

CHAPTER 13

BUSINESS CYCLE DECOUPLING

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13.1. Introduction

The past two decades have witnessed very strong growth in the global economic integration. While total output was growing quite rapidly, volume of international trade grew at pace which was often almost three times as fast. Trade integration has been accompanied and sometimes preceded by financial integration because capital flows have also grown in size. The geographical area, where the economic growth has been strongest and which has also progressed more than the others in economic integration, is Asia. Therefore, in this chapter, we concentrate on the financial integration of two largest Asian emerging market countries, China and India. We measure financial integration by the degree of co-movement in stock market returns. We look at the co-movement first with simple rolling correlations, which are already quite informative. Then, we turn to dynamic correlation analysis, which is a more robust methodology than the ordinary static correlation. Our main aim is to assess how much financial integration, as measured by stock return co-movements, has changed during the recent economic crisis.

Our main results are the following. First, stock market co-movements clearly increased during the crisis, even for countries like China and India, which otherwise were relatively less affected by the crisis. This offers further proof on the nature of the recent crisis. Second, for the two large

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1 Asian countries, their dynamic correlation increased more with the other
2 countries in Asia and around the Pacific. Moreover, correlation of India
3 seems to be much higher than of China, which is somewhat surprising
4 given the fact that India is a much more closed economy than China when
5 measured by foreign trade. To our knowledge, this result is new to the
6 literature.

7 The chapter is structured as follows. In the Section 13.1, we provide
8 short literature survey on the topic of stock market correlation especially
9 as it relates to emerging market countries. Section 13.2 describes the
10 data and methodology used, while Section 13.3 discusses the results.
11 Section 13.4 concludes.

12 13 **13.2. Literature Survey** 14

15 There is a large literature on financial integration investigating co-movements
16 of stock markets, including emerging markets. However, so far only a hand-
17 ful of papers have looked at the Chinese case, and India is still almost
18 uncharted territory. There are two basic approaches to financial integration of
19 stock markets. Some papers look co-movement in first moments, e.g., returns,
20 and some look at co-movement in second moments, e.g., variance. Many
21 different methodologies are used, ranging from simple or conditional correla-
22 tions, to dynamic correlation, VAR and multivariate GARCH models, and so
23 on. Corsetti *et al.* (2005) provide a critical overview of the empirical work in
24 this area.

25 For our purposes, we can note some papers which assess the degree
26 of stock market correlation in East Asia. Kozluk (2008) looks at the
27 effects of global and regional shocks on price movements on stock move-
28 ments in individual countries or stock exchanges. This is done by
29 regressing stock market returns on a number of orthogonal common fac-
30 tors and an idiosyncratic component. For example, if a single common
31 factor can explain a large share of price variation in many different stock
32 markets, it can be called “global factor.” In addition, stock market returns
33 can be explained by several regional or sectoral factors.

34 Kozluk finds that a global factor can explain much of the stock mar-
35 ket movements around the world, which implies large degree of
36 integration between different markets. However, between 1996 and 2007,

the Chinese stock markets seem to have a specific position, and the global factor plays almost no role in explaining changes in Chinese stock market prices. Moreover, integration between the Chinese markets and the rest of the world did not seem to increase during the sample period. Bae (2011) utilizes similar methodology to assess the stock market integration between several Asian and other stock markets for somewhat longer time period. While correlation between stock market price movements has increased in many regions, including Europe and East Asia, Chinese stock markets are again surprisingly isolated from the rest of the world. By contrast, India is much better integrated with the rest of the world.

However, Johansson and Ljungwall (2009) find that the stock markets in Mainland China are strongly correlated with the other stock markets in the so-called Greater China, i.e., the area consisting also of Hong Kong and Taiwan. Despite the correlation in day-to-day price changes, it should be noted that the markets do not share long-run trends.

From the literature reviewed before we can see that Chinese stock markets have been very little integrated with the other markets, at least during the pre-crisis period.

13.3. Data and Empirical Methodology

13.3.1. Data

We assess the degree of financial integration between countries with the dynamic correlation of high-frequency stock prices. For this purpose, we have gathered daily share index data for all selected countries in our data sample from Bloomberg. We have striven to use the most widely used/representative price index for each market. Stock market data starts from January 5, 1999, and ends on March 30, 2010. As our main variable we use the log-differenced indices, which are, of course, very close to percentage changes. Table 13.A1 lists the stock market indices used in the work. Our main emphasis is on two large Asian countries, China and India, and we report dynamic correlation of their stock market indices against other countries. As an example, Figure 13.1 shows the daily price

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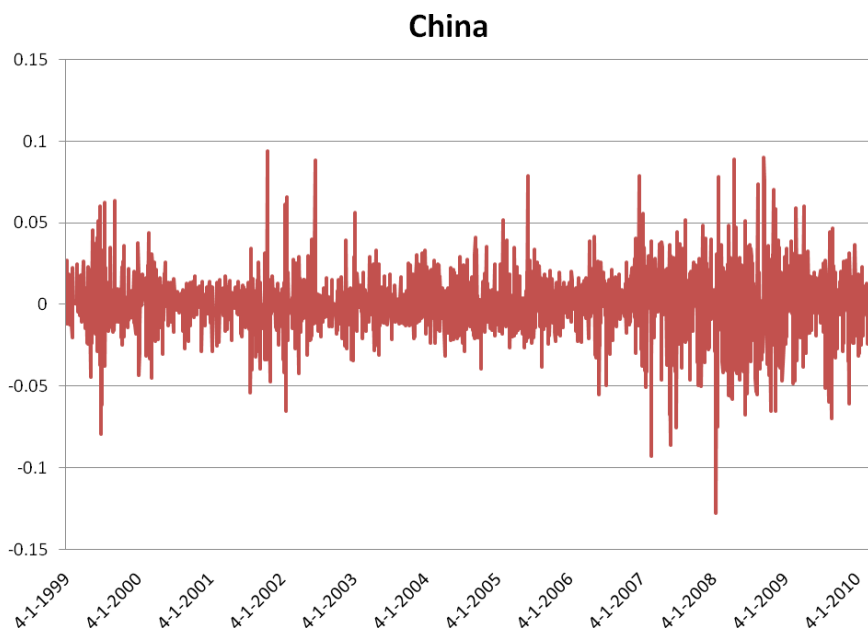


Figure 13.1. Log difference of Shanghai Composite Index.

changes (as log differences) of the Chinese Shanghai Composite Index which tracks the prices of both A and B shares.

While in the empirical part of this chapter we utilize more advanced methods, it is instructive to start examination of the data by looking at ordinary rolling correlations of price changes. Figure 13.2 shows correlation for one-year rolling window¹ between the Chinese stock market and selected major markets in developed and emerging economies. We can see that before the crisis hit, the average correlation of Chinese stock markets with the outside world was relatively low, averaging roughly at 0.1. When the crisis hit, correlation jumped much higher for most countries and regions. It is especially interesting to see that correlation with India and Japan are equally strong, while the US market seems to have very little

¹ The data points are quarterly to make the presentation of the data easier. For example, correlation for the third quarter of 2007 refers to the correlation of stock index changes from the beginning of October 2006 (i.e., fourth quarter of 2006) to the end of September 2007 (i.e., third quarter of 2007).

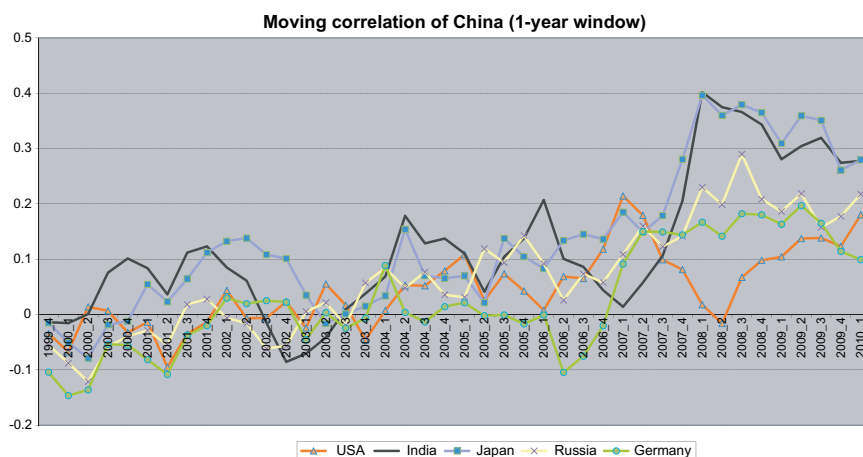


Figure 13.2. Moving correlation of Chinese stock market (one-year window).

co-movement. Looking at the correlation coefficients for the whole period, correlation of the Shanghai index is highest with Hong Kong (0.31), which is not surprising. Correlation is 0.21 with both Singapore and Australia, underlining the regional links around the Pacific Ocean. For practically all European and American stock markets, the correlation is under 0.1.

For India, the correlations are generally much higher, even although India is a much more closed economy in terms of foreign trade than China.² India also has higher correlation with almost all countries than China. In Figure 13.3, we can see that during the crisis the correlation of Indian stock market price changes with Japan and Germany both rises to over 0.5. For India the highest correlation coefficients for the entire data sample are with Hong Kong (0.46) and Singapore (0.45). One should remember that the Chinese market also was very much correlated with these two markets. Table 13.1 shows the correlation coefficients for the entire 1999–2010 period for the Chinese and Indian stock market returns with various countries.

² During the 2000s, the average share of exports and imports in the Chinese GDP was 57.6%, while for India, this ratio was 38.2%.

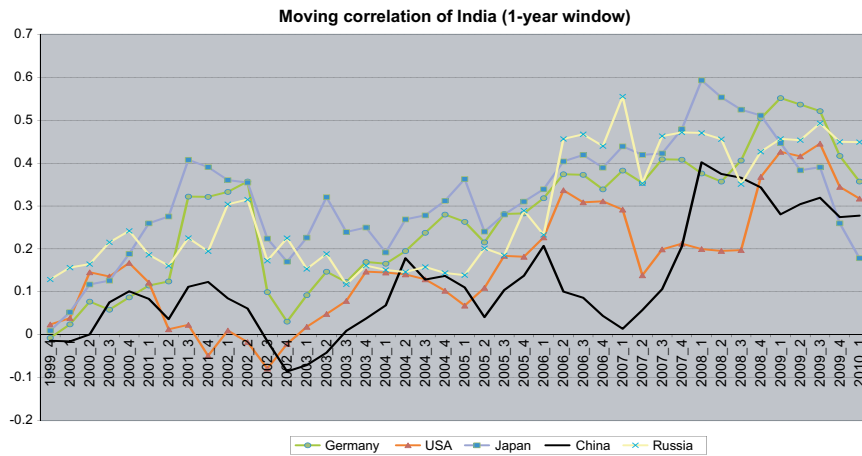
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Figure 13.3. Moving correlation of Indian stock market (one-year window).

13.3.2. Empirical methodology

We employ spectral analysis, especially the so-called dynamic correlation, to study integration of selected stock market indices. The most common measure of co-movement between time series is classical correlation, which is also commonly used in business cycle correlation. Unfortunately, classical correlation does not allow for a separation of idiosyncratic components and common co-movements. It is also basically a static analysis, so it fails to capture dynamics in co-movement. For our purposes here, we prefer the alternative measure of synchronization of business cycles, namely dynamic correlation, as proposed by Croux *et al.* (2001).³ Bátorová *et al.* (2008) and Fidrmuc and Korhonen (2010) apply dynamic correlation for analysis of business cycles of emerging economies.

Similarly to correlation analysis, we consider two stationary variables for output in countries i and j , y_i and y_j . The spectral density functions for

³ Messina *et al.* (2009) discuss dynamic correlation for discussion of wage developments over the business cycle. De Haan *et al.* (2008) discuss alternative measures of synchronization of business cycles.

Table 13.1. Correlation of Chinese and Indian stock market returns.

	China	India
UK	0,06	0,28
France	0,06	0,29
Germany	0,06	0,27
Austria	0,12	0,33
Belgium	0,09	0,29
Denmark	0,09	0,32
Finland	0,04	0,23
Portugal	0,08	0,32
Spain	0,06	0,29
Sweden	0,05	0,28
Switzerland	0,05	0,27
Norway	0,05	0,27
Poland	0,08	0,33
Netherlands	0,06	0,29
Italy	0,14	0,40
USA	0,07	0,23
Canada	0,07	0,23
Mexico	0,07	0,24
Brazil	0,10	0,23
Chile	0,10	0,24
Argentina	0,06	0,20
India	0,17	1,00
Australia	0,21	0,38
Japan	0,19	0,33
Hong Kong	0,31	0,46
Singapore	0,21	0,45
Taiwan	0,15	0,29
Russia	0,09	0,31
China	1,00	0,17

these variables are denoted by $S_i(\lambda)$ and $S_j(\lambda)$ and their the co-spectrum is $C_{ij}(\lambda)$, where frequency λ is defined between zero and π . Then, the dynamic correlation, ρ_{xy} , equals

$$\rho_{ij}(\lambda) = \frac{C_{ij}(\lambda)}{\sqrt{S_i(\lambda)S_j(\lambda)}}. \quad (13.1)$$

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The dynamic correlation lies between -1 and 1 . Moreover, it is interesting to analyze the average dynamic correlations over a given interval of frequencies. If we define such interval as $\Lambda = [\lambda_1, \lambda_2]$, then the dynamic correlation within the frequency band Λ is defined as

$$\rho_{ij}(\Lambda) = \frac{\int_{\Lambda} C_{ij}(\lambda) d\lambda}{\sqrt{\int_{\Lambda} S_i(\lambda) d\lambda \int_{\Lambda} S_j(\lambda) d\lambda}} \quad (13.2)$$

Particularly, if $\lambda_1 = 0$ and $\lambda_2 = \pi$, the $\rho_{xy}(\Lambda)$ is reduced to the static correlation between y_i and y_j , $\text{corr}(y_i, y_j)$. The dynamic correlation within the frequency band, defined in (2), can be used, for example, to measure the comovement of business cycles of two countries as we can select the frequency band of interest (one-day frequency, or longer) and evaluate the dynamic correlation within this frequency band. In practice, the results are reported in charts, where the right hand of the vertical axis shows the very short-run correlation, in our case one day. Moving to left indicates that more and more days (as well as the indices' own autocorrelation) are taken into account.

We estimate the dynamic correlation for three different periods 1999–2002, 2003–2006 and 2007–2010. This allows us to discern changes in the dynamic correlation over time.

13.4. Results

In this section, we briefly sketch the results obtained from dynamic correlation analysis. In Figure 13.3, we see the dynamic correlation of the Chinese stock market against all the countries in the sample. We can see that for practically all countries the dynamic correlation is higher during the last period, i.e., during the crisis. Moreover, correlations are higher for Asian and other countries around the Pacific (e.g., Australia). This shows the importance of regional integration. Interestingly, for many European countries the dynamic correlations seem to increase when we move away from the very short-run developments. This could mean that especially the intraday and weekly dynamics of analyzed stock markets is different. For Asian countries, there is no such effect. This reflects, for example, similarities in the regulations, habits, and general investor behavior among Asian capital markets.

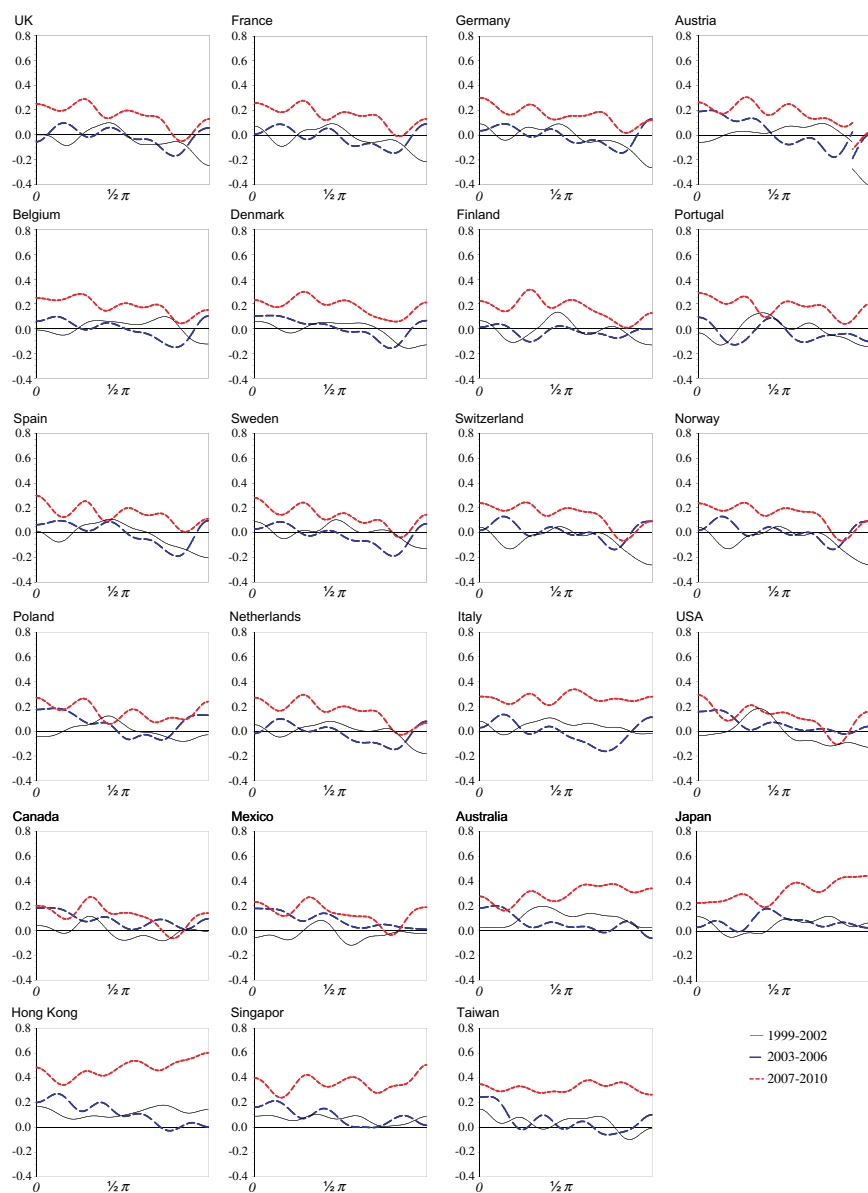


Figure 13.4. Dynamic correlation of stock market returns between China and selected countries.

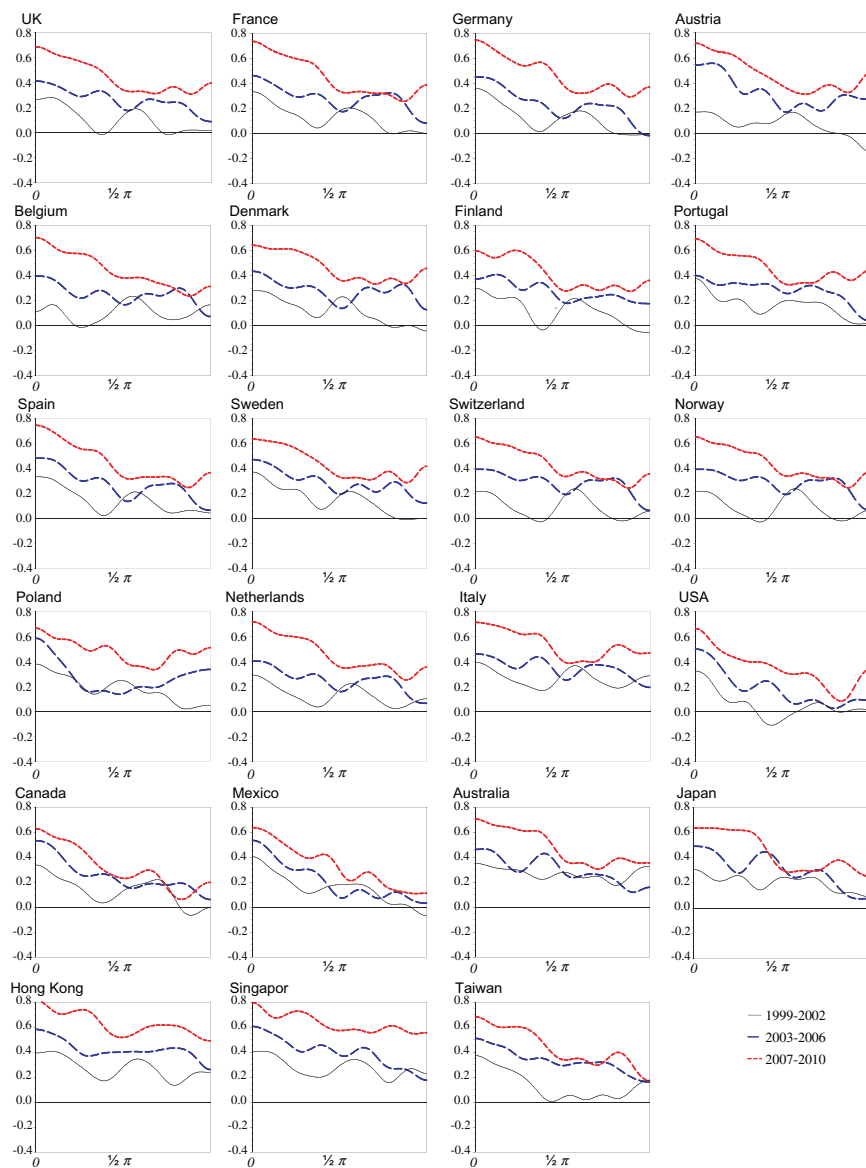


Figure 13.5. Dynamic correlation of stock market returns between India and selected countries.

For India, dynamic correlations are generally higher than for China, even for the pre-crisis period. Nevertheless, they did increase during the crisis. Interestingly, India seems to be highly correlated also with European stock markets. Dynamic correlation is the lowest — for China — for the very short-run movements and increases then steadily for longer-run frequencies. For India, Asian countries behave in the same manner as all the others.

The most important feature documented by Figures 13.4 and 13.5 is that there was a structural change in integration of stock markets around the world. Dynamic correlations for the most recent period, 2007–2010, increased both in China and India. Moreover, the increases are especially important for the long-run frequencies. The intraday dynamic remained nearly unchanged in comparison to nonAsian economies, but it increased among China (to a lesser degree also for India) and Asian economies as well.

In India, the increases of integration of stock markets continued the previous convergence of stock performance since 1999. By contrast, integration of Chinese financial markets was low before 2006. It will be interesting to observe whether integration of China will continue also in future.

13.5. Conclusions

In this chapter, we have assessed the integration of Chinese and Indian stock markets with the markets elsewhere in the world. Our focus has been on the correlation of stock market returns across different countries. The recent economic crisis — the Great Recession — provides a very interesting test case for integration of financial markets. We can see that in normal times most of the stock markets in our data sample are quite highly correlated, regardless whether we use the traditional correlation measures or more advanced dynamic correlations. However, China is the most noticeable outlier, despite it becoming a major economic power during this period. Correlation of its main stock market, Shanghai, with the other markets of the world is essentially zero for most of the 2000s, despite China's rapid integration with the rest of the world through foreign trade and inward foreign direct investment.

However, the special nature of the recent financial crisis is revealed when we look at the estimations for 2007–2010. Correlations for all markets jump up, and even the Chinese market registers correlation coefficients of well over 0.5 with different countries. Nevertheless, it is noteworthy that

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even during the crisis the highest dynamic correlation coefficients were registered with other Asian and Pacific countries. Even if day-to-day correlation of different markets becomes less as the crisis passes, it is clear that integration of Chinese markets with the other markets in the region will increase.

Appendix

Table 13.A1. Stock indices used.

Country	Stock index
UK	FTSE 100
France	CAC 40
Germany	DAX
Austria	ATX
Belgium	Bel20
Denmark	OMX 20
Finland	OMXH
Portugal	PSI 20
Spain	IBEX 35
Sweden	OMXS 30
Switzerland	SSMI
Norway	OSE
Poland	WIG 20
Netherlands	AEX
Italy	S&P/MIB
Ireland	ISEQ
US	NASDAQ
Canada	S&P/TSX
Mexico	IPC
Brazil	BOVESPA
Chile	IGPA
Argentina	MERVAL
India	S&P CNX Nifty
Australia	S&P/ASX 200
Japan	TOPIX
Singapore	TSI
Taiwan	TAIEX
Russia	RTSI
China	SSEC

Source: Bloomberg.

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