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Investing in the Chinese Stock Markets :

Historical Perspective and Performance Analysis

Mémoire réalisé par
Jérôme Vanassche

Promoteur
Mikael Petitjean

Lecteur
Floris Laly

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Abstract

Since the creation of its stock markets in 1990, China has registered an exceptional growth with tremendous returns and a high volatility. In three decades, the country has moved from the status of underdeveloped country to one of the world's largest economies. The thesis aims at providing a thorough understanding of the risk and performance profile of Chinese Equity indices throughout their existence (1990-2015) and in comparison with other countries worldwide. The analysis is adapted to suit the point of view of an American investor, taking the S&P500 as the market benchmark and the US 10 years Treasury bill as the risk-free rate. The study retraces the history of China, presents its economy and ,in more detail, the Chinese stock markets before the accomplishment of a performance analysis. A large sample of risk adjusted ratios like the Sharpe ratio, the Information ratio, the Sortino ratio, etc., will be presented and computed through the statistical software R using monthly prices of indices from Bloomberg.

This thesis points out very specific characteristics of the Chinese stock markets: high returns, high volatility, insulated market (low Beta and correlation), speculation (especially due to the presence of many individual investors and the presence of small-cap stocks), government ownership, an alphabet soup of stocks, a lack of Blue chips, etc. However, since 2002, China has made huge progress in opening up its markets to the global economy. As a result of the reforms, Chinese stocks became more easily accessible to foreign investors, thus offering a good opportunity to diversify their portfolio. Over the past few years, the new emerging countries took the lead (Mexico and Indonesia in our sample), while Shenzhen and Shanghai stocks fluctuations moved closer to the benchmark. Shenzhen tends to beat Shanghai as a result of the outperformance of small-cap stocks (due to speculation from individual investors).

Keyword: China, Stock Markets, Equity, Indexes, Performance Analysis

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Introduction

Since the economic reforms of 1978, the evolution of China's growth has been spectacular. In three decades, China has moved from the status of underdeveloped country to the second place of the world's largest economies, just behind the United States. The country is even at the first place if we consider the gross domestic product expressed as local purchasing power. Throughout its long history, China has been marked by up and downs. Being a world economic power between 1100 AD and 1800 AD, China suffered from the Western and especially British imperial invasion during the 19th Century. Since the 20th Century, China has re-constructed its whole economy from the communism revolution, with a transition to capitalism and is currently a major World Class competitor. The country has based its exceptional growth on high productivity and exportation. However, over the past few years China met a transition from developing country to developed country lowering its production and increasing the tertiary sector activities. Concerning its stock markets, China presents specific characteristics and has registered very high returns over the 1992-2015 period. Nevertheless, Chinese stock markets have often been described as a casino with a lot of speculation and high volatility. Finally, reforms to open up the Chinese economy to the global market tend to increase the demand and interest for Chinese Equity investment and thus the need for tools and performance indicators.

That is the reason why I decided to focus my research on providing a thorough understanding of the risk and performance profile of Chinese Equity indices throughout their existences (1990-2016) and in comparison with other countries. The main objective will be to determine if Chinese stocks have been a good investment opportunity during the last thirty years compared to other countries. The thesis will be divided in two main parts: The historical perspective of Chinese economy and its stock markets, and a performance analysis.

First of all, I will discuss the major parts of Chinese history from 1100 up to now presenting its rise, fall and re-emergence as a global power.

Secondly, I will execute a SWOT analysis of the Chinese economy presenting its main strengths and weaknesses as well as the threats and opportunities.

Thirdly, I will focus my research more precisely on the Chinese stock markets, giving an overview of the market, presenting the two Chinese stock exchanges, namely Shanghai and Shenzhen, as well as the Hong Kong Stock Exchange. Furthermore, I will depict the different characteristics that make China's stock market so particular and introduce the main reforms that occurred in order to open up the economy of China to foreign investors and global market.

Finally, the empirical part of the study will consist in the performance analysis of Chinese stock indices, especially focusing on the A-share market and comparing their performance to other main world indices. The analysis will take the point of view of an American investor with the Standard & Poor's 500 index as the benchmark. With this aim in mind, I will first explain the different ratios and metrics that will be used in the analysis, then interpret the results and end up with the implications and limitations of the thesis.

Part 1: Historical Perspective

A. The Chinese Economy

This section will firstly be dedicated to sketch the foundations of the cultural and economic background of modern China. Then, the history of China will be presented broadly highlighting some of the main events and transitions of the country in order to facilitate the understanding of the up and downs of China as a world class competitor. Of course, it does not aim at gathering and presenting the whole history and thus should be considered as a very simplified and non-exhaustive version of the Chinese economic history. Finally, a SWOT analysis will be realized gathering the major strengths, weaknesses, opportunities and threats of the economy of modern China.

1. The origins of the Chinese economy

a. Confucianism

Looking at the origins of China leads me to describe the main school of thought at the origin of the Chinese culture: Confucianism. Confucius, called K'ongFou-tseu in Chinese, was born in 551 BC in a noble family in precarious situation. Confucius was a reasoner who wanted to establish moral principles in a period of chaotic politic and social changes. The ideology models the ideal man: the Jun-zi. To become a Jun-zi, a man must realize the virtue and the moral in his person and his actions. The Confucianism is mainly based on three virtues: men personal qualities, society life rules and respect of others and oneself. This ideology should be applied in the social order and political order as well and every man should follow an appropriate education to promote these values. The education oriented to the political responsibilities led to the application of a recruitment of civil servants based on exams. Men who knew by heart the Confucian canon possessed the administrative competence and could be qualified to serve in the government. According to Confucius, the force of the State is based on economy, army and crowd confidence. This last value is primordial as the sovereign must take care of promoting justice and equality. (A. Molina & P. Premand, 2001)

b. An economy based on agriculture

Looking at the major characteristics of the Chinese economy over time, there is no doubt about the fact that it has been based on its human labor, especially the peasants, and the contribution of farming in its development. Indeed, the Chinese population is composed in majority of peasants (80% of the whole population of China between 206BC and 24AD and still 80% between 1950 and 1960). (Duteil, 2009) Under the Western Han dynasty (206BC-24AD), China's territory was made up of large farming zones which represented one of the major sources of employment and the main state's revenue derived from the taxation. In fact, China's economic development and territorial expansion are mostly due to the alliance between state and peasantry. On one side, peasants benefited from private landholding property rights, which was an incentive to produce more and better. On the other side, the state was allowed to tax the peasant's revenue. And this alliance prevented the reestablishment of feudalism and decentralization policy. (Deng, 2004) In addition, in opposition to feudalism, landowners and authorities were two separate institutions and rent and taxes were also separated. Furthermore, both the fiscal state and landholding peasantry were eager to increase farming lands, because more land meant more resources for peasants and more taxes for the state. Territorial expansion stopped only when the land was no longer physically suitable for farming, for example, encountering a desert. (Deng, 1999) This incentive for farming led to three green revolutions in 206bc-24ad, 960-1127 and 1368-1911. Finally, based on the constant surplus produced by farming activities and thanks to the re-investment of state taxation into the economy, the market economy developed in premodern China and has been the source of the growth of many others sectors. (Deng, 2004)

c. Backward East (Eurocentrism)

China's history has often been erased by the Eurocentric historians. Indeed, many Europeans described the Eastern civilizations, especially China, as societies unable to develop themselves because of their backwardness. According to them, only Europe was supposed to develop and reach capitalism thanks to its innate sense of rationality. (Zurndorfer, 1989) Alain Peyrefitte saw the source of non-development (in opposition of under-development) of the Chinese economy in Confucianism. Confucian values would have presented an aversion against merchants, business and foreign inventions. In other words, Confucianism would have

prevented China from scientific rationality, the source of development. (Zurndorfer, 1989) Weber saw the East as predestined for economic backwardness because there was no separation between public and private domains. This avoided the apparition of rationalism and thus the development of politics, economy, culture, etc. (Hobson, 2004) In addition, Lynn White said: "One thing is so certain that it seems stupid to verbalize it: both modern technology and modern science are distinctively Occidental". (White, 1974, p.39) Karl Marx, on his turn, adds that China suffered from governmental despotism and was supposed to remain non-developed because of its unchangeableness and the absence of a progressive history. (Hobson, 2004) Marx viewed China as a "rotting semi-civilization ...vegetating in the teeth of time" (Marx cited in Pulleyblank, 1971, p.14) To conclude, China, as well as other Asian countries have sometimes been described as imitative, ignorant, passive, irrational, despotic, morally regressive and economically stagnant countries. (Hobson, 2004, p.8) According to Marx, the East could only hope for development and access to capitalism being rescued by the British capitalist imperialism. This point of view led Europeans and especially British imperialists to justify their conquest of the Eastern societies and especially explain the Opium War. But in the following section, I will present different points that illustrate how China surpassed Western civilizations during the 1100-1800 period, just before the European invasion.

2. History of China

a. 1100-1800: Dominance of China

From 1100-1800, China has been very dominant against the Western civilizations, especially in terms of innovation in many sectors like agriculture, navy, textile, paper printing and production of iron and steel. The superiority of China was particularly linked to its intensive power, in other words, its high degree of productive power within its own borders. This has to be compared with the extensive power described as a nation's ability to project its economy outside of its frontiers. (Mann, 1986)

China started an industrial revolution many years before Britain (around 600 years). From 600 to 1100, the Chinese were the first producers of iron and steel to make weapons, decorative art and a lot of different tools like knives, hatchets, chisels, hammers and mallets, ploughshares and many others. In parallel, breakthroughs in smelting allowed the Chinese to discover cast and wrought iron a long time before the Europeans. A considerable fact is that in 1078, China produced around 125000 tons of steel on an annual basis, while Britain only produced 76000

tons in 1788. Concerning the textile manufacturing, China launched a revolution in the 14th century, while it only happened in the 18th century in Britain. The different breakthroughs in the production of steel and iron made possible the progress in farming. As it has been described earlier, China also outperformed the Western civilizations in the agricultural sector. Furthermore, with the developing of money economy, the increasing demand for paper money led the Chinese to be the first to work out paper printing long before Gutenberg himself. In parallel, they also invented the gunpowder and the compass. The latter was very useful for navigation and allowed Chinese to create better maps. Concerning their naval revolution, while British ships could transport around 400 tons in 1588, China's ones were able to displace around 3000 tons. At the end of the 18th century, Chinese' merchants were employing around 130000 transport ships and the Chinese naval force was composed of 20500 ships. (Hobson, 2004)
This section thus shows some real facts that cannot be rejected and that illustrate how China was a dominant country until the 19th century.

b. 19th Century: the decline

Myth of a decline: the Tribute system

According to some European historians, the Chinese decline would have begun in 1434 when Ming proclaimed an imperial ban on foreign trading, sending China back into isolationism. (Hobson, 2004) A first contradiction is that the ban had been kept official for political reasons in order to keep the legitimacy of the Chinese state. Moreover, it has been circumvented in different ways: the Portuguese navigator Cortes Cartaz, the Chinese trade mixed up with the Japanese, the Cantonese trade practice, many smuggling trades and the relocation of Chinese merchants.[1] I will not explain in details all the tools used for avoiding the ban; but what should be remembered is that the Chinese trading system has never been completely shut down. (Hobson, 2004)
In addition, Ming established in 1368 the so-called tribute system which lasted until 1911 under the Qing dynasty. This tribute system is a major concern and is in fact a trading system based on the Confucian values. The tribute system is an international relation system organized around a central power involving a number of rights and obligations as well for the dominant power as for the vassal states. The system is based on the independency of the vassals and on good relations between counterparties. It is in fact a win-win relation where the vassals beneficiated

[1] Read (Hobson, 2004) for further explications.

from the protection and the generosity of the power state. In counterpart, the vassals accepted their submission and some rules to respect while keeping their independence. (Colognesi, 2012) The tribute system created a stable climate favorable to economic growth

Opium War

The imperial conquest of the East, mainly undertaken by the British imperialists has been legitimized for the reason that it was the only way to allow China to access to development and capitalism thanks to the sense of rationality of the Europeans (what China was not supposed to have). In addition, British emperors wanted to repay the British's debts standing at more than 28 million pounds. To achieve that goal, they wanted to count on the triangular market between England, China and India. British sold cotton produced in Calcutta, in India, to the Chinese. The surplus of the transaction served to repay the debts in addition of buying Chinese tea. However, once China began to produce its own cotton, they stopped buying the one from India and this angered the British emperors. (Zurndorfer, 1989) In parallel, China had accumulated the majority of the world's silver stocks for four reasons. First, in the middle of the 15th century, Chinese money was converted into a silver currency. Then, the demand for silver increased as the Chinese economy became stronger. In addition, China's economy relied more on exports than imports, what made a positive trade surplus. Finally, the price of silver relative to gold ratio in China was the higher in the world. As a result, China was attracting silver from all over the world that was sold against gold. (Hobson, 2004)

Because China showed its non-interest in Indian cotton, England decided to force China's hand by imposing illegal importation of Opium in China. They even forced the Chinese to sign illegal treaties allowing the importation of Opium although this narcotic product was illicit. In addition, silver was used by China to pay Opium importations and thus allowed English to fill their silver reserves and allow them to repay their debts and even getting so much surplus that they reversed the silver balance creating some troubles in China. Indeed, as the Chinese silver reserves decreased, silver became more expensive and this resulted in an increase of the taxes that peasants had to pay. (Zurndorfer, 1989) This led to the beginning of the Opium war in 1839 and to the decline of China's economy.

Unlike China, Britain based its industrial revolution and territorial expansion on an imperial military policy. In fact, the British assimilated the technologies and inventions of the East and relied on their superior military power to send mercenaries to exterminate entire communities,

conquer, plunder, monopolize resources and impose unequal treaties to lower the tariffs. As a result, the imperialist conquest obliged higher production and taxation of the Chinese people, especially the peasants, to repay the war debts and finance trade deficits. This had led to the starvation and revolts of the peasants and had made of China a semi-colonial country led by corruption, enslavement and where the main ports were under British control. (Hobson, 2004)

c. 20th Century: The Re-emergence

Communist revolution

The re-emergence of China began with the communist revolution in the middle of the 20th century after over 150 years of domination. Indeed, the Chinese "Red Army" defeated the Japanese imperial army and repulsed the US imperialist compradors attacks just after the liberation of the country. The communist government achieved the unification of the country and abolished the illegal treaties, the extra-territorial privileges of Europeans and put an end to brothels and traffickers of women and drugs. (Petras, 2012) Thanks to the huge human labor forces and the agrarian reforms, Chinese communists rebuilt the country with roads, airfields, canals and industries. Under Mao, public money was mainly invested into the educational and health systems, which became entirely free and were combined with a good social security. This made of the Chinese population a healthy, literate and motivated work force, which was at the origin of the Chinese reconstruction. (Petras, 2012)

Transition to Capitalism

In 1980, the Chinese government switched to capitalism. This policy change was accompanied with major structural changes. The free educational and health systems became paid services and an end was put to the subsidies for public housing. In opposition, public money was provided to real estate speculators for the construction of luxury hotels and buildings and this was the starting point of the private sector development and growth rates of more than 10%. All these measures allowed China to become the world's second largest economy. (Petras, 2012)

World Class Competitor

The modern Chinese economy has registered a considerable sustained growth and is in transition from a developing country to a developed country. This growth was mainly based on the manufacturing sector with cheap human labor and huge exportations to the rest of the world increasing the trading surplus of the country. This made of China the major US creditor in terms of US debts. Based on large investments and trade agreements, China is also a big importer of agro-mineral raw materials from Africa and Latin America. (Petras, 2012)

3. SWOT analysis

This section will focuses on analyzing different strengths and weaknesses of the Chinese economy against the whole world economy as well as the opportunities and threats that derive from them.

a. Strengths

First of all, China is the biggest manufacturer and exporter in the world. The country has been relying on its superior productive capacity to feed the world with its manufactured products while being a major importer of raw materials, especially from Africa and Latin America. That makes of China one of the main trading partners of many countries. (Lisbonne-de Vergeron, 2012) Thanks to its highly positive trading surplus, China owns big reserves that can be reinvested into various economic sectors. (Petras, 2012) In addition, this has allowed China to present limited external debts (Lisbonne-de Vergeron, 2012) and to buy the world's debt, especially the US debt. (Petras, 2012) Another strength that made this remarkable economic growth is the low cost of its work forces. However, wages and public services have been increased during the past few years in order to alleviate the deviances of the workers and avoid revolts of the people. (Petras, 2012) Then, the last decade has been marked by a relocation of industrial activity to China. In addition, the Chinese economy's growth is based on banking services, monetary growth and savings. Public money is reinvested in new technologies (especially renewable energies) and services. (Lisbonne-de Vergeron, 2012) To conclude, as James Petras says: "China has a powerful trading, financial and investment networks covering the globe as well as powerful economic partners". (Petras, 2012)

b. Weaknesses

On the other hand, while some characteristics of China's economy appear to be strengths, the fact remains that they also lead to some weaknesses. Comparing with its historical background, China nowadays features a low military power against the rest of the world and especially against the US. In fact, China has huge difficulties to protect its bilateral trade and investment agreements threatened by the US strategies in controlling overseas trading. (Petras, 2012) Furthermore, China faces considerable structural problems. As a consequence of the European conquest of the East in the past, many Chinese politicians are influenced by Western values and act in as Europeans or US intermediaries (many of them earn money in China but put their children in private Western universities and buy houses in Europe or US). They think and act using the same economic and financial logic that led to the global financial crisis. (Petras, 2012) In addition, the over-reliance on exports and investment has made China very dependent against the world's demand. Furthermore, this has resulted in an abundance of labor and capital accompanied by a huge consumption of resources, wastage and pollution, a lack of security and maintenance creating major problems, especially with regard to the environment, and revolting the labor classes. (Lisbonne-de Vergeron, 2012) The lack of security has resulted in increasing savings and lowering consumption. The huge consumption of resources and energies (mainly coal and water) exhausts the Chinese resources. (Albert, 2016) Another weakness is to be found in the social and geographical instability and inequalities. Indeed, capitalism has allowed the richest people to invest in real estate and luxury apartments and buildings, making a new class of thousands of billionaires, while workers and peasants are suffering from poverty. (Petras, 2012) These inequalities are appearing geographically too, in that coast manufactories in eastern China are dealing with the whole world while the mainland is still mainly based on agriculture. (Wei, 1999) Finally, due to the abolishment of the free educational and health systems combined with the bad quality of the Chinese tertiary education, there is an important lack of skilled people, who mainly went to Europe and who will be essential in improving the sector of the new technologies. (Lisbonne-de Vergeron, 2012)

c. Threaths

Linked to its weaknesses, China is facing some threats. First, because of its low military power, China is confronted to the permanent American military threat. In fact, the US economy is slowly but surely outperformed by that of the Asian countries and mainly the Chinese economy. In order to remain one of the world's leading economy, the US counts on its military superiority by developing a "massive arsenal, forward bases and strategic geo-military positions on the Chinese coasts and adjoining territories". (Petras, 2012) Another threat is related to the over-reliance on exports leading to a dependency against the rest of the world and especially Europe. In addition, combined with the cheap human labor, China faces some difficulties in developing a middle class and thus has trouble in increasing the consumption. In fact, this illustrates another threat, namely rising class inequalities. (Lisbonne-de Vergeron, 2012) Then, if the social security system is not well put in place, Chinese could continue their excessive savings, the consumption will remain low and so prevent the tertiary sector to develop. Concerning their superior productive capacity, it is bound to a huge consumption of energy and China faces the risk of draining all the resources in addition of producing serious environmental pollution. (Lisbonne-de Vergeron, 2012) About the pollution, China is facing a serious environmental crisis. In fact, China is the world's major contributor to carbon emissions, the air quality of many cities fail to meet the international health standards and even water is polluted and become a scare resource. As a consequence, China's economic growth could suffer as well as the domestic stability. (Albert, 2016) Finally, the increasingly competitive and complicated global environment could harm the capacity of China to sustain its drive to a global economic leadership. (Zeng & Wang, 2007)

d. Opportunities

Being aware of its major weaknesses while focusing its economic growth on its considerable strengths, China faces some opportunities that could enable the country to become the new world's economic gravity center (with the rest of Asia). (Lisbonne-de Vergeron, 2012) First of all, even if the country does not beneficiate from the most powerful army and thus could not resist US aggressions, China does have some keys for dissuading the US. In clear, as China owns a big part of the US debt, a withdrawal of the money would lead the US into a considerable fiscal crisis. In addition, China is in measure to associate its economic power with the Russian

military power. Furthermore, being a major trading partner of many countries, China has a lot of partisans. (Petras, 2012)

Then, as a result of the social instability, new national movements emerge and ask for the restoration of free health and educational services besides a better sharing out of China's wealth among the population. In addition, the large positive trading surplus and thus the huge reserves of China offer the possibility to re-establish health and educational services, to pursue an intensive public housing program and to set up a system of progressive income taxes to lower the inequalities. (Petras, 2012) Moreover, facing serious pollution challenges, they should go on investments in new technologies, with a focus on renewable energies. The environmental crisis has become a political challenge and pressure comes from the environmental NGO community. Greenpeace even sees "an entirely new administration with an entirely different outlook on climate change". (Albert, 2016) Furthermore, China should focus on constructing a strong foreign policy based on military and diplomatic solidarity as well as a stable regime promoting social justice. (Petras, 2012)

To conclude, China is in transition from a developing country and is supposed to become in the following years a developed country lowering its exports and increasing its tertiary sector and the services. So, China can expect to face a boom in consumption. China will continue to attract more foreign companies in the new technologies sector and will remain a major actor in terms of FDI (Foreign Direct Investment). (Lisbonne-de Vergeron, 2012)

B. The Chinese Stock Markets

This section will present an overview of the Chinese market as well as its different stock exchanges, their histories and characteristics. Then, I will introduce the specific features of the stock market that explain the differences with other countries and that lead China to face some difficulties preparing its consistent long term growth. Finally, the different reforms that have been taken to improve its structural problems will be displayed.

1. Market overview

The Chinese first stock market has been created in 1891 with the foundation of the "ShanghaiSharebrokers' Association". However, when studying the Chinese stock market, people used to begin their analysis in 1990 with the re-opening of its two stock exchanges, respectively the Shanghai and Shenzhen Stock Exchanges, after 41 years of interruption by the communist revolution. Deng Xiaoping, the originator of these stock exchanges, transformed China's poor and centrally planned economy into an export-oriented economy that remains one of the world's largest economy despite the recent decline. In parallel, the Hong Kong stock exchange has its own characteristics as a result of the Hong Kong history but contributes to the Chinese economy and its specific features (Hunter &Wong, 2015).

Since the creation of its stock exchanges, China has experienced a tremendous growth. Nevertheless, the Chinese market and its development differ from other stock markets. In fact, China has its own specificities that make its market so particular compared to other countries. With a history of less than thirty years, the Chinese stock market is still considered as a developing market. One could say that the Chinese stock market is like a casino. Indeed, with an incomplete corporate governance structure, an inadequate regulatory capacity and the presence of many manipulators, China lacks a solid foundation and structure to prepare the long term growth of its economy (Gao, 2002, p.4).

So, what makes China's stock market so different?

"Despite their size, China's markets trade like the wildest emerging markets with huge volatility, big boom and bust cycles driven by fast-trading individual investors and heavy involvement of the government. Unlike every other major stock market in the world, China's markets are almost completely closed to foreign investors" (Hunter & Wong, 2015).

Indeed, China's stock market has presented abnormal returns as well as a tremendous volatility and it has recorded a huge growth over its whole existence. Furthermore, the Chinese stock market seems to have a very low correlation with other world's stock markets. That makes China's market an interesting investment place for foreign investors wanting to diversify their portfolio (Carpenter, Lu, Whithelaw, 2014, p.4). However, as I will show later on, China's market has been hitherto an isolated market and a one highly regulated by the government. In addition, its structure, described as an inverted pyramid (the presence of many small-cap stocks), is a source of speculation.

As Malkiel (2007, p.3) says, China's stock market is "an alphabet soup of different kinds of Chinese shares". These share classes are restricted either to domestic or to foreign investors. The three main classes are A, B and H-share, of which the characteristics will be described in the following section.

Then, China's stock market is a pure order driven market, what means that every bids and asks are displayed, in opposition to a quote driven market (Carpenter, Lu, Whithelaw, 2014, p.5). All buyers and sellers expose the prices at which they are willing to sell or buy a particular security as well as the amounts of the security. Mainly countries as the US have a hybrid market (mix of order and driven market). The advantage of the order driven market is that it improves transparency (Langager, Investopedia).

Moreover, the Chinese stock market is an insulated and centralized market and has a daily price change limit of 10% in order to reduce the volatility and the possibility of price manipulation. In addition, there is no extended trading period for institutional investors (compared to individual investors) (Carpenter, Lu, Whithelaw, 2014, p.5).

Finally, the Chinese stock markets are composed of many individual investors. In fact, households (as well as companies) do not have many others investment solutions. Indeed, Chinese banks propose placements with very low rates. That is the reason why most of the Chinese households invest around 40% of their revenues on the stock markets searching for the least return. As a consequence of the increasing stocks demand, prices have risen consequently. This is thus a particular explanation of the broker euphoria in China since 2005 (Delatte, 2008)

2. Stock Exchanges

As we have seen earlier, China has two stock exchanges in the mainland and it also deals with the Hong Kong stock exchange, which is more independent. Each of them have their own characteristics. Both Shanghai stock exchange and Shenzhen stock exchange are supervised by the Chinese Securities Regulatory Committee (CRSC) that supervises new stock listing and daily trading activities and assures a centralized securities supervisory system.

a. The Shanghai Stock Exchange (SSE)

As the name indicates, the Shanghai Stock Exchange operates in the city of Shanghai. It was re-established in November 1990 after 41 years of interruption under the communist revolution. It started operations in December 1990 (Min, Jinqing & Avery, 2009, pp. 237-239).

It is the world's 4th largest stock market by capitalization at CNY 25,064 billion (US$ 3.817trillion) - as of June 2016 - with 1,145 listed stocks, 1,101 companies and 7,231 securities. It is a non-profit organization supervised by the CRSC. The SSE has different functions: providing marketplace and facilities for the securities trading, formulating business rules, accepting and arranging listings, organizing and monitoring securities trading, regulating members and listed companies and managing and disseminating market information (SSE, 1).

Because of the close capital account controls by the Chinese mainland authorities, Shanghai market is still not completely open to foreign investment. Four main types of securities are listed on this exchange: bonds, stocks, funds and derivatives. Bonds traded on SSE include treasury bonds, corporate bonds and convertible corporate bonds. There are two types of stocks: on the one hand, A-shares that are priced in the local Renminbi currency (RMB) and mainly opened to domestic investors except for some foreign investors that have acquired the Qualified Foreign Institutional Investors (QFII); on the other hand, B-shares that refer to the RMB-denominated special shares with their par values marked in RMB in their circulation and to be subscribed in foreign currencies. So, the last ones are designed for foreign investment (SSE, 3).

The main board of Shanghai operates under the "Rules governing the listing of Stocks on Shanghai Stock Exchange" (became effective in 1998). Although there are no regulations on which board an issuer should list the stock, medium or large-size firms usually choose the SSE main board.

Below is the historical data of the SSE composite index, which tracks the performance of all A-shares and B-shares listed on the Shanghai Stock Exchange:

Figure 1: Evolution of the Shanghai Composite Stock Market Index's price from 1990 to 2016

Source: (Trading Economics, 2016)

The SSE composite index has a base value of CNY100 as of December 19, 1990.

b. The Shenzhen Stock Exchange (SZSE)

The Shenzhen Stock Exchange is based in the Futian district of Shenzhen (Guangdong). It was founded in 1987 and formally opened on December 1st, 1990. It began its operations on July 3rd, 1991. As of June 2016, the Shenzhen SE is the world's 8th largest stock market with CNY 20,469.12 billion (US$ 3.118 trillion), 1,175 listed companies and 3,783 securities (SZSE, 2).

Just like the Shanghai Stock Exchange, the SZSE is also regulated by the Chinese Securities Regulatory Committee, has the same functions, is still not completely opened to foreign investment and proposes equity (A and B-shares), funds, bonds and asset-backed securities. (SZSE, 2).

The SZSE also has its main board to list medium and large-size companies. However, they created two other boards: the SME board and the ChiNext.

In 2004, the so-called Small & Medium Enterprise board was created. It has an independent trading system from the Shenzhen main board as well as its regulatory system, its stock coding

and stock price indices. On this board are exclusively traded smaller firms that satisfy the listing conditions of the main board. The SME board was considered as a transitional step toward the creation of the ChiNext (Liu, 2011, p.2).

Finally, the ChiNext, also called the 'New Market', is the China Nasdaq and opened in October 2009. The ChiNext operates under the "Rules governing the listing of stocks on the ChiNext of Shenzhen Stock Exchange" and operates independently from the main board (Liu, 2011, p.2). "As an independent market, ChiNext offers a new capital platform tailor-made for the needs of enterprises engaged in independent innovation and other growing venture enterprises. The difference between ChiNext and the main board lies in their mechanisms of financing investment and risk management for issuers at various stages of development, rather than simply the size" (SZSE, 1).

c. Hong Kong Stock Exchange (SEHK)

The Stock Exchange of Hong Kong (SEHK) has been founded in 1891 as the Association of stockbrokers and has been renamed SEHK in 1914. Because of its history, Hong Kong and its exchange are different from the two previous ones. In fact, the city has been a British colony during 155 years and it was only re-attributed to China in 1997. Hong Kong benefits of the principle of "One country, two systems" that allows the city to keep its own legal system, its money, its political regime and even its own international sport team and immigration laws. China has also promised Hong Kong a relative independence until 2047 (Wikipedia, 2016).

Accounting for around two-thirds of trading, institutional investors have always been more accommodated in SEHK that in the Chinese stock market. The first state-owned mainland Chinese enterprise was listed in 1993 in Hong Kong. Since then, China used to list its largest firms on the Hong Kong stock exchange which has the particularity to be completely open to foreign investment. The H-shares are the stocks of Chinese companies that list on the SEHK and whose accounting statements are in accordance with the international accounting standards (Hunter, 2015).

As of May 2016, the Hong Kong Stock Exchange is the world's 6th largest stock market with a capitalization of US$ 23,130 billion, 1,899 listed companies and 8,525 securities (HKEX, 2016). These numbers gather the information from the main board of Hong Kong stock exchange and GEM. GEM, Growth Enterprise Market, is an alternative stock market operated

by the Hong Kong Exchanges and Clearing Limited. As many firms are not able to fulfill the track record/profitability requirements to be listed on the main board of the SEHK, the GEM has been created to offer them the opportunity to be listed on an alternative stock market (Hong Kong GEM, 2016).

Finally, in order to enable both foreign and domestic investors to trade shares coming from the different markets, the Shanghai-Hong Kong Stock Connect has been created in November 2014. Through the intermediary of their local brokers and clearing houses, they could reach the stock markets and trade the shares of Hong Kong and Shanghai (Prasad, 2016).

3. Specific features of the Chinese stock market

The aim of this section is to present and explain the main characteristics of the Chinese stock market. The focus will be put on what makes China's market so different from that of the other countries, beginning with its high returns and volatility, continuing with its stock market structure and the role of state regulators and ending with its well-known speculation.

a. Abnormal returns

Since the creation of its different stock exchanges around 1990, China has experimented a huge growth compared to other countries. From 1994 to 2001, the Down Jones China Index has registered a cumulative return of 79.82%. In fact, according to the senior director of Dow Jones Indexes, Mr. Gao, China's growth has been unusual and intriguing during this period. (Gao, 2002) The historical outperformance of China's market would be concentrated on three trends: the "1996 Oddity", the "Single-day Oddity" and the "Segment Oddity". First of all, the year 1996 with an increase of 125% of the DJ China Index would have entirely contributed to this performance. Secondly, the growth appears to rely only on singular day trading sessions with some day percentage gain going over 20% gain and even one with 34.2% gain. This was possible before the implementation of the 10% day limit threshold in December 1996. According to some experts, if one investor would have missed the 10 best trading days, it would have suffered a loss of 65% over the 1994-2001 period. Finally, the "Segment Oddity" corresponds to the fact that China's growth has not been equal depending on the index on which investments have been made and thus depending on the segment of the market. For example, the Dow Jones China Offshore Index had fallen by 35% over the 1994-2001 period. All this reveals the particular nature of China's stock market. (Gao, 2002) Further up to date measures of the Chinese stocks returns will be presented in the performance analysis section and will confirm that China has presented high returns on the 1992-2015 period.

b. Tremendous volatility

Measuring the riskiness of an asset, we usually use the volatility. According to the Capital Asset Pricing Model theory, the riskier an asset is, the higher its expected returns should be. "If something is risky, people generally won't buy it unless it also offers chances for big winnings". (Smith, 2015) Even if some finance theorists affirm that volatility is not considered as a risk while the portfolio can be well diversified, the former theory is well illustrated with the Chinese volatility (Smith, 2015). Indeed, in addition of its high returns, China's market also shows high volatility. The table below shows the volatility of the major indexes worldwide for the period 1994-2001.

Table 1: Volatility of Major Indexes Worldwide (1994-2001)

	DJIA	STOXX	Nikkei 225	Hang Seng	DJ World Emerging Markets	DJ China
Average Volatility	15.80%	14.53%	20.80%	31.09%	27.92%	51.10%
Highest Volatility	20.90%	20.79%	25.13%	46.02%	45.14%	117.03%
(Year)	1998	2001	1995	1998	1998	1994
Lowest Volatility	8.19%	5.24%	16.61%	15.99%	12.33%	17.34%
(Year)	1995	1996	1999	1996	1996	2001

Source: (Gao, 2002)

As shown in the table, China's volatility for this period has been remarkable compared to the other major indexes. Volatility affects compound earnings and enhances the creation of market speculation, as investors are led to make short-term bets rather than long term investment (Wang, 2007). In order to reinforce the data, different measures of the volatility of major indices worldwide will be presented in the performance analysis section. The results will confirm the tendency of Chinese stock markets to present high volatility.

c. Share classes

As discussed previously, China's stock market is composed of a lot of different share classes. There exist the A, B, H, N, L and S-shares. The three main classes are A, B and H shares. A and B-shares are traded on both Shanghai and Shenzhen Stock Exchanges, while H-share are traded on the Hong Kong Stock Exchange (State Street Global Advisors, 2015).

A-shares are mainly available to domestic investors and accessible since 2002 to a limited extent by foreign investors who attain the QFII (Qualified Foreign Institutional Investor) quota.

These shares are denominated in Renminbi (RMB) and typically consist of state-owned shares (owned by either the central government or the local government), legal-person (LP) shares (owned by state-owned institutions) or negotiable-shares (owned by individual domestic investors). (State Street Global Advisors, 2015).

In opposition to this, B-shares are designed for foreign investors and are mainly denominated in USD dollar. Since the inception of the QFII program, B-shares seem less attractive. Furthermore, it only represents a very small part of the outstanding shares: 53 constituents in shanghai and 51 in Shenzhen as of July 2015. (State Street Global Advisors, 2015).

As for the H-shares, these are the stocks of Chinese companies that list on the Hong Kong Stock Exchange and mainly represent the largest Chinese companies. (State Street Global Advisors, 2015).

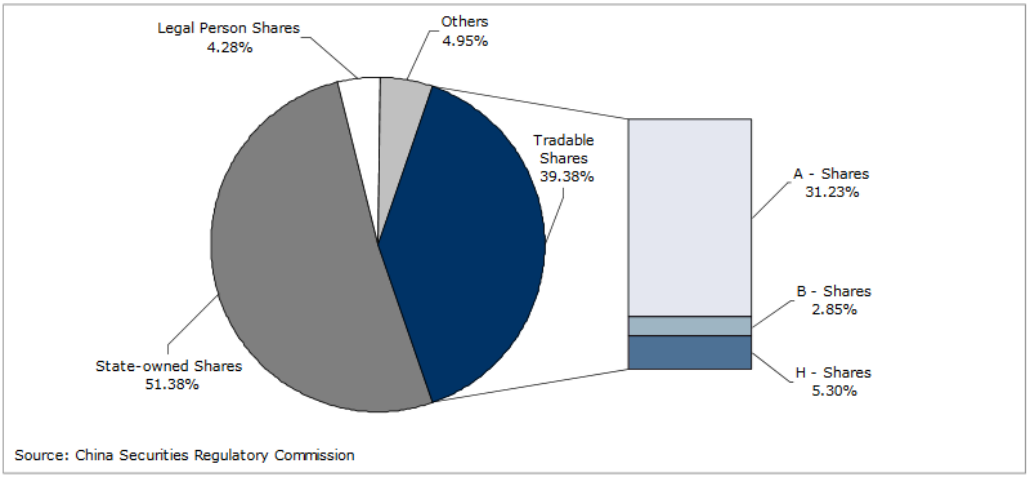
Finally, the N, L and S-shares are listed in New-York, London and Singapore respectively. These share classes are denominated in hard currencies and are available to global investors. Chinese investors are not allowed to trade shares in the Hong Kong Stock Exchange and overseas as well as foreign investors have limited access to A-shares. (State Street Global Advisors, 2015). It illustrates quite well the insulation of the Chinese market. As a reminder, in 2014, the Shanghai Hong Kong Stock Connect has been put in place to withdraw partially this insulation allowing both domestic and foreign investors to trade in both stock markets.

d. Government ownership and control

Government ownership is a major feature of the structure of the Chinese market. In fact, China's stock markets have been divided and fragmented since their creation to prevent foreign institutions from taking control over Chinese companies and protect China's market against the fluctuations of world's markets. This is especially illustrated by the shares structure. Thus, China's market features a highly insulated market where foreign investors only own 1.5% of the total shares on the Shanghai and Shenzhen stock markets. (Yan, 2015).

While the world's government ownership of public companies is decreasing, the situation is very different in China. Many of the shares issued on the Chinese stock markets are called "non-tradable shares" as they are the possession of either the government or the business itself and are not allowed to trade.

Figure 2: Outstanding Shares of Chinese listed companies by Class in 2006



Source: A. Beltratti & B. Bortolotti, 2006

According to the figure from the China Securities Regulatory Commission, state-owned shares represented 51.38% of the total listed shares in 2006. Moreover, tradable shares only accounted for 39.38%. This percentage is called the free-float ratio, the proportion of freely tradable shares available to investors, and represent a stock liquidity and "investability". Based on Dow Jones indexes data, China's free float have been well over-performed by other world's stock markets with an average of 93.9% for the US, 79.7% for Europe and 77.5% for the emerging markets as of January 2002. (Gao, 2002) This graph illustrates quite well the tendency of government ownership and means that shareholders have very little control over the companies in which they invest. In order to reinforce the results, in 2014 150.000 enterprises were owned by the central or local governments. (The economist, 2014). According to the website Fortune (Cendrowski, 2015), the top 12 of Chinese companies are all state-owned. In addition, from the 98 Chinese based companies out of the Global 500 list, only 22 are private. (Cendrowski, 2015)

Linked to the government ownership, is the manipulation that it practices on the market. With the intermediary of state-owned market insiders, the Chinese securities regulators have been successful in shaping market trends. That is the reason why China's stock market is often seen as a policy-driven market. In addition, under the supervision of the Central Financial Work Committee, the China Securities Regulatory Commission (CSRC) supervises, monitors and regulates the market and its participants. More precisely, the CSRC sets the quota for a new listing each year, selects the qualified companies and, until 2001, even chose on which stock exchange the stock would be listed. (Green, 2004)

Both government ownership and manipulation have led to the criticism that stock markets are favoring state-owned firms over entrepreneurial ventures. Stock markets seem to be used by the government as a capital-raising tool for state-owned enterprises rather than as a vehicle for privatization. (Green, 2004) These specific features are a serious obstacle to the healthy development of China's economy and stock markets.

e. Reliance on external expansion

The growth of stock markets generally relies on two different tendencies: internal growth and/or external expansion. Internal growth is related to the appreciation of existing stocks on the stock market, whereas external expansion means the issuance of new shares such as IPO (Initial Public Offerings), secondary offerings and follow-up offerings. While each stock market growth is made up of both modes, the trend for most of the world stock markets is to have an internal growth based expansion. However, this has not been the case for China until 2002. (Gao, 2002)

Computing internal growth and external expansion can be done with the intermediary of a stock index that covers a considerable part of the market (say 80%). With a working index divisor, the performance of the benchmark index can be used as an indicator of the market internal growth. Then, comparing this performance with the overall evolution of the market, the difference can be interpreted as the external expansion. As the IPO's are not directly included in the stock indexes, their value would be registered in the overall market value and not in the index value. (Gao, 2002)

Table 2: Stock Market Expansions in the U.S. and China (%)

	U.S.			China		
Year	Size Change	Index G/L	Difference	Size Change	Index G/L	Difference
2001	-11.1	-12.1	1.0	-9.5	-25.5	16.0
2000	-9.9	-11.8	1.9	81.7	49.3	32.4
1999	23.8	22.0	1.8	35.7	15.9	19.8
1998	23.0	21.7	1.3	11.3	-12.2	23.5
1997	33.3	29.2	4.1	78.1	37.9	40.2
1996	23.7	18.8	4.9	183.3	124.9	58.4
1995	35.3	33.4	1.9	-5.9	-15.6	9.7
1994	-1.3	-2.5	1.2	4.5	-39.4	43.9
Average	**14.6**	**12.3**	**2.3**	**47.4**	**16.9**	**30.5**
Percentage		**84.3%**	**15.7%**		**35.6%**	**64.4%**

Source: (Gao, 2002)

This table illustrates how US stock market growth is influenced by internal growth which represent 84.3% of its whole expansion, while China's one is led by external expansion that accounts for 64.4% (only 35.6% of internal growth) in 2002. "Obviously, when a stock market mainly relies on external expansion, the relationship between changes in market size and the return on existing stocks becomes weaker, and the return on existing stocks may fall far behind any increases in stock market size". (Gao, 2002, p.18)

However, the situation has changed since 2002. In fact, the China's regulatory commission has highly regulated the issuance of IPO in order to limit the market volatility and improve market stability. Thus, in period of hot markets, the IPO issuance has been allowed in order to cool down the market. It is assumed that investors are likely to invest in those new shares and thus not in the existing ones, thus reducing the rising prices. In period of cold market, the issuance of IPO has been stopped in order to warm up the markets. (Packer & Spiegel, 2016)

According to the study from the Federal Reserve Bank of San Francisco, no correlation is found between issuance of IPO and stocks prices fluctuations on the Chinese stock markets. The reason pointed out is that the overall size of Initial Public Offerings issuance is small relative to total capitalized market values (0.06% in Shanghai and 0.14% in Shenzhen). One critic that can face the study is that the lack of correlation could be due to China's regulatory commission policy of regulating IPO issuance. (Packer & Spiegel, 2016)

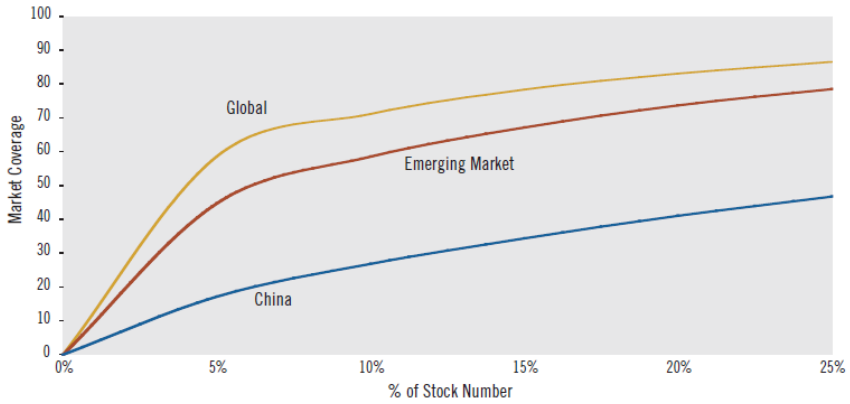
f. Lack of blue chips

China stock market suffers from a lack of blue chips, which generates different structural problems. Blue chips are large companies, nationally recognized and well-established. They generally weather downturns and operate profitably against adverse economic conditions. (Investopedia) Blue chips firms typically have a large market value, a low volatility, a high liquidity and a solid shareholder base. (Gao, 2002) In fact, this lack of blue chip companies is mainly the result of a short economic history and mainly because most of the Chinese large-cap companies are listed on the overseas exchanges and especially on the Hong Kong Stock Exchange. In addition, the fact that China's stock market is based on external expansion also contributes to the presence of more small-cap companies on the market.

As a consequence, Chinese investors cannot invest in these blue chip firms and are limited to invest in the Shanghai and Shenzhen stock exchanges with a predominance of small-cap stocks.

According to Gao (2002), 88% of the Chinese stocks can be described as small or micro-cap stocks. Moreover, following the parameters of the Dow Jones Emerging Market Index in year 2001, only one Chinese company could be considered as a large company (with a market capitalization over US$ 1.2 billion): the Shenzhen Development Bank. Finally, to illustrate this small-cap leading, we can have a look at the price per share, which was equal to 1.007$ in 2002 compared to 34$ at the NYSE. (Gao, 2002)

Figure 3: Comparison of Market Concentration in China and Rest of the World



Source: (Gao, 2002)

This chart illustrates the presence of small-cap firms on the Chinese market compared to the rest of the world. This is presented as a percentage of market coverage in terms of capitalization. While 5% of the largest stocks in the global market represent almost 60% of the market, the 5% largest Chinese stocks would only cover less than 20% of the market.

The senior director of the Dow Jones Index has presented different problems linked to this specificity of China's market. In fact, to be a good benchmark for investors, indexes should cover at least 60% of the market. With the 88 largest Chinese companies on the Shanghai and Shenzhen exchanges, the Dow Jones China 88 Index covers only 24% of the broad market. To improve this market coverage, it should increase the number of index components which would result in a deterioration of index liquidity. Furthermore, as there are almost no large companies, this makes it harder for index providers to create an index, as they are not representative of the market and would diverge from each other. Finally, index-based investing is not simple as it requires a lot of resources and money to hold the vast number of stocks required for index replication on the long term. (Gao, 2002)

However, all the data dates from 2002. Since 2002, the situation has a bit changed. Even if the biggest Chinese companies are still listed on the Hong Kong Stock Exchange, the Shanghai

SSE180 Index gathers 180 original Blue-chips. (SSE, 2) Shenzhen, unlike Shanghai, is still mainly composed of small-cap stocks. In contradiction, most of the Blue chips stocks are state-owned and are thus not available for trading. (Cendrowski, 2015) But, since the opening of the Shanghai-Hong Kong Stock Exchange Connect, investors do have access to a larger sample of Blue chips stocks. (Prasad, 2016)

g. Speculation

As it already has been said, the extreme volatility present on the Chinese stock market, added to a particular market structure, stimulates speculation.

In fact, with a high concentration of small-cap stocks, individual speculators are incited to speculate and seize the short term opportunity for making profits. This trend is reinforced by the increasing number of individual retail investors on the Chinese market (around 80% of trading). (Kyoungwha, 2015) In opposition to institutional investors who are driven by a long term vision of investment, retail investors tend to speculate. In a normal top heavy structure market with blue chips companies guiding the market, speculation is discouraged. Indeed, big companies cannot been manipulated and small-cap have a too insignificant impact on the market to affect its return and tendency. However, in China, the presence of small-cap stocks means that speculation can impact the return of the stock as well as the index return and even influence the overall market trends. (Gao, 2002)

Even if speculation is present in all other world's markets, China's one is really high and has led the Chinese stock market to be described as a casino. The effect of this speculation is that it prevents the creation of a dominant core of blue chip companies; indeed, once investors have made their short-term profit, they sell the stocks whose return will decrease and will no more constitute a large-cap firm. Thus, the lack of blue chip enterprises brings about speculation, which in turn avoids the appearance of blue chip companies, thus generating an endless cycle. (Gao, 2002)

A good way to illustrate that speculation has been present throughout the development of the Chinese stock market and that it is a big concern, is to focus on the turnover rate. In fact, this metric is often used as an indicator to measure the degree of speculation by dividing the total annual trading value by the average market capitalization. A turnover of 100% means that the average holding period of the stock is one year. (Loth, Investopedia). According to some

analysis made by the Dow Jones Index company, China's turnover over the 1994-2001 period has been over 500% in average. (Gao, 2002) That means that stocks were held for a period of around two months. This illustrates the high frequency trading in China in order to make short-term profits. Actually, the turnover rate has a bit decreased but remains around 200%. (SZSE, 3) In addition, speculation is still present today on the Chinese stock markets and especially on the Shenzhen Stock Exchange. Indeed, as the latter is mainly composed of small-cap stocks, domestic retail investors that look for short-term profits are very attracted by this market. (Noble, 2015) This will particularly be one of the reason why Shenzhen will tend to outperform Shanghai Stock Exchange on the 2002-2015 period (see the performance analysis section).

4. Reforms

With an insulated market, a high percentage of state-owned stocks (non-tradable), an incomplete corporate governance structure, an inadequate regulatory capacity and an increasing speculation, China lacked a solid foundation and structure to prepare the long term growth of its economy. That is the reason why different reforms have been put in place to improve the information environment (especially stock prices informativeness), to liberalize the economy in order to empower the market to attract capital, allocate it efficiently and contribute to the economic growth worldwide. (Carpenter & Whitelaw, 2014). This section aims at presenting and describing the regulatory reforms developed to liberalize capital flows as well as other main reforms

First of all, it is necessary to introduce the China Securities Regulatory Commission (CSRC). The CSRC was created in 1997 and launched its activities in 1999 as the country's only regulatory and supervisory institution for the securities market (stocks and bonds). It monitors and controls markets and markets participants on a daily basis and is supervised by the Central Financial Work Committee. (Wang, 2007)

With an insulated economy, China needed to open up its securities industry and its capital flows to foreign investment. As S. Neftci and M. Yuan (2007) pointed out, three principles were adopted. First, the securities industry should be opened in an active, cautious and progressive manner. Secondly, China must combine the opening up with domestic liberalization. Thirdly, authorities should try to promote competition and mutual benefits. (Neftci, 2007)

Different schemes have been designed to liberalize cross-border capital inflows, outflows or both. Concerning the capital inflows, two channels can be presented: the QFII and RQFII. The QFII, Qualified Foreign Institutional Investor, allows foreign institutions to invest in the Renminbi denominated stocks on the A-shares market and also on B-shares of both Shanghai and Shenzhen stock exchanges. It was launched in 2002 and is limited to a specific quota. The RQFII, Renminbi Qualified Foreign Institutional Investors, was launched in 2011 and allows institutional investors that received the RDFII qualification to use offshore RMB funds to invest in RMB denominated financial instruments. The aim of these two schemes is to attract long term foreign funds. (Prasad, 2016)

Then come the channels for capital outflows: QDII and QDII2. The first one, the Qualified Domestic Institutional Investor scheme was launched in 2006 and is similar to the QFII but for domestic investors. It allows them to invest in offshore financial products such as securities and

bonds. The second channel, the Qualified Domestic Individual Investor concerns individual investors rather than institutional and allows them to invest on the overseas market. (Prasad, 2016) The QDII2 was proposed in 2013 but has not been launched yet because of some fears against a devaluation of the Yuan and uncertainty about their (regulatory institutions) ability to manage systematic risk (Wei, 2016).

In addition, channels to improve both capital inflows and outflows have been implemented. The first one, launched in September 2013, is the Free Trade Zone of Shanghai. In this zone, cross-border capital transactions and financial institutions have been liberalized. In 2015, other FTZs have been implemented in Fujian, Guangdong and Tianjin. The second one is the Shanghai and Hong Kong Stock Exchange Connect, which has already been presented earlier. This was launched in 2014 and allows both foreign and mainland Chinese investors to invest in Shanghai A-shares and overseas stocks from the Hong Kong exchange respectively. The third one is the Mutual Fund Connect launched in 2015 which enables fund managers to access to Hong Kong funds and mainland funds in both exchanges. (Prasad, 2016)

According to J. Carpenter & al (2014), opening up capital flows should reduce systematic risk as well as the cost of equity capital while boosting investment growth and wages in China. That is as well the opportunity for foreign investors to diversify their portfolio and mitigate their risk as China's stock market appeared to have low correlation with other world's stock markets although the liberalization of the Chinese economy will probably lead to an increase of this correlation. (Carpenter & Whitelaw, 2014)

As a continuity of opening its economy, China became member of the World Trade Organization on December 21st, 2001.

Finally, with a dramatic situation at the end of the year 2004 as the non-tradable shares of listed companies represented 64% of the total share capital on the domestic market, a share structure reform has been put in place by the CSRC in 2005. The aim of this reform was to unlock non-tradable shares gradually and privatize them to improve the ownership structure of listed companies and allow investors to access more shares for trading. (Neftci, 2007)

To conclude, China has shown strong indications that it is willing to open its market to international investors. Beginning in 2001 with its admission to the World Trade Organization and with the launch of the QFII quota in 2002 followed by many other reforms, the Chinese regulators and stock exchanges are making significant efforts to improve the regulatory environment and trading mechanisms. (FTSE Russell, 2015)

Part 2: Performance Analysis

A. Research Objectives

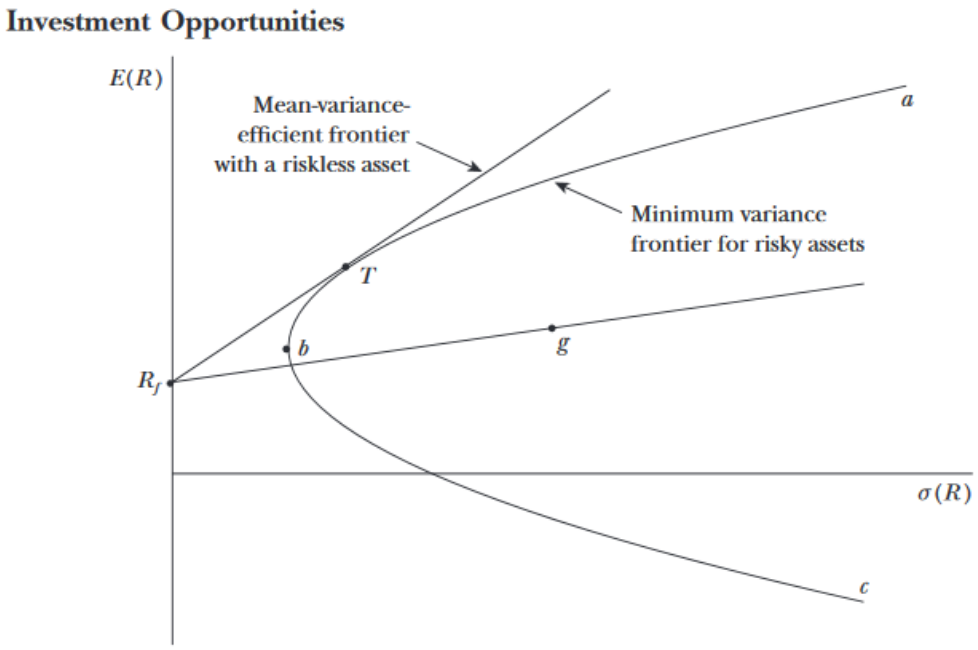
Linked to the efforts of opening China's exchanges to foreign investors as well as allowing domestic investors to invest abroad, the need for tools and performance indicators is supposed to rise with the increasing demand for Equity investment. After having presented an overview of the Chinese economy and the main characteristics of its stock exchanges which make China's economy so particular, I will aim at presenting a performance analysis of the main Chinese stock indices. Through this analysis, I wish to provide a thorough understanding of the risk and performance profile of Chinese Equity indices throughout their existences (1990-2016) and in comparison with other countries. Using the S&P 500 as a benchmark, my analysis will take the point of view of an American investor and will aim at determining the interest of investing in the Chinese stock markets compared to other world markets for the last 25 years. Using a modern statistical software, R, the study will gather several general performance and risk metrics such as the Alpha, Beta and Sharpe ratio as well as other misrepresented ratios such as Sortino ratio, M^2 or the information ratio.

B. The Capital Asset Pricing Model

Conducting a performance analysis leads me to speak about the Capital Asset Pricing Model (CAPM). In fact, the CAPM is at the origin of modern portfolio theories and many performance measures that I will use and present in the 'results' section. In order to introduce the CAPM, let's have a look back at Markowitz's theory (1952). According to Fama and French (2004), "the CAPM builds on the model of portfolio choice developed by Harry Markowitz (1959)". In fact, according to Markowitz, investors are risk averse and their choice of portfolio is based on two criteria: the highest expected return and the lowest variance (or standard deviation) as a measure of the risk. Thus, investors select at time t-1 a portfolio that produces a stochastic return at t and which is mean-variance-efficient. This means that they will tend to minimize the portfolio's variance of returns given the expected returns and try to maximize the expected returns of the portfolio given the variance of returns. (Markowitz, 1952, pp.77-91) With this reasoning, the portfolio theory identify the efficient frontier that will be the same for all

investors. Then, investors' risk profile will play a role when choosing an efficient portfolio along the efficient frontier. (Nielsen, 2008)

Figure 4: CAPM: Investment opportunities



Source: (Fama and French, 2004, p.27)

This figure illustrates the principle described above. On the abscise axis, we find the standard deviation while on the vertical axis there are the expected returns of the portfolios. The abc curve represents the minimum variance frontier for risky assets (the portfolios do not include risk-free borrowing and lending) and delimits the best combinations of expected return and risk minimizing variance at each levels of expected returns. (Fama & French, 2004, p.26). Thus, depending on their risk profiles, investors will tend to choose risky portfolio (a), intermediates (T) or safer portfolios (b). By the way, if risk free lending and borrowing is excluded, the abc curve is also the mean-variance-efficient frontier as it also maximizes the expected returns of portfolios for a same level of risk.

According to Fama and French (2004), Sharp (1964) and Lintner (1965), added two important assumptions to Markowitz's mean-variance model. The first one says that investors can unlimitedly lend and borrow money at the risk-free rate. The second stipulates that there is a complete agreement meaning that investors agree on the joint distribution of returns and that the distribution is the true one. Thus, introducing risk free lending and borrowing, we find the risk free rate (Rf) on the vertical axis. The new mean-variance-efficient frontier results in the straight line, also called Capital Market Line (CPL), from Rf and tangent to the abc curve (at

the point T). As a result, all efficient portfolios are a combination of the risk-free asset and a single risky portfolio, T. Since all investors hold the same portfolio T of risky assets (because of the complete agreement), T must be the value weight portfolio of risky assets. (Fama & French, 2004, p.27)

According to the authors, this results in the equation of the Sharp-Lintner CAPM:

Equation 1: Sharpe-Lintner CAPM

$$E(r_i) = E(r_f) + [E(r_m) - E(r_f)] * \beta$$

Where:

$E(r_i)$: Expected return of asset i

$E(rf)$: Expected return of risk-free asset

$E(r_m)$: Expected return of market portfolio

β: Beta of asset I, measuring the systematic risk of the asset i

Measuring the risk in the CAPM requires to make the distinction of two components of the total risk (variance or standard deviation), namely, the systematic risk and the unsystematic risk. The first one is linked to the market risk and represent the risk that cannot be diversified away. On the opposite, the unsystematic risk represents the risk linked to a particular asset and can be diversified away when increasing the number of assets in the portfolio. The Capital Asset Pricing Model only focuses on the systematic risk, measured by the Beta of the asset and do not compensate for unsystematic risk. The main logic in the CAPM is that the more systematic risk we take, the higher should be the expected return of the portfolio or asset. (Levisauskaite, 2010)

The different assumptions concerned by the CAPM and presented by Levisauskaite (2010) are:

1) All investors look only one-period expectations about the future
2) Investors are price takers and they can't influence the market individuality
3) There is risk free rate at which an investor may either lend or borrow money unrestrictedly
4) Investors are risk averse
5) Taxes and transaction costs are irrelevant
6) Information is freely and instantly available to all investors

However, these assumptions may be unrealistic. For example, according to Fama and French (2004), unrestricted lending and borrowing at the risk-free rate is unrealistic. That is the reason why different authors developed different versions of the CAPM in order to resolve the unrealistic assumptions. According to Black (1972), market can be mean-variance-efficient even without the unrestricted lending and borrowing at the risk-free rate condition. However, his assumption stipulates that short-selling should be unlimited which is also considered as unrealistic for Fama and French (2004). In addition, investor do faces taxes and costs when investing in portfolios in the real world. Furthermore, information is not available to all investors by the same way. Finally, investors used to make many-periods expectations about the future. Despite these assumptions form an ideal world far from the reality, the Capital Asset Pricing Model provides useful outcomes, is easy to compute, takes into account the systematic risk and represents the origin of the modern portfolio theory. In the following, other metrics and ratios will be presented while many of them ensue from the CAPM.

C. Data

In order to compute the different ratios and metrics necessary to realize the performance analysis, monthly data has been collected from Bloomberg. My analysis is focused on the period 1992-2015 for the reason that before 1990 no data existed for Chinese indices and that much of the other index prices used in the analysis were not available before 1992. That led me with 278 observations for each index. The benchmark used to represent the fluctuation of the whole market is the S&P 500 and the risk free rate is the US 10 years Treasury bond. The reason why I decided to use the S&P 500 as the benchmark to represent the fluctuations of the global market is the following: the S&P 500 is an index based on 500 big companies quoted on the American stock market and is a capitalization weighted index. It is thus the most representative of the American stock market. Furthermore, this index is largely used as a measure of the global level of stock prices especially because it gathers growth stocks and value stocks (Rosa, 2011, pp. 915-934). I decided to focus my research on 32 worldwide indices including 4 Chinese indices and one stock market index for Hong Kong. Concerning the Chinese stock markets, since the B-share markets are much smaller than the A-share markets with less than 10% of the total outstanding shares, I will concentrate my study on the A-share markets. I selected two indices including the composite index for both the Shanghai and Shenzhen stock markets. Here is the list of all the indices used.

Table 3: List of the Indices included in the Performance Analysis

	Country	Ticker	Conventional index
1	Chine	SHCOMP	Shanghai Composite Index
2	Chine	SZCOMP	Shenzhen Composite Index
3	Chine	SHASHR	Shanghai A Share index
4	Chine	SZASHR	Shenzhen A share index
5	Hong Kong	HSI	Hong Kong Hang Seng index
6	Brazil	IBOV	Ibovespa Sao Paulo Stock Exchange index
7	Mexico	INMEX	Mexican Stock Exchange index
8	India	NIFTY	Indian Stock Exchange index
9	Indonesia	JCI	Jakarta Stock Exchange Composite Index
10	United States	NYA	New-York Stock Exchange Composite Index
11	United States	CCMP	Nasdaq Composite Index
12	United States	INDU	Dow Jones Industrial Average Index
13	United States	SPX	Standard and Poor's 500 Index
14	United States	NDF	Nasdaq Financial 100 Index
15	United States	RAY	Russell 3000 Index
16	Canada	SPTSX	S&P Toronto Stock Exchange Composite Index
17	United Kingdom	UKX	Footsie 100 Index
18	France	CAC	CAC 40 Index
19	Germany	DAX	Deutsche Boerse AG German Stock Index
20	Switzerland	SMI	Swiss Market Index
21	Europe	SX5E	Euro Stoxx 50 Price EUR Index
22	Spain	IBEX	IBEX 35 Index
23	Netherlands	AEX	AEX Index
24	Belgium	BEL20	BEL20 Index
25	Portugal	BVLX	PSI All-share Index Gross Return Index
26	Ireland	ISEQ	Irish Stock Exchange Overall Index
27	Japon	NKY500	Nikkei 500 Index
28	South Korea	KOSPI	Korea Stock Exchange Index
29	Taïwan	TWSE	Taïwan Stock Exchange Weighted Index
30	Australia	AS30	Australian Stock Exchange All Ordinaries Index
31	Malaysia	FBMKLCI	FTSE Bursa Malaysia KLCI Index
32	Thaïland	SET	Stock Exchange of Thaïland

Source: Author

Monthly returns have been calculated from the monthly prices on Excel and the annualized returns of the US 10 years Treasury bond have been transformed into monthly returns (monthly risk free rates). Then, all the returns have been imported into the statistical software R and converted into time series to compute the different ratios.

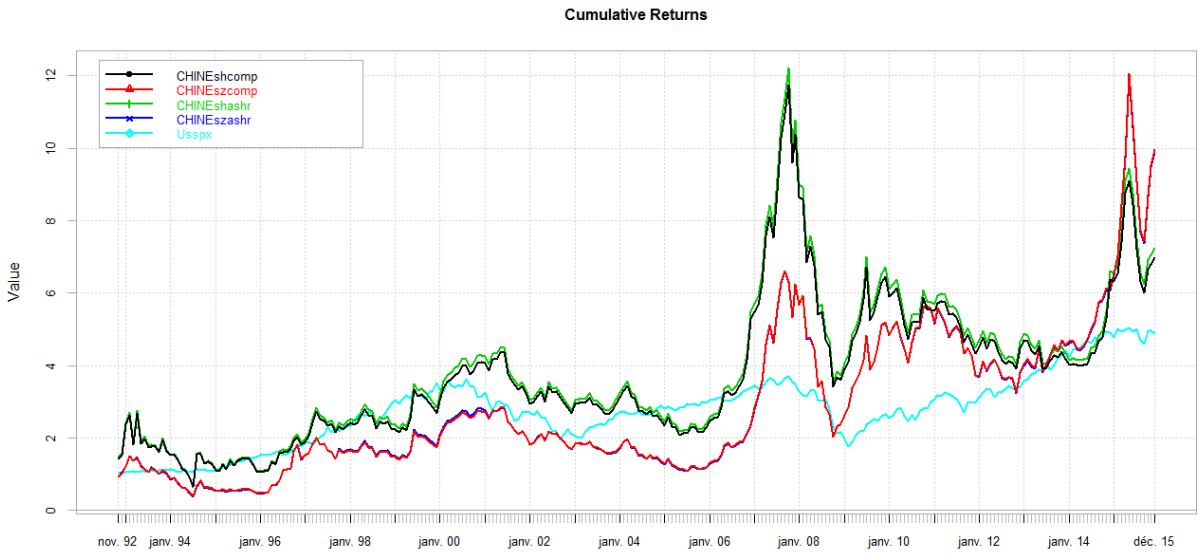
D. Results

1. 1992-2015 Period

In order to achieve my analysis about the performance and risk profile of Chinese stock market indices, I have used a wide range of different ratios and metrics that are available in the PerformanceAnalytics package of the statistics software R. I will present each of these measures before analyzing and interpreting the results associated.

The average monthly returns, the annualized returns and the global returns have been calculated for each index using both arithmetic and geometric means. The results are available on Annex n°1, p.84. Given that all indices registered positive returns on the 1992-2015 period, presenting a positive return will not be sufficient for an index to be viewed as a good performer. The benchmark (S&P500) registered an annualized return of 7.08%, which has been outperformed by only 13 indices, including that of Ireland (7.98%), some US indices and mainly those of developing countries like India (10.35%), Indonesia (12.38%), Mexico (14.61%), Brazil (48.41%) as well as the four Chinese indices (around 8.8% for Shanghai and 10.4% for Shenzhen). As to the global returns, the tendency is the same: developing countries offer higher returns on the 25 years period than developed countries. We can notice that while the S&P 500 global return is about 184%, 18 indices present a higher global return, 14 have one above 200% and only Brazil (1168%) and Mexico (393%) recorded a higher or equal global return than Chinese composite indices (around 386%) and Chinese A-share indices (between 391% and 401%). Thus, a first evidence seems to be that developing countries have outperformed during the last 25 years.

Figure 5: Cumulative Returns of four Chinese indices and the S&P500



Source: Author, data from Bloomberg

The graph above has been computed with R and represents the cumulative returns of the four Chinese indices and the S&P500 benchmark (USspx on the graph). This illustrates that since 1996, the Chinese stock markets have outperformed the benchmark, especially for the years 2006 to 2008 and since 2014. Another characteristic that can be pointed out is the superiority of Shanghai stocks returns compared to Shenzhen ones until 2013-2014. Since 2014, Shenzhen stocks seem to better perform than Shanghai.

a. Risk Measures

Considering the risk of an index, we are concerned by the variability of the returns from the average. The following three first metrics are used to measure the variability (Bacon, 2…, p.62).

Mean Absolute Deviation

The Mean Absolute Deviation is calculated by taking the absolute value of the difference of each daily return with the mean return and dividing the total sum by the number of observation.

Equation 2: Mean Absolute Deviation

$$Mean\ Absolute\ Deviation = \frac{\sum_{i=1}^{i=n} |r_i - \bar{r}|}{n}$$

Variance

The Variance is calculated by summing the squared deviation of returns from the mean return and dividing the total sum by the number of observation.

Equation 3: Variance

$$Variance = \frac{\sum_{i=1}^{i=n}(r_i - \bar{r})^2}{n}$$

Taking the square of the difference avoids the problem of negative deviations that cancel the positive deviation and give a more important impact to high deviations from the mean.

Standard Deviation

The Standard Deviation is simply obtained by taking the square root of the variance. Standard deviation is often preferred because of its non-squared unit.

Equation 4: Standard deviation

$$Standard\ deviation = \sqrt{\frac{\sum_{i=1}^{i=n}(r_i - \bar{r})^2}{n}}$$

Covariance

Covariance measures the degree to which portfolio/asset returns are fluctuating in the same way that the benchmark. A positive Covariance means that they are moving in the same way. A negative Covariance means that when one return is increasing, the other is decreasing. And a Covariance equal to zero indicates an absence of relationship between the portfolio/asset and the benchmark.

Equation 5: Covariance

$$Covariance = \frac{\sum_{i=1}^{i=n}(r_{pi} - \bar{r}_p) * (b_i - \bar{b})}{n}$$

Correlation

The Covariance measure is not easy to interpret and can therefore be transformed into the Correlation. This last metric has the same interpretations than the covariance but is scaled between -1 and +1. A Correlation of +1 means that the portfolio fluctuates exactly the same way as the global market. Correlation is calculated by dividing the Covariance by the result of the multiplication of the standard deviation of the portfolio and the standard deviation of the benchmark.

Equation 6: Correlation

$$Correlation = \frac{Covariance}{\sigma_{i}*\sigma_{M}}$$

Correlation can also be a measure of the systematic risk - the risk that cannot be diversified - divided by the total risk of the portfolio.

Equation 7: Correlation (Beta)

$$Correlation\ (Beta) = \frac{\beta_{i} * \sigma_{M}}{\sigma_{i}}$$

The metrics presented here above were calculated with R and landed similar results (Annex n°2, p.85). In terms of mean absolute deviation, standard deviation and variance, only the United Kingdom, Australia as well as the New-York stock Exchange and the Dow Jones Industrial average indices present a risk inferior to the benchmark. It seems logical than other indices do carry much risk than the benchmark, as they are less diversified and are more susceptible to seasonality and short-term fluctuations.

Figure 6: Standard deviation of returns by index

Source : Author, data from Bloomberg.

While Chinese indices are good performers in terms of returns, risk measures show that they are riskier than their counterparties. Only Brazil registered higher standard deviation measures and mean absolute deviation than Chinese indices. Concerning China's stock market, we can see that composite indices are less risky than the A-share indices. Just like the reasoning for the benchmark and its diversification compared to other indices, composite indices are more

diversified than their counterparties, as they are composed of more stocks and cover a bigger part of the Chinese market. Another characteristic that can be highlighted is that Shanghai indices are riskier than those of the Shenzhen stock market.

Then, a look at the correlation on Annex n°2, p.85, shows that while most of the indices have a correlation with the benchmark of at least 0.7, Asian countries as well as developing countries have a much smaller correlation with the S&P 500. With regard to Asian countries, Japan has the highest correlation with only 0.498. For developing countries, the correlation ranges between 0.2039 for Mexico and 0.4649 for Brazil. Finally, Chinese indices correlations are far below, as they fluctuate between 0.1311 and 0.1385 and are statistically significant at a 95% confidence level. These results illustrate one of the main characteristics of China's stock market: insulation. Indeed, the fact that China's economy has been and remains an insulated economy, despite the important progress in reforming and opening its markets, explains why stock markets do not depend very much on the fluctuations of the global market (represented here with the S&P 500).

b. Distribution of returns

Skewness

In practice, the distribution of data is rarely normally distributed (skewness equal to zero). In fact, there is often an asymmetry. The Skewness is the statistical measure of the asymmetry of the distribution of returns. A positive Skewness means that there exist more extreme values on the right tail of the distribution. Skewness can be measured in two different ways:

Equation 8: Skewness

$$Fisher's\ skewness = \sum (\frac{r_i - \bar{r}}{\sigma_p})^3 * \frac{1}{n}$$

$$Sample\ skewness = \sum (\frac{r_i - \bar{r}}{\sigma_{Sp}})^3 * \frac{n}{(n-1)*(n-2)}$$

Kurtosis

The Kurtosis is an additional measure that will help to determine the shape of the distribution of returns. For a normally distributed curve, the Kurtosis is equal to 3 and is called mesokurtic. A Kurtosis higher than 3 (called *platykurtic*) is represented by a peaked distribution with fat

tails, while a kurtosis less than 3 (called *leptokurtic*) means that the distribution will be flatter with thinner tails.

Equation 9: Kurtosis

$$Kurtosis = \sum (\frac{r_i - \bar{r}}{\sigma_p})^4$$

To facilitate the understanding of the measure, the excess Kurtosis is often calculated by deducting 3 (the kurtosis of the normal distribution).

Equation 10: Excess Kurtosis

$$Excess\ Kurtosis = \sum (\frac{r_i - \bar{r}}{\sigma_p})^4 * \frac{1}{n} - 3$$

Skewness-Kurtosis ratio

According to Bacon (2008), investors are interested by returns that present a positive skewness and low kurtosis. Thus, they are looking for the highest skewness-kurtosis ratio which is simply the skewness divided by the kurtosis.

Equation 11: Skewness-Kurtosis ratio

$$Skewness - Kurtosis\ ratio = \frac{S}{K}$$

This ratio is often used in combination with the Sharpe ratio to rank portfolios.

Analyzing the distribution of the returns for each index of the database, skewness and kurtosis measure have been both calculated on Excel and R and landed similar results (view Annex n°2, p.85). Regarding the skewness, we can observe that 25 indices are higher than the benchmark but only 10 have a positive skewness, namely from the lowest to the highest: Hong Kong, Thailand, Malaysia, Taiwan, South Korea, Shenzhen Composite, Shenzhen A-share, Brazil, Shanghai Composite and Shanghai A-share. Asian countries, in addition of Brazil, present an interesting distribution of their returns with more extreme values than their counterparties. To explain why investors are more interested by distributions with a positive skewness, we can make a comparison with the lottery. People are attracted by huge possible gains even if they have a low probability and even if the mean return is low. Lottery players often have a negative mean return but hope to win the jackpot. With this reasoning, Brazil and Chinese indices are the most attractive in terms of skewness.

Let us see now what the kurtosis measure shows us. While the kurtosis of a normal distribution is 3, we can see that only 8 indices have a higher kurtosis. From the lowest to the highest, these

are: Taiwan, Shenzhen Composite, Malaysia, South Korea, Shenzhen A-share, Brazil, Shanghai Composite and Shanghai A-share. Once again, Asian indices, with the exception of Brazil, present higher measures than others and in particular the Shanghai indices which present an exceptional kurtosis of 38.97 for the Composite index and 44.92 for the A-share index. One could say that investors prefer low kurtosis because when it is combined with a positive skewness, it reduces downside risk.

In order to rank my indices in terms of return distribution, I will use the skewness-kurtosis ratio and follow what Bacon (2008) recommends for securities: high skewness and low kurtosis and thus the highest skewness-kurtosis ratio. As 10 indices have a positive skewness, only 10 have a positive ratio. From the lowest to the highest we have now: Hong Kong, Shanghai A-share, Shanghai Composite, Malaysia, Thailand, South Korea, Shenzhen A-share, Taiwan, Shenzhen Composite and Brazil. So, Brazil and Shenzhen indices are still well ranked and present the highest skewness-kurtosis ratios while Shanghai has been penalized for its very high kurtosis. However, high kurtosis can also be considered as a positive characteristic depending of the point of view. Indeed, considering Chinese indices that have the highest skewness, having a high kurtosis also increases the probability of abnormally high returns and do not necessary increase too much the downside risk as they present very high means.

c. Performance Measures adapted to risk

Beta

The Beta is a measure of the volatility of an asset compared to the global market. It represents the intrinsic risk of the asset or, in other words, the risk that cannot be diversified away, also called the systematic risk. In opposition, there exists the specific risk of an asset which can be softened or even cancelled thanks to the diversification of the portfolio. The Beta is used by the Capital Asset Pricing Model (CAPM) to anticipate and calculate the expected return of an asset depending on the previous market returns and the volatility of the asset (Beta) in comparison to the global market. According to the CAPM, the relation between an asset's return and its Beta is linear. A Beta equal to1 means that the asset moves exactly in the same way as the market. A Beta higher than 1 Beta illustrates a riskier asset as it is more volatile. For example, if the market return is 10%, an asset with a Beta of 1.5 is supposed to encounter a return of 15%. In opposite, an asset with a Beta lower than 1 is supposed to be less volatile, less risky and thus presenting lower returns. In the concern of portfolio management, the Beta is often used as a

predictive measure of the future returns of assets. However, as the calculation of Beta is based on historical data, it and does not have a good predictive power. In fact, the risk profile of the company in which you invest could change from one day to another and could not reflect the past returns on which the Beta has been calculated. Another difficulty with the Beta consists in the capacity of choosing an index that reflects the global market returns. To conclude, even if the Beta can be described as a bad measure to predict returns, it is nevertheless very useful to compare portfolio returns and is even a good measure of risk if the portfolio is well diversified (no specific risk).

Equation 12: Beta

$$Beta = \frac{\sum_{i=1}^{i=n} [\,(r_i - r_{Fi} - \bar{r} - \bar{r}_F) * (b_i - r_{Fi} - \bar{b} - \bar{r}_F)\,]}{\sum_{i=1}^{i=n} (b_i - r_{Fi} - \bar{b} - \bar{r}_F)^2}$$

Table 4: Beta results

Index	Beta	Index	Beta
SHANGHAI COMPOSITE	0,4220	HONGKONG	1,0967
SHENZHEN COMPOSITE	0,3604	NYA	0,9633
SHANGHAI A-SHARE	0,4256	CCMP	1,2981
SHENZHEN A-SHARE	0,3565	INDU	0,9311
BRAZIL	1,1159	SPX	1
MEXICO	1,0179	NDF	0,8663
INDIA	0,6994	RAY	1,0111
INDONESIA	0,8812	CANADA	0,7719

Index	Beta	Index	Beta
UNITED KINGDOM	0,7653	Portugal	0,6789
France	0,9803	IRELAND	0,9060
GERMANY	1,1114	JAPON	0,6428
SWITZERLAND	0,7363	SOUTH KOREA	0,8932
EUROPE	1,0209	TAIWAN	0,8079
SPAIN	0,9835	AUSTRALIA	0,6303
NETHERLANDS	1,0069	MALAYSIA	0,6248
BELGIUM	0,7971	THAILAND	0,9401

Source: Author, data from Bloomberg

Observing the Beta of the different indices, we can see that 8 indices have a Beta superior to 1. That means that they bear more systematic risk than the global market and are more volatile. From the highest to the lowest, we have: the Nasdaq Composite Index (1.2981), Brazil, Germany, Hong Kong, Europe, Mexico, Russell 3000 and Netherlands (1.0069). Regarding at the Chinese indices, we observe that the Betas are very low: Shenzhen A-share (0.3565), Shenzhen Composite (0.3604), Shanghai Composite (0.422) and Shanghai A-share (0.4256).

This means that China's stock markets bear less systematic risk than the other developing countries from the sample. So, when the global market fluctuates, they tend to move in smaller proportions, which thus means that they are less impacted by the overall market fluctuations. This observation illustrates and is explained by the insulation of the Chinese economy. However, it does not mean that they are less volatile than the market. On the opposite, the Hong Kong index has a Beta closer to one. Unlike Shanghai and Shenzhen, the Hong Kong stock Exchange is composed of the biggest Chinese companies whose stocks are available to foreign investors resulting in stock fluctuations closer to the benchmark.

In this study, the benchmark used to represent the global market is the S&P 500, which is an American index. The fact that Chinese indices are not so much correlated with the benchmark as well as the isolation of the Chinese market do not give much information about the prediction of the future returns of China's stock markets. Indeed, a Beta of 0.4256 should indicate that if the market goes up by 10%, the Shanghai A-share should increase by 4.256%. Nevertheless, one could expect these Chinese indices to offer lower returns than the S&P 500, but it is never the case. All Chinese indices offer higher returns while displaying a lower Beta. This outperformance, especially of Chinese indices, while presenting lower systematic risk, is explained by another measure of the CAPM: the Jensen's Alpha. Considering the results we have at this moment, we should expect Chinese indices to offer higher Alpha. We will analyze this measure (the Jensen's Alpha) in the following section. Finally, we can say that China's indices become more and more a source of diversification for American investors. Indeed, they can slowly but surely enter China's stock market and invest in stocks that present a very low correlation with the global market (or at least the US market) with high returns and volatility.

Jensen's Alpha

According to Jensen, two portfolios with the same risk-return profiles could have different returns related to the ability of a manager to better choose and predict assets that will have higher returns. In his 1967 paper, Jensen only pays attention to evaluate the manager's predictive ability and not to evaluate the portfolio's efficiency. Jensen (1967, p. 389) describes the manager's predictive ability as "his ability to earn returns through successful prediction of security prices which are higher than those we could expect given the level of riskiness of his portfolio". While other measures, like the Sharpe ratio and the Treynor ratio, are relative performance measures (meaning that we can only make the comparison between two portfolios), Jensen aims at creating an absolute measure of the risk, an absolute standard to rank

portfolio performances. In the CAPM, the return of the portfolio is a linear function of the risk-free rate, the Beta of the asset, the market return and a random error which has an expected value of zero (Jensen, 1967). However, as Jensen said, one clever manager could systematically tend to select securities which present a positive epsilon (random error). That is the reason why he added to the CAPM equation, a constant representing that manager's ability, namely the portion of return that cannot be explained by the market.

Equation 13: Jensen's Alpha (CAPM)

$$Jensen's\ Alpha = \propto\ + \beta i * \ [r_M - r_F] + \ \varepsilon$$

Graphically, the constant Alpha represents the intercept of the regression equation of the CAPM and is the excess return adjusted for systematic risk (Bacon, 2008). A positive Alpha means that the manager has the ability to forecast securities movements. Finally, Jensen also added that Alpha's size could be overstated because of the relation between Alpha and Beta. He explains that if Alpha is positive, the estimate of Beta will be biased downward. To maintain the regression line going through the point of sample means, Alpha should thus be biased upward (Jensen, 1967).

Modified Jensen's Alpha

The modified Jensen's Alpha is similar to the Treynor ratio explained below except that the numerator is composed of the Jensen's Alpha.

Equation 14: Modified Jensen's Alpha

$$Modified\ Jensen'sAlpha = \frac{\alpha}{\beta}$$

Table 5: Alpha results

Index	Alpha	Index	Alpha
SHANGHAI COMPOSITE	0,0091	HONGKONG	0,0004
SHENZHEN COMPOSITE	0,0092	NYA	-0,0005
SHANGHAI A-SHARE	0,0096	CCMP	0,0023
SHENZHEN A-SHARE	0,0094	INDU	0,0005
BRAZIL	0,0351	SPX	0
MEXICO	0,0075	NDF	0,0009
INDIA	0,0052	RAY	0,0002
INDONESIA	0,0067	CANADA	-0,0001

Index	Alpha	Index	Alpha
UNITED KINGDOM	-0,0020	Portugal	0,0014
France	-0,0015	IRELAND	0,0016
GERMANY	0,0021	JAPON	-0,0023
SWITZERLAND	0,0007	SOUTH KOREA	0,0011
EUROPE	-0,0009	TAIWAN	-0,0003
SPAIN	0,0007	AUSTRALIA	0,0000
NETHERLANDS	-0,0004	MALAYSIA	0,0003
BELGIUM	-0,0006	THAILAND	-0,0016

Source: Author, data from Bloomberg

Concerning the Alpha results, 21 indices have a positive Alpha. That means that they have the capacity of systematically outperforming the benchmark and thus present higher returns than what could be expected considering their systematic risk (Beta). It is the excess return of the indices adjusted for systematic risk. As it has been shown previously, all four Chinese indices have a Beta lower than one but earn higher returns than the S&P 500. This excess return that cannot be explained by the market belongs to the Jensen's Alpha measure. Having a look at the eight highest Alpha, namely, Brazil, Shanghai A-share, Shenzhen A-share, Shenzhen Composite, Shanghai Composite, Mexico, Indonesia and India, all except Brazil and Mexico have a Beta lower than 1. While we could have thought that with a Beta lower than 1, they should present lower return than the S&P 500, all of them outperform the benchmark for the 1992-2015 period. This superior performance is thus the result of what Jensen called the index manager's predictive ability.

On the opposite, 10 indices have a negative Alpha (The New-York Stock Exchange, Canada, United Kingdom, France, Europe, Netherlands, Belgium, Japan, Taiwan and Thailand). All of these indices, with the exception of Europe and Netherlands, also have a Beta lower than 1. The two measures combined explain why they also earn lower returns than the S&P 500. Concerning Europe and Netherlands, even if their Beta is superior to 1, what could lead to higher returns than the benchmark, the fact that they support a negative Alpha is the reason of their underperformance against the S&P 500, while bearing more systematic risk.

Finally, looking at the significativity of the alphas (annex n°12, p.104), we can only affirm that those of Brazil and Mexico are statistically significant at a 95% confidence level. This implies that we cannot affirm that Chinese indices have the capacity to systematically outperform the S&P500 benchmark at a 95% confidence level. In order to improve the significativity, we could try to increase the amount of data and see if it strengthens the results.

Sharpe Ratio

According to the Capital Asset Pricing Model, the higher the risk of the asset the higher the return the investor will expect. However, this model has faced some difficulties as some assets did not follow this simple equation. In 1966, William Sharpe wrote a paper in which he invented a single measure of performance using a sample of 34 mutual funds that he called the reward-to-variability ratio. What is called the reward provided to investor for bearing risk is calculated on the numerator by the difference between the fund's average annual return and the risk free rate. The denominator is composed of the standard deviation of the annual rate of return and represents the risk that is actually born by the investor (Sharpe, 1966, pp. 119-138). The Sharpe ratio is thus a measure of the excess return the asset has generated compared to the total risk it has borne.

Equation 15: Sharpe ratio

$$Sharpe\ ratio = \frac{r_p - r_F}{\sigma_p}$$

Table 6: Sharpe ratio results

Index	Sharpe Ratio	Index	Sharpe Ratio
SHANGHAI COMPOSITE	0,0787	HONGKONG	0,0496
SHENZHEN COMPOSITE	0,0938	NYA	0,0577
SHANGHAI A-SHARE	0,0794	CCMP	0,0945
SHENZHEN A-SHARE	0,0935	INDU	0,0805
BRAZIL	0,2698	SPX	0,0713
MEXICO	0,1445	NDF	0,0728
INDIA	0,0999	RAY	0,0743
INDONESIA	0,1186	CANADA	0,0520

Index	Sharpe Ratio	Index	Sharpe Ratio
UNITED KINGDOM	0,0063	Portugal	0,0626
France	0,0257	IRELAND	0,0790
GERMANY	0,0882	JAPON	-0,0076
SWITZERLAND	0,0649	SOUTH KOREA	0,0462
EUROPE	0,0407	TAIWAN	0,0284
SPAIN	0,0605	AUSTRALIA	0,0493
NETHERLANDS	0,0459	MALAYSIA	0,0320
BELGIUM	0,0377	THAILAND	0,0143

Source: Author, data from Bloomberg

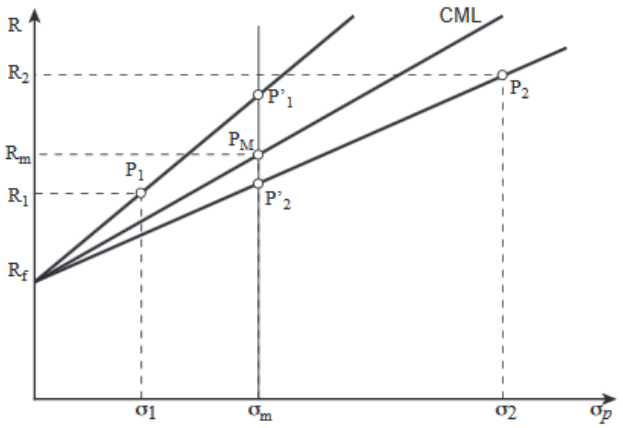
Regarding the different results obtained by the computation of the Sharpe ratios, we can see that Brazil (0.27), Mexico (0.14), Indonesia (0.12) and India (0.099) have the highest values. Concerning Chinese stock markets, all four indices present better ratios than the S&P 500 (0.07) but are much lower than those of the other developing countries. We can even notice a distinction between Shenzhen indices (around 0.93) and Shanghai indices (around 0.79). This outperformance of Brazil, Mexico, Indonesia and India is even more observable with the annualized Sharpe ratio while Chinese indices are now below the ratio of the S&P 500. What is to be remembered in this analysis is the fact that, while earning high returns compared to other indices, China's stock markets bear more risk and their higher return are thus a compensation for the risk to which they are exposed. This interpretation is in concordance with the risk analysis where we observe that China and more precisely Shanghai indices are more volatile. In terms of excess return against the total risk borne, Brazil has thus completely outperformed the 31 other indices. By contrast, Japan records a negative Sharpe ratio and illustrates the fact that Japanese indices earn lower returns than the benchmark.

However, the Sharpe ratio has its limitations. Indeed, two indices with different risk-return profiles could have the same Sharpe ratio. As an illustration, although the Dow Jones Industrial Average Index and the Shanghai Composite Index both have similar Sharpe ratios (about 0.8), Shanghai Composite Index presents much higher returns with a great volatility. Using only Sharpe ratios to rank portfolios is thus difficult, as we cannot determine which of 'low excess return' or 'high standard deviation' is responsible for a low Sharpe ratio. Finally, other limitations of the Sharpe ratios will be presented in the following sections with the computation of the Adjusted Sharpe ratio, the Value at Risk and other deviations of the Sharpe ratio.

M^2 Measure

Often mistakenly described as a risk-adjusted return, the reward-to-variability ratio of Sharpe is only a ratio (Bacon, 2008, p.62). In fact, when comparing different portfolios, the Sharpe ratio is not the easiest one to interpret. Modigliani and Modigliani invented a new way to easily compare two portfolios presenting different profiles of risk and return. This method is called the M^2 measure. To facilitate the comparison of two portfolios P1 and P2, Modigliani and Modigliani proposed to create two new portfolios P1' and P2' and see what will be their return for a same level of risk.

Figure 7: Graph of the Modigliani-Modigliani measure



(Pearson, 2010, p.142)

In the graph above we easily see that P'1 has a better return than P'2 for the same level of risk.

Equation 16: M² measure

$$M^2 = r_F + \frac{\sigma_M}{\sigma_i} * (r_i - r_F)$$

In this equation, M² measures the return of the portfolio i (ri) if it has the same risk profile than the benchmark (M). Comparing the newly risk-adjusted return with the benchmark return, we obtain the M² excess return.

Equation 17: M² Excess Return

$$M^2 excess\ return = M^2 - r_M$$

A positive M² excess return means that for the same level of risk, the portfolio outperformed the benchmark.

This measure is thus a good alternative to the Sharpe ratio to compare indices with different risk-return profiles. Looking at the M² results (view Annex n°3, p.87), only 8 indices have a positive M² excess return and thus succeed in outperforming the S&P 500 for the same level of risk. From the highest to the lowest we have: Brazil, Mexico, Indonesia, India, Dow Jones Industrial Average, NASDAQ Composite, Germany and Russell 3000 Index. Once again, if we compare with the results obtained from the Sharpe ratios, Chinese indices are not the best performers. Both Shanghai and Shenzhen indices record negative M² excess measures. Shenzhen indices are still better performers than Shanghai ones which even underperform the Hong Kong index. Only 10 indices have a lower M² excess measure than the Shanghai indices. To conclude about M² measures, we can say that developing countries, with the exception of Chinese indices, are good performers. Indeed, they offer high excess returns compared to the

benchmark while presenting an acceptable level of risk and thus resulting in positive M² excess returns. However, Chinese indices, which also registered high returns, bear too much risk and thus are beaten by the S&P 500 benchmark and the Hong Kong Index.

Adjusted Sharpe Ratio

The adjusted Sharpe ratio is simply the Sharpe ratio adjusted for skewness and kurtosis. As investors tend to choose portfolios which present positive skewness and low kurtosis, the adjusted Sharpe ratio puts in a penalty for negative skewness and excess kurtosis.

Equation 18: Adjusted Sharpe ratio

$$Adjusted\ Sharpe\ ratio = SR * [1 + \left(\frac{S}{6}\right) * SR - \left(\frac{K-3}{24}\right) * SR^2]$$

Value at Risk

The variance is often chosen as a measure of risk and is useful when the investor is confronted to normally distributed returns. In this case, variance does correctly represent the risk of loss. However, if the distribution of returns does not only depend on its mean and variance (as it is in reality), it becomes more complicated to justify the choice of variance as a measure of risk. Indeed, two distributions of returns could have the same variance but with different returns for the same level of risk. Here comes the interest of finding other methods of measuring the risk

The Value at Risk (VaR) tries to answer to the question: "What is the maximum loss that I can face with my investment?" VaR gives an amount which corresponds to the maximum possible loss on a particular time period under normal market conditions and within a certain confidence level. Assuming a normal distribution of returns, VaR is quite easy to calculate:

Equation 19: Value at Risk

For a 95% confidence interval: $VaR = \bar{r} - 1.65 * \sigma$

For a 99% confidence interval: $VaR = \bar{r} - 2.33 * \sigma$

Taking into account that most of the returns are not normally distributed, VaR can be modified to adjust for kurtosis and skewness using a Cornish-Fisher expansion (Bacon, 2008, p.102).

Equation 20: Modified VaR

$$MVaR_\alpha = R_L - E(R) + Z\,\sigma(R)\ \_$$

$$Z = Z_{1\text{-}\alpha} - \frac{1}{6}(Z^2{}_{1\text{-}\alpha} - 1)S(R) + \frac{1}{24}(Z^3{}_{1\text{-}\alpha} - 3Z_{1\text{-}\alpha})K(R) - \frac{1}{36}(2Z^3{}_{1\text{-}\alpha} - 5Z_{1\text{-}\alpha})(S(R)^2)$$

One criticism that can be leveled against the VaR is that it does not provide any information about the size of the expected loss outside the confidence interval. While the VaR is only a threshold above which we consider the loss as catastrophic, the Conditional VaR, or expected shortfall in R, evaluates the extent of the anticipated loss in case of disaster (above the VaR).

Equation 21: Conditional VaR (Cornish-Fisher)

$$CVaR_{\alpha} = E(R_L - R | R_L - R > VaR_{\alpha})$$

Finally, concerning the Sharpe ratio, the denominator can be replaced by the VaR or the CVaR in order to be a better measure of the risk than the variance.

One of the main criticisms against the Sharpe ratio is that it is only meaningful in case of a normal distribution of returns. As it never is the case in reality, other versions of the Sharpe ratio have been developed using the Value at Risk or the Cornish-Fisher VaR.

First, let's have a look at the different VaR and Expected Shortfall measures: Gaussian, historical and modified. The results are available at Annex n°4, p.88. Beginning with the Gaussian method, Chinese indices have, with Brazil, the highest VaR measures at a 99% confidence interval: Shanghai A-share (-0.302), Shanghai Composite (-0.290), Brazil (-0.288), Shenzhen A-share (-0.246) and Shenzhen Composite (-0.239). In addition, only Australia, United Kingdom and the Dow Jones Industrial Average have a lower VaR than the benchmark (-0.090). Whereas the VaR does not give an idea of what would be the loss in case we are out of this 99% confidence interval, the Expected Shortfall (ES) does. The ranking is very similar, except that Brazil has now the second worst place. While the ES of the S&P 500 is about -0.105, Chinese and Brazilian ES ranges between -0.277 and -0.348. Once again, Australia, United Kingdom and the DJIA are the only indices to present a lower ES. However, this first look at the VaR and ES is based on the Gaussian method with parametric estimates and is thus adapted for normal distributions of returns.

The historical method is based on historical data and gives a measure that is better adapted to a non-normal distribution. We can observe that even if the ranking is almost unchanged for the worst VaR and Expected Shortfall of our sample (Chinese indices and Brazil), both VaR and ES have been reduced for indices that present better skewness-kurtosis ratios and have been increased for indices that present bad skewness-kurtosis ratios. Taking the case of Brazil which is the most representative, its VaR is now equal to -0.219 (reduction of 23.9%) and its ES equal to -0.293 (reduction of 12.7%).

Then, the modified method adapts the measures for skewness and kurtosis in the sense that indices will be penalized for low kurtosis and low skewness, thus increasing their Value at Risk and Expected Shortfall. According to this logic, one observation we can make is the remarkable reduction of Brazilian VaR (-0.137) and ES (-0.134). With this method the ranking has been removed. There are still three indices that have a lower VaR than the benchmark (-0.117): Australia, United Kingdom and the DJIA Index. For the Cornish-Fisher VaR or ES, three new indices, in addition of the former three cited above, succeed in beating the S&P 500 (-0.151), namely: New-York Stock Exchange, Canada and even Brazil. Considering the other side of the ranking, the five worst indices in terms of VaR are Indonesia (-0.239), Shanghai Composite (-0.222), Shenzhen A-share (-0.221), Thailand (- 0.218) and Shenzhen Composite (-0.213). Concerning the CVaR measure, the ranking is totally different, as the five riskier indices are South Korea (-0.553), Malaysia (-0.402), Thailand (-0.359), Hong Kong (-0.296) and Mexico (-0.243). A final observation is the evolution of the Shanghai A-share VaR and ES measures from the Gaussian to the modified method. Like Brazil, Shanghai A-share VaR (-0.186) and ES (-0.186) register a big decrease (respectively 38.5% and 46.6%) taking into account its high skewness and kurtosis.

Finally, a short look at the gap between VaR and the Expected shortfall is also interesting. Indeed, an index presenting a low Value at Risk but having big Expected Shortfalls is likely to suffer from big shocks in its returns. That is why for the indices with the same VaR, the lower the gap between VaR and ES, the better.

As a conclusion about the different VaR and CVaR results, we can affirm that Australia, United Kingdom and the DJIA index are the safest indices in the sense that they will face the lowest maximal loss with a 99% confidence interval and present the lowest risk in case of abnormal losses. However, taking into account its risk return profile, Brazil is quite safe compared to others and is thus a good performer too, followed by the Chinese Shanghai A-Share Index.

Using these different measures presented above, different variations of the Sharpe ratio have been computed with the statistical software R (Annex n°5, p.90). These risk measures can replace the standard deviation into the denominator of the Sharpe ratio to adjust for a non-normal distribution of returns. Using the three methods (Gaussian, historical and modified) as well as the VaR and CVaR at the denominator, leaves us with 6 more kinds of Sharpe ratios than those previously calculated in the Sharpe ratio section. A first observation points out that Japan is the only index to show a negative Sharpe ratio as it already was the case in the previous

section. Then, 12 indices display better ratios than the benchmark whatever the method or the denominator used: Brazil, Mexico, the four Chinese indices, India, Indonesia, Germany, DJIA, Russell 3000 and the Nasdaq Composite. The tendency that can be highlighted switching from the Gaussian method to the two others is similar to what have been described earlier: indices that present a higher skewness and kurtosis have a better Sharpe ratio. Adding a skewness-kurtosis adapted denominator further increases this trend. Taking the example of the Shanghai A-share index, Sharpe ratios increase from 0.036 for Gaussian Sharpe VaR and 0.031 for Gaussian Sharpe CVaR to 0.042 for historical Sharpe VaR and 0.035 for historical Sharpe CVaR and to 0.058 for modified Sharpe VaR and 0.058 for modified Sharpe CVaR,, also called the modified Sharpe ratio. So, the more we adjust for skewness and kurtosis, the more we increase the Sharpe ratio if the index presents high skewness and kurtosis. However, Sharpe ratio's values seem to become smaller when using Value at Risk and Expected Shortfall at the denominator instead of the standard deviation. This effect is logical as we now consider the worst-case risk. Using CVaR further decreases the Sharpe ratio as it takes into account the expected shortfall outside the confidence interval instead of the maximum loss with a 99% confidence interval (VaR), which one is logically smaller.

Finally, in order to rank the different indices, I would prefer to use the modified Sharpe CVaR ratio as it is the one that better captures the asymmetry and kurtosis of the return distributions. In this way, emerging countries indices are the 8 first best performers compared to the S&P 500's Sharpe ratio of 0.0198: Brazil (0.287), Shanghai A-share (0.058), Shenzhen Composite (0.048), Shenzhen A-share (0.047), Shanghai Composite (0.046), Mexico (0.043), Indonesia (0.039) and India (0.032).

Downside Risk

The Downside Risk, also called the semi-standard deviation, is another measure of the risk of loss that interests 'risk adverse' investors. The downside risk only focuses on the negative variability of an asset/portfolio. It is the probability that the return of the portfolio/asset will decrease under a set threshold. All the returns above this threshold will not be taken into account. Investors themselves set this threshold.

Equation 22: Downside risk

$$Downside\ risk = \sqrt{\sum_{j=1}^{n} \frac{\min[r_j - MAR), 0]^2}{n}}$$

Looking at the downside risk, we observe that results are very similar to the Sharpe VaR and CVaR measures here above (view Annex n°6, p.93). In this case, we compute the variability of the returns only when they are under the minimum acceptable rate. Semi-standard deviation has been computed using both Excel and R and landed similar results. Thanks to the semi-standard deviation, we can affirm that Chinese indices, Thailand and Brazil are the riskiest indices. While the S&P 500 has a monthly semi-standard deviation of 0.0305 and an annualized semi-standard deviation of 0.1056, others respectively have: Shanghai A-share (0.0655-0.2269), Shanghai Composite (0.0647-0.224), Shenzhen A-share (0.064-0.2216), Shenzhen Composite (0.063-0.2183), Thailand (0.0588-0.2037) and Brazil (0.0565-0.1956). Thus even if Brazil have good Sharpe ratios compared to Chinese indices, its semi-standard deviation shows it still is a risky index compared to others. Finally, three indices are safer than the benchmark: Australia (0.0283-0.0979), Dow Jones Industrial Average (0.0295-0.1021) and United Kingdom (0.0299-0.1035). These results are coherent with the previous measures and reinforce our confidence about the safety of these three assets.

However, investors could want to invest in indices with high downside risk if it is compensated by a high upside potential. That is the reason why the Omega ratio has been created as the ratio between upside potential and downside potential. This ratio will be presented in the next section.

Finally, a short remark should be made about the relation between the Beta and the downside risk. Let's take two portfolios A and B with the Beta of A higher than that of B. An investor could consider the portfolio A to be riskier as it bears more systematic risk. However, using the downside risk as a measure of risk, portfolios A and B could display the same downside risk while A would earn a higher upside potential. The higher Beta of A will thus be at the origin of its higher upside potential and not a result of a higher risk. That is one of the reasons why downside risk is a very useful risk measure.

Omega

The Omega ratio measures the relation between the expected excess returns of a portfolio and the expected excess losses compared to a threshold set by the investor, the MAR (minimum acceptable rate). If the Omega is equal to 1, it means that in average, portfolio returns have not overtaken the threshold return.

Equation 23: Omega ratio

$$Omega = \frac{\frac{1}{n} * \sum_{j=1}^{n} \max[(r_j - MAR), 0]}{\frac{1}{n} * \sum_{j=1}^{n} \max[(MAR - r_j), 0]}$$

The Omega is thus a relative measure of the likelihood that the MAR will be beaten by the portfolio return. The Omega calculation uses the historical returns distribution instead of a theoretical normal distribution and is therefore a more appropriate performance measure as it automatically corrects for the skewness and kurtosis. (Evestment)

Table 7: Omega results

Index	Omega	Index	Omega
SHANGHAI COMPOSITE	1,3157	HONGKONG	1,1532
SHENZHEN COMPOSITE	1,3010	NYA	1,1784
SHANGHAI A-SHARE	1,3282	CCMP	1,2971
SHENZHEN A-SHARE	1,3034	INDU	1,2516
BRAZIL	2,4472	SPX	1,2182
MEXICO	1,4601	NDF	1,2247
INDIA	1,2982	RAY	1,2266
INDONESIA	1,3882	CANADA	1,1604

Index	Omega	Index	Omega
UNITED KINGDOM	1,0295	Portugal	1,1936
France	1,0767	IRELAND	1,2439
GERMANY	1,2748	JAPON	0,9900
SWITZERLAND	1,2004	SOUTH KOREA	1,1468
EUROPE	1,1208	TAIWAN	1,0878
SPAIN	1,1834	AUSTRALIA	1,1481
NETHERLANDS	1,1400	MALAYSIA	1,1111
BELGIUM	1,1188	THAILAND	1,0471

Source: Author, data from Bloomberg

A look at the Omega ratios gives us some interesting information. The top 8 performers in terms of expected excess returns against expected excess losses are: Brazil (2.4472), Mexico (1.4601), Indonesia (1.3882), Shanghai A-share (1.3282), Shanghai Composite (1.3157), Shenzhen A-share (1.3034), Shenzhen Composite (1.301) and India (1.2982). Thus, emerging countries outperform other indices. Even those with a high downside risk are better ranked. This is

explained by their high upside potential and thus by the fact that they propose very interesting investments for investors who are ready to take more risk with a long term horizon. The benchmark has an Omega ratio of 1.2182 and is situated above 17 indices in the ranking. As the S&P 500 has not a high downside risk, even with a low upside potential this index can be a better investment than 17 other indices. For example, Japan has the twelfth lowest downside risk - which is good - but has the worst omega ratio (0.99). This illustrates that Japan takes too much risk in comparison to the poor returns it offers to investors. Finally, a short comparison can be made between the Chinese indices. Shanghai indices seem to outperform their Shenzhen counterparty by a narrow margin. This can be explained by the fact that while Shenzhen indices have better upside potentials, they also have higher downside risk. As they are worst ranked, this means that they bear too much excess risk compared to the Shanghai indices for the excess return they offer.

Sortino Ratio

The Sortino ratio is quite similar to the Sharpe ratio. To create his ratio, Sortino used a combination of the Roy's measure and the downside risk. Roy thought that to calculate the excess return of a portfolio, the risk-free rate could be replaced by the reserve return of the investor, in other words, the return above which the investor considers that the portfolio gets a justified return for the risk borne (Pearson, 2010). So, at the numerator of the Sortino ratio, we find the difference between the portfolio return and the reserve return fixed by the investor. The denominator, for its part, is composed of the downside risk instead of the standard deviation as a measure of risk. The Sortino ratio is said to better capture risk for non-normally distributed returns than the Sharpe ratio (Scherer, 2009).

Equation 24: Sortino ratio

$$Sortino\ ratio = \frac{r_i - r_T}{\sigma_D}$$

Table 8: Sortino ratio results

Index	Sortino Ratio	Index	Sortino Ratio
SHANGHAI COMPOSITE	0,1627	HONGKONG	0,0783
SHENZHEN COMPOSITE	0,1658	NYA	0,0847
SHANGHAI A-SHARE	0,1683	CCMP	0,1404
SHENZHEN A-SHARE	0,1666	INDU	0,1195
BRAZIL	0,6836	SPX	0,1045
MEXICO	0,2203	NDF	0,1070
INDIA	0,1556	RAY	0,1079
INDONESIA	0,1786	CANADA	0,0758

Index	Sortino Ratio	Index	Sortino Ratio
UNITED KINGDOM	0,0149	Portugal	0,0956
France	0,0404	IRELAND	0,1136
GERMANY	0,1292	JAPON	-0,0055
SWITZERLAND	0,0953	SOUTH KOREA	0,0772
EUROPE	0,0608	TAIWAN	0,0482
SPAIN	0,0921	AUSTRALIA	0,0734
NETHERLANDS	0,0664	MALAYSIA	0,0529
BELGIUM	0,0547	THAILAND	0,0244

Source: Author, data from Bloomberg

Using the Sortino ratio to rank the portfolios, we end with almost the same ranking that for the Omega ratio. In fact, they are quite similar. Thus, Brazil (0.6836), Mexico (0.2203), Indonesia (0.1786), Shanghai A-share (0.1683), Shenzhen A-share (0.1666), Shenzhen Composite (0.1658), Shanghai Composite (0.1627) and India (0.1556) present the best risk-return profile in terms of both Omega and Sortino ratios. Similar conclusions can be made about the differences between Shenzhen and Shanghai indices as well as between A-share and Composite indices. The only distinction is that this time the Shenzhen Composite outperforms the Shanghai Composite in terms of Sortino ratio.

Treynor Ratio

In its 1966 paper, Sharpe observes during his analysis on a sample of 34 mutual funds that for the period 1954-1963, almost 90 percent of the variance of the funds' returns in his sample was due to its co-movement with the Dow-Jones Industrial Average. (Sharpe, 1966, p.127) As a consequence, Treynor decided to use this relationship between the fund returns and the market returns as a measure of the volatility and thus the risk of the portfolio. Taking the Sharpe ratio, the Treynor ratio thus replaces the standard deviation by the beta of the portfolio as a measure of risk. It is interesting to note that this ratio works under the hypothesis that the portfolio is well diversified. Indeed, the beta only captures the systematic risk, while the standard deviation included the specific risk (which can be diversified away) in addition. However, for a portfolio

that is perfectly diversified, both Sharpe ratio and Treynor ratio will land the same result as only the systematic risk will be present in both the Beta and the standard deviation.

Equation 25: Treynor ratio

$$Treynor\ ratio = \frac{ri - rf}{\beta i}$$

Table 9: Treynor ratio results

Index	Treynor Ratio	Index	Treynor Ratio
SHANGHAI COMPOSITE	0,0977	HONGKONG	0,0102
SHENZHEN COMPOSITE	0,1593	NYA	0,0191
SHANGHAI A-SHARE	0,1007	CCMP	0,0378
SHENZHEN A-SHARE	0,1603	INDU	0,0322
BRAZIL	0,3791	SPX	0,0255
MEXICO	0,0960	NDF	0,0325
INDIA	0,0812	RAY	0,0270
INDONESIA	0,0864	CANADA	0,0202

Index	Treynor Ratio	Index	Treynor Ratio
UNITED KINGDOM	-0,0085	Portugal	0,0342
France	-0,0012	IRELAND	0,0377
GERMANY	0,0386	JAPON	-0,0349
SWITZERLAND	0,0312	SOUTH KOREA	0,0073
EUROPE	0,0085	TAIWAN	-0,0094
SPAIN	0,0225	AUSTRALIA	0,0219
NETHERLANDS	0,0115	MALAYSIA	-0,0026
BELGIUM	0,0094	THAILAND	-0,0317

Source: Author, data from Bloomberg

Observing the Treynor results, we see that developing countries are once again above all others indices. From the highest to the lowest we have: Brazil (0.3791), Shenzhen A-share (0.1603), Shenzhen Composite (0.1593), Shanghai A-share (0.1007), Shanghai Composite (0.0977), Mexico (0.096), Indonesia (0.0864) and India (0.0812). All developing countries are far above the S&P 500 benchmark Treynor ratio of 0.0255. The fact that the benchmark has a non-null Treynor ratio finds an explanation in the computation of the ratio. In fact, the Treynor ratio uses the risk-free rate and measures the absolute excess return of an index, while the benchmark has a return higher than the risk-free rate. A particular attention can be accorded to Brazil that has the highest Treynor ratio although it has a Beta superior to all other developing countries. This can only be explained by its superiority in offering very high excess returns compared to the others. Then, what makes Shenzhen indices superior in terms of Treynor ratios compared to Shanghai indices is the result of lower betas and thus lower systematic risk. Finally, six indices, namely United Kingdom, France, Japan, Taiwan, Malaysia and Thailand have a negative Treynor ratio. This illustrates their underperformance in terms of returns compared to the risk-free rate.

Information Ratio

The information ratio is a measure of the relative risk of an index compared to a benchmark. The computation is quite similar to that of the Sharpe ratio with the difference that the latter uses an absolute measure of risk and return. The information ratio measures the excess return of an index over the return of the benchmark, also called the active premium, divided by a relative measure of the risk: the tracking error. The tracking error is the standard deviation of excess return of the index over the benchmark. It also measures the capacity of an index manager's ability to outperform the benchmark. So, the higher the information ratio, the better. But a high tracking error can also benefit to investors that are willing to take more risk and access to better returns. The Information ratio is one of the most used metrics in order to evaluate indices or trackers. The only condition for that measure to work is that indices should not be perfectly diversified. If not, the tracking error would equal 0, as the index would perfectly follow the markets (benchmark) movements and the computation would not be available.

Equation 26: Information ratio

$$\text{Information ratio} = \frac{Annualized\ excess\ return}{Annualized\ tracking\ error}$$

Table 10: Information ratio results

Index	Information Ratio	Index	Information Ratio
SHANGHAI COMPOSITE	0,0363	HONGKONG	-0,0724
SHENZHEN COMPOSITE	0,0868	NYA	-0,2027
SHANGHAI A-SHARE	0,0385	CCMP	0,1857
SHENZHEN A-SHARE	0,0841	INDU	0,0981
BRAZIL	0,8889	SPX	NA
MEXICO	0,3692	NDF	0,0254
INDIA	0,1394	RAY	0,1099
INDONESIA	0,2198	CANADA	-0,1032

Index	Information Ratio	Index	Information Ratio
UNITED KINGDOM	-0,3821	Portugal	-0,0142
France	-0,2256	IRELAND	0,0651
GERMANY	0,1290	JAPON	-0,2911
SWITZERLAND	-0,0218	SOUTH KOREA	-0,0774
EUROPE	-0,1538	TAIWAN	-0,1453
SPAIN	-0,0229	AUSTRALIA	-0,1114
NETHERLANDS	-0,1134	MALAYSIA	-0,1230
BELGIUM	-0,1534	THAILAND	-0,2126

Source: Author, data from Bloomberg

Concerning the Information ratio results, 14 indices present a positive ratio. This is the consequence of their outperformance over the benchmark in terms of relative excess returns. Logically, the information ratio cannot be calculated for the benchmark because the numerator would be equal to 0 (the benchmark cannot outperform itself). Considering those with a positive ratio, Chinese indices have been surpassed. The reason behind this poor ratio lies in the fact they have superior tracking errors. Indeed, while they have good active premiums, they are in the top 5 of the highest tracking errors with Brazil. The reason why Brazil does not suffer from the same scenario, lies in its remarkable over-performance in terms of relative excess return. Here is the ranking of the five best active premiums: Brazil (0.4133), Mexico (0.0753), Indonesia (0.0529), Shenzhen Composite (0.0335) and Shenzhen A-share (0.0332). Thus, despite its high tracking error, Brazil keeps the first place in terms of information ratio. Then, 8 indices succeed in beating Chinese indices, namely Brazil, Mexico, Indonesia, Nasdaq Composite, India, Germany, Russell 3000 and the Dow Jones Industrial Average Index. Taking the example of the two last cited indices, we can see that even with a low active premium they can outperform some indices relying on the low tracking error, due to the fact that they do not fluctuate a lot compared to the S&P 500. Shenzhen indices have a more than twice higher information ratio than Shanghai and are the result of their outperformance over Shanghai in terms of active premiums. Finally, even if the high tracking errors of Chinese indices make them worse performers in terms of information ratio, this can also be interpreted in a good way. This high tracking error can also be the result of an active management. Indeed, as the Chinese indices also have good Jensen's alpha, they are able to systematically beat the benchmark. Furthermore, as high returns generally lead to high risk, their volatility against the benchmark return can be the cost to pay for their good active premiums.

Conclusion

As a conclusion, we have seen through a large number of metrics and ratios measuring the risk-return profiles of our 32 indices sample, that developing countries have presented high returns during the 1992-2015 period. However, they also recorded high volatility as it is mainly the case of Chinese indices and Brazil. This volatility is at the origin of a somewhat widespread idea that China's stock market can be described as a casino. Much of the returns of Chinese indices are the result of much risk taken. But taking the point of view of an American investor who would like to diversify his portfolio, investing in Chinese indices is a good alternative.

Indeed, we have seen that the correlation with the S&P 500 is very low and that Betas of Shanghai and even more Shenzhen indices are very low, which means that they present less systematic risk than other indices. This illustrates one of the main characteristics of China's stock market: its isolation. In terms of distribution of returns, Asian countries present higher positive skewness, resulting in high abnormal returns with a positive mean return which is very attractive to investors that are willing to take more risk with the hope of earning very high returns. Shanghai indices, with the highest kurtosis, also have particular peaked distributions with fat tails increasing even more the probability of earning abnormally high returns. Furthermore, Shanghai indices present the highest tracking error, a fact that can be interpreted as their ability to systematically outperform the benchmark thanks to their active management. With a similar reasoning, Jensen's alpha presented by developing countries show their ability to beat the S&P 500 even if they register lower beta. Finally, looking at the downside risk, Value at Risk and Expected Shortfall, developing countries are the riskiest indices but this is the cost of offering higher returns.

To go deeper in the analysis, one could wonder if these different metrics and ratios could have changed during the period 1992-2015. Taking the case of China and its willingness to open the frontiers of its stock markets, we could think that its correlation with the global market would increase. Furthermore, as some analysts say that China is in transition from a developing country to a developed country, we could expect its returns to decrease. That is the reason why I decided to execute a second time the whole analysis for the period from 2002 to 2015 and for all developing countries of my sample (namely Chinese indices, Mexico, Brazil, India and Indonesia) in addition to the S&P 500 benchmark and Hong Kong which is in relation with the Chinese stock markets. The reason why I decided to begin the analysis in 2002 is explained by the fact that the first reform to open China's stock market has taken place during this year.

2. 2002-2015 period

Analyzing the evolution of the returns, especially the arithmetic and geometric mean, the global return as well as the annualized return, we can observe that while keeping the lead over other indices, the gap return has largely fallen (view Annex n°7, p.95). The tendency of the benchmark since 2002 shows a decreasing trend. The most striking observation is the decline of annualized returns for Brazil and Shanghai indices: from 0.087 to 0.05 for Shanghai Composite, from 0.089 to 0.05 for Shanghai A-share and from 0.48 to 0.08 for Brazil. Conversely, five indices keep offering strong annualized returns and even increase them: Indonesia (0.1922), India (0.1548), Mexico (0.1492), Shenzhen Composite (0.1194) and Shenzhen A-share (0.1192).

Table 11: Overview of the results for the comparison between 1992-2015 and 2002-2015

	SHANGHAI COMPOSITE		SHENZHEN COMPOSITE	
	1992-2015	2002-2015	1992-2015	2002-2015
Alpha (monthly)	0,0091	0.0043	0,0092	0.0101
Annualized Alpha	0,1144	0.0529	0,1159	0.128
Beta	0,4220	0.5804	0,3604	0.5423
Tracking Error	0,4579	0.2803	0,3862	0.3183
Information Ratio	0,0363	0.0505	0,0868	0.243
Treynor Ratio	0,0977	0.0369	0,1593	0.1523
Sharpe Ratio (monthly, Stand, Dev,):	0,0787	0.0628721610888585	0,0938	0.117804631144738
Omega	1,3157	1.1575	1,3010	1.3234
Sortino ratio	0,1627	0.0809	0,1658	0.1712
VaR (modified)	-0,2223	-0.205582812736204	-0,2134	-0.20739038631411
Expected Shortfall (modified)	-0,2223	-0.263121451483742	-0,2134	-0.244595068068561

	SHANGHAI A-SHARE		SHENZHEN A-SHARE	
	1992-2015	2002-2015	1992-2015	2002-2015
Alpha (monthly)	0,0096	0.0043	0,0094	0.0101
Annualized Alpha	0,1209	0.0534	0,1187	0.1285
Beta	0,4256	0.5803	0,3565	0.5372
Tracking Error	0,4755	0.2804	0,3952	0.3207
Information Ratio	0,0385	0.052	0,0841	0.2405
Treynor Ratio	0,1007	0.0376	0,1603	0.1534
Sharpe Ratio (monthly, Stand, Dev,):	0,0794	0.0633013155134497	0,0935	0.117430148566821
Omega	1,3282	1.1588	1,3034	1.3223
Sortino ratio	0,1683	0.0816	0,1666	0.171
VaR (modified)	-0,1860	-0.205653403077521	-0,2212	-0.20803265556874
Expected Shortfall (modified)	-0,1860	-0.263658712804091	-0,2212	-0.24534752981311

	BRAZIL		MEXICO	
	1992-2015	2002-2015	1992-2015	2002-2015
Alpha (monthly)	0,0351	0.0049	0,0075	0.0089
Annualized Alpha	0,5123	0.0602	0,0934	0.1121
Beta	1,1159	1.0552	1,0179	0.8815
Tracking Error	0,4649	0.1812	0,2039	0.1309
Information Ratio	0,8889	0.2451	0,3692	0.8184
Treynor Ratio	0,3791	0.0481	0,0960	0.1267
Sharpe Ratio (monthly, Stand, Dev,):	0,2698	0.0946554146470779	0,1445	0.193921665754987
Omega	2,4472	1.2413	1,4601	1.5699
Sortino ratio	0,6836	0.1278	0,2203	0.2844
VaR (modified)	-0,1337	-0.167708507405699	-0,2064	-0.126427870103824
Expected Shortfall (modified)	-0,1337	-0.205411753477932	-0,2429	-0.15712009625231

	INDIA		INDONESIA	
	1992-2015	2002-2015	1992-2015	2002-2015
Alpha (monthly)	0,0052	0.0103	0,0067	0.0128
Annualized Alpha	0,0639	0.1304	0,0831	0.1653
Beta	0,6994	0.927	0,8812	0.8022
Tracking Error	0,2350	0.1991	0,2409	0.1905
Information Ratio	0,1394	0.5663	0,2198	0.7879
Treynor Ratio	0,0812	0.1263	0,0864	0.1912
Sharpe Ratio (monthly, Stand, Dev,):	0,0999	0.168198208655407	0,1186	0.219310826596019
Omega	1,2982	1.5297	1,3882	1.7425
Sortino ratio	0,1556	0.2464	0,1786	0.318
VaR (modified)	-0,1753	-0.191803623050981	-0,2386	-0.207715591485314
Expected Shortfall (modified)	-0,2242	-0.229120121972261	-0,2386	-0.207715591485314

	SPX		HONGKONG	
	1992-2015	2002-2015	1992-2015	2002-2015
Alpha (monthly)	0	0,0000	0,0004	0.0014
Annualized Alpha	0	0,0000	0,0050	0.0173
Beta	1	1,0000	1,0967	0.9766
Tracking Error	0	0,0000	0,2037	0.1521
Information Ratio	NA	NA	-0,0724	0.0378
Treynor Ratio	0,0255	0,0077	0,0102	0.0136
Sharpe Ratio (monthly, Stand, Dev,):	0,0713	0.0366267887337663	0,0496	0.0487641109479751
Omega	1,2182	1.0596	1,1532	1.1078
Sortino ratio	0,1045	0.0288	0,0783	0.0532
VaR (modified)	-0,1170	-0.122165469869913	-0,1917	-0.16528351776454
Expected Shortfall (modified)	-0,1512	-0.153054977511562	-0,2961	-0.204563607338255

Source: Author, data from Bloomberg

a. Risk Measures

Considering risk analysis like the mean absolute deviation and standard deviation, we observe a downward trend (view Annex n°8, p.96). However, this is well marked for Shanghai Composite (from 0.4547 to 0.2865), Shanghai A-share (from 0.4726 to 0.2867) and Brazil indices (from 0.4933 to 0.2383) in terms of annualized standard deviation. Indeed, remembering the CAPM reasoning, if lower returns one could expect to have lower risk and it is the case here with China and Brazil.

As it has been said earlier, the various reforms to open China's economy should result in a higher correlation with the global market and thus the benchmark. This affirmation is verified not only for Chinese indices but for all the developing countries of the sample. This time the p-values are lower and we can say that correlations measures are significant at a 99% confidence interval except for the Shenzhen indices (significant at 95%).

b. Distribution of returns

Having a look at the distributions of returns, we are confronted with a negative skewness for all the 33 indices (view Annex n°8, p.97). This means that there exist more extreme values on the left tail of the distribution. It is thus less attractive for investors than positive skewness. The only index that has a higher skewness for the 2002-2015 period is Mexico. Nevertheless, although negative, Chinese indices present the highest skewness with a deeply reduced kurtosis. As a result, Chinese indices are those that present the best skewness-kurtosis ratio and thus are the most desirable for investors according to Bacon (2008). From the highest to the lowest, we have: Shanghai A-share (-0.082), Shanghai Composite (-0.088), India (-0.113), Shenzhen A-share (-0.141), Indonesia (-0.219) and Shenzhen Composite (-0.226). We can notice that India and Indonesia are the only two developing countries that present higher kurtosis for the 2002-2015 period. Contrary to the high kurtosis of Chinese indices during the 1992-2015 period, the fact that they present negative skewness in combination with fatter tails improves the probability of earning abnormally low returns. It is thus a negative criterion for both India and Indonesia.

c. Performance Measures adapted to risk

Then, concerning the beta, we notice that Chinese indices as well as the Indian Index have a higher Beta than for the previous analysis. Thus, this means that they tend to move closer to the fluctuations of the global market and by the way, increasing their systematic risk. In opposition, Brazil, Hong Kong, Mexico and Indonesia present a lower beta for the 2002-2015 period. However, even if Chinese indices betas have increased, they remain the lowest and bear less systematic risk than all indices from the sample. As we have seen in the previous analysis, the reason why they even though present higher returns than the S&P 500 despite their lower betas is due to a positive Jensen's alpha: the manager's ability to systematically do better than the benchmark. Indeed, for all developing countries and Hong Kong, Alphas are

positive. Only Shanghai indices and Brazil offer a lower alpha than for the 1992-2015 period analysis. On the contrary, Shenzhen indices as well as Mexico, Hong Kong, India and Indonesia succeed in increasing their Alpha. The most spectacular increase is attributed to India (0.0639 to 0.1304) and Indonesia (0.0831 to 0.1653). The new top 5 ranking from the highest to the lowest is: Indonesia, India, Shenzhen A-share, Shenzhen Composite and Mexico.

In order to compare risk-return profiles of the sample of indices with the S&P 500 benchmark, M^2 measure is a good metric of relative performance. Compared to the 1992-2015 situation, we are now confronted to a positive excess return for all developing countries and Hong Kong (view Annex n°9, p.98). That means that for a same level of risk than the S&P 500, all indices earn a superior performance. While Chinese indices as well as Hong Kong had negative excess M^2, they now have a positive one. This seems logical because their return has weakly decreased while they succeed in sharply reducing their risk. The only index that present a lower Excess M^2 is Brazil due to the decline of its returns. According to these results, the new top 5 ranking is: Indonesia (0.0944), Mexico (0.0818), India (0.0652), Shenzhen Composite (0.0332) and Shenzhen A-share (0.0329).

Regarding the different results about Value at Risk, Expected Shortfall and Sharpe ratios according to the modified method (considered as the most relevant), there is a considerable trend for Mexico and Indonesia to outperform their counterparties. This tendency is not so obvious when looking at the different VaR measures, as all indices but Brazil and India have lowered their VaR. These results are in concordance with the fact that all of them are safer on the 2002-2015 period than over the last 25 years. It is to notice that the Mexican VaR has fallen down from -0.206 to -0.126 and has almost the same VaR as the S&P500 while offering higher returns on the 2002-2015 period. Then, taking into account the Expected Shortfall or CVaR with the modified method (adapting for skewness and kurtosis), only three indices do better than for the 1992-2015 period: Hong Kong, Mexico and Indonesia. Furthermore, Indonesia has a null gap between its VaR and ES and Mexico has a 0.031 gap which is the second lowest. This reinforces the superiority of these two indices. On the other side, while they tend to become safer, Chinese indices see their CVaR increase considerably. The biggest difference is registered by the Shanghai A-share index: from -0.1859 to -0.2636. In addition of presenting one of the highest VaR, Chinese Shanghai indices also present the highest gap between their Value at Risk and Expected Shortfall.

Now, let's see how these results impact the different Sharpe ratios (view Annex n°10, p.99). Looking at the S&P 500, we see there is a downward trend. Looking at the Sharpe CVaR ratios using the modified method we can see that indices that suffer the most in comparison with the 1992-2015 period are Brazil (from 0.287 to 0.031), Shanghai A-share (from 0.058 to 0.019) and Shanghai Composite Index (from 0.046 to 0.019). So, even if Brazil and Shanghai present less risk compared to the previous period analyzed, they record a too important decrease in their returns. That is the reason why they present worse Sharpe ratios. On the opposite, Mexico, India and Indonesia have quite better Sharpe ratios whatever method or denominator is used. This does not seem irrational as all three have better returns while bearing more risk in terms of standard deviation as well as VaR and ES. Only India has a worse VaR and ES from low margin and is well compensated by its returns. So, the new ranking using the modified method for computing the modified Sharpe ratio (CVaR at the denominator) is as follows: Indonesia (0.067), Mexico (0.065), India (0.051), Shenzhen Composite (0.0447), Shenzhen A-share (0.0446), Brazil (0.03), Shanghai A-share (0.0198) and Shanghai Composite (0.0197). Shanghai indices have even been outperformed by South Korea, Malaysia and Thailand for the 2002-2015 period but still present not bad Sharpe ratios. In addition, we can observe that the gap with the other indices has been considerably reduced.

Considering the downside risk and upside potential (view Annex n°11, p.102), indices could be ranked against their Sortino and Omega ratios. While the S&P 500 present higher downside risk during the 2002-2015 period, all developing countries have a lower one. This is well noticed for Indonesia, Mexico and India followed by Brazil and Shanghai indices. This is not surprising as we have already seen that they can be qualified as safer for this period according to the last analysis. For the upside potential, while there also is a downward trend, this is for Brazil and Shanghai indices that the reduction is the biggest. Finally, taking into account the Sortino and Omega ratios results, we observe that five indices have better results, especially Indonesia, Mexico and India. On the opposite, four have lower measures and especially Brazil and the two Shanghai indices. The new ranking is the same for both Sortino and Omega ratio: from the best to the worst we have: Indonesia, Mexico, India, Shenzhen Composite, Shenzhen A-share, Brazil, Shanghai A-share and Shanghai Composite.

Then, the Treynor ratios have been calculated. As a reminder, it is the ratio between the absolute excess return (above the risk-free rate) and the Beta of the index. We can observe

that the Treynor ratios are higher for Mexico, Indonesia, India and Hong Kong and lower for Brazil and the four Chinese indices. Considering the four Chinese indices, we explain the decrease thanks to their higher beta. The lower Treynor ratio of Brazil is on the contrary explained by the big decrease of its excess return. Finally, concerning Mexico, India and Indonesia, their bigger ratios are the consequence of both higher excess return and lower beta (except for India which have a bigger beta). Thanks to their lower Beta, Shenzhen indices are still well ranked considering the Treynor ratios: Indonesia (0.1912), Shenzhen A-share (0.1534), Shenzhen Composite (0.1523), Mexico (0.1267) and Indonesia (0.1263). Shanghai indices are far below as their excess returns are too low despite of their low beta: Shanghai A-share (0.037) and Shanghai Composite (0.036).

Finally, looking at the evolution of tracking error and active premium, we observe that all indices have a lower tracking error. This is well marked for Brazil and the two Shanghai indices which also present lower active premiums. All other developing countries indices have succeeded in lowering their tracking error while increasing their active premium. That is why they also display better Information ratios. It can be noticed that only Brazil records a worse information ratio for the 2002-2015 period than for the 25 last years. The top five ranking in terms of information ratio is as follows: Mexico (0.8184), Indonesia (0.7879), India (0.5663), Shenzhen Composite (0.243) and Shenzhen A-share (0.2405). According to Thomas Goodwin (1998, p.40), information ratios of 0.5 can be described as “good” and one that is higher than 0.75 is a very good information ratio. Thus, Mexico, Indonesia and India are very good performers in terms of information ratio. One final remark concerns the still high tracking errors of Chinese indices which do not necessarily should be viewed as a negative aspect. Even if they tend to move closer to the benchmark because of the opening of their economic frontiers, tracking error is the proof that they are actively managed and is one of the reasons why they succeed in outperforming the benchmark.

As a conclusion, we observe that comparing our results for the 2002-2015 period with the previous results for the 1992-2015 period, China presents smaller returns, although still high compared to others. In fact, the new strong indices in terms of risk-performance profiles, are now the new developing countries: Mexico and Indonesia in our sample. As a consequence of lower returns, we also see that Chinese indices become safer (less volatility and lower Value

at Risk expect for the Shanghai A-share). However, they present a much higher Expected Shortfall.

This means that in case of downturns, investors in Chinese stocks could suffer from very high loss, big shocks. This is a real negative feature. Then, China has registered during these last years a higher Beta and correlation. This is certainly a main consequence of its opening reforms to the global economy. Although still being a good alternative to diversify the portfolio, China's stock markets fluctuations tend to move closer to the S&P500 benchmark. It thus increases the systematic risk of Chinese stocks but not their total risk. Finally, Shenzhen stocks tend to outperform Shanghai ones with higher alphas, Sharpe, Omega and Sortino ratios.

E. Implications & Limitations

Becoming slowly but surely a developed country and opening up its economic frontiers to the global world economy, Chinese stock markets are a major concern. This analysis provides a thorough understanding of the risk and performance profile of different Chinese indices in comparison with a wide, yet incomplete, range of world equity indices. These indices cover various geographical areas and focus on the major leading economies. However, some limitations have been encountered.

The most important one is the data snooping bias. In fact, while analyzing the results, we found out that developing countries have been the best performers during the 25 last years and especially China. However, despite these results, we cannot generalize them and say that China is a better performer than others. This comes from the fact that the database is composed of different unique timer series. This means that China could have outperformed other indices in this sample of data while it would not have been the case with other time series. In other words, the outperformance of Chinese indices could be linked to pure chance. This is called the data snooping bias. In order to generalize the results one could have performed the most up-to-date method to deal with data snooping: The Superior Predictive Ability (SPA). The package R not being available to proceed to this analysis, the data snooping problem has been considered as out of the scope of this thesis.

The second limitation is the availability of data. In fact, in order to complete a good performance analysis of the Chinese markets, I decided to focus on the whole existence of the Shanghai and Shenzhen markets (1990-2015). Then, the selection of indices have been restricted by this time period and many indices did not present data for the whole period. This led me to choose indices with different profiles. For example, not all indices in my sample have been created by the same index providers. This leads to difficulty in comparison as the calculation method is not the same: some are capitalization-weighted, others are float adjusted, etc. In order to improve the comparisons, one could create different samples gathering indices from the same family and comparing the results between samples.

Another limitation of this performance analysis is that, although taking into account both Shanghai and Shenzhen stock markets, we only focus on A-shares and not B-shares. As it has been explained earlier, B-shares represent less than 10% of the total outstanding shares and are expecting to decrease over the following years with the increasing accessibility of A-shares for foreign investors.

Finally, in order to facilitate the comparison, a unique benchmark has been taken: the S&P500 index as well as a unique risk-free rate: the US 10 years Treasury bond. This means that all the results we found are to be looked at from the point of view of an American investor. In order to extend and generalize the results, one could re-perform the analysis with different benchmarks and risk-free rates and compare the results.

Conclusion

Conclusion

Throughout this thesis, the objective was to provide a thorough understanding of the Chinese stock markets as well as the risk and performance profile of Chinese Equity indices throughout their existence (1990-2016) compared to a large sample of other indices.

In order to answer the question: “Did Chinese stocks presented a good investment opportunity during the last thirty years?”, we first introduced Chinese economy, moving from its origins and history to a SWOT analysis. We saw that China’s history is made up of rises and falls. In fact, after being a global leader and making many breakthroughs during the period between 1100 AD and 1800 AD, the country was invaded by Western civilizations and was forced to fall into decline in the mid-19th Century. The re-emergence was made possible thanks to the communist revolution and the rise to a world leading power has been led by a transition to capitalism with high productivity and exportation. The SWOT analysis showed us that Chinese economy presents many weaknesses that lead to some threats like the environmental crisis, the US military threat, the social inequalities and unstability to which China is actually confronted. However, especially thanks to its high trading surplus and the possession of a large part of the US debts (as well as that of other countries), China has the opportunity to continue its expansion to the world leading economy, even moving the economic gravity center to the East.

Then, we focused the analysis on the Chinese stock markets, especially on their specific features and on the reforms implemented to open up the Chinese economy to the global market. We saw that Shanghai and Shenzhen stock markets have presented high returns and high volatility since their creation. Other interesting features are the fact that many stocks are state-owned and that there is still a lack of blue chips in the Shenzhen Stock Exchange. Furthermore, with the presence of many individual domestic investors, the turnover rate is particularly high and illustrates the presence of speculation on the market. Finally, the Chinese market has remained isolated for a long time but reforms to open up the economy since 2002 showstrong indications that China is making significant efforts to improve its regulatory environment and trading mechanisms.

The main part of the thesis was devoted to an empirical analysis focused on the risk and performance profile of Chinese Equity indices. Beginning with a reminder about the Capital Asset Pricing Model as well as the different ratios and metrics used to perform the study, we computed different risk adjusted measures like the Sharpe ratio, the Information ratio, etc. What

came as a conclusion is that over the 1992-2015 period, China has been a good opportunity of diversification. Indeed, with a low correlation and Beta compared to the S&P500 benchmark, Chinese stocks fluctuations did not move the same way as the global market. This is particularly due to its isolement. Undeniably, since the coming into effect of the opening reforms, the Betas and correlation rose. In addition, Chinese stock markets presented high returns (with higher risk) as well as good risk adjusted ratios involving the Sharpe ratio. This leads us to think that China has outperformed (with Brazil) the other indices from the sample over the 1992-2015 period. As an illustration, their positive alphas, although not statistically significant, show us their capacity of systematically beating the benchmark. Then, we carried out once again the analysis but for the 2002-2015 period. The aim was to analyze an eventual evolution of the metrics and ratios. As a conclusion, we saw that, since 2002, the best performers in terms of risk-adjusted measures are Mexico and Indonesia, the two new emerging countries from the sample. Concerning Chinese stock markets, both presented lower returns, tending to become safer (except Shanghai with a bigger Expected Shortfall) and to move closer to the market fluctuations (higher Beta and correlation). Comparing Shanghai and Shenzhen indices for the 2002-2015 period, we have observed that Shenzhen tends to outperform Shanghai. It is probably due to the fact that Shenzhen Stock Exchange is mainly composed of small-cap stocks. Linked to the presence of many individual investors and the high speculation on the Chinese markets, Shenzhen small-cap stocks attracted investors that wanted to make short-term profits, increasing their prices but with a rising risk of crash when the market correction comes. (Noble, 2015)

However, as it has been presented in the limitations of the thesis, the data snooping bias prevented us from concluding that China has been a good performer. Indeed, this could be linked to pure chance. In order to reinforce the results statistically, I invite anyone to further complete my analysis with other points of view (European, Asian, etc.) and with more indices (including all emerging countries from the BRICS and MINT) and to focus on the statistical aspect of the results, in performing, for example, the Superior Predictive Ability Test.

Finally, one last major concern concerns the future of Chinese economy. In fact, China is in complete transition from the status of developing country to a developed one. Its tertiary sector activity is rising and China should record a boom in consumption over the following years. Becoming a developed country also means the lowering of stocks returns. That is why I really think it will be interesting to see what the future holds for China and how it will affect the rest of the world.

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Annexes

Annex 1: Returns of indices 1992-2015

	CHINEshcomp	CHINEszcomp	CHINEshashr	CHINEszashr
Arithmetic Mean	0.0139	0.0139	0.0145	0.0141
Geometric Mean	0.007	0.0083	0.0071	0.0083
Global return (Arithmetic mean)	3.87717704587539	3.85731211124243	4.01772556757687	3.91448640493872
Global return (Geometric mean)	5.97719467718085	8.96679185012522	6.23353641866825	8.91219992613566
Annualized return	0.0874714851093117	0.104340781609109	0.0891664963640819	0.104078991512587

	BRAZILibov	MEXICOinmex	INDIAnifty	INDONESIAjci
Arithmetic Mean	0.042	0.0141	0.0109	0.0129
Geometric Mean	0.0334	0.0114	0.0082	0.0098
Global return (Arithmetic mean)	11.684766114769	3.92873161462121	3.02744130928479	3.59565376680879
Global return (Geometric mean)	9382.10822510827	22.5562988787336	8.811883388692	13.9327264451524
Annualized return	0.484117219349069	0.146113538569355	0.103594316422332	0.123782497176242

	HONGKONGhsi	Usnya	Usccmp	Usindu
Arithmetic Mean	0.0073	0.006	0.0098	0.0069
Geometric Mean	0.0046	0.0051	0.0076	0.0061
Global return (Arithmetic mean)	2.03360773933103	1.67602710694053	2.72474493396296	1.93188554270544
Global return (Geometric mean)	2.53989619896973	3.16056669633591	7.27438901465704	4.40096643812688
Annualized return	0.0560814949824664	0.0634718696797776	0.0955053448967118	0.0755174816875162

	Usspx	Usndf	Usray	CANADAsptsx
Arithmetic Mean	0.0066	0.0071	0.0068	0.0058
Geometric Mean	0.0057	0.0059	0.0059	0.0049
Global return (Arithmetic mean)	1.8380981721218	1.97148272143431	1.88917816108982	1.62006099121099
Global return (Geometric mean)	3.88186681952805	4.18131683690596	4.08732495360215	2.89972483004208
Annualized return	0.0708364202212752	0.0735916947845126	0.0727436408378397	0.0605038693621607

	Ukukx	FRANCEcac	GERMANYdax	SWITZERLANDsmi
Arithmetic Mean	0.0039	0.005	0.0091	0.0065
Geometric Mean	0.0031	0.0035	0.0071	0.0055
Global return (Arithmetic mean)	1.07550090457692	1.3939442043573	2.51836597501816	1.81956486570116
Global return (Geometric mean)	1.34823759545575	1.66130624426079	6.19886485472284	3.61414368688188
Annualized return	0.0375361881865106	0.0431563789016143	0.0889406301061464	0.0682325409741087

	EUROPEsx5e	SPAINibex	NETHERLANDSaex	BELGIUMbel20
Arithmetic Mean	0.0058	0.0073	0.0062	0.0054
Geometric Mean	0.0043	0.0054	0.0046	0.0042
Global return (Arithmetic mean)	1.61783154870188	2.02943284537183	1.72209507982557	1.50694533096216
Global return (Geometric mean)	2.33403397785827	3.52166744837191	2.56162837565497	2.24599108740657
Annualized return	0.0533537495728504	0.0672994147940746	0.0563605399773317	0.0521376124947477

	PORTUGALbvlx	IRELANDiseq	JAPONnky500	SOUTHKOREAkospi
Arithmetic Mean	0.007	0.008	0.0032	0.0074
Geometric Mean	0.0055	0.0064	0.0017	0.0042
Global return (Arithmetic mean)	1.95015354826602	2.2173386548044	0.892414482708517	2.05579535396015
Global return (Geometric mean)	3.63849842897305	4.93232360288595	0.622559632857755	2.1861171578024
Annualized return	0.0684753139647893	0.0798827691092583	0.0211120707377321	0.0512924086633375

	TAIWANtwse	AUSTRALIAas30	MALAYSIAfbmklci	THAILANDset
Arithmetic Mean	0.0058	0.0055	0.0058	0.0049
Geometric Mean	0.003	0.0048	0.0035	0.0011
Global return (Arithmetic mean)	1.60322928097826	1.52854176821048	1.62007634219763	1.35165178190743
Global return (Geometric mean)	1.29589204043252	2.74845526835899	1.6391448753333	0.369724038921675
Annualized return	0.0365270461991103	0.0586943717603647	0.0427799146294008	0.0136728875716996

Annex 2: Volatility and correlation of indices 1992-2015

	CHINEshcomp	CHINEszcomp	CHINEshashr	CHINEszashr
Mean Absolute deviation	0.0775	0.0799	0.0786	0.0807
Monthly Std Dev	0.1313	0.1093	0.1364	0.1119
Annualized Std Dev	0.4547	0.3786	0.4726	0.3876
Variance	0.0172	0.0119	0.0186	0.0125
Skewness	4.1762	1.1543	4.6026	1.2945
Kurtosis	38.9729	4.7368	44.9222	5.8304
Correlation	0.1351	0.1385	0.1311	0.1338
Correlation (P-Value)	0.0243	0.0209	0.0289	0.0257

	BRAZILibov	MEXICOinmex	INDIAnifty	INDONESIAjci
Mean Absolute deviation	0.0927	0.0562	0.0572	0.0575
Variance	0.1424	0.0727	0.0728	0.0785
Monthly Std Dev	0.4933	0.252	0.2521	0.2721
Annualized Std Dev	0.0203	0.0053	0.0053	0.0062
Skewness	2.0252	-0.5523	-0.0644	-0.4601
Kurtosis	8.3084	1.7914	0.8168	2.6666
Correlation	0.3297	0.5875	0.403	0.4705
Correlation (P-Value)	0	0	0	0

	HONGKONGhsi	Usnya	Usccmp	Usindu
Mean Absolute deviation	0.0545	0.0314	0.0489	0.0311
Variance	0.0746	0.0418	0.0655	0.0414
Monthly Std Dev	0.2584	0.1448	0.2267	0.1434
Annualized Std Dev	0.0056	0.0017	0.0043	0.0017
Skewness	0.2199	-0.7887	-0.42	-0.5898
Kurtosis	2.2512	2.1861	1.4576	1.2338
Correlation	0.6172	0.9686	0.8326	0.9455
Correlation (P-Value)	0	0	0	0

	Usspx	Usndf	Usray	CANADAsptsx
Mean Absolute deviation	0.0318	0.0358	0.0326	0.032
Variance	0.042	0.0477	0.0427	0.0424
Monthly Std Dev	0.1455	0.1653	0.1481	0.147
Annualized Std Dev	0.0018	0.0023	0.0018	0.0018
Skewness	-0.6779	-0.6792	-0.748	-0.94
Kurtosis	1.2698	2.2942	1.4633	2.9345
Correlation	1	0.7632	0.9932	0.7651
Correlation (P-Value)	0	0	0	0

	Ukukx	FRANCEcac	GERMANYdax	SWITZERLANDsmi
Mean Absolute deviation	0.0305	0.0429	0.0462	0.0339
Variance	0.0396	0.0543	0.0616	0.0451
Monthly Std Dev	0.1373	0.1882	0.2136	0.1562
Annualized Std Dev	0.0016	0.003	0.0038	0.002
Skewness	-0.5711	-0.3292	-0.5233	-0.6156
Kurtosis	0.5159	0.1581	1.8771	1.5279
Correlation	0.8113	0.7579	0.7573	0.6867
Correlation (P-Value)	0	0	0	0

	EUROPEsx5e	SPAINibex	NETHERLANDSaex	BELGIUMbel20
Mean Absolute deviation	0.0418	0.0458	0.0419	0.0354
Variance	0.0541	0.0608	0.0562	0.0478
Monthly Std Dev	0.1873	0.2107	0.1946	0.1657
Annualized Std Dev	0.0029	0.0037	0.0032	0.0023
Skewness	-0.4589	-0.2285	-0.7205	-0.9922
Kurtosis	0.7059	0.6758	1.6213	2.5408
Correlation	0.794	0.6798	0.7538	0.6998
Correlation (P-Value)	0	0	0	0

	PORTUGALbvlx	IRELANDiseq	JAPONnky500	SOUTHKOREAkospi
Mean Absolute deviation	0.0404	0.0413	0.0428	0.0581
Variance	0.0543	0.0552	0.0541	0.0818
Monthly Std Dev	0.188	0.1911	0.1873	0.2833
Annualized Std Dev	0.0029	0.003	0.0029	0.0067
Skewness	-0.2737	-0.6671	-0.1723	0.9117
Kurtosis	1.4317	1.7931	0.2645	5.5585
Correlation	0.5263	0.6899	0.498	0.4582
Correlation (P-Value)	0	0	0	0

	TAIWANtwse	AUSTRALIAas30	MALAYSIAfbmklci	THAILANDset
Mean Absolute deviation	0.0557	0.0298	0.0455	0.0623
Variance	0.0758	0.0381	0.0691	0.0869
Monthly Std Dev	0.2624	0.132	0.2392	0.301
Annualized Std Dev	0.0057	0.0015	0.0048	0.0075
Skewness	0.7645	-0.6883	0.6428	0.3696
Kurtosis	3.1391	0.6557	4.8761	2.4493
Correlation	0.4478	0.6948	0.3795	0.4533
Correlation (P-Value)	0	0	0	0

Annex 3: M² Excess returns results 1992-2015

	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
M² Excess return	-0,0139	-0,0051	-0,0140	-0,0057

	BRAZIL	MEXICO	INDIA	INDONESIA
M² Excess return	0,0942	0,0288	0,0059	0,0135

	HONGKONG	NYA	CCMP	INDU
M² Excess return	-0,0199	-0,0068	0,0048	0,0048

	SPX	NDF	RAY	CANADA
M² Excess return	0,0000	-0,0011	0,0013	-0,0098

	UNITED KINGDOM	France	GERMANY	SWITZERLAND
M² Excess return	-0,0313	-0,0263	0,0027	-0,0042

	EUROPE	SPAIN	NETHERLANDS	BELGIUM
M² Excess return	-0,0189	-0,0109	-0,0171	-0,0187

	Portugal	IRELAND	JAPON	SOUTH KOREA
M² Excess return	-0,0080	-0,0002	-0,0423	-0,0229

	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
M² Excess return	-0,0301	-0,0097	-0,0268	-0,0401

Annex 4: VaR and CVaR results 1992-2015

Gaussian Method	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
VaR	-0,2908	-0,2399	-0,3023	-0,2458
Expected Shortfall	-0,3352	-0,2769	-0,3485	-0,2836

Historical Mathod	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
VaR	-0,2560	-0,2088	-0,2601	-0,2221
Expected Shortfall	-0,3030	-0,2294	-0,3130	-0,2340

Modified Method	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
VaR	-0,2223	-0,2134	-0,1860	-0,2212
Expected Shortfall	-0,2223	-0,2134	-0,1860	-0,2212

Gaussian Method	BRAZIL	MEXICO	INDIA	INDONESIA
VaR	-0,2886	-0,1548	-0,1581	-0,1695
Expected Shortfall	-0,3368	-0,1794	-0,1827	-0,1960

Historical Mathod	BRAZIL	MEXICO	INDIA	INDONESIA
VaR	-0,2196	-0,1566	-0,1648	-0,2184
Expected Shortfall	-0,2939	-0,2630	-0,2028	-0,3062

Modified Method	BRAZIL	MEXICO	INDIA	INDONESIA
VaR	-0,1337	-0,2064	-0,1753	-0,2386
Expected Shortfall	-0,1337	-0,2429	-0,2242	-0,2386

Gaussian Method	HONGKONG	NYA	CCMP	INDU
VaR	-0,1659	-0,0910	-0,1422	-0,0892
Expected Shortfall	-0,1911	-0,1051	-0,1643	-0,1032

Historical Mathod	HONGKONG	NYA	CCMP	INDU
VaR	-0,1536	-0,1036	-0,1824	-0,1187
Expected Shortfall	-0,2251	-0,1522	-0,2174	-0,1385

Modified Method	HONGKONG	NYA	CCMP	INDU
VaR	-0,1917	-0,1268	-0,1803	-0,1136
Expected Shortfall	-0,2961	-0,1458	-0,2205	-0,1438

Gaussian Method	SPX	NDF	RAY	CANADA
VaR	-0,0909	-0,1037	-0,0925	-0,0927
Expected Shortfall	-0,1051	-0,1198	-0,1069	-0,1071

Historical Mathod	SPX	NDF	RAY	CANADA
VaR	-0,1100	-0,1337	-0,1068	-0,1364
Expected Shortfall	-0,1417	-0,1814	-0,1468	-0,1727

Modified Method	SPX	NDF	RAY	CANADA
VaR	-0,1170	-0,1447	-0,1215	-0,1370
Expected Shortfall	-0,1512	-0,1565	-0,1577	-0,1377

Gaussian Method	UNITED KINGDOM	France	GERMANY	SWITZERLAND
VaR	-0,0882	-0,1212	-0,1341	-0,0982
Expected Shortfall	-0,1016	-0,1396	-0,1550	-0,1134

Historical Mathod	UNITED KINGDOM	France	GERMANY	SWITZERLAND
VaR	-0,1022	-0,1307	-0,1713	-0,1189
Expected Shortfall	-0,1190	-0,1476	-0,2077	-0,1526

Modified Method	UNITED KINGDOM	France	GERMANY	SWITZERLAND
VaR	-0,1047	-0,1341	-0,1784	-0,1282
Expected Shortfall	-0,1345	-0,1607	-0,2063	-0,1579

Gaussian Method	EUROPE	SPAIN	NETHERLANDS	BELGIUM
VaR	-0,1197	-0,1339	-0,1242	-0,1056
Expected Shortfall	-0,1380	-0,1545	-0,1432	-0,1218

Historical Mathod	EUROPE	SPAIN	NETHERLANDS	BELGIUM
VaR	-0,1432	-0,1460	-0,1775	-0,1565
Expected Shortfall	-0,1592	-0,1796	-0,1973	-0,1806

Modified Method	EUROPE	SPAIN	NETHERLANDS	BELGIUM
VaR	-0,1426	-0,1525	-0,1642	-0,1511
Expected Shortfall	-0,1791	-0,1899	-0,2052	-0,1779

Gaussian Method	Portugal	IRELAND	JAPON	SOUTH KOREA
VaR	-0,1190	-0,1201	-0,1224	-0,1825
Expected Shortfall	-0,1374	-0,1388	-0,1407	-0,2102

Historical Mathod	Portugal	IRELAND	JAPON	SOUTH KOREA
VaR	-0,1488	-0,1611	-0,1154	-0,1727
Expected Shortfall	-0,1757	-0,1788	-0,1571	-0,2385

Modified Method	Portugal	IRELAND	JAPON	SOUTH KOREA
VaR	-0,1465	-0,1610	-0,1319	-0,2083
Expected Shortfall	-0,1832	-0,1927	-0,1576	-0,5528

Gaussian Method	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
VaR	-0,1701	-0,0830	-0,1545	-0,1969
Expected Shortfall	-0,1958	-0,0959	-0,1779	-0,2263

Historical Mathod	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
VaR	-0,1666	-0,1098	-0,1805	-0,2114
Expected Shortfall	-0,1899	-0,1216	-0,2125	-0,2545

Modified Method	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
VaR	-0,1665	-0,1013	-0,1898	-0,2185
Expected Shortfall	-0,2416	-0,1363	-0,4028	-0,3595

Annex 5: Sharpe results 1992-2015

Gaussian Method	CHINEshcomp	CHINEszcomp	CHINEshashr	CHINEszashr
StdDev Sharpe	0,0787	0,0938	0,0794	0,0935
VaR Sharpe	0,0355	0,0428	0,0358	0,0426
ES Sharpe	0,0308	0,0370	0,0311	0,0369

Historical Mathod	CHINEshcomp	CHINEszcomp	CHINEshashr	CHINEszashr
StdDev Sharpe	0,0787	0,0938	0,0794	0,0935
VaR Sharpe	0,0403	0,0491	0,0416	0,0471
ES Sharpe	0,0341	0,0447	0,0346	0,0447

Modified Method	CHINEshcomp	CHINEszcomp	CHINEshashr	CHINEszashr
StdDev Sharpe	0,0787	0,0938	0,0794	0,0935
VaR Sharpe	0,0465	0,0481	0,0583	0,0473
ES Sharpe	0,0465	0,0481	0,0583	0,0473

Gaussian Method	BRAZILibov	MEXICOinmex	INDIAnifty	INDONESIAjci
StdDev Sharpe	0,2698	0,1445	0,0999	0,1186
VaR Sharpe	0,1331	0,0679	0,0460	0,0550
ES Sharpe	0,1140	0,0586	0,0398	0,0475

Historical Mathod	BRAZILibov	MEXICOinmex	INDIAnifty	INDONESIAjci
StdDev Sharpe	0,2698	0,1445	0,0999	0,1186
VaR Sharpe	0,1750	0,0671	0,0441	0,0427
ES Sharpe	0,1307	0,0400	0,0359	0,0304

Modified Method	BRAZILibov	MEXICOinmex	INDIAnifty	INDONESIAjci
StdDev Sharpe	0,2698	0,1445	0,0999	0,1186
VaR Sharpe	0,2874	0,0509	0,0415	0,0390
ES Sharpe	0,2874	0,0433	0,0324	0,0390

Gaussian Method	HONGKONGhsi	Usnya	Usccmp	Usindu
StdDev Sharpe	0,0496	0,0577	0,0945	0,0805
VaR Sharpe	0,0223	0,0265	0,0435	0,0374
ES Sharpe	0,0193	0,0229	0,0376	0,0323

Historical Mathod	HONGKONGhsi	Usnya	Usccmp	Usindu
StdDev Sharpe	0,0496	0,0577	0,0945	0,0805
VaR Sharpe	0,0241	0,0233	0,0339	0,0281
ES Sharpe	0,0164	0,0158	0,0284	0,0240

Modified Method	HONGKONGhsi	Usnya	Usccmp	Usindu
StdDev Sharpe	0,0496	0,0577	0,0945	0,0805
VaR Sharpe	0,0193	0,0190	0,0343	0,0293
ES Sharpe	0,0125	0,0165	0,0280	0,0232

Gaussian Method	Usspx	Usndf	Usray	CANADAsptsx
StdDev Sharpe	0,0713	0,0728	0,0743	0,0520
VaR Sharpe	0,0329	0,0335	0,0344	0,0238
ES Sharpe	0,0285	0,0290	0,0297	0,0206

Historical Mathod	Usspx	Usndf	Usray	CANADAsptsx
StdDev Sharpe	0,0713	0,0728	0,0743	0,0520
VaR Sharpe	0,0272	0,0260	0,0298	0,0162
ES Sharpe	0,0211	0,0191	0,0216	0,0128

Modified Method	Usspx	Usndf	Usray	CANADAsptsx
StdDev Sharpe	0,0713	0,0728	0,0743	0,0520
VaR Sharpe	0,0256	0,0240	0,0261	0,0161
ES Sharpe	0,0198	0,0222	0,0201	0,0160

Gaussian Method	Ukukx	FRANCEcac	GERMANYdax	SWITZERLANDsmi
StdDev Sharpe	0,0063	0,0257	0,0882	0,0649
VaR Sharpe	0,0028	0,0115	0,0406	0,0298
ES Sharpe	0,0025	0,0100	0,0351	0,0258

Historical Mathod	Ukukx	FRANCEcac	GERMANYdax	SWITZERLANDsmi
StdDev Sharpe	0,0063	0,0257	0,0882	0,0649
VaR Sharpe	0,0024	0,0107	0,0318	0,0246
ES Sharpe	0,0021	0,0095	0,0262	0,0192

Modified Method	Ukukx	FRANCEcac	GERMANYdax	SWITZERLANDsmi
StdDev Sharpe	0,0063	0,0257	0,0882	0,0649
VaR Sharpe	0,0024	0,0104	0,0305	0,0228
ES Sharpe	0,0019	0,0087	0,0264	0,0185

Gaussian Method	EUROPEsx5e	SPAINibex	NETHERLANDSaex	BELGIUMbel20
StdDev Sharpe	0,0407	0,0605	0,0459	0,0377
VaR Sharpe	0,0184	0,0275	0,0207	0,0171
ES Sharpe	0,0159	0,0238	0,0180	0,0148

Historical Mathod	EUROPEsx5e	SPAINibex	NETHERLANDSaex	BELGIUMbel20
StdDev Sharpe	0,0407	0,0605	0,0459	0,0377
VaR Sharpe	0,0154	0,0252	0,0145	0,0115
ES Sharpe	0,0138	0,0205	0,0131	0,0100

Modified Method	EUROPEsx5e	SPAINibex	NETHERLANDSaex	BELGIUMbel20
StdDev Sharpe	0,0407	0,0605	0,0459	0,0377
VaR Sharpe	0,0154	0,0241	0,0157	0,0119
ES Sharpe	0,0123	0,0194	0,0126	0,0101

Gaussian Method	PORTUGALbvlx	IRELANDiseq	JAPONnky500	SOUTHKOREAkospi
StdDev Sharpe	0,0626	0,0790	-0,0076	0,0462
VaR Sharpe	0,0285	0,0363	-0,0033	0,0207
ES Sharpe	0,0247	0,0314	-0,0029	0,0180

Historical Mathod	PORTUGALbvlx	IRELANDiseq	JAPONnky500	SOUTHKOREAkospi
StdDev Sharpe	0,0626	0,0790	-0,0076	0,0462
VaR Sharpe	0,0228	0,0270	-0,0035	0,0219
ES Sharpe	0,0193	0,0244	-0,0026	0,0158

Modified Method	PORTUGALbvlx	IRELANDiseq	JAPONnky500	SOUTHKOREAkospi
StdDev Sharpe	0,0626	0,0790	-0,0076	0,0462
VaR Sharpe	0,0232	0,0271	-0,0031	0,0181
ES Sharpe	0,0185	0,0226	-0,0026	0,0068

Gaussian Method	TAIWANtwse	AUSTRALIAas30	MALAYSIAfbmklci	THAILANDset
StdDev Sharpe	0,0284	0,0493	0,0320	0,0143
VaR Sharpe	0,0126	0,0226	0,0143	0,0063
ES Sharpe	0,0110	0,0196	0,0124	0,0055

Historical Mathod	TAIWANtwse	AUSTRALIAas30	MALAYSIAfbmklci	THAILANDset
StdDev Sharpe	0,0284	0,0493	0,0320	0,0143
VaR Sharpe	0,0129	0,0171	0,0122	0,0059
ES Sharpe	0,0113	0,0155	0,0104	0,0049

Modified Method	TAIWANtwse	AUSTRALIAas30	MALAYSIAfbmklci	THAILANDset
StdDev Sharpe	0,0284	0,0493	0,0320	0,0143
VaR Sharpe	0,0129	0,0185	0,0116	0,0057
ES Sharpe	0,0089	0,0138	0,0055	0,0035

Annex 6: Downside risk results 1992-2015

	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
Monthly downside risk	0,0647	0,0630	0,0655	0,0640
Annualised downside risk	0,2240	0,2183	0,2269	0,2216
Downside potential	0,0333	0,0347	0,0336	0,0351
Omega	1,3157	1,3010	1,3282	1,3034
Sortino ratio	0,1627	0,1658	0,1683	0,1666
Upside potential	0,0438	0,0452	0,0446	0,0458
Upside potential ratio	0,9185	0,9506	0,9130	0,9094
Omega-sharpe ratio	0,3157	0,3010	0,3282	0,3034

	BRAZIL	MEXICO	INDIA	INDONESIA
Monthly downside risk	0,0565	0,0486	0,0480	0,0532
Annualised downside risk	0,1956	0,1684	0,1662	0,1844
Downside potential	0,0267	0,0233	0,0250	0,0245
Omega	2,4472	1,4601	1,2982	1,3882
Sortino ratio	0,6836	0,2203	0,1556	0,1786
Upside potential	0,0653	0,0340	0,0325	0,0340
Upside potential ratio	1,2950	0,7915	0,8338	0,6862
Omega-sharpe ratio	1,4472	0,4601	0,2982	0,3882

	HONGKONG	NYA	CCMP	INDU
Monthly downside risk	0,0497	0,0308	0,0454	0,0295
Annualised downside risk	0,1721	0,1065	0,1574	0,1021
Downside potential	0,0254	0,0146	0,0215	0,0140
Omega	1,1532	1,1784	1,2971	1,2516
Sortino ratio	0,0783	0,0847	0,1404	0,1195
Upside potential	0,0293	0,0172	0,0278	0,0175
Upside potential ratio	0,7491	0,6073	0,7546	0,6803
Omega-sharpe ratio	0,1532	0,1784	0,2971	0,2516

	SPX	NDF	RAY	CANADA
Monthly downside risk	0,0305	0,0343	0,0312	0,0317
Annualised downside risk	0,1056	0,1188	0,1082	0,1098
Downside potential	0,0146	0,0163	0,0149	0,0150
Omega	1,2182	1,2247	1,2266	1,1604
Sortino ratio	0,1045	0,1070	0,1079	0,0758
Upside potential	0,0178	0,0200	0,0182	0,0174
Upside potential ratio	0,6138	0,6395	0,6019	0,6273
Omega-sharpe ratio	0,2182	0,2247	0,2266	0,1604

	UNITED KINGDOM	France	GERMANY	SWITZERLAND
Monthly downside risk	0,0299	0,0394	0,0436	0,0328
Annualised downside risk	0,1035	0,1364	0,1510	0,1135
Downside potential	0,0150	0,0207	0,0205	0,0156
Omega	1,0295	1,0767	1,2748	1,2004
Sortino ratio	0,0149	0,0404	0,1292	0,0953
Upside potential	0,0155	0,0223	0,0261	0,0187
Upside potential ratio	0,6452	0,6978	0,6932	0,6459
Omega-sharpe ratio	0,0295	0,0767	0,2748	0,2004

	EUROPE	SPAIN	NETHERLANDS	BELGIUM
Monthly downside risk	0,0394	0,0421	0,0417	0,0365
Annualised downside risk	0,1364	0,1457	0,1444	0,1264
Downside potential	0,0198	0,0211	0,0198	0,0168
Omega	1,1208	1,1834	1,1400	1,1188
Sortino ratio	0,0608	0,0921	0,0664	0,0547
Upside potential	0,0222	0,0250	0,0225	0,0188
Upside potential ratio	0,6662	0,7089	0,6122	0,5835
Omega-sharpe ratio	0,1208	0,1834	0,1400	0,1188

	Portugal	IRELAND	JAPON	SOUTH KOREA
Monthly downside risk	0,0376	0,0401	0,0390	0,0514
Annualised downside risk	0,1301	0,1388	0,1350	0,1781
Downside potential	0,0185	0,0187	0,0215	0,0270
Omega	1,1936	1,2439	0,9900	1,1468
Sortino ratio	0,0956	0,1136	-0,0055	0,0772
Upside potential	0,0221	0,0232	0,0213	0,0310
Upside potential ratio	0,7106	0,6422	0,7650	0,8347
Omega-sharpe ratio	0,1936	0,2439	-0,0100	0,1468

	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
Monthly downside risk	0,0486	0,0283	0,0454	0,0588
Annualised downside risk	0,1682	0,0979	0,1573	0,2037
Downside potential	0,0267	0,0140	0,0216	0,0305
Omega	1,0878	1,1481	1,1111	1,0471
Sortino ratio	0,0482	0,0734	0,0529	0,0244
Upside potential	0,0290	0,0161	0,0240	0,0319
Upside potential ratio	0,8359	0,6575	0,6447	0,7198
Omega-sharpe ratio	0,0878	0,1481	0,1111	0,0471

Annex 7: Returns of indices 2002-2015

	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
Arithmetic Mean	0,0080	0,0137	0,0080	0,0137
Geometric Mean	0,0046	0,0094	0,0046	0,0094
Global return (Arithmetic mean)	1,3433	2,3045	1,3496	2,3097
Global return (Geometric mean)	1,1502	3,8512	1,1630	3,8369
Annualized return	0,0562	0,1194	0,0567	0,1192

	BRAZIL	MEXICO	INDIA	INDONESIA
Arithmetic Mean	0,0093	0,0131	0,0145	0,0169
Geometric Mean	0,0069	0,0117	0,0121	0,0148
Global return (Arithmetic mean)	1,5633	2,1930	2,4343	2,8332
Global return (Geometric mean)	2,1928	6,0078	6,5033	10,7158
Annualized return	0,0865	0,1492	0,1548	0,1922

	HONGKONG	NYA	CCMP	INDU
Arithmetic Mean	0,0057	0,0039	0,0070	0,0041
Geometric Mean	0,0039	0,0029	0,0056	0,0033
Global return (Arithmetic mean)	0,9634	0,6560	1,1829	0,6908
Global return (Geometric mean)	0,9228	0,6265	1,5674	0,7388
Annualized return	0,0478	0,0354	0,0697	0,0403

	SPX	NDF	RAY	CANADA
Arithmetic Mean	0,0043	0,0038	0,0048	0,0039
Geometric Mean	0,0034	0,0027	0,0038	0,0031
Global return (Arithmetic mean)	0,7291	0,6382	0,8036	0,6493
Global return (Geometric mean)	0,7803	0,5646	0,9019	0,6922
Annualized return	0,0421	0,0325	0,0470	0,0383

	UNITED KINGDOM	France	GERMANY	SWITZERLAND
Arithmetic Mean	0,0019	0,0014	0,0063	0,0027
Geometric Mean	0,0011	0,0000	0,0044	0,0019
Global return (Arithmetic mean)	0,3188	0,2321	1,0606	0,4529
Global return (Geometric mean)	0,1964	0,0027	1,0819	0,3740
Annualized return	0,0129	0,0002	0,0538	0,0230

	EUROPE	SPAIN	NETHERLANDS	BELGIUM
Arithmetic Mean	0,0006	0,0025	0,0009	0,0030
Geometric Mean	-0,0009	0,0008	-0,0008	0,0017
Global return (Arithmetic mean)	0,1008	0,4132	0,1567	0,5052
Global return (Geometric mean)	-0,1415	0,1365	-0,1282	0,3301
Annualized return	-0,0108	0,0092	-0,0098	0,0206

	Portugal	IRELAND	JAPON	SOUTH KOREA
Arithmetic Mean	0,0026	0,0028	0,0047	0,0079
Geometric Mean	0,0013	0,0010	0,0034	0,0062
Global return (Arithmetic mean)	0,4439	0,4661	0,7949	1,3271
Global return (Geometric mean)	0,2433	0,1901	0,7678	1,8273
Annualized return	0,0157	0,0125	0,0415	0,0771

	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
Arithmetic Mean	0,0041	0,0035	0,0060	0,0106
Geometric Mean	0,0024	0,0028	0,0053	0,0086
Global return (Arithmetic mean)	0,6899	0,5887	1,0122	1,7750
Global return (Geometric mean)	0,5020	0,5908	1,4315	3,2390
Annualized return	0,0295	0,0337	0,0655	0,1087

Annex 8: Volatility and correlation of indices 2002-2015

	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
Mean Absolute deviation	0,0624	0,0731	0,0624	0,0736
Monthly Std Dev	0,0827	0,0927	0,0828	0,0933
Annualized Std Dev	0,2865	0,3212	0,2867	0,3231
Variance	0,0068	0,0086	0,0068	0,0087
Skewness	-0,0787	-0,0374	-0,0747	-0,0245
Kurtosis	0,8888	0,1652	0,9016	0,1738
Correlation	0,2966	0,2471	0,2964	0,2433
Correlation (P-Value)	1,00E-04	0,0012	1,00E-04	0,0015

	BRAZIL	MEXICO	INDIA	INDONESIA
Mean Absolute deviation	0,0546	0,0425	0,052	0,0471
Variance	0,0688	0,0529	0,0695	0,0642
Monthly Std Dev	0,2383	0,1833	0,2409	0,2222
Annualized Std Dev	0,0047	0,0028	0,0048	0,0041
Skewness	-0,2297	-0,3754	-0,2391	-0,7879
Kurtosis	0,453	0,407	2,1179	3,5889
Correlation	0,6491	0,705	0,5636	0,5291
Correlation (P-Value)	0	0	0	0

	HONGKONG	NYA	CCMP	INDU
Mean Absolute deviation	0,0449	0,0331	0,0418	0,0299
Variance	0,0603	0,0445	0,053	0,0402
Monthly Std Dev	0,2088	0,154	0,1837	0,1392
Annualized Std Dev	0,0036	0,002	0,0028	0,0016
Skewness	-0,3704	-0,7514	-0,3915	-0,5786
Kurtosis	1,2767	2,095	0,366	1,3256
Correlation	0,685	0,9759	0,9321	0,9697
Correlation (P-Value)	0	0	0	0

	SPX	NDF	RAY	CANADA
Mean Absolute deviation	0,0315	0,0345	0,0325	0,0287
Variance	0,0422	0,0471	0,0433	0,0378
Monthly Std Dev	0,1461	0,163	0,15	0,1309
Annualized Std Dev	0,0018	0,0022	0,0019	0,0014
Skewness	-0,6849	-0,8034	-0,7006	-1,0445
Kurtosis	1,5161	2,57	1,5815	3,0199
Correlation	1	0,8213	0,9966	0,7765
Correlation (P-Value)	0	0	0	0

	UNITED KINGDOM	France	GERMANY	SWITZERLAND
Mean Absolute deviation	0,0312	0,0406	0,045	0,0306
Variance	0,0405	0,0519	0,0616	0,0399
Monthly Std Dev	0,1403	0,1799	0,2134	0,1382
Annualized Std Dev	0,0016	0,0027	0,0038	0,0016
Skewness	-0,6019	-0,4386	-0,5954	-0,5607
Kurtosis	0,6566	0,5888	2,5685	0,7473
Correlation	0,8592	0,851	0,8259	0,765
Correlation (P-Value)	0	0	0	0

	EUROPE	SPAIN	NETHERLANDS	BELGIUM
Mean Absolute deviation	0,0421	0,0432	0,043	0,0365
Variance	0,0545	0,058	0,0582	0,0503
Monthly Std Dev	0,1887	0,2011	0,2016	0,1741
Annualized Std Dev	0,003	0,0034	0,0034	0,0025
Skewness	-0,4772	-0,2775	-0,8134	-1,1154
Kurtosis	0,9557	0,7833	1,8663	2,8074
Correlation	0,856	0,7429	0,8104	0,7939
Correlation (P-Value)	0	0	0	0

	Portugal	IRELAND	JAPON	SOUTH KOREA
Mean Absolute deviation	0,0386	0,0435	0,0403	0,0445
Variance	0,0513	0,0582	0,0514	0,058
Monthly Std Dev	0,1777	0,2017	0,178	0,2008
Annualized Std Dev	0,0026	0,0034	0,0026	0,0034
Skewness	-0,755	-0,6909	-0,4827	-0,4015
Kurtosis	1,6201	1,6353	0,7607	1,159
Correlation	0,6319	0,7197	0,6068	0,6443
Correlation (P-Value)	0	0	0	0

	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
Mean Absolute deviation	0,0445	0,03	0,0275	0,0461
Variance	0,0579	0,0381	0,038	0,0614
Monthly Std Dev	0,2007	0,132	0,1318	0,2127
Annualized Std Dev	0,0034	0,0015	0,0014	0,0038
Skewness	-0,1956	-0,8735	-0,2983	-0,705
Kurtosis	0,4687	0,9279	2,2857	3,375
Correlation	0,6305	0,776	0,5129	0,5367
Correlation (P-Value)	0	0	0	0

Annex 9: M² Excess results 2002-2015

	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
M² Excess return	0,0065	0,0333	0,0067	0,0330

	BRAZIL	MEXICO	INDIA	INDONESIA
M² Excess return	0,0258	0,0818	0,0653	0,0944

	HONGKONG	NYA	CCMP	INDU
M² Excess return	0,0036	-0,0062	0,0209	-0,0017

	SPX	NDF	RAY	CANADA
M² Excess return	0	-0,0083	0,0046	-0,0039

	UNITED KINGDOM	France	GERMANY	SWITZERLAND
M² Excess return	-0,0291	-0,0328	0,0074	-0,0193

	EUROPE	SPAIN	NETHERLANDS	BELGIUM
M² Excess return	-0,0395	-0,0232	-0,0363	-0,0174

	Portugal	IRELAND	JAPON	SOUTH KOREA
M² Excess return	-0,0210	-0,0208	-0,0006	0,0242

	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
M² Excess return	-0,0090	-0,0088	0,0251	0,0436

Annex 10: Sharpe ratio results 2002-2015

Gaussian Method	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
StdDev Sharpe	0,0629	0,1178	0,0633	0,1174
VaR Sharpe	0,0283	0,0543	0,0285	0,0541
ES Sharpe	0,0246	0,0469	0,0247	0,0468

Historical Mathod	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
StdDev Sharpe	0,0629	0,1178	0,0633	0,1174
VaR Sharpe	0,0250	0,0512	0,0251	0,0513
ES Sharpe	0,0224	0,0466	0,0226	0,0467

Modified Method	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
StdDev Sharpe	0,0629	0,1178	0,0633	0,1174
VaR Sharpe	0,0253	0,0527	0,0255	0,0527
ES Sharpe	0,0198	0,0447	0,0199	0,0446

Gaussian Method	BRAZIL	MEXICO	INDIA	INDONESIA
StdDev Sharpe	0,0947	0,1939	0,1682	0,2193
VaR Sharpe	0,0433	0,0936	0,0797	0,1066
ES Sharpe	0,0375	0,0804	0,0687	0,0916

Historical Mathod	BRAZIL	MEXICO	INDIA	INDONESIA
StdDev Sharpe	0,0947	0,1939	0,1682	0,2193
VaR Sharpe	0,0447	0,0990	0,0682	0,1073
ES Sharpe	0,0312	0,0701	0,0534	0,0601

Modified Method	BRAZIL	MEXICO	INDIA	INDONESIA
StdDev Sharpe	0,0947	0,1939	0,1682	0,2193
VaR Sharpe	0,0388	0,0811	0,0610	0,0677
ES Sharpe	0,0317	0,0653	0,0510	0,0677

Gaussian Method	HONGKONG	NYA	CCMP	INDU
StdDev Sharpe	0,0488	0,0250	0,0801	0,0328
VaR Sharpe	0,0219	0,0112	0,0366	0,0148
ES Sharpe	0,0190	0,0097	0,0317	0,0128

Historical Mathod	HONGKONG	NYA	CCMP	INDU
StdDev Sharpe	0,0488	0,0250	0,0801	0,0328
VaR Sharpe	0,0191	0,0106	0,0382	0,0110
ES Sharpe	0,0154	0,0072	0,0289	0,0100

Modified Method	HONGKONG	NYA	CCMP	INDU
StdDev Sharpe	0,0488	0,0250	0,0801	0,0328
VaR Sharpe	0,0178	0,0082	0,0320	0,0116
ES Sharpe	0,0144	0,0071	0,0260	0,0093

Gaussian Method	SPX	NDF	RAY	CANADA
StdDev Sharpe	0,0366	0,0213	0,0459	0,0283
VaR Sharpe	0,0165	0,0095	0,0208	0,0128
ES Sharpe	0,0143	0,0083	0,0180	0,0111

Historical Mathod	SPX	NDF	RAY	CANADA
StdDev Sharpe	0,0366	0,0213	0,0459	0,0283
VaR Sharpe	0,0141	0,0074	0,0186	0,0099
ES Sharpe	0,0111	0,0058	0,0139	0,0068

Modified Method	SPX	NDF	RAY	CANADA
StdDev Sharpe	0,0366	0,0213	0,0459	0,0283
VaR Sharpe	0,0126	0,0067	0,0158	0,0086
ES Sharpe	0,0101	0,0064	0,0127	0,0082

Gaussian Method	UNITED KINGDOM	France	GERMANY	SWITZERLAND
StdDev Sharpe	-0,0222	-0,0272	0,0571	-0,0025
VaR Sharpe	-0,0097	-0,0119	0,0258	-0,0011
ES Sharpe	-0,0085	-0,0103	0,0224	-0,0010

Historical Mathod	UNITED KINGDOM	France	GERMANY	SWITZERLAND
StdDev Sharpe	-0,0222	-0,0272	0,0571	-0,0025
VaR Sharpe	-0,0081	-0,0106	0,0210	-0,0010
ES Sharpe	-0,0072	-0,0091	0,0158	-0,0008

Modified Method	UNITED KINGDOM	France	GERMANY	SWITZERLAND
StdDev Sharpe	-0,0222	-0,0272	0,0571	-0,0025
VaR Sharpe	-0,0081	-0,0102	0,0183	-0,0009
ES Sharpe	-0,0063	-0,0082	0,0183	-0,0007

Gaussian Method	EUROPE	SPAIN	NETHERLANDS	BELGIUM
StdDev Sharpe	-0,0403	-0,0058	-0,0320	0,0042
VaR Sharpe	-0,0174	-0,0025	-0,0139	0,0019
ES Sharpe	-0,0152	-0,0022	-0,0121	0,0016

Historical Mathod	EUROPE	SPAIN	NETHERLANDS	BELGIUM
StdDev Sharpe	-0,0403	-0,0058	-0,0320	0,0042
VaR Sharpe	-0,0152	-0,0023	-0,0096	0,0013
ES Sharpe	-0,0132	-0,0021	-0,0093	0,0011

Modified Method	EUROPE	SPAIN	NETHERLANDS	BELGIUM
StdDev Sharpe	-0,0403	-0,0058	-0,0320	0,0042
VaR Sharpe	-0,0144	-0,0022	-0,0104	0,0013
ES Sharpe	-0,0115	-0,0018	-0,0084	0,0011

Gaussian Method	Portugal	IRELAND	JAPON	SOUTH KOREA
StdDev Sharpe	-0,0030	-0,0004	0,0377	0,0881
VaR Sharpe	-0,0013	-0,0002	0,0169	0,0403
ES Sharpe	-0,0011	-0,0001	0,0147	0,0349

Historical Mathod	Portugal	IRELAND	JAPON	SOUTH KOREA
StdDev Sharpe	-0,0030	-0,0004	0,0377	0,0881
VaR Sharpe	-0,0010	-0,0001	0,0167	0,0372
ES Sharpe	-0,0009	-0,0001	0,0119	0,0272

Modified Method	Portugal	IRELAND	JAPON	SOUTH KOREA
StdDev Sharpe	-0,0030	-0,0004	0,0377	0,0881
VaR Sharpe	-0,0010	-0,0001	0,0141	0,0328
ES Sharpe	-0,0008	-0,0001	0,0112	0,0263

Gaussian Method	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
StdDev Sharpe	0,0226	0,0186	0,0849	0,1266
VaR Sharpe	0,0101	0,0084	0,0393	0,0589
ES Sharpe	0,0088	0,0073	0,0340	0,0509

Historical Mathod	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
StdDev Sharpe	0,0226	0,0186	0,0849	0,1266
VaR Sharpe	0,0098	0,0063	0,0366	0,0582
ES Sharpe	0,0078	0,0056	0,0253	0,0349

Modified Method	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
StdDev Sharpe	0,0226	0,0186	0,0849	0,1266
VaR Sharpe	0,0091	0,0067	0,0295	0,0388
ES Sharpe	0,0075	0,0046	0,0261	0,0388

Annex 11: Downside risk results 2002-2015

	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
Monthly downside risk	0.0565	0.0601	0.0564	0.0604
Annualised downside risk	0.1956	0.2083	0.1955	0.2092
Downside potential	0.029	0.0318	0.029	0.032
Omega	1.1575	1.3234	1.1588	1.3223
Sortino ratio	0.0809	0.1712	0.0816	0.171
Upside potential	0.0336	0.0421	0.0336	0.0423
Upside potential ratio	0.7437	0.8455	0.7446	0.8319
Omega-sharpe ratio	0.1575	0.3234	0.1588	0.3223

	BRAZIL	MEXICO	INDIA	INDONESIA
Monthly downside risk	0.046	0.0339	0.0449	0.0423
Annualised downside risk	0.1594	0.1173	0.1556	0.1464
Downside potential	0.0244	0.0169	0.0209	0.0181
Omega	1.2413	1.5699	1.5297	1.7425
Sortino ratio	0.1278	0.2844	0.2464	0.318
Upside potential	0.0303	0.0265	0.032	0.0315
Upside potential ratio	0.8663	0.882	0.7739	0.6579
Omega-sharpe ratio	0.2413	0.5699	0.5297	0.7425

	HONGKONG	NYA	CCMP	INDU
Monthly downside risk	0.0434	0.0337	0.0375	0.0299
Annualised downside risk	0.1504	0.1168	0.1301	0.1035
Downside potential	0.0214	0.0163	0.0192	0.0146
Omega	1.1078	1.0294	1.1886	1.047
Sortino ratio	0.0532	0.0142	0.0963	0.023
Upside potential	0.0237	0.0168	0.0228	0.0153
Upside potential ratio	0.6712	0.5814	0.7996	0.6399
Omega-sharpe ratio	0.1078	0.0294	0.1886	0.047

	SPX	NDF	RAY	CANADA
Monthly downside risk	0.0318	0.0361	0.0325	0.0294
Annualised downside risk	0.1101	0.125	0.1125	0.1018
Downside potential	0.0154	0.0171	0.0157	0.0141
Omega	1.0596	1.0219	1.0867	1.0311
Sortino ratio	0.0288	0.0104	0.0418	0.015
Upside potential	0.0163	0.0175	0.017	0.0146
Upside potential ratio	0.5767	0.5448	0.5905	0.5885
Omega-sharpe ratio	0.0596	0.0219	0.0867	0.0311

	UNITED KINGDOM	France	GERMANY	SWITZERLAND
Monthly downside risk	0.0317	0.04	0.0451	0.0308
Annualised downside risk	0.1096	0.1387	0.1563	0.1068
Downside potential	0.0163	0.0212	0.0212	0.0156
Omega	0.9062	0.9037	1.1359	0.9534
Sortino ratio	-0.0483	-0.0511	0.064	-0.0237
Upside potential	0.0148	0.0192	0.0241	0.0149
Upside potential ratio	0.6036	0.6204	0.6127	0.5941
Omega-sharpe ratio	-0.0938	-0.0963	0.1359	-0.0466

	EUROPE	SPAIN	NETHERLANDS	BELGIUM
Monthly downside risk	0.0426	0.0432	0.0463	0.0402
Annualised downside risk	0.1475	0.1496	0.1604	0.1393
Downside potential	0.0223	0.0221	0.0226	0.0184
Omega	0.8735	0.9562	0.8896	0.9773
Sortino ratio	-0.0663	-0.0224	-0.0538	-0.0104
Upside potential	0.0195	0.0211	0.0201	0.018
Upside potential ratio	0.5824	0.6214	0.5057	0.4961
Omega-sharpe ratio	-0.1265	-0.0438	-0.1104	-0.0227

	Portugal	IRELAND	JAPON	SOUTH KOREA
Monthly downside risk	0.0395	0.0451	0.0375	0.04
Annualised downside risk	0.1367	0.1563	0.1298	0.1387
Downside potential	0.0197	0.022	0.0196	0.0202
Omega	0.9602	0.9705	1.0668	1.2218
Sortino ratio	-0.0198	-0.0144	0.0349	0.1118
Upside potential	0.0189	0.0214	0.0209	0.0246
Upside potential ratio	0.63	0.6032	0.7081	0.7562
Omega-sharpe ratio	-0.0398	-0.0295	0.0668	0.2218

	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
Monthly downside risk	0.0414	0.0299	0.0266	0.0424
Annualised downside risk	0.1436	0.1034	0.092	0.147
Downside potential	0.0219	0.015	0.0126	0.0199
Omega	1.0311	1.0053	1.2061	1.3582
Sortino ratio	0.0164	0.0026	0.0979	0.1683
Upside potential	0.0226	0.0151	0.0152	0.0271
Upside potential ratio	0.7316	0.5876	0.6228	0.6939
Omega-sharpe ratio	0.0311	0.0053	0.2061	0.3582

Annex 12: Significativity of Alpha 2002-2015

	SHANGHAI COMPOSITE	SHENZHEN COMPOSITE	SHANGHAI A-SHARE	SHENZHEN A-SHARE
Alpha mensuel de jensen	0,0091	0,0092	0,0096	0,0094
*t** with H0: alpha = 0	1,1581	1,4080	1,1744	1,4069
P-value	0,2478	0,1602	0,2413	0,1606

	BRAZIL	MEXICO	INDIA	INDONESIA
Alpha mensuel de jensen	0,0351	0,0075	0,0052	0,0067
*t** with H0: alpha = 0	4,3412	2,1063	1,2893	1,5983
P-value	0,0000	0,0361	0,1984	0,1111

	HONGKONG	NYA	CCMP	INDU
Alpha mensuel de jensen	0,0004	-0,0005	0,0023	0,0005
*t** with H0: alpha = 0	0,1171	-0,7575	1,0523	0,6701
P-value	0,9068	0,4494	0,2936	0,5033

	SPX	NDF	RAY	CANADA
Alpha mensuel de jensen	0,0000	0,0009	0,0002	-0,0001
*t** with H0: alpha = 0	NA	0,4745	0,5007	-0,0619
P-value	NA	0,6355	0,6170	0,9507

	UNITED KINGDOM	France	GERMANY	SWITZERLAND
Alpha mensuel de jensen	-0,0020	-0,0015	0,0021	0,0007
*t** with H0: alpha = 0	-1,4634	-0,7213	0,8722	0,3667
P-value	0,1445	0,4713	0,3839	0,7142

	EUROPE	SPAIN	NETHERLANDS	BELGIUM
Alpha mensuel de jensen	-0,0009	0,0007	-0,0004	-0,0006
*t** with H0: alpha = 0	-0,4326	0,2750	-0,1973	-0,2838
P-value	0,6656	0,7835	0,8437	0,7768

	Portugal	IRELAND	JAPON	SOUTH KOREA
Alpha mensuel de jensen	0,0014	0,0016	-0,0023	0,0011
*t** with H0: alpha = 0	0,4918	0,6847	-0,8243	0,2517
P-value	0,6233	0,4941	0,4105	0,8015

	TAIWAN	AUSTRALIA	MALAYSIA	THAILAND
Alpha mensuel de jensen	-0,0003	0,0000	0,0003	-0,0016
*t** with H0: alpha = 0	-0,0662	-0,0042	0,0879	-0,3361
P-value	0,9473	0,9966	0,9300	0,7371