilibrium analysis by Park et al. (2021). By 2030, Park et al. (2021) estimate an incremental increase of $465 bn in exports from RCEP members to other RCEP members as well as $49 bn to other countries due to RCEP. In line with FTA theory, they also project a significant decrease in trade outside RCEP, which goes alongside an estimated increase in intra-RCEP trade of 11.4 percent. Other studies find RCEP's impact on trade to go in the same direction, however, the range of empirical results is large. For instance, Mahadevan and Nugroho (2019) find more moderate effects pointing to existing agreements with substantial tariff reductions. Cui and Li (2021) confirm earlier research by Petri and Plummer (2020) in finding that reductions in tariff and non-tariff barriers increase the GDP of ASEAN members. Observing the single countries, we see that the large impact projected for RCEP's economic giants China, Japan and South Korea is reflected by the estimation results. Especially the two trading relations of China and Japan as well as Japan and South Korea will see rising trade volume. Furthermore, Park et al. find that RCEP is able to lift global income by 0.2 percent by 2030 and RCEP members' income by 0.6 percent. RCEP has a significantly larger (positive) effect on world income than the CPTPP with added $263 bn in income on top of the $188 bn added by the CPTPP. We also see similar effects on

[3]Source: Author's illustration based on Park et al. (2021). Abbreviations here and in the following based on ISO 3166-1 country codes, except for CLM in this figure, which is the sum of Cambodia (KHM), Lao (LAO) and Myanmar (MMR).

country-level. Europe is estimated to see additional income of $14 bn by each of the two FTAs while losing $12 bn due to the trade war between the USA and China, also referred to as the US-China trade war.

3 Empirical analysis

Before we turn to the analysis of the major RCEP indices as well as the most relevant sectors in the context of our financial market analysis, we derive the theoretical implementation underlying our approach as well as specifications for the application.

3.1 Theoretical implementation

We analyze the heterogeneous market situations of the RCEP members and investigate whether concluding the RCEP agreement had a significant impact on the markets of the respective member states. For this purpose, we first look at the price time series, followed by the respective volatilities. Volatility analysis has been used for decades in such contexts and provides a suitable tool for our analysis. In this article, we restrict ourselves to a simple GARCH(1,1) model, which has proven to be the most variable model in many studies.

ARCH and GARCH models serve as risk management and analytical tools since the 1980's. These models are used to analyze effects unexplained by econometric models, residually leaving the error term unexplained. With ϵ_t denoting the error terms and $\alpha_0 > 0, \alpha_i \geq 0, i > 0$, a time series σ_t^2 using ARCH is modelled by:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \epsilon_{t-i}^2$$

If a model, for the realisations of a stochastic process, imposes an assumption on the conditional variance of the process, it is considered a GARCH(p,q) model (where p is the order of σ^2 and q is the order of ϵ^2) and described as a generalisation of ARCH models. It is given by:

$$y_t = x_t' b + \epsilon_t$$

$$\epsilon_t|\psi_{t-1} \sim N(0, \sigma_t^2)$$

$$\sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i \epsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_i \sigma_{t-i}^2$$

Moreover, for the models applied we assume a normal distribution of the data. The boxplot figures in the following show that this fits best to the data. ARCH and GARCH models and their extensions are highly popular due to their performance in estimating volatility in risk measurement (see e.g. Poon and Granger, 2005). An exact explanation of these models will be omitted here and at this point we refer to the well known literature like "An Introduction to Univariate GARCH Models" (Teraesvirta, T.) or "Analysis of Financial Time Series" (Tsay, R.S.).

3.2 Specifications

The largest companies of an economy (that are listed on the stock market) oftentimes constitute the majority of a country's GDP and output, making them a suitable approximation for our analysis in this context and allowing for good interpretability of results. For this reason, the financial market analysis focusses on those RCEP members with the highest economic influence. In order to make the appropriate selection of economies, Table **??** illustrates the RCEP members with key indicators of economic development and trade. We see the dominance of China reflected by GDP and the fact that it constitutes 60 percent of RCEP's economic power (in terms of GDP), while China, Japan and South Korea jointly make up more than 80 percent of RCEP in this regard. The cumulated RCEP share of GDP shows that the top six countries account for approximately 94 percent of the RCEP GDP. Therefore, the following financial market analysis focusses on these six, namely China, Japan, South Korea, Australia, Indonesia and Thailand.

Table 2: RCEP members' indicators of economic development and trade (in $ bn)[4]

RCEP Member	GDP, 2011	10-year GDP growth	GDP, 2021	Ranked cumulated RCEP share	GDP per capita, 2021	Exports of goods and services, 2021	Imports of goods and services, 2021
CHN	7551.5	135%	17734.1	59.84%	12556.3	3553.5	3091.3
JPN	6233.1	-21%	4940.9	76.51%	39312.7	910.5	936.4
KOR	1253.2	45%	1811.0	82.62%	34997.8	761.2	694.4
AUS	1398.4	11%	1552.7	87.86%	60443.1	342.8	276.3
IDN	893.0	33%	1186.1	91.86%	4332.7	255.7	223.7
THA	370.8	36%	505.9	93.57%	7066.2	294.5	295.7
SIN	279.4	42%	397.0	94.91%	72794.0	733.8	609.3
PHI	234.2	68%	394.1	96.24%	3460.5	101.4	148.8
MAL	298.0	25%	373.0	97.50%	11109.3	256.8	230.2
VIE	172.6	112%	366.1	98.74%	3756.5	341.6	341.2
NZL	168.3	48%	249.9	99.58%	48781.0	56.3	66.4
MMR	54.1	20%	65.1	99.80%	1209.9	18.4	16.2
KHM	12.8	110%	27.0	99.89%	1625.2	17.4	18.2
LAO	8.8	115%	18.8	99.95%	2535.6	0.0	0.0
BRU	18.5	-24%	14.0	100.00%	31449.1	11.2	9.4

In the following, we also analyse the most important sectors of the RCEP member countries, in order to find more specific implications of the financial market development. We focus on the top three most important industries, which we determine by two steps. Firstly, the global trade volume of RCEP members in terms of trade in value-added (TiVA) is analysed, which is a trade measure capturing only the value a country adds to a good or service based on harmonised international trade data as well as input-output data. Secondly, this is combined with the analysis of the most impacted sectors by RCEP provisions, as discussed in the following.

Table 3 depicts RCEP members' global imports and exports in 2018 by industry in terms of TiVA. It includes the three sectors with the largest trade volume for both imports and exports as well as those that are contained in the top three of the other trade metric, respectively. Therefore, for example, we include D05T06: Mining and quarrying, energy producing products in gross exports even though it is not part of the top three of gross exports, but among the top three of gross imports. We follow the United Nations (UN) International Standard Industrial Classification of economic activities (UN, 2008), and analyse based on the most specific differentiation of industries the OECD TiVA database allows for in the context of a comparison of all sectors of the economy (OECD, 2023).

We see that D26: Computer, electronic and optical products is RCEP's largest import and export industry, in the following referred to as the electronic sector. It is followed by D45T47: Wholesale and retail trade; repair of motor vehicles, which has the highest export volume and second highest import volume. The service sector D45T47 is closely

[4]Source: Author's illustration based on World Bank (2023).

connected to D29: Motor vehicles, trailers and semi-trailers, as these services provided by the D45T47 industry form part of buying, selling and using D29 products. Hence, for the subsequent analysis they are jointly treated and referred to as the automotive sector. The third largest industry is D20T21: Chemicals and pharmaceutical products.

Table 3: RCEP members' international trade (TiVA), imports and exports in 2018 (in $ bn)[5]

	Gross imports					Gross exports				
RCEP Member	D05 T06	D20 T21	D26	D29	D45 T47	D05 T06	D20 T21	D26	D29	D45 T47
CHN	342.7	166.8	319.2	70.6	195.0	19.7	153.8	528.5	45.9	145.3
JPN	2.6	48	73.1	29.9	84.6	0.1	57.8	94.1	156.8	116.3
KOR	116.9	44	70.3	16	53.9	0.0	71.1	205.7	65.4	42.8
AUS	8.6	17.7	27.3	25.3	30.4	78.0	5.8	2.7	1.2	25.6
IDN	12.3	22.1	14.9	7.3	23.5	41.3	12.6	7.5	5.3	18.0
THA	31.9	18.4	33	9.5	26	0.1	19.4	38.5	29.5	32
SIN	34.5	5.7	21.4	4.7	22.8	0.0	37.3	58	0.7	61
PHI	8.6	8.9	23	6.6	14.4	0.7	1.3	21	2.3	8.2
MAL	6.7	12.8	28.7	8.3	18	15.5	12.5	61.8	0.4	22.1
VIE	5.9	24.7	11	4.6	23.5	28.7	4.9	23.8	4.1	12.3
NZL	5.7	3.8	3.2	3.5	6	1.7	0.6	0.3	0.1	6.1
MMR	0.1	1.4	0.5	0.5	2.3	3.6	0.1	0.1	0.0	1.4
KHM	0.1	1.1	0.7	0.5	1.9	0.0	0.1	0.1	0.1	1.3
LPD	0.0	0.3	0.6	0.5	0.7	0.0	0.1	0.0	0.0	0.6
BRU	0.0	0.2	0.2	0.2	0.5	5.8	0.2	0.0	0.0	0.2
RCEP	576.4	375.9	627.2	188.2	503.6	195.3	377.5	1042.2	311.7	493.2

These findings are supported by Estrades et al. (2022), who find that the sectors affected most (in absolute terms) are the manufacturing industries related to electrical equipment and machinery; chemicals, rubber and plastics; metals; motor vehicles and parts, food and beverages as well as wearing apparel and leather. Applying a slightly different composition of sector activities, they find the industry referred to as electrical equipment and machinery to increase the most due to effects of the RCEP provisions, seeing additional net trade of approximately $163 bn, including $18 bn additional exports to non-RCEP countries. Therefore, we add electrical equipment (D27) to the electronic sector (D26), corresponding to the computer, electronic and electrical equipment (D26T27) in the OECD classification. They also find both the automotive and the chemical (including rubber and plastics, which is D22: Rubber and plastics products in the OECD classification) industry to be among the most affected sectors by RCEP (foremost in terms of additional intra-RCEP export trade). These findings are also consistent with those of Park et al. (2021).

Consequently, the top three industries of interest for our financial market analysis of

[5]Source: OECD (2023). D05T06: Mining and quarrying, energy producing products; D20T21: Chemicals and pharmaceutical products; D26: Computer, electronic and optical products; D29: Motor vehicles, trailers and semi-trailers; D45T47: Wholesale and retail trade; repair of motor vehicles

RCEP effects are the electronic, the automotive as well as the chemical sector. Therefore, the following analysis is going to examine these in detail regarding their development, stock returns as well as volatility and associated risk. This is done based on the five most important companies of each of these sectors in terms of revenue. Prior to this analysis we examine the six largest economies of the RCEP zone in the same context by means of their respective financial market indices.

Moreover, our subsequent analysis focusses on the stock market. All stock market data, especially in terms of price time series, are retrieved from Yahoo Finance (2023), based on which we calculate, for instance, returns, cumulative returns and volatilities. This specific source will thus not be noted in the following. The main time span for our analysis reaches approximately five years back from the present and spans from January 1st, 2018 until June 30th, 2023. This provides information on the recent past in which RCEP has been effective, the months before when RCEP's entry into force was expected, as well as a small number of years before the agreement as a reference.

3.3 The development of the major RCEP indices

Before we turn to volatility and market risk, let us look at the price time series of the major indices as the basis for the subsequent analysis. Table 4 illustrates the indices for our selection of RCEP's member states together with the MSCI World Index. The latter is a commonly used reference index as it contains approximately 1,500 constituents from 23 highly developed economies. It entails a focus on the USA market as close to 70 percent of the investments are in companies from the USA and, for instance, slightly more than 10 percent are covered by Apple, Microsoft and Amazon taken together (MSCI, 2023).

Table 4: RCEP's major financial indices

Index	Country	Short Symbol	Constituents	ISIN
SSE	CHN	000001.SS	50	GB0007908733
Nikkei	JPN	N225	225	JP9010C00002
KOSPI Composite Index	KOR	KS11	928	KRD020020008
S&P/ASX 200	AUS	AXJO	n/a	AU000000ASX7
IDX COMPOSITE	IDN	JKSE	n/a	QT0009982189
SET	THA	SET.BK	50	XC0009694164
iShares MSCI World Index	ETF	URTH	1600	US4642863926

Figure 1: The price and returns time series of RCEP's largest financial markets

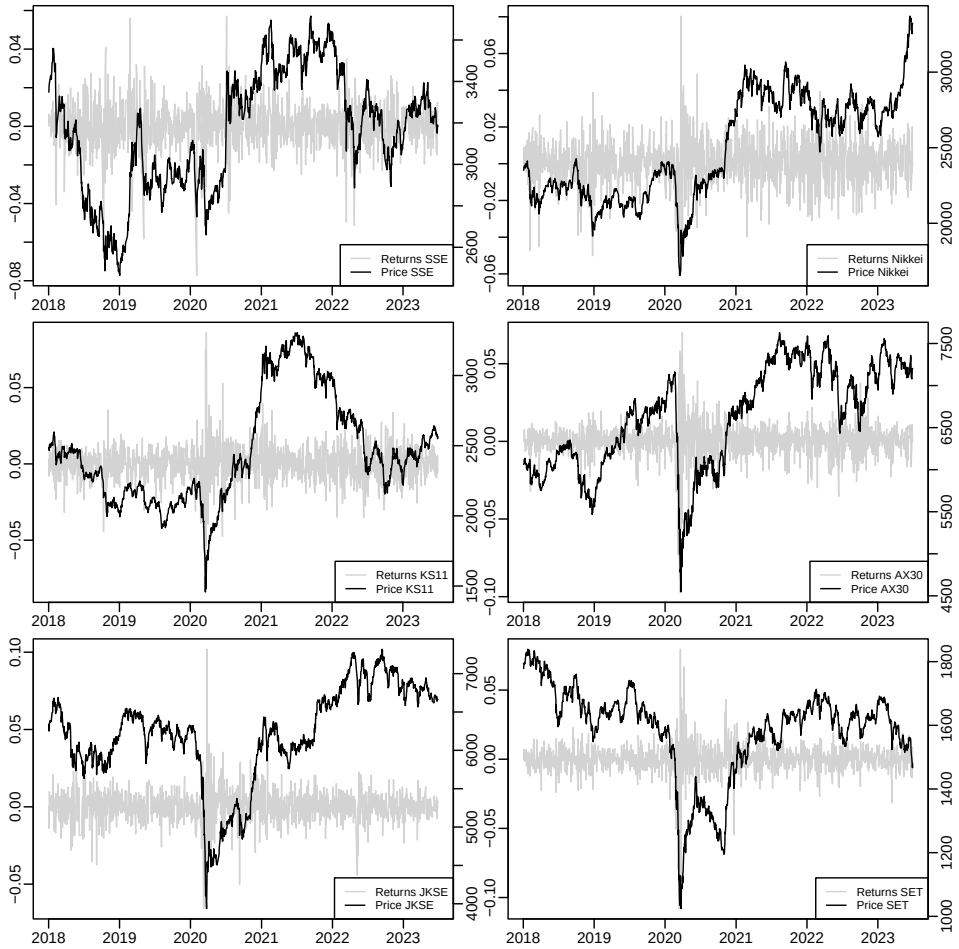
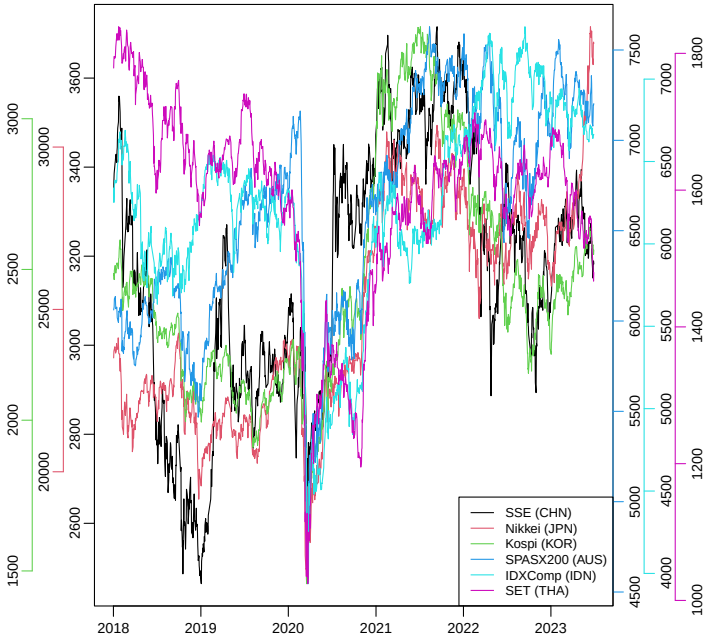


Figure 1 depicts the price and returns series from 2018 to June 30$^{\text{th}}$, 2023. The left axis depicts the returns while the right axis indicates the stock price in local currency. The price graphs of the six indices each show a consistently positive development in the long term, despite differences in their level and development. The impact of the COVID-19 crisis from early 2020 onward can be clearly seen. While this crisis resulted in heavy losses on the market, the price developments have since recovered. The Chinese Shanghai Composite index (SSE) stands out in this respect, since the price reaction as well as the subsequent rise in stock prices seen so clearly for most of the indices is much less significant for the SSE. The last 1.5 years represent the time of the RCEP agreement being effective, for which we see different developments, however, many factors play a role in this context. Concerning volatility of returns, the six indices show differences in their overall level of volatility as well as their changes over time. The Chinese stock market, for instance,

depicts an overall larger volatility than the Indonesian IDX Composite (also referred to as the JKSE) or the SET from Thailand. We turn to a specific volatility analysis at a later stage.

To illustrate and enable a better comparison of the different developments of the country indices, Figure 2 shows the six indices in a summary figure. A direct comparison shows that especially the Chinese financial market, represented by the SSE, has performed less well than the rest of the indices. A possible reason for this is the impact of trade restrictions in the context of the US-China trade war.

Figure 2: The price time series of RCEP's largest financial markets - summary

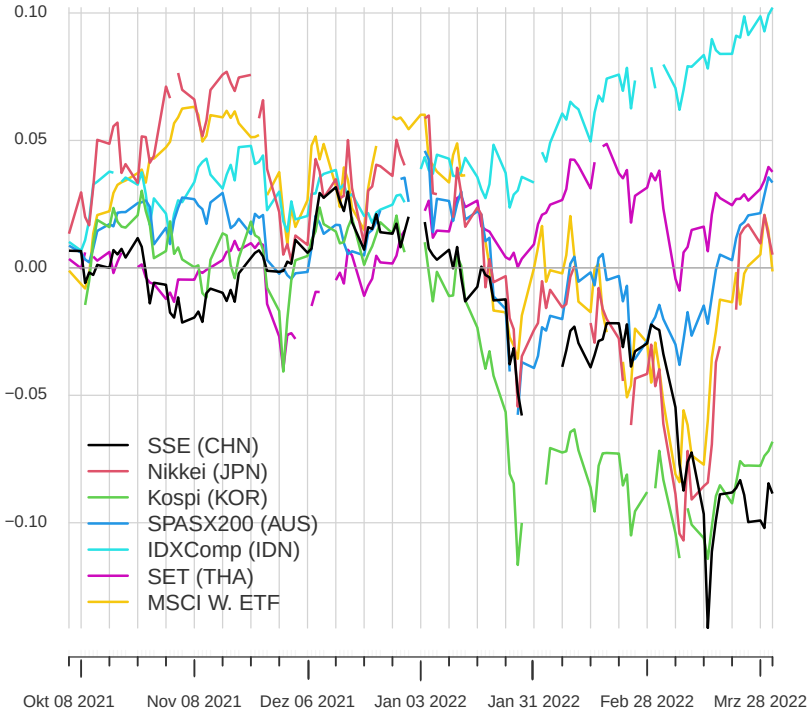


The previous illustrations form a basic understanding of the six main RCEP indices for our analysis. In the following, for most parts of the analysis, the time scale is adapted to a smaller time span of the more recent stock market development in the wake of the RCEP agreement's entry into force. We now turn to examine whether the formation of the RCEP free trade zone has had a positive effect on the financial markets under consideration as well as which markets might gain or lose. At this point, it needs to be acknowledged that there are, of course, many different influences on a country's financial market affecting index levels and changes. In this study we focus solely on the effect of the RCEP agreement and do not explicitly incorporate other influences into our analysis. Hence, the ability for causal interpretations is limited.

Besides a general positive effect on the stock market, among others in the form of returns, we expect a short-term effect on the stock markets of those RCEP members for which the agreement enters into force, specifically once the date of entry into force is certain as well as for a limited time span shortly after the entry into force itself. The minimum requirement for RCEP to enter into force 60 days later for the respective countries was a minimum of six ASEAN as well as three non-ASEAN states domestically ratifying the agreement, which was met on November 2nd, 2021 (RCEP, 2022b). Moreover, as mentioned above, The RCEP contract was signed in November 2020 and entered into force for the first 10 of the 15 countries on January 1st, 2022, including China, Japan, Australia and Thailand, while South Korea followed one month later and Indonesia on January 2nd, 2023. Hence, we expect to be able to see a potential effect on the indices at the time of RCEP's entry into force for all of the six nations but Indonesia, for which its JKSE index could exhibit an effect in early 2023.

Let us take a look at the short-term price changes for these periods. Figures 3 and 4 show us the cumulative returns of the six indices for the six-month time span of October 2021 to March 2022 and the corresponding boxplots, respectively. This allows us to see a potential effect from both the time of knowing the future date of entry into force as well as the entry into force itself. All graphs interrupt at certain dates, determined by days on which the respective stock markets are closed, such as public holidays.

Figure 3: Short-term stock market performance of the major indices - cumulative returns (10/2021 - 03/2022)



Observing the development of the graphs at the beginning of November, when the entry into force was known, we see a mixed development of the indices. In the first week of November, while the Australian and Indonesian indices mainly rise, others like the Chinese and South Korean fall slightly. The first few weeks of November are overall characterised by slightly rising cumulative returns of the indices. The expected entry into force of RCEP can be a contributing factor. Since China and Japan as well as Japan and South Korea had been lacking bilateral FTAs entirely we expect large increases of international trade volume for them. This expectation might contribute to the slightly rising cumulative returns of several RCEP indices in the first few weeks of November, however, does not seem to have a large effect if any.

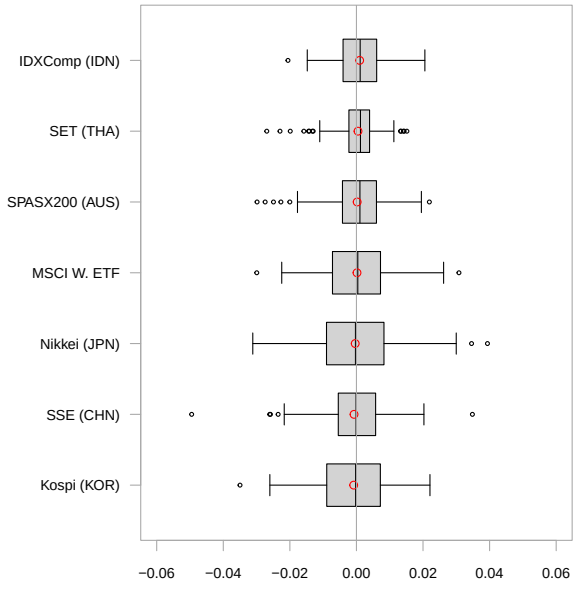
Regarding the second time of interest, the entry into force beginning of January 2022, we again observe a relatively similar development of the indices although with different magnitudes of cumulative returns. Afterwards, however, it can be clearly seen that all major country indices fall along with the reference index. In particular, the large countries show a sustained and stronger negative change than the smaller countries. Even though it is theoretically possible that there is a positive effect of RCEP's entry into force at this point, which is overcompensated by negative effects with a larger magnitude in total, we

reject our hypothesis of a short-term effect on the stock markets for the country indices of those RCEP members for which the agreement enters into force, shortly after entry into force. A supporting factor is the similar development of the Nikkei and the MSCI World index, since we expect a large positive impact for the Japanese economy. The Nikkei does not develop much differently from the reference index in terms of the stock market's cumulative returns over the observed period. Moreover, the country indices grow apart in following weeks until the end of the first quarter of 2022. While the stock markets of Australia and Thailand develop positively, the cumulative returns of others like the SSE and the Nikkei are mostly negative.

Figure A4 in the Appendix depicts the cumulative returns of the six country indices against the reference index over the same period and illustrates the described similarities as well as increasing variability towards the end of the period.

Figure 4 shows the corresponding boxplot for the same period, from which we can see changes in the cumulative returns from a different perspective. It shows us the distribution as well as the range of returns at a glance.

Figure 4: Short-term stock market performance (returns) of the major indices - boxplot (10/2021 - 03/2022)



The dot inside a box depicts the median of returns, i.e. the middle or 50 percent data point, while the solid line inside a box equals the mean. The box itself stands for the inter-quartile range (IQR) including the middle 50 percent of all data points. It follows that the lower and upper ends of a box depict the first and third quartile, respectively,

and that the remaining 25 percent of data points on each side lie outside the boxes. The lower and upper T-shaped whiskers end at the point of 1.5 times the IQR, unless the data points do not range as far, and any points outside are identified as outliers and can be seen outside of the T-shaped whiskers.

The indices are ranked in descending order of cumulative returns over the analysed time span and we see an almost normal distribution for all seven time series, which is important regarding the selection of the GARCH model for the volatility analysis. Comparing the indices, it becomes clear that four out of the six country indices outperformed the MSCI World, the latter exhibiting a negative median and mean. The similar development of the Nikkei and the MSCI World observed by the graphs are supported by similar boxplots, however, the latter reveal that the Nikkei performed better and has a positive mean as opposed to the MSCI World. As these aspects are easier to identify by means of the boxplot diagram it will be part of following sections.

More important than the analysis of price time series, however, is the consideration of market risk and volatility. The volatility of stock markets is influenced by a myriad of factors that play a significant role in shaping the dynamics of financial markets, a well-studied nexus in research. Firstly, macroeconomic indicators such as interest rates, inflation rates, and GDP growth rates as well as overall economic stability have a substantial impact on stock market volatility. Changes in these variables can affect the perceived accuracy of market predictions and investor sentiment, leading to fluctuations in stock prices. Additionally, geopolitical events, such as trade disputes, political instability, or major policy changes, can trigger volatility in stock markets, as they introduce uncertainty and alter market expectations. This is something we might expect for the SSE to reflect because of the US-China trade war. On the other hand, consistent and transparent government policies, especially in areas such as taxation, regulation, and trade, can provide certainty to investors and reduce market volatility.

Officer (1973) shows the strong relation of the volatility of such macroeconomic factors and stock market volatility while Schwert (1989a) finds that in times of recessions many aggregate economic factors are more volatile, especially financial asset returns and measures of real economic activity. Stock market volatility, however, does not show long-term effects from shocks like financial crises or wars (Schwert, 1989b). This supports our focus on the time span around the RCEP agreement's announcement and entry into force while

neglecting the relatively recent COVID-19 economic crisis as we do not expect long-term effects on the stock market volatility.

Furthermore, investor behaviour and sentiment, driven by factors like risk appetite, market sentiment, and herd mentality, can amplify market volatility. The level of market liquidity, influenced by factors such as trading volume and bid-ask spreads, also plays a crucial role in determining stock market volatility. Finally, advances in technology and the widespread use of algorithmic trading have introduced new dynamics, where rapid information dissemination and high-frequency trading can exacerbate market volatility.

It is important to note that while these factors can contribute to reducing volatility, no market is entirely free from fluctuations. Stock markets inherently involve risks, and periodic volatility is a normal part of the investment landscape. Overall, uncertainty plays a crucial role and prices of speculative assets should react quickly to new information about economic events (Schwert, 1989a). Therefore, we expect stock market volatility to reduce around the time of knowing the future date of RCEP's entry into force as well as at the time of its entry into force itself.

Figure 5: Volatility comparison of China's major index (SSE) vs. the MSCI World index

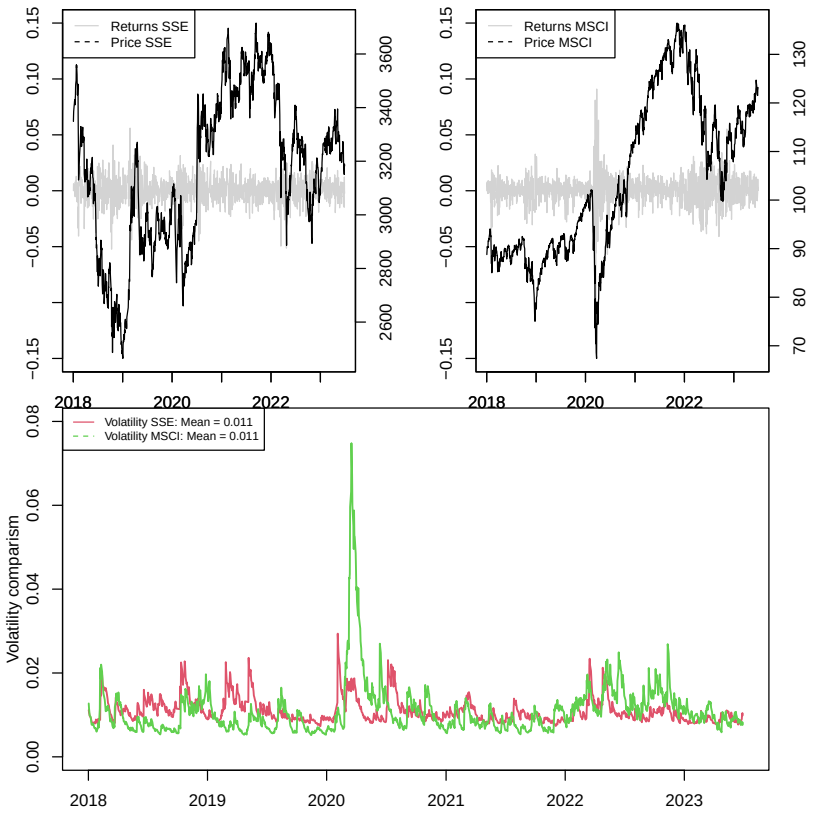


Figure 5 again displays the development of returns (left axis) and stock price (right axis) together with the historic volatility (lower part) of the Shanghai Composite index in direct comparison with the MSCI World as the reference index. For the calculation of historic volatility we make use of a standard GARCH model and daily data. The lower diagram illustrates that the volatility of the Chinese index is on a slightly higher level than the MSCI World over long periods and therefore, at these times, more uncertain. During other periods, such as the second quarter of 2020 the second half of 2022, we observe the opposite. For the latter point in time we see higher fluctuations of volatility for the MSCI World. Overall, the SSE and the MSCI World observe an equal mean volatility. We clearly see the dominant effect of the COVID-19 pandemic in the first months of 2020, which does not last long. This is in line with our hypothesis derived earlier as stock market volatility does not show long-term effects from shocks like financial crises. Moreover, for the SEE we can reject the hypothesis of reducing volatility due to RCEP as at the time of entry into force and shortly afterwards we see a rise in volatility.

In order to see examine the volatility for all indices, Table 5 shows the mean volatility values calculated by the mentioned GARCH(1,1,) model for the six RCEP indices together with our reference index for all half-year periods of the years 2020, 2021, 2022 and the first half of 2023. Some further details on the GARCH calculation can be found in the Appendix for the two largest indices of the RCEP zone, SEE and Nikkei225, as well as for the MSCI World as the reference index.

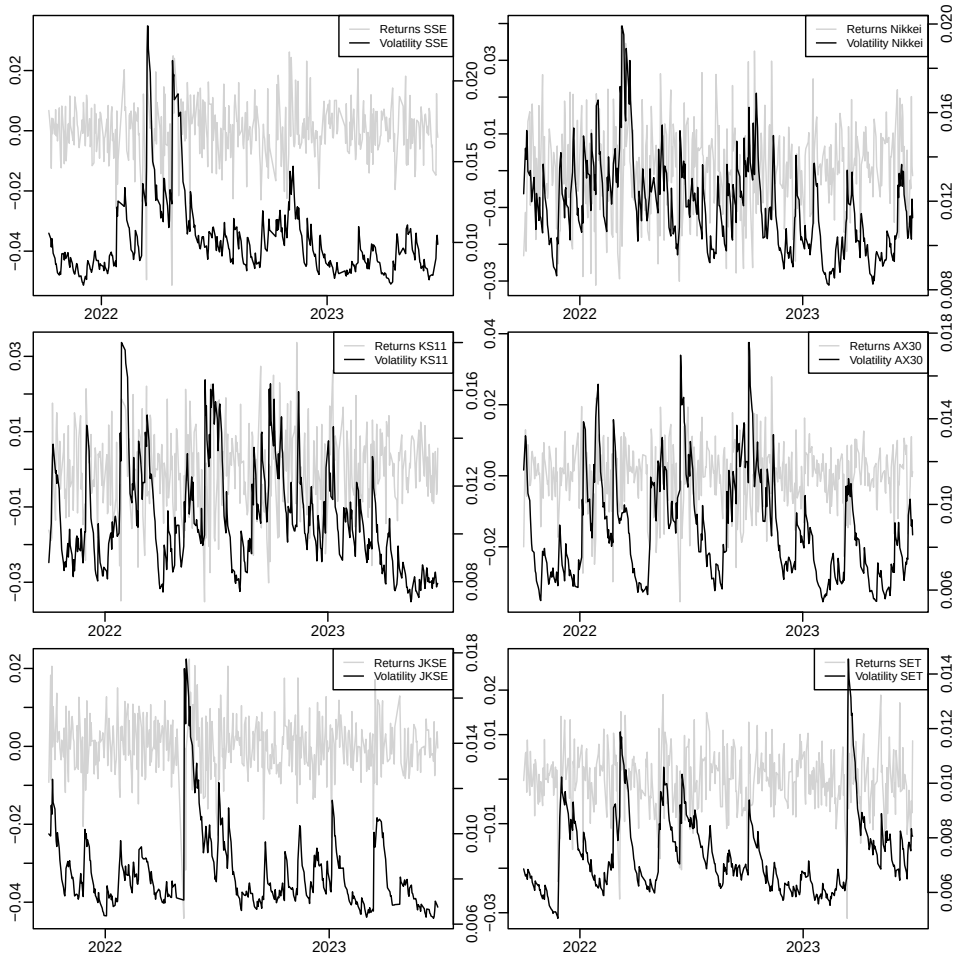
Table 5: Volatility comparison of RCEP's major indices over time

Volatility	CHN (SSE)	JPN (Nikkei)	KOR (KS11)	AUS (AX30)	IDN (JKSE)	THA (SET)	Reference (MSCI)
2020-HY1	0.0123	0.0166	0.0172	0.0180	0.0153	0.0181	0.0209
2020-HY2	0.0117	0.0106	0.0110	0.0100	0.0105	0.0104	0.0102
2021-HY1	0.0102	0.0120	0.0110	0.0081	0.0095	0.0090	0.0086
2021-HY2	0.0094	0.0114	0.0094	0.0073	0.0083	0.0073	0.0082
2022-HY1	0.0121	0.0132	0.0114	0.0101	0.0090	0.0079	0.0143
2022-HY2	0.0102	0.0117	0.0112	0.0095	0.0080	0.0070	0.0138
2023-HY1	0.0089	0.0104	0.0094	0.0074	0.0076	0.0075	0.0094

Comparing the development of volatility for the different indices over time, we see that for the Chinese, Japanese, South Korean as well as Australian financial market, volatility increases from 2021 to the first half of 2022 and then reduces to reach the lowest value in 2023. The magnitude of changes is very similar for these indices, even though the markets observe some differences in their level of volatility as the Chinese, Japanese and South Korean markets are more volatile than the Australian financial market. Regarding Indonesia, for which RCEP entered into force in the beginning of 2023, changes in volatility

are not as pronounced and the volatility reduces over time. The volatility of the Thai financial market changes only slightly in the last four half-year periods. Over the same time, the reference index shows the most pronounced rise from 2021 to 2022 as well as decline to 2023. A relatively low volatility at the points of interest regarding RCEP and its entry into force indicates relatively little movement of the markets, which can potentially be based on expectations surrounding the agreement, for instance, in the form of a wait-and-see behaviour.

Figure 6: The volatility and returns time series of RCEP's largest financial markets

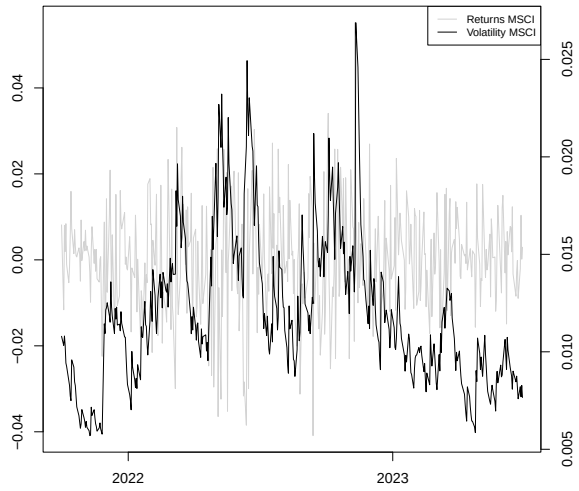


Overall, we see decreasing volatility at the time of knowing the future date of RCEP's entry into force as well as at the time of its entry into force itself, some indices' volatility declining to their lowest levels in years. As discussed, many factors influence this pattern such as the COVID-19 pandemic and its consequences and we therefore cannot infer causality. In order to see short-term changes that might be more indicative of an RCEP effect at the two main periods of interest, Figure 6 illustrates the development of volatility

(right axis) for our six financial market indices from October 2021 to the end of the first half of 2023 together with the indices' returns (left axis). We can thus examine the development for the recent past, starting with the time when the imminent entry into force of RCEP was known, analogously to the analysis of the cumulative returns.

Analogously, Figure 7 shows this development for our reference index. The indices depicted in Figures 6 and 7 observe clear differences in the volatility development, their levels and we do not see a pattern of reduced volatility at the time of or after RCEP's entry into force. Thus, we cannot identify a specific effect that is highly indicative of a large RCEP impact on these country indices, even though RCEP is likely to be a contributing factor for the overall pattern of reduced volatility that we saw earlier. The following sector level analyses will include this approach and is more insightful in this regard.

Figure 7: The volatility and returns time series of the reference index MSCI World



3.4 Sector analysis

The analysis of an entire index is, of course, diluted to some extent. Because of the many heterogeneous industries a market index is composed of, its development is often somewhat smoother than that of individual industries. Hence, we now turn to analyse the stock market development of industries most relevant to RCEP and its members. As derived, the top three industries of interest for our financial market analysis of RCEP effects are the automotive industry, the electronic sector as well as the chemical industry, by order of RCEP members' international trade in value-added.

In order to approximate the industries we analyse the five most influential RCEP com-

panies in terms of revenue for each of the three industries. This allows for good interpretability and we expect the largest impact of RCEP, for instance in terms of additional trade volume, for the largest companies of an industry. For comparison, for each sector we add a reference in the form of an ETF for the respective industry. Analogously to the analysis of the country indices, after examining the longer time span regarding stock market performance we turn to the shorter time span of October 2021 to March 2022 for the event analysis of RCEP for each of the sectors.

3.4.1 The automotive industry

We first analyse to what extent RCEP has an effect on the automotive industry's stock market and its development. For this purpose, we analyse those five companies in the RCEP zone with the highest revenue in the automotive sector, namely Toyota, Hyundai, Honda and Nissan as well as SAIC Motor and compare them with a benchmark ETF, the iShares STOXX 600 Automobiles. Table 6 lists these along with variables of interest. Revenue is depicted for 2021, although financial years of companies sometimes differ in their reporting and can overlap with other years for a few months. All five companies are among the ten largest automotive companies in the world. The reference ETF consists of holdings of the largest European stock-listed companies of the industry and contains large investments in Mercedes-Benz (22.2 percent of ETF), Stellantis (14.2 percent of ETF), BMW (13.6 percent of ETF) as well as Ferrari (13.3 percent of ETF)[6].

Table 6: RCEP's major companies of the automotive industry

Company	Country	Revenue in 2021 (in US$ bn.)	Stock Symbol
Toyota	JPN	245	7203.T
SAIC Motor	CHN	121	600104.SS
Honda	JPN	110	7267.T
Hyundai	KOR	99	005380.KS
Nissan	JPN	74	7201.T
iShares STOXX 600 Europe Automobiles & Parts	ETF	n/a	EXV5.DE

Figure 8 shows the stock price development (right axis) of the top five RCEP automotive companies together with their returns series (left axis) and in comparison with the reference ETF. The left axis depicts the returns while the right axis indicates the stock price in local currency, which is Euro for the ETF. In comparison to the indices

[6]Shares of ETF according to Yahoo Finance (2023). The ETF's company holdings are adapted over time.

of the economies, we see that company stocks are much more volatile. Both indicators develop very differently for the five companies as well as for the reference ETF. In fact, we see very different developments of stock price for the three Japanese companies Toyota, Honda and Nissan, despite them sharing the same economy. Moreover, the last 1.5 years represent the time of the RCEP agreement being effective, for which we see a differing development.

Figure 8: The price and returns time series of RCEP's largest automotive companies

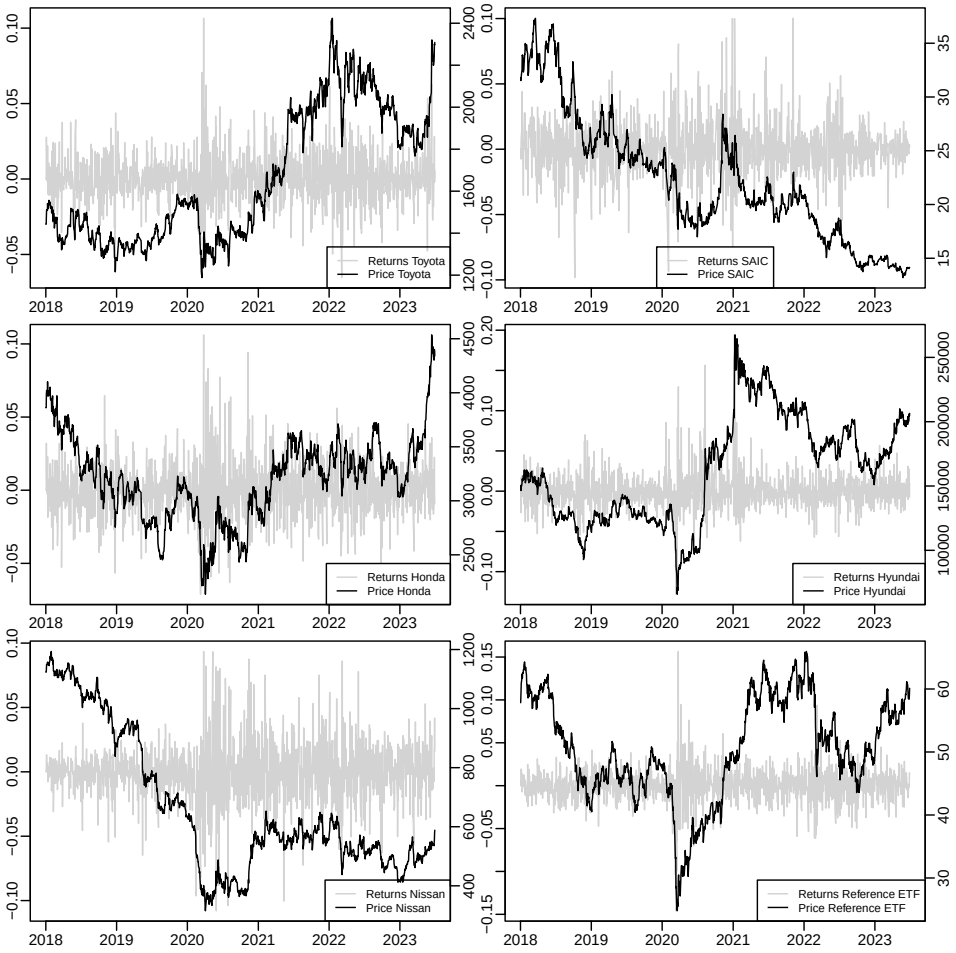
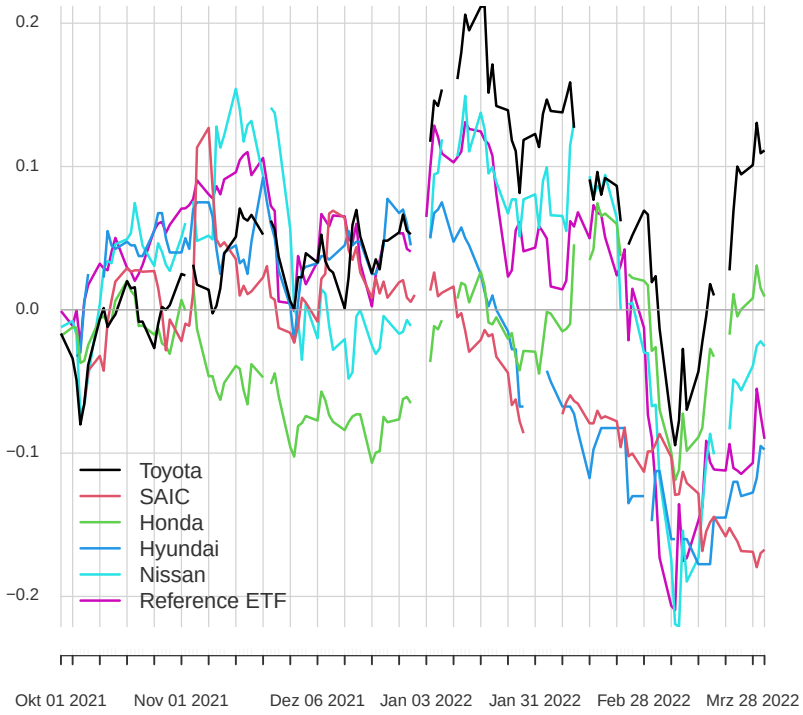


Figure 9 depicts the cumulative returns of the automotive industry for the chosen period from October 2021 to March 2022. As pointed out, this enables to see a potential effect around the time of knowing the imminent entry into force of RCEP beginning of November 2021 while being able to see a potential effect of the entry into force itself in the beginning of 2022. The first point of interest in the beginning of November is characterised by rising cumulative returns for the first two to three weeks (depending on the company) after the future entry into force of RCEP was known. Honda's returns are negative and decreasing

at this time, however, and SAIC's cumulative returns increase steeply in the beginning and fall just as much thereafter. The development is broadly consistent with that of the reference ETF, speaking against a distinctive RCEP effect on the returns. Nevertheless, it is possible that investors' expectations regarding the upcoming entry into force of RCEP lead to a rise of many of the industry's company stock returns, including those of European companies and therefore also the reference ETF. Several European automotive companies are heavily invested in the RCEP zone and will thus benefit from local RCEP provisions. Any causality is, however, speculative.

Figure 9: Short-term stock market performance of the automotive industry - cumulative returns (10/2021 - 03/2022)

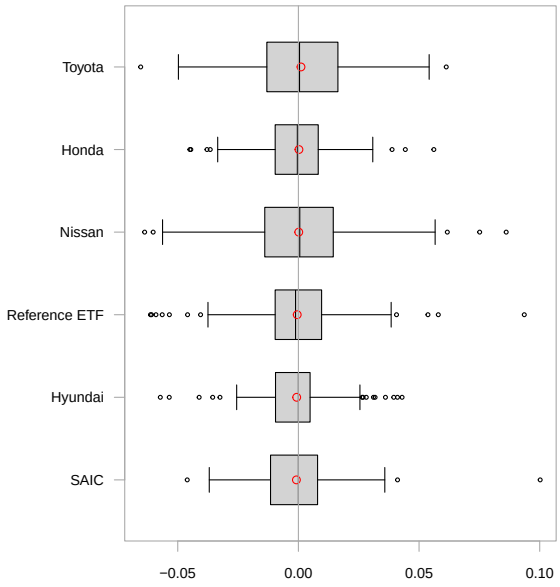


For the second time of interest in the beginning January, we see a substantial rise in returns that is most prominent for the three Japanese companies Toyota, Honda and Nissan. Cumulative returns of Chinese SAIC and South Korean Hyundai fall below zero after a short rise. This is in line with expectations for the latter as RCEP entered into force for South Korea later on February 1st and at that time we do see a short-term increase in returns as opposed to the other companies' returns. Even though we cannot infer causality, these developments are indicative of a potential short-term RCEP effect on the stock returns of the automotive sector shortly after entry into force. After several weeks, the price time series decrease for all stocks as well as the reference ETF.

Figure A5 in the Appendix depicts the cumulative returns of the automotive industry against its reference ETF over the same period and illustrates the similarity of the developments described.

Figure 10 shows the corresponding boxplots, illustrating that over the period of expecting the imminent entry into force of RCEP and the first months of its effect, the stocks of Japanese Honda, Toyota and Nissan (in descending order of cumulative returns) outperformed the reference ETF. The latter, together with Hyundai and SAIC Motor, observe negative median and mean values. We again see the that a normal distribution of the data can be assumed, while there is a higher scattering of the measurement values compared with the market indices with SAIC motor, for example, showing a positive outlier of a 10 percent increase in returns on one day. This is according to the expectation of company stocks in relation to indices for an entire financial market. Moreover, we observe outliers for all stocks and in both directions, showing comparatively very high and low returns, or large gains and losses, respectively. These observations add to the understanding of the automotive industry stocks' performance around the time of RCEP's entry into force, however, are not able to depict the development over the six-month period nor a specific short-term effect of RCEP on stocks' returns.

Figure 10: Short-term stock market performance (returns) of the automotive industry - boxplot (10/2021 - 03/2022)



For this purpose, we now turn to analyse volatility of the companies' stocks. Before comparing all five companies among each other, against the reference ETF as well as over

time, let us take a look at the development of Toyota, the largest automotive company of the RCEP zone as well as worldwide in terms of sold cars (German Volkswagen is the largest in terms of revenue). Figure 11 illustrates a broad indication over the past five years in terms of stock price, returns and volatility of Toyota and the reference ETF. The lower diagram shows that the volatility of Toyota is on a lower level than the reference ETF and therefore less uncertain, something very unexpected. Nevertheless, we can reject the hypothesis of reducing volatility due to RCEP, since at the time of entry into force and shortly afterwards we see a rise in volatility and an overall high fluctuation. Moreover, for both volatilities we see phases of low and high measurement values over the five-year period.

Figure 11: Volatility comparison of Toyota vs. the reference ETF

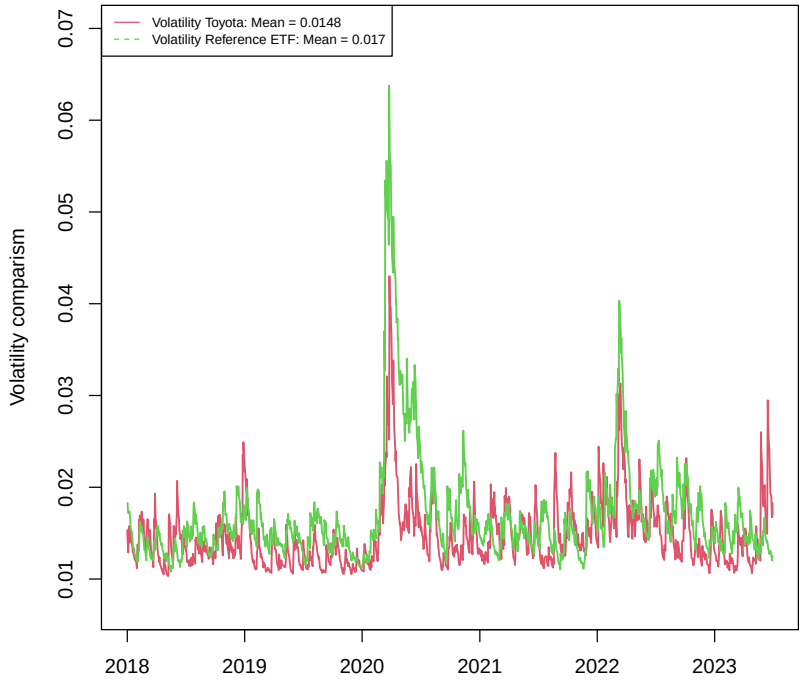


Table 7 shows the volatility of the five automotive companies together with the benchmark ETF for 2021, 2022 and the first half of 2023, illustrating the sequential phases relevant for stock market expectations regarding RCEP and its entry into force in terms of its mean volatilities.

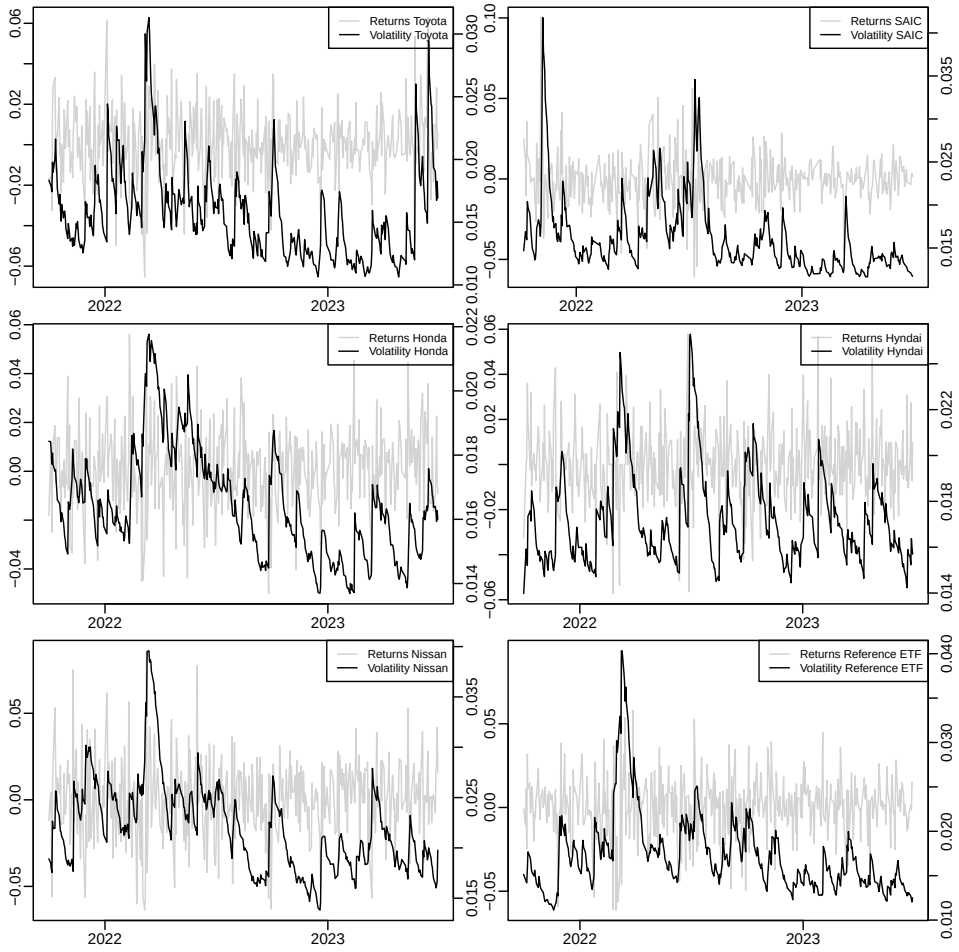
Table 7: Volatility comparison of RCEP's major automotive companies over time

Volatility	Toyota	Hyundai	Honda	Nissan	SAIC	Reference ETF
2020-HY1	0.0187	0.0229	0.0244	0.0295	0.0326	0.0280
2020-HY2	0.0143	0.0235	0.0218	0.0268	0.0294	0.0177
2021-HY1	0.0151	0.0212	0.0182	0.0257	0.0236	0.0149
2021-HY2	0.0149	0.0193	0.0168	0.0156	0.0231	0.0151
2022-HY1	0.0185	0.0172	0.0181	0.0175	0.0260	0.0206
2022-HY2	0.0144	0.0167	0.0160	0.0176	0.0198	0.0176
2023-HY1	0.0145	0.0133	0.0153	0.0169	0.0197	0.0147

The data exhibits higher levels than seen for the market indices, which is as expected for stocks of single companies. We also see that the company stocks' volatility levels differ more than those of the country indices. Toyota's volatility is relatively stable across the half-year volatilities while that of Hyundai is clearly decreasing for every half-year period. Japanese Honda and Nissan show a decline over time, with increases in 2022 before declining again towards 2023, which is similar to the stock of Chinese SAIC motor, although on a different level. The reference ETF depicts a mixed development. Overall, we see decreasing volatility over time for the half-year periods as well as relatively low values for the last two half-year periods, corresponding to the time of knowing the future date of RCEP's entry into force as well as at the time of its entry into force itself.

Let us look at the more detailed volatility development of the companies' stocks (right axis), illustrated by Figure 12 together with the companies' returns (left axis). Although some of the graphs exhibit a decline for some parts of late 2021 and around the time that RCEP's imminent entry into force became knowledgable in the beginning of November, the graphs exhibit substantially different developments at that time. Moreover, the reference ETF also shows a decline of volatility around that time. Therefore, even though RCEP might have contributed to a declining volatility at that time, several aspects speak against a distinctive RCEP effect. At the time of RCEP's entry into force we see a rather increasing volatility, speaking against a volatility-reducing effect of RCEP. The returns' development exhibit that the rising volatility is not based on clearly rising returns at the points of interest, which could have been explained by an RCEP effect. In addition, the fact that the volatility of the reference ETF develops similarly supports this and indicates that other factors than RCEP might cause this development. Over time, however, we do see the reductions in volatility shown by the half-year periods in Table 7, which is most pronounced for Chinese SAIC motor. RCEP can be a contributing factor.

Figure 12: The volatility and returns time series of RCEP's largest automotive companies



3.4.2 The computer, electronic and electrical equipment industry

We now turn to analyse a potential RCEP effect on the stock market of the electronic industry, which has a broader profile with more diverse activities including the production of electronic components, such as microprocessors or integrated circuits, the manufacture of computers and computer peripherals, consumer electronics, magnetic and optical media as well as irradiation and electromedical equipment, among others (UN, 2008).

As depicted by Table 8, analogously to the previous section, the five largest companies headquartered in the RCEP zone operating in this field are Samsung Electronics, Sony, Hitachi, Panasonic as well as Xiaomi. Revenue is depicted for 2021, although financial years of companies sometimes differ in their reporting and can overlap with other years for a few months. Many of the industry's companies worldwide are located in the RCEP

region or Asia in general. While Chinese Huawei is omitted due to missing data, the large Taiwanese company Hon Hai Precision Industry would have made the top five with approximately $ 212 bn in revenue in 2022 had Taiwan become a member of RCEP. While the agreement became effective for Samsung only on February 1st, for all others it did so in the beginning of January. Our benchmark is the iShares Global Tech ETF that consists of more than 100 holdings of stock-listed companies from around the world including large holdings of Apple (22.5 percent of ETF) and Microsoft (19.9 percent of ETF). It also contains small holdings of Samsung Electronics (2.4 percent of ETF) and Xiaomi (0.2 percent of ETF)[7].

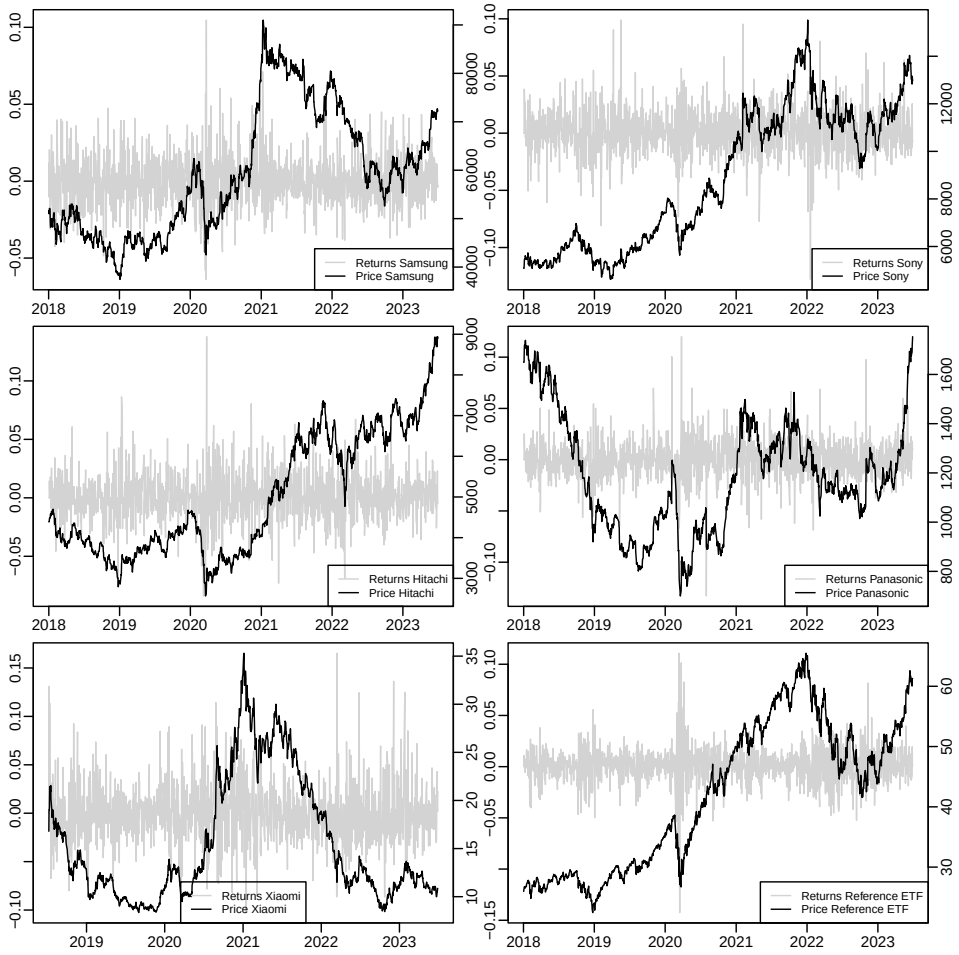
Table 8: RCEP's major companies of the electronic industry

Company	Country	Revenue in 2021 (in US$ bn.)	Stock Symbol
Samsung Electronics	KOR	228	005930.KS
Sony	JPN	82	6758.T
Hitachi	JPN	73	6501.T
Panasonic	JPN	63	6752.T
Xiaomi Corporation	CHN	51	1810.HK
iShares Global Tech ETF	ETF	n/a	IXN

Figure 13 illustrates the development of returns (left axis) and stock price (right axis) of these companies together with that of the reference ETF. In comparison to the indices of the economies, we again see that company stocks are much more volatile analogous to the automotive industry. The price time series of Sony and Hitachi develop relatively similarly compared with that of the reference ETF in terms of stock price, although on different levels, while the other companies' stock prices develop differently. Returns are most volatile for Xiaomi over time and least volatile for Panasonic, while the reference ETF is much less volatile nonetheless, as can be expected.

[7]Shares of ETF according to Yahoo Finance (2023). The ETF's company holdings are adapted over time.

Figure 13: The price and returns time series of RCEP's largest electronic companies



In order to analyse the times of interest regarding RCEP's entry into force, Figure 14 shows the cumulative returns of the companies over the six-month period until the end of March 2023, analogous to the section on the automotive industry. The first point of interest in the beginning of November is characterised by rising returns for the first two to three weeks (depending on the stock) before most companies' returns fall for some time. This rise, however, is in line with that of the reference ETF, which speaks against a distinctive RCEP effect on the returns. Xiaomi's returns fall over most of the observed time span.

Regarding the second time of interest in the beginning January, we see a mixed development of returns, although most companies' stocks yield positive returns for some time between the first and second week of January, before most returns decrease for some time. Overall, Sony's returns develop very much in line with those of the reference ETF. Samsung's returns do not indicate a distinctive development in the beginning of Febru-

ary. Overall, however, we do see a tendency of positive returns of most companies' stocks during the periods of interest, potentially being based in parts on an RCEP effect.

Figure A6 in the Appendix depicts the cumulative returns of the electronic industry against its reference ETF over the same period. We observe the close similarity of Sony and a tendency of increased distance to the returns of the reference ETF towards the end of the period. Compared with the automotive industry, we see a higher variability in the comparison of company stocks and the reference ETFs over the entire period.

Figure 14: Short-term stock market performance of the largest electronic companies - cumulative returns (10/2021 - 03/2022)

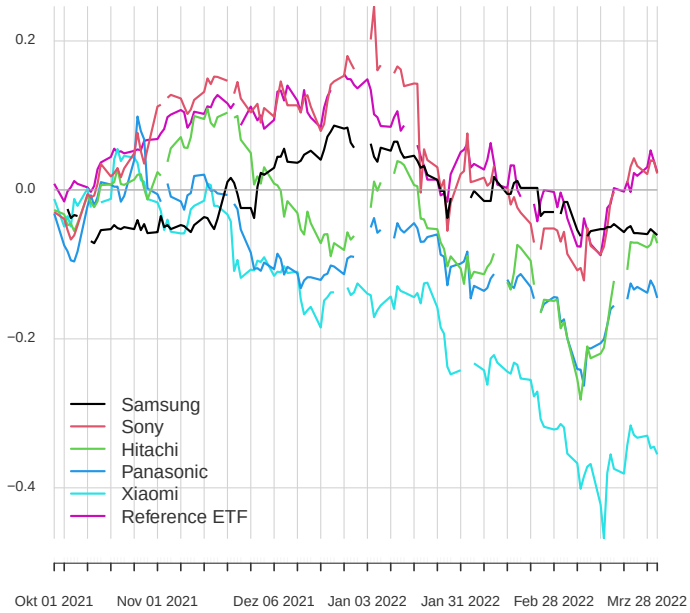
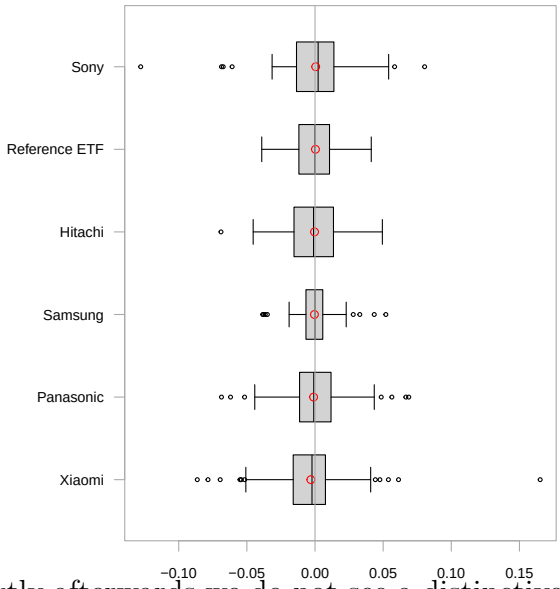


Figure 15 shows the corresponding boxplots, illustrating that for this industry merely two companies outperformed the reference ETF, namely the two Japanese companies Hitachi and Panasonic. Moreover, performance of the industry was relatively weak, as indicated by the mostly negative values of median and mean. The scattering of data points is similar compared with the automotive industry, although some outliers of Sony and Xiaomi are more extreme.

Before turning to the detailed volatility comparison for the industry, Figure 16 depicts the volatility of Samsung Electronics, the largest electronic company among RCEP members, and of the reference ETF. The diagram illustrates that the volatility of Samsung is very much on the level of the reference ETF, with less fluctuation. Therefore, it can be argued that Samsung's stock is associated with less risk, something unexpected. Moreover, we can reject the hypothesis of reducing volatility due to RCEP, since at the time

Figure 15: Short-term stock market performance (returns) of the largest electronic companies - boxplot (10/2021 - 03/2022)



of entry into force and shortly afterwards we do not see a distinctive change of pattern in volatility.

Figure 16: Volatility comparison of Samsung Electronics vs. the reference ETF

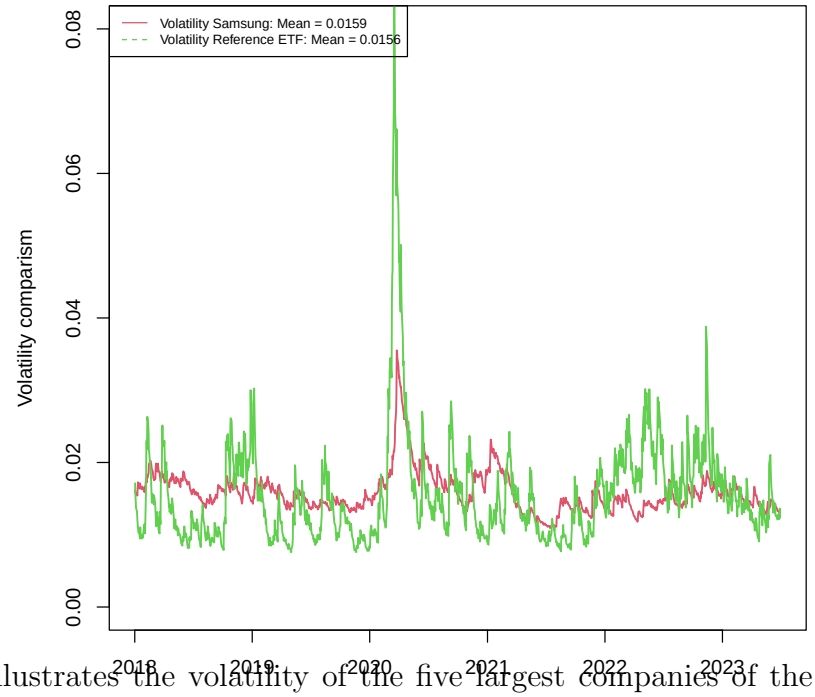


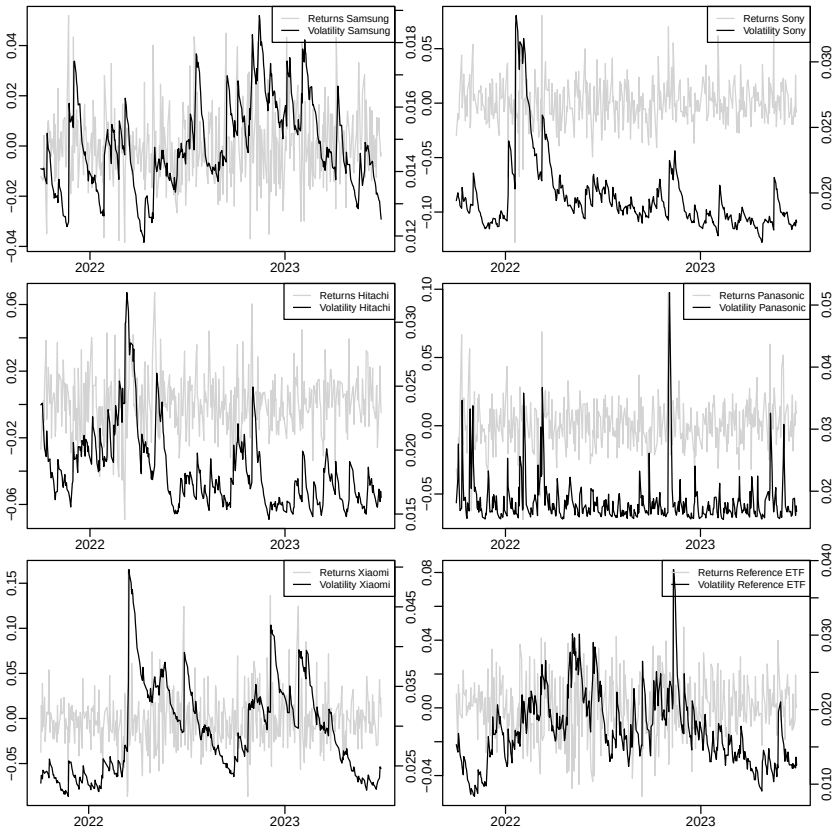
Table 9 illustrates the volatility of the five largest companies of the electronic sector together with the benchmark ETF for 2021, 2022 and the first half of 2023. We again see different developments and levels of the companies' stocks. Together with Figure 17 we can observe a pattern of reducing volatility especially for Sony and Hitachi. At the time when RCEP's imminent entry into force was known in late 2021, the graphs of Samsung

Table 9: Volatility comparison of RCEP's major electronic companies over time

Volatility	Samsung	Sony	Hitachi	Panasonic	Xiaomi	Reference ETF
2020-HY1	0.0208	0.0199	0.0245	0.0218	0.0301	0.0251
2020-HY2	0.0168	0.0185	0.0194	0.0187	0.0358	0.0148
2021-HY1	0.0156	0.0201	0.0196	0.0190	0.0308	0.0137
2021-HY2	0.0136	0.0187	0.0188	0.0186	0.0240	0.0116
2022-HY1	0.0139	0.0223	0.0208	0.0185	0.0313	0.0206
2022-HY2	0.0158	0.0193	0.0176	0.0180	0.0307	0.0190
2023-HY1	0.0149	0.0180	0.0166	0.0177	0.0288	0.0139

Electronics, Sony, Hitachi and Xiaomi exhibit a decline in volatility, which is in line with the development of returns. This is true for the reference ETF, too, however. Moreover, for Samsung Electronics RCEP came into effect one month later. In the beginning of 2022 we see a tendency of increasing volatility for the companies' stocks. Thus, although RCEP might be a contributing factor for rising returns and reducing volatility in late 2021, we cannot clearly identify a distinctive RCEP effect. Furthermore, the volatility of the stock of Samsung Electronics shows a clear decline in 2023.

Figure 17: The volatility and returns time series of RCEP's largest electronic companies



3.4.3 The chemical industry

The chemical industry in the RCEP zone contains two large companies in terms of revenue that operate in other industries for most of their business, namely Chinese Sinopec and Petrochina. Although they had chemical industry sales of approximately $66 bn and $40 bn in 2021, respectively, this was merely a relatively small share of their total revenue, namely 16 and 10 percent, respectively (Tullo, 2022). Thus, we turn to chemical industry sales revenue as the metric for our company selection and with this definition the top five RCEP companies of the chemical industry are LG Chem, Mitsubishi Chemical, Hengli Petrochemical, Wanhua Chemical as well as Sumitomo Chemical (Tullo, 2022). Table 10 lists these along with variables of interest. Revenue is depicted for 2021, although financial years of companies sometimes differ in their reporting and can overlap with other years for a few months. All of these companies made between 85 and 100 percent of their total sales revenue in the chemical sector. Our benchmark index is the iShares STOXX Europe 600 Chemicals, consisting of holdings of the largest European stock-listed companies of the industry. It contains large investments in Air Liquide (31.3 percent of ETF), BASF (14.2 percent of ETF) and Givaudan (9.6 percent of ETF)[8].

Table 10: RCEP's major companies of the chemical industry

Company	Country	Revenue in 2021 (in US$ bn.)	Stock Symbol
LG Chem	KOR	37	051910.KS
Mitsubishi Chemical Group	JPN	31	4188.T
Hengli Petrochemical	CHN	28	600346.SS
Wanhua Chemical	CHN	23	600309.SS
Sumitomo Chemical Company	JPN	7.8	4005.T
iShares STOXX Europe 600 Chemicals	ETF	n/a	EXV7.DE

Figure 18 illustrates the stock price development (right axis) of the top five RCEP companies of this industry together with that of the reference ETF. In comparison to the indices of the economies, we once more see that company stocks are much more volatile analogous to the other two industries analysed. Moreover, the companies of the chemical industry observe hardly any similarities in their development of stock price. Hence, their stock market valuation might be influenced significantly by different factors despite operating in the same industry.

[8]Shares of ETF according to Yahoo Finance (2023). The ETF's company holdings are adapted over time.

Figure 18: The price and returns time series of RCEP's largest chemical companies[9]

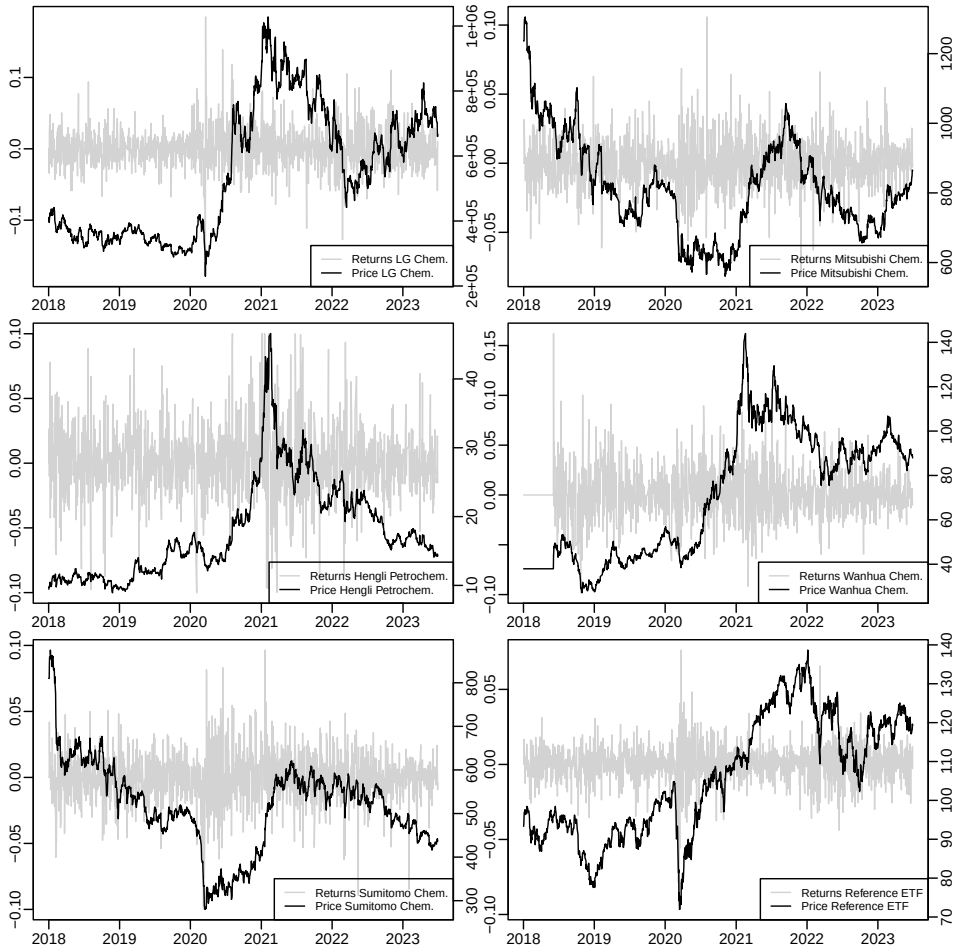
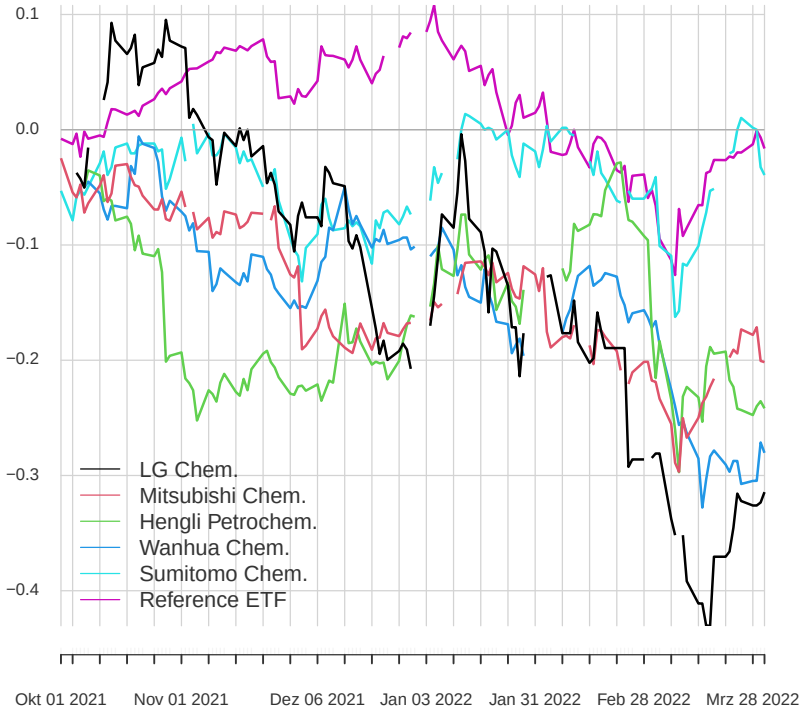


Figure 19 depicts the cumulative returns of the chemical industry for the chosen period. Leading up to the first point of interest in the beginning of November the returns develop very differently before the point when Mitsubishi Chem., Hengli Petrochem. as well as Wanhua Chem. seem to change course for a short period in the first two to three weeks after the future entry into force of RCEP was known. The reference ETF shows a different development at this time.

The second time of interest in the beginning January is characterised by a change of the previous pattern of mainly decreasing returns to now rising returns, except for Wanhua Chemical. The turning point varies from mid-December to the beginning of January and therefore, comes at the time of RCEP's imminent entry into force. The development of returns of LG Chem, Mitsubishi Chem. as well as Hengli Petrochem. are most similar, while the short-term effect is most prominent for LG Chem, for which however, the agreement became effective in February only. The subsequent changes in returns of both

[9]Data for Wanhua Chemical are unavailable until June, 5^{th}, 2018.

Figure 19: Short-term stock market performance of the largest chemical companies - cumulative returns (10/2021 - 03/2022)



the companies' stocks as well as the reference ETF are more similar compared with the last quarter of 2021, before RCEP came into effect. Both of these factors indicate a potential RCEP effect on the returns of the chemical industry, namely the change of pattern for four of the five chemical companies at the time of RCEP's imminent entry into force and the overall increased similarity of the returns' development afterwards.

Figure A7 in the Appendix depicts the cumulative returns of the chemical industry against its reference ETF over the same period and supports this development, illustrating the closer similarity of the stocks' returns in the beginning of 2022 until mid-March. Moreover, compared with the automotive industry, the overall variability of returns is again larger.

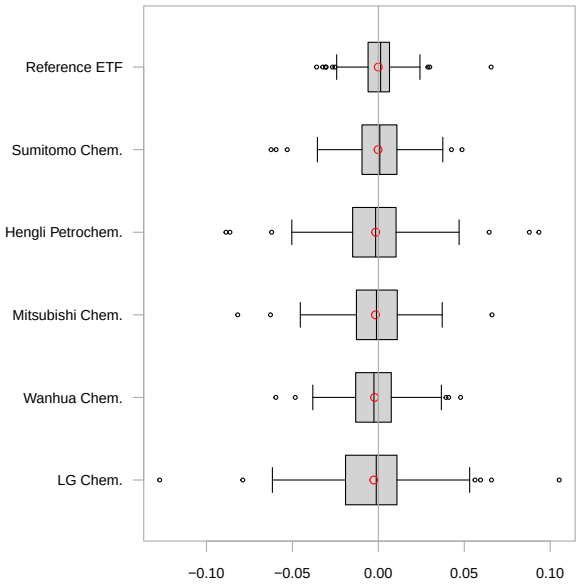
Figure 20 shows the corresponding boxplots, illustrating that over the period of expecting the imminent entry into force of RCEP and the first months of its effect, the stocks of Japanese Sumitomo Chem. and Mitsubishi Chem. as well as Chinese Hengli Petrochem. outperformed the reference ETF. We can see that the distribution of data points are very similar for Sumitomo Chem. and the reference ETF, while overall the scattering of data points is lower compared with the other two industries. Nevertheless, performance of the chemical industry over the observed period was relatively weak as can be seen, for

Table 11: Volatility comparison of RCEP's major chemical companies over time

Volatility	LG Che.	Mitsubishi Che.	Hengli Che.	Wanhua Che.	Sumi- tomo Che.	Reference ETF
2020-HY1	0.0344	0.0193	0.0232	0.0234	0.0234	0.0180
2020-HY2	0.0320	0.0186	0.0270	0.0259	0.0214	0.0116
2021-HY1	0.0280	0.0176	0.0348	0.0310	0.0193	0.0097
2021-HY2	0.0240	0.0169	0.0285	0.0213	0.0182	0.0095
2022-HY1	0.0318	0.0177	0.0269	0.0203	0.0185	0.0143
2022-HY2	0.0276	0.0157	0.0202	0.0177	0.0159	0.0127
2023-HY1	0.0246	0.0158	0.0209	0.0143	0.0152	0.0104

instance, by mostly negative median and mean values.

Figure 20: Short-term stock market performance (returns) of the largest chemical companies - boxplot (10/2021 - 03/2022)

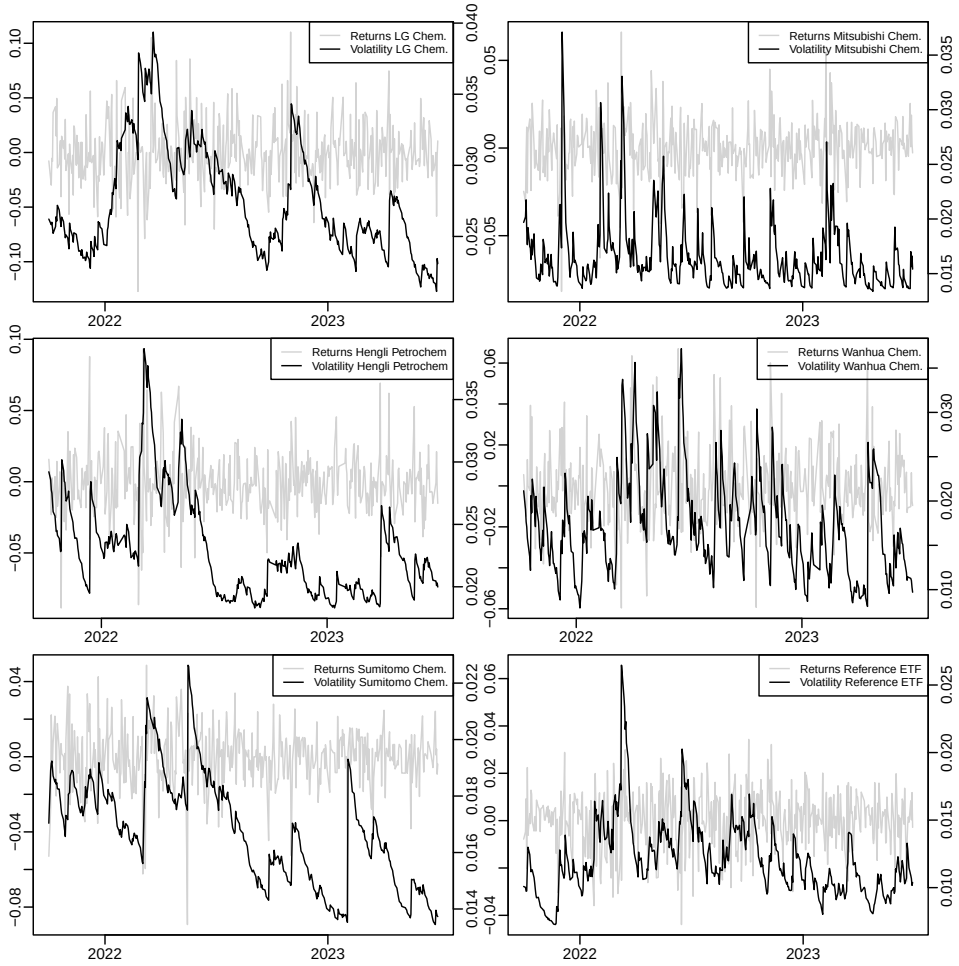


Before turning to the detailed volatility comparison for the chemical industry, Figure 21 depicts the volatility of the largest chemical company LG Chem together with the reference ETF. The diagram illustrates that the volatility of LG Chem is on a much higher level than that of the reference ETF with a mean more than twice as high, while the graphs intersect merely briefly around the time of the COVID-19 outbreak in the beginning of 2020. Therefore, it can be argued that LG Chem's stock is associated with more risk. Moreover, we can reject the hypothesis of reducing volatility due to RCEP for LG Chem, as at the time of entry into force and shortly afterwards we see a rise in volatility.

Observing the detailed development of volatility through Table 11 and Figure 22 (right axis) we see a similar pattern as for the other two industries in the sense that volatilities in later half-year periods are lower than in earlier half-year periods for all companies and the reference ETF while at the same time we see different levels and developments of the

stocks' volatilities. Both Japanese companies Mitsubishi Chem. and Sumitomo Chem. observe clearly and gradually declining volatility over the half-year periods. Figure 22 depicts that also LG Chem and Hengli decrease in their stocks' volatility measures over the period. For our two points of interest we see a decline in volatility matching the short-term rise in returns in late 2021, supporting our observation of a potential RCEP effect. The developments around our second point of interest at the beginning of 2022, however, do not match this as we see diverse trends.

Figure 22: The volatility and returns time series of RCEP's largest chemical companies



4 Conclusion

In our stock market analysis of RCEP's largest economies, making up 94 percent of its economic power, we find that the cumulative returns of the six market indices grow apart

after RCEP's entry into force, indicating a potential effect of the agreement that impacts the markets differently. The first few weeks of November, when RCEP's entry into force 60 days later was certain, were overall characterised by slightly rising returns of the indices, for which the expected entry into force can be a contributing factor. Nevertheless, for the country indices we reject our hypothesis of a short-term effect on stock returns after the agreement's entry into force, as we do not see a distinctive effect. The results indicate declining volatility over the past years, especially for the Chinese, Japanese, South Korean as well as Australian financial market. We cannot infer causality, however, as there are many factors at play that are beyond the scope of this analysis. Concerning short-term effects, we do not see a pattern of reduced volatility at the time of knowing the future date of RCEP's entry into force in the beginning of November 2021 or after RCEP's entry into force itself. Thus, we cannot identify a specific effect that is highly indicative of a large RCEP impact on these country indices, even though RCEP is likely to be a contributing factor for the overall pattern of reduced volatility of the financial market indices.

On industry-level, cumulative returns of the automotive industry clearly show a short-term change of pattern in favour of rising returns, in particular once RCEP became effective for most of its member states in the beginning of January 2022. This indicates that investors recognise the impact of RCEP on this industry. In terms of volatility, while over time we see an overall decreasing volatility, especially for Chinese SAIC motor, there is no distinctive short-term effect around our two points of interest. Concerning the electronic industry we observe a tendency of positive returns of most companies' stocks during the periods of interest, potentially being based in parts on an RCEP effect. Compared with the automotive industry, however, the pattern is weak. Moreover, we can observe a pattern of reducing volatility especially for Sony, Hitachi and Xiaomi at the time when RCEP's imminent entry into force was known in late 2021. Nevertheless, taking together volatility and returns, we cannot clearly identify a distinctive RCEP effect. The chemical sector clearly shows a change of pattern with rising returns specifically around the two points of interest and the development of the companies' stock returns is much more similar after RCEP's entry into force. The results show a decline in volatility that match the short-term rise in returns in late 2021, supporting our observation of a potential RCEP effect. The developments around our second point of interest at the beginning of 2022, however, are not conclusive. Compared with the automotive industry, we see a higher variability in the comparison of company stocks and reference ETF over the entire

period for the other two industries.

Consequently, although we see patterns of rising returns at the points of interest, the results are not conclusive of reduced volatility and thus risk regarding the automotive and the electronic industries as well as regarding the six main country indices due to RCEP. However, in respect of the chemical industry, the results indicate a pattern of reduced volatility and rising returns that speak in favour of an RCEP effect which reduces the associated risk. Moreover, the RCEP agreement and its provisions are likely to be a contributing factor for an overall reducing volatility over the past years as well as for short-term rises in stock market returns. It will be interesting to see how RCEP is able so strengthen the region economically and in how far this will reflect on the financial markets in the future.

As pointed out above, it needs to be acknowledged that there are, of course, many different influences on a country's financial market affecting index levels and changes. In this study we focus solely on the effect of the RCEP agreement and do not explicitly incorporate other influences into our analysis. Hence, the ability for causal interpretations is limited and presents a recommendation for further research regarding the analysis of other influencing factors that are specific to an country or industry of interest. Furthermore, the sector-analysis can be complemented by incorporating more companies and thus increasing the representativeness of an industry. Furthermore, other methods of causality analysis can be considered besides our chosen event analysis. At last, this research, together with the recommendations for further research named here, can be conducted again in the future to examine whether RCEP has a volatility-reducing effect.

Appendix

The subsequent three diagrams depict details on the volatility of the Chinese SSE, the Japanese Nikkei as well as the MSCI World index. The following list provides a description of each plot. For a more detailed description refer to the manual of the R package *rugarch*.

The plots illustrate the following:

1. Series plot with two conditional standard deviations (SD) superimposed
2. Series plot with Value at Risk (VaR)
3. Conditional SD plot
4. Autocorrelation function (ACF) plot of observations
5. ACF plot of squared observations
6. ACF plot of absolute observations
7. Cross correlation plot between r^2 and r
8. Density of standardised residuals
9. Quantile-quantile (QQ) plot of standardised residuals
10. ACF plot of standardised residuals
11. ACF plot of squared standardised residuals
12. News impact curve

Figure A1: Details on the volatility of the Shanghai Composite index (SSE)

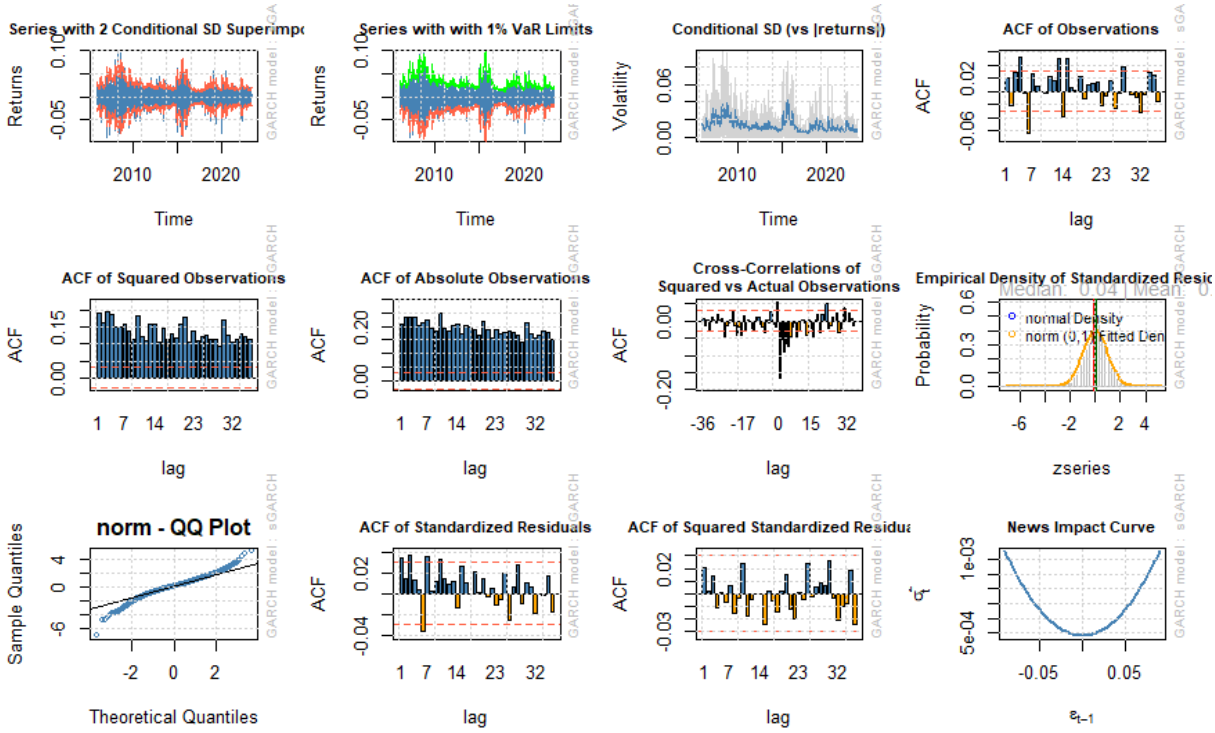


Figure A2: Details on the volatility of the Nikkei index (Nikkei225)

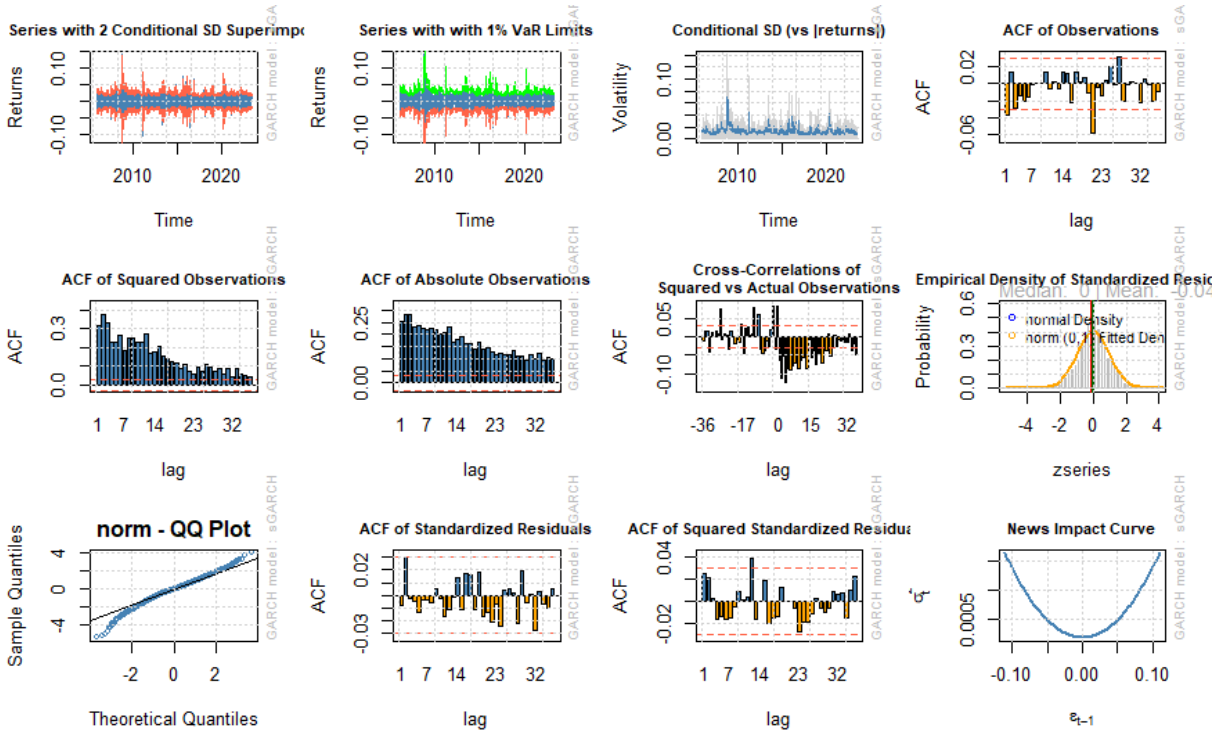


Figure A3: Details on the volatility of the MSCI World index

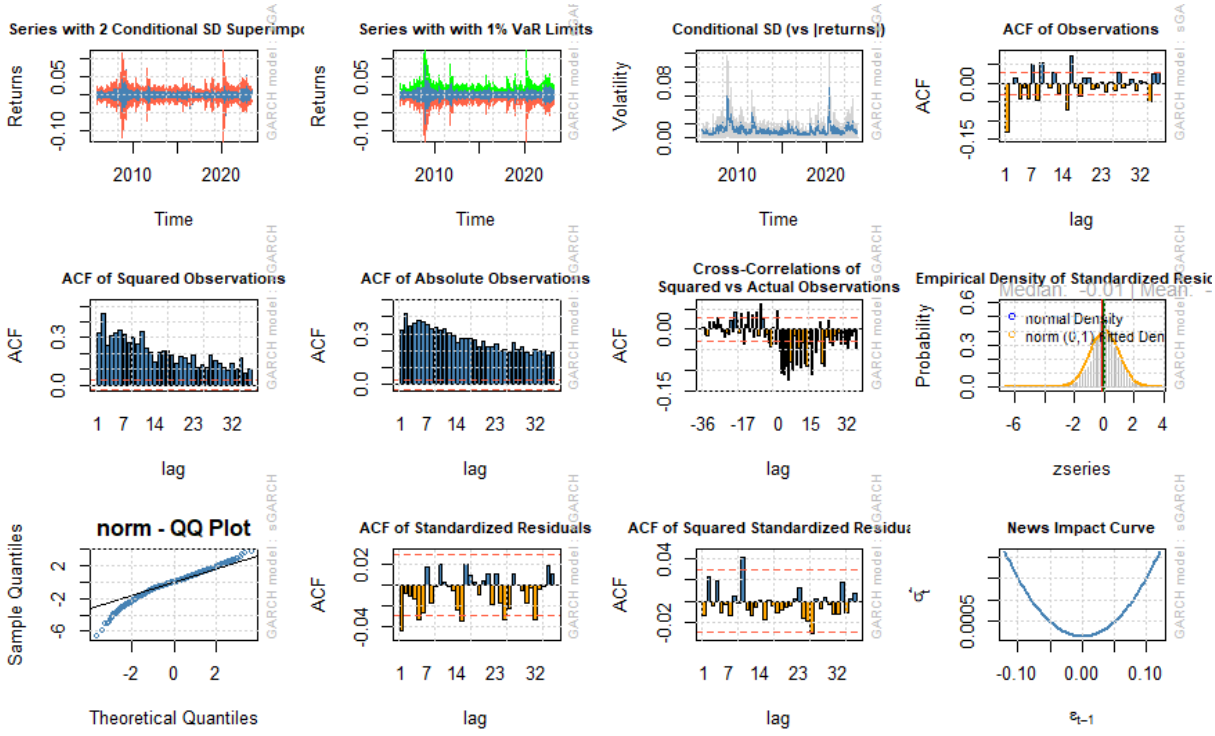


Table A1: Coefficients from the models - MSCI World Time Series

Coefficients	GARCH(1,1)	APARCH(1,1)	EGARCH(1,1)	CGARCH(1,1)	GJR-GARCH(1,1)
μ	1.975335e-04	7.146113e-05	-2.562657e-05	2.118073e-04	-3.880657e-06
SD	2.703153e-04***	2.748067e-04***	2.743534e-04***	2.703896e-04***	2.721879e-04***
ω	7.660894e-06	7.854418e-08	-9.520942e-01	6.270199e-08	1.098440e-05
SD	6.315498e-07***	5.882265e-07***	2.541219580e-01	2.066718e-07***	3.356957e-07***
α_1	1.196866e-01	7.718987e-02	-9.494102e-02	1.354138e-01	8.261367e-02
SD	1.222261e-02*	2.048450e-02*	2.56418265e-02*	2.456941e-02*	1.260986e-02*
β_1	8.254659e-01	8.173770e-01	8.934384e-01	7.819402e-01	7.802359e-01
SD	1.509137e-02*	6.618938e-02	2.80300226e-02*	4.771101e-02*	1.624072e-02*
γ_1		9.871257e-02	2.801331e-01		1.103199e-01
SD		5.685787e-02	3.57906698e-02*		3.310576e-02*
δ_1		1			
SD					
ρ				9.997288e-01	
SD				1.663330e-04***	
ϕ				1.057866e-02	
SD				4.061926e-04***	

Table A2: GARCH(1,1) Coefficients from the GARCH model - country indices

	μ	ω	α_1	β_1
SSE	1.975335e-04	7.660894e-06	1.196866e-01	8.254659e-01
SD	2.703153e-04***	6.315498e-07***	1.222261e-02*	1.509137e-02*
Nikkei	6.359045e-04	1.323395e-05	1.342873e-01	7.747692e-01
SD	2.898387e-04***	5.136751e-07***	1.449923e-02*	1.823236e-02*
KS11	3.251292e-04	8.084509e-06	1.459739e-01	7.880712e-01
SD	2.561318e-04***	7.107093e-07***	1.633788e-02*	1.839772e-02*
AX30	3.467828e-04	4.321557e-06	1.494232e-01	8.031107e-01
SD	1.959252e-04***	1.314767e-06***	1.822688e-02*	1.394859e-02*
JKSE	2.285863e-04	6.779299e-06	1.283316e-01	7.980171e-01
SD	2.249588e-04***	4.831086e-07***	1.264494e-02*	1.608565e-02*
SET	-6.918421e-05	2.449884e-06	9.898301e-02	8.722037e-01
SD	2.040584e-04***	1.496963e-06***	1.493174e-02*	1.694263e-02*
MSCI W.	7.231845e-04	4.628321e-06	1.861070e-01	7.873699e-01
SD	2.225469e-04***	4.124110e-06***	2.617211e-02*	3.602901e-02*

Table A3: GARCH(1,1) Coefficients from the GARCH model - automotive industry

	μ	ω	α_1	β_1
Toyota	5.364034e-04	1.831338e-05	1.175362e-01	8.037959e-01
SD	3.658298e-04***	6.211024e-06***	2.571753e-02*	4.702096e-02*
SAIC	-2.070899e-04	2.432017e-05	1.456488e-01	7.964493e-01
SD	4.515656e-04***	6.960994e-06***	2.660972e-02*	3.678872e-02*
Honda	2.106299e-04	6.252052e-06	3.876661e-02	9.412998e-01
SD	4.512636e-04***	9.913819e-07***	4.537114e-03**	6.975000e-03**
Hyundai	6.885493e-05	8.097091e-06	6.158213e-02	9.214050e-01
SD	4.872086e-04***	1.832113e-06***	6.477019e-03**	7.842776e-03**
Nissan	-4.488679e-04	4.788880e-06	7.295931e-02	9.204531e-01
SD	4.718779e-04***	4.250764e-06***	2.162889e-02*	2.500319e-02*
Reference ETF	4.447001e-04	1.118877e-05	8.913732e-02	8.739313e-01
SD	4.059992e-04***	8.865779e-07***	7.840081e-03***	1.194692e-02*

Table A4: GARCH(1,1) Coefficients from the GARCH model - electronic industry

	μ	ω	α_1	β_1
Samsung	3.996784e-04	4.894513e-06	4.118145e-02	9.394991e-01
SD	4.084954e-04***	1.609770e-06***	5.190926e-03**	8.074355e-03**
Sony	1.212738e-03	2.149165e-05	4.082169e-02	9.024663e-01
SD	5.111686e-04***	1.155074e-05***	1.335439e-02*	4.037712e-02*
Hitachi	9.124839e-04	2.388718e-05	7.996834e-02	8.559305e-01
SD	4.828105e-04***	1.648435e-05***	3.287198e-02*	7.435167e-02
Panasonic	0.0004225068	0.0001442550	0.2144618266	0.3866067476
SD	4.771393e-04***	4.527111e-05***	5.067564e-02	1.577640e-01
Xiaomi	-3.124670e-04	1.612339e-05	4.635230e-02	9.352004e-01
SD	7.882787e-04***	6.360159e-06***	2.649123e-03**	8.661211e-03**
Reference ETF	1.317380e-03	8.937518e-06	1.770126e-01	7.977947e-01
SD	3.145013e-04***	4.230331e-06***	4.160286e-03**	1.589298e-02*

Table A5: GARCH(1,1) Coefficients from the GARCH model - chemical industry

	μ	ω	α_1	β_1
LG Chem.	3.367352e-04	6.669248e-06	3.351383e-02	9.574217e-01
SD	6.509245e-04***	4.351126e-06***	2.294327e-03**	3.592974e-03**
Mitsubishi Chem.	6.928178e-05	6.826598e-05	1.678605e-01	6.095432e-01
SD	4.317602e-04***	1.824739e-05***	3.337635e-02*	7.831816e-02
Hengli Petrochem.	3.265063e-04	1.842525e-05	5.174596e-02	9.203592e-01
SD	6.541748e-04***	7.794466e-06***	1.274899e-02*	2.172971e-02*
Wanhua Chem.	1.942046e-05	2.146098e-11	1.984702e-01	7.966947e-01
SD	3.100090e-06***	5.011370e-07***	1.018811e-02*	7.907474e-03**
Sumitomo Chem.	-4.322788e-04	5.378773e-06	2.708087e-02	9.564347e-01
SD	4.694991e-04***	8.648515e-07***	2.488452e-03**	4.033460e-03**
Reference ETF	5.393420e-04	6.661767e-06	1.041943e-01	8.493465e-01
SD	2.751480e-04***	8.186049e-07***	1.234414e-02*	1.392818e-02*

Figure A4: Short-term stock market performance of the major indices against the reference ETF - cumulative returns

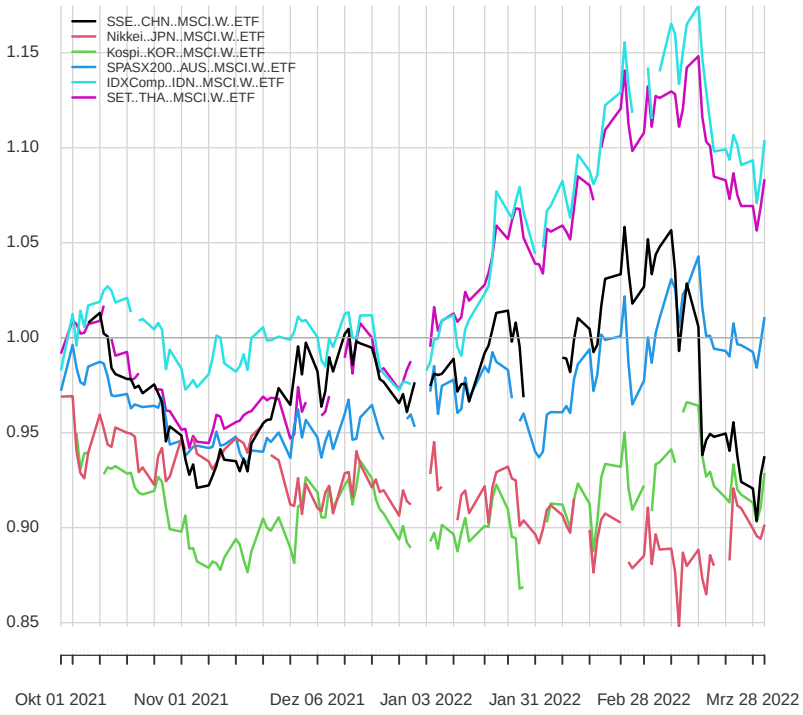


Figure A5: Short-term stock market performance of the automotive industry against the reference ETF - cumulative returns (10/2021 - 03/2022)

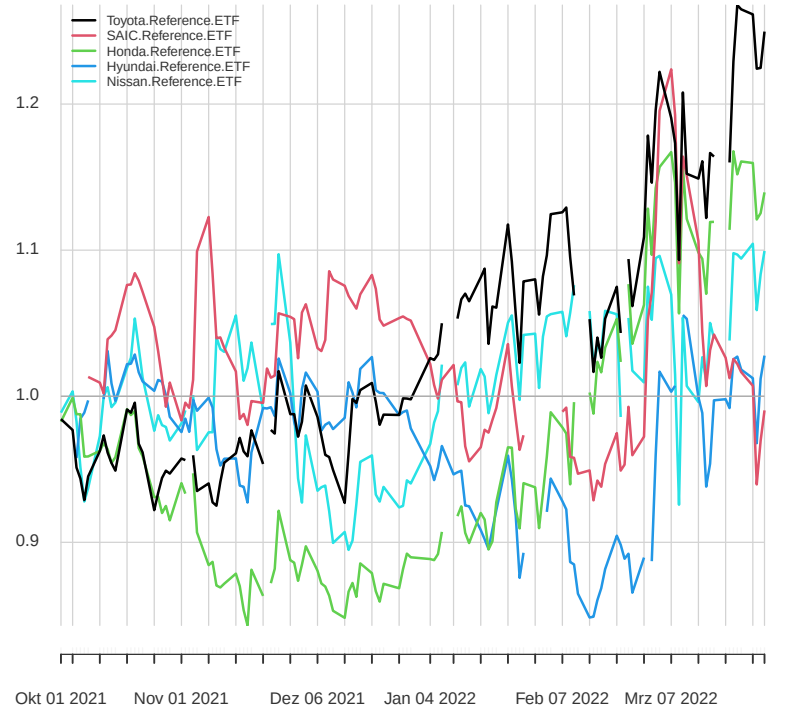


Figure A6: Short-term stock market performance of the electronic industry against the reference ETF - cumulative returns (10/2021 - 03/2022)

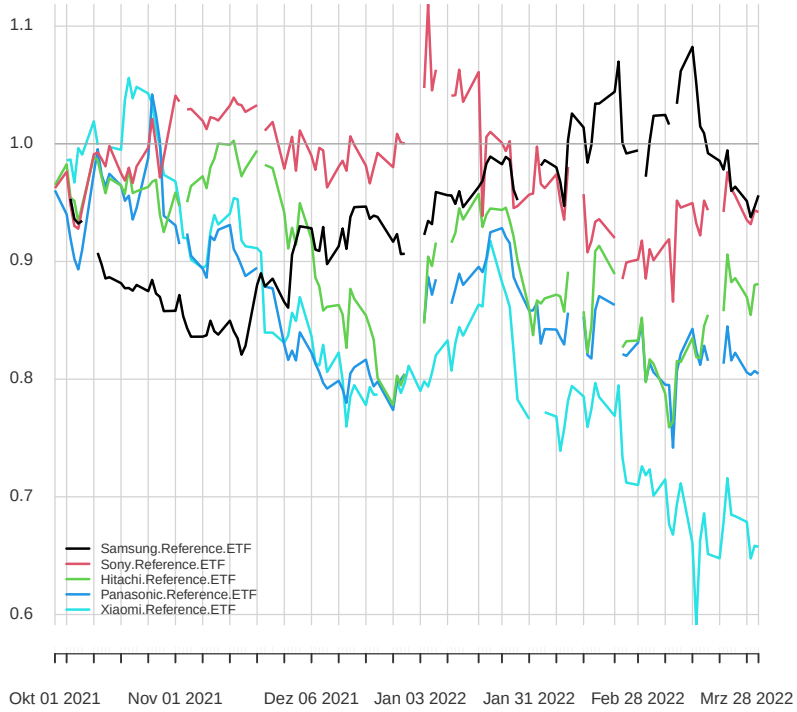


Figure A7: Short-term stock market performance of the chemical industry against the reference ETF - cumulative returns (10/2021 - 03/2022)

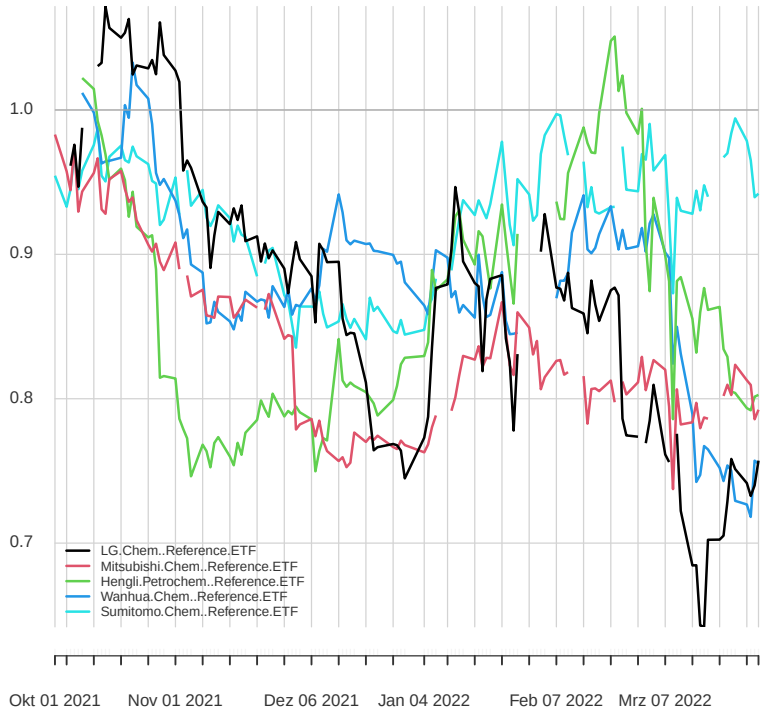


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Figure 21: Volatility comparison of LG Chem vs. the reference ETF