TWO SIGMA

Street View

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EXECUTIVE SUMMARY China's financial markets faced increased stress this summer, but the country appears well-positioned to manage short-term systemic risks due to its still large foreign exchange reserves, forecasted economic growth, and government policy. Nevertheless, these three supports have weakened since last summer, and the long-term outlook appears more challenging.

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CHINA FINANCIAL SYSTEM RISK: THE SEQUEL

ANOTHER SUMMER HAS PASSED, leaving film critics yet another set of Hollywood blockbusters to cite when criticizing the industry for repetitive storylines and formulaic sequels. Market observers might level the same complaints about financial themes (and the market commentaries that describe them). For example, in September 2014, *Two Sigma Street View* wrote:

> *Investors may feel like they have already seen this movie: Financial institutions in a large economy issue credit at a historically unprecedented pace over multiple years. Borrowers initially feast on the plethora of opportunities created by supply-side structural changes (e.g., productivity growth, new resource availability, economic liberalization) and access to credit. The economy enjoys strong growth, particularly in a trendy sector such as real estate… Reality eventually hits… The economy slows. Depending on the year and setting, the movie typically falls under the horror genre, due to a large and sudden contraction causing massive economic upheaval, or the drama genre, due to the protracted but still sorrowful conclusion. Recent examples include the United States (2007-2009), the euro zone (2009-tbd), and, depending on the critic, Japan (1997-tbd)… For good reason, some argue that filming of a remake of this story may have already begun in China.*

One year later, it seems the story is indeed being re-told in China, with the risk of a systemic shock emanating from China's financial sector reaching a new high. In the short-term, the Chinese market appears strong:

- China maintains large, though shrinking, foreign exchange reserves.
- Even if headline growth rates disappoint, China's economic growth levels still warrant excitement.
- While the Chinese government's reputation for crisis management may have lost its luster, the government has demonstrated recognition of the problem and a willingness to act.

Nevertheless, these very points remain a challenge for the country in the long-term – exhaustible foreign exchange reserves, slowing economic growth that stresses social order, and moral hazards from government intervention. While the Chinese economy threatens to bankroll yet another installment in the "financial crisis film series," the premiere date in China remains unclear. Whether we'll be seeing this blockbuster next summer, or another time, remains any critic's guess.

FINANCIAL SECTOR OUTLOOK HAS WORSENED IN THE PAST YEAR

Along a number of dimensions, the 2015 installment of the China "movie" looks very similar to the 2014 version. Figure 1 helps to depict this situation. The amount of outstanding credit or total social finance extended to the Chinese economy exceeds 200 percent of GDP and shows no sign of slowing. As the quantity of this credit increases, its quality seems to suffer. Non-performing loans have marched higher (currently 2.5x their 2011 levels), both in absolute terms and relative to the existing loan book. Chinese banks cut their lending by more than half during a single month (August),[1] creating concerns of a systemic financial crisis that afflicts other parts of the Chinese economy. Chang, Chen, Waggoner, and Zha (2015) note that preferential credit policy disproportionately fuels China's heavy industries and underpins economic growth.

The sharp decline in equity prices further fans fears of a systemic crisis. Data shared by NYU Stern's Volatility Institute based on previously published

1 During July 2014, Chinese banks cut lending by 86 percent, stirring concerns of a China market crash. The People's Bank of China responded by reducing its benchmark interest rates and bank reserve requirements.

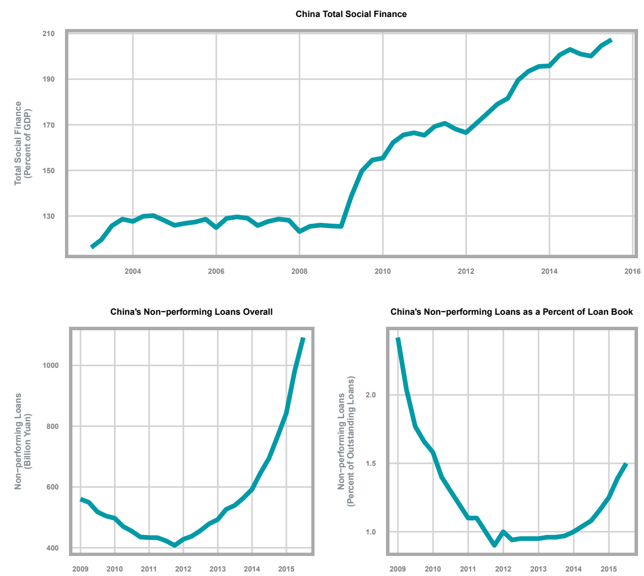
academic research (Acharya, Engle, and Richardson, 2012) argues that systemic risk from a financial crisis in China has climbed to its highest level in more than five years (Figure 2).[2]

According to Acharya et al., the systemic risk of the Chinese banking sector now tops USD 650 billion. This risk exceeds the levels in Japan (approximately USD 500B) and the U.S. (approximately USD 400B), markets with more mature financial systems. Similar concerns in China arose last summer but eventually abated, in part because Chinese equity prices increased. This summer's equity market correction in China brought those systemic risks back to the forefront.

CHINA APPEARS RELATIVELY WELL POSITIONED TO MANAGE THE PROBLEM IN THE SHORT-TERM, BUT THE LONG-TERM RISKS HAVE, IN MANY WAYS, WORSENED

Countries in similar situations tend to rely on three capabilities to fight credit-driven crises: liquidity from monetary and fiscal authorities, economic growth, and financial crisis management. By international standards, China scores strongly along the first two dimensions. Along the third dimension, debate on the Chinese government's hyperactive response to the financial market volatility abounds.[3] At least in the short-term, the government's actions seem to have successfully tamped down volatility. Consider each of the three capabilities in turn.

FIGURE 1



Notes: Data from the People's Bank of China, China's National Bureau of Statistics, and Bloomberg

Foreign Exchange Reserves: Rumors of the demise of China's foreign exchange reserves have perhaps

2 The Acharya et al. approach to quantifying systemic risk employs publicly available data to mimic the stress tests that central banks in the United States and Europe have created. This approach utilizes three steps. First, Acharya et al. calculate the decline in equity value that each large, publicly listed financial firm would lose from a two percent decline in the overall equity markets. This measure seeks to incorporate the volatility of the firm's shares, its correlation to the market, and its behavior under "tail" scenarios. Second, the authors extrapolate this measure from observed behavior of individual firms to a scenario in which the equity markets lose even larger amounts over longer periods. They claim this would accurately simulate the environment during a financial crisis. Finally, they combine current equity market prices and outstanding debt measures with this estimated risk measurement to forecast the magnitude of the capital shortfall each firm might face during a financial crisis. NYU's Volatility Institute then aggregates these shortfalls across the largest financial firms by country using real-time equity price data. For more information, see http://vlab.stern.nyu.edu

3 See the following section for a timeline of the Chinese government's responses during the recent financial market stress. The July *Two Sigma Street View* also discusses this topic.

FIGURE 2

Notes: Data from NYU Stern Volatility Institute been greatly exaggerated. It seems true that China sold record quantities of dollars to prop up the yuan.[4] However, the Chinese government's balance sheet remains strong. At USD 4.1 trillion, foreign exchange reserves still exceed last year's level. The economy has amassed gross foreign assets worth 62 percent of GDP and liabilities of only 42 percent of GDP. The majority of those liabilities stem from relatively "sticky" foreign direct investment (IMF, 2015).

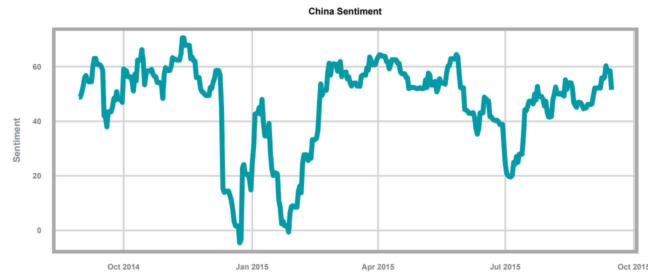
Economic Growth: China's economic growth rate seems to have slowed in percentage terms but not in levels. The median forecast of 6.8 percent for economic growth from Consensus Economics suggests that China will fall short of its stated seven percent annual growth rate target.[5] However, even assuming that growth rate, China will have increased its gross domestic product more this year than it did in 2007, when the economy grew by 14 percent. In dollar terms, economic forecasts suggest China will contribute more to global GDP growth this year than the United States, Germany, and Japan combined.

Government Intervention: The Chinese government also seems to have successfully dampened volatility in the Chinese equity markets. Index prices remain positive year-to-date despite the June "correction." The Two Sigma Alpha Capture Sentiment Score (Figure 3) reports that sell-side sentiment has nearly returned to pre-crisis levels. In part, this reflects the role of government policies. The number of short (i.e., negative) trade ideas fell considerably, as equity sales restrictions have limited many investors' options. The government's interventions seem designed to ensure that equity prices have only one direction to go in the short-term.

4 For example, see this report in Bloomberg: http://www.bloomberg.com/news/articles/2015-09-14/china-s-yuan-positions-drop-by-record-amid-defense-of-currency

5 Data from Consensus Economics as of September 15, 2015.

FIGURE 3



Notes: Data from NYU Stern Volatility Institute

While these points position China well in the near future, the risks outlined last September appear even more concerning for the long-term:

> *In the longer term, the medicine that the Chinese government applies during times of financial crisis may create more deleterious effects. Foreign exchange reserves, once used, may need replenishment, and any effort to do so may spur either resistance from trade partners or economic distortions away from more sustainable sectors. Economic growth of seven percent over an extended period – even if sustainable – may not satisfy the demands of a country used to faster improvements in quality-of-life metrics. Such disappointment may stress the social order. Policies imposed to manage the financial crisis may also fertilize moral hazard in the financial sector.*

Last September's *Two Sigma Street View* also asked whether the summer 2014 financial crisis "movie" represented a standalone tale (for China) or the first installment of a longer series. The answer to that question now seems obvious. The next question might be how many sequels to expect. If Hollywood serves as the model, the answer is simply "more."

References

Acharya, V. V., Engle, R. F., & Richardson, M. (2012). "Capital Shortfall: A New Approach to Ranking and Regulating Systemic Risks" *American Economic Review,* 102(3), 59-64.

Chang, C., K. Chen, D. F. Waggoner, and Tao Zha. *Trends and Cycles in China's Macroeconomy.* National Bureau of Economic Research working paper 21244.

International Monetary Fund (IMF). (2015, June). *2015 External Sector Report – Individual Economy Assessments.*

TIMELINE OF CHINA MARKET TURMOIL

BY STANLEY CHAU

Date	Event	Source
November 21, 2014	PBOC cuts rates by 40 bps	
December 28, 2014	PBOC changes rules on loan deposit requirements to ease liquidity pressure.	
January 19, 2015	The Shanghai equity market falls nearly 8% as regulators clamp down on margin lending	
February 28, 2015	PBOC cuts rate by 25 bps	
March 5, 2015	China GDP growth target cut from 7.5% to 7%	
May 10, 2015	PBOC cuts rate by 25 bps	
June 19, 2015	Shanghai equity market index falls 6.4%	
June 27, 2015	PBOC cuts rates by 25 basis points and RRR by 50 basis points for selected banks. 4th cut since last Nov.	
June 29, 2015	Ministry of Human Resources and Social Security and Ministry of Finance releases draft rules that allow local pension funds to purchase stocks, with 30% cap of the net asset value	*Click for source*
July 1, 2015	CSRC cancells margin ratio requirement rule. Investors no longer to maintain guarantees if their margin ratio reaches 130%. Brokers will also allowed to roll over margin trading contracts with clients	*Click for source*
July 3, 2015	The China Securities Finance Corp annouces a capital increase from RMB24billion to RMB100billion	*Click for source*
July 4, 2015	Asset Management Association of China (AMAC) and 25 of its Chinese mutual fund members agree to hold their additional stock investments for at least a year and to speed up the application and issuance of equity funds	*Click for source*
	21 brokerage houses in China agree to buy at least RMB120billion shares and committed not to sell until the Shanghai Compsite index reaches 4,500 points	*Click for source 1* *Click for source 2*
	CSRC stopps new shares issuance on the Shanghai and Shenze stock exchanges and returns all money to investors	*Click for source*
July 5, 2015	Government buyback starts when China state owned investment company, China Huijin, annouces its active investment in the A-shares ETF market, and will continue doing so in the near future	*Click for source*
	CSRC annouces that in order to maintain market stability, the PBOC will support as much liquitdy as the CSF needs to support their A-shares purchases	*Click for source*
July 7, 2015	CFFEX tightens daily limit for new CSI500 futures daily open position to 1200 contracts, in order to supress extensive trading	*Click for source*
July 8, 2015	50% companies on SHSE and SZSE suspended for trading	
	The MOF and SASAC reiterate guarantee that they will not sell shares in the market to maintain market stability	*Click for source 1* *Click for source 2*
	CSF received further liquidity support from the PBOC. CSF also provided RMB260billion credit limits to 21 securities firms	*Click for source 1* *Click for source 2* *Click for source 3* *Click for source 4*
	CSF increased buying of small/mid cap stocks and subscribe to mutual funds	*Click for source 1* *Click for source 2*
	CSRC waived short-swing profit restructions, and annouced a 6 months ban on selling excess shares of over 5%	*Click for source 1* *Click for source 2*

July 9, 2015	CIRC allows asset managers to engage in margin trading and secirities firms must provide liquitidy support	*Click for source*
July 9, 2015	MPS and CSRC start investigation on illegal activities in securities and futures trading	*Click for source*
July 12, 2015	NIIO stops internet promotion on margin financing	
	CSRC issues opinion on stopping illegal securities busienss activities	*Click for source*
July 22, 2015	CSFC denies selling shares and indicates that portfolio changes were position transfers	*Click for source*
July 22, 2015	Backed by central financing, CSFC becomes top shareholder of many listed firms	*Click for source*
July 27, 2015	CSRC investigates foreign brokers on suspicion they engaged in activity that violated the Exchanges' abnormal trading rules	*Click for source*
August 3, 2015	SSE and SZSE amend their respective stock lending rules, requiring that short positions be held at least overnight and effectively prohibiting short sell day trading. Brokers suspended short-selling business	*Click for source*
	CFFEX defines "abnormal trading" as when an investor engages in stock futures arbitrage or speculative trading, and orders cancellations in excess of 400 times per day per contract or cross-trades are in excess of 5 times per day per contract	*Click for source*
	CSFC reported to have bought $32 billion worth of China mutual funds	*Click for source*
August 11, 2015	PBOC announces a 1.9% devaluation of RMB vs USD	*Click for source*
August 14, 2015	CSRC approves 14 new issuances and encourages companies to restructure and M&A	*Click for source*
August 21, 2015	CSRC investigates major shareholders for potentially violating regulations on holding at least 5% of listed stocks	*Click for source*
August 28, 2015	Investigations being in 22 cases involving violation of trading regulations, market manipulation, releasing false public information, insider trading, and illegal trading activities	*Click for source*
September 2, 2015	CSRC plans to administratively punish 3 listed companies for operating illegal securities business	*Click for source*
September 6, 2015	CSRC continues to promote the importance of the entire financial industry to work together promoting market stability	*Click for source*
September 7, 2015	The State Administratin of Taxation relaxes personal income tax on dividends if holding period exceeds 1 year	*Click for source*
September 11, 2015	CSRC announces administrative pubishments in two short-term stock manipulation cases for as well as several brokers in violation of abnormal futures trading activities	*Click for source 1* *Click for source 2*
September 14, 2015	CSRC closes more than 3255 accounts involved in illegal or abnormal trading activities, with 2094 accounts still pending cancel. Total capital involved amounts to RMB187billion	*Click for source*

INTERESTING TECHNOLOGY-RELATED ARTICLES

Two Sigma is a technology company that applies a rigorous, scientific method-based approach to investment management. We draw upon a diverse set of fields to inspire our technology, including artificial intelligence and distributed computing. Occasionally, we read articles in the popular press that describe applications of technology that we find interesting, thought-provoking, and relevant for people thinking about improving the investment management process. Below is a subset of the articles we read this month. Please do not view the inclusion of these articles as an endorsement by Two Sigma of their viewpoints or the companies discussed therein. Two Sigma welcomes discussions (and contributions) about these and other such technology-related articles.

"Thousands of Connected Cars to Roll out Across U.S." by Lindsey Kratochwill, *Popular Science*, September 16, 2015 (http://www.popsci.com/connected-cars-to-roll-out-across-us).

> "Yesterday, transportation secretary Anthony Foxx announced the U.S.'s largest vehicle-to-vehicle pilot program. The $42 million project will roll out in New York City, Tampa, and Wyoming to cut down on traffic problems, and crashes." Vehicle-to-vehicle technology links advances in communications, sensors, and automation with the goal of reducing road congestion and human errors like car crashes.

"More from Moore" *The Economist,* September 5, 2015 (http://www.economist.com/news/technology-quarterly/21662644-chipmaking-moores-law-may-be-running-out-steam-chip-costs-will-continue).

> "According to the tick-tock of Moore's law, Intel's next generation of processors, code-named Cannonlake, were to be fabricated using a 10nm technology and arrive in mid-2016. But the company recently admitted that the migration from 22nm to 14nm had been far more difficult than expected. As a result, 10nm chips are to be delayed until later in 2017. Suddenly, the doubling of processor performance is to take more than three years instead of two. Many have declared this to be the end of Moore's law." The death of Moore's "law" (more like a rule-of-thumb) has seemed imminent for years, in part due to the physical limitations of shrinking transistors to sizes approaching single atoms. However, Moore's law jointly described the number of transistors per chip and the cost of computing power. Since better chip design (particularly systems-on-chip) continue to drive costs down by approximately half every year, Moore's law looks set to continue.

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