A Weakening Chain?
Impact of China's Economic Slowdown on Global Supply Chain Management of US Multinational Enterprises: A Capital Market's Perspective

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In this paper, we explore the consequences of China's economic slowdown in 2015 on the supply-chain based industry sectors in the United States economy and capital markets. We analyze the impact directly on major multinational corporations headquartered and traded in the United States with their supply chains most exposed to the Chinese slowdown. We test the hypothesis whether China's economic slowdown poses a real threat to the global supply chain management of the US Multinational Enterprises (MNEs). We find that the United States businesses and economy have limited exposure to the Chinese meltdown, and systematic risks of the MNEs with the greatest exposure of their global supply chains were not adversely impacted immediately following the worst news regarding China's economic slowdown, capital market volatility and currency devaluation, assuring investors regarding future prospects and impacts from global trade with China.

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I. INTRODUCTION

While the world had been watching China's economic deceleration in the last two years, "the factory of the world" officially declared its economic slowdown in the third quarter of 2015 with its GDP growth falling below 7% for the first time since 2009. China's slowdown was concentrated in the industrial sector while its emerging service sector has shown strength (Spiegel, 2015), resulting in global concerns regarding increasing risks to multinational enterprises (MNEs) that heavily rely on running physical supply chains in China. Previous research has shown that supply chain performance is correlated with the state of the economy (Osadchiy et al., 2015). In an increasingly globalized world economy, supply chain risk management has risen toward the top of

executives' lists today as supply chain disruptions threaten to hurt a company's revenue, cut into its market share, increase costs, and disrupt production and distribution (Bosman, 2006). While overall global economic growth has been relatively steady in recent years, the United States has proven to be a strong anchor economy in the post 2008 great recession era, and interestingly the growth rates among emerging markets and the developed world have shifted away from conventional wisdom. Perhaps, the greatest news that rocked the capital markets worldwide, and sent shocks and shivers throughout the emerging markets in particular, was the surprising slowdown in China's economic growth. Used to double digit growth rates, the Chinese economy grew at a much slower, yet still spectacular by most measures, growth rate of 6.9% in 2015. Going forward, most analysts see a slowdown and deceleration in emerging market economies, and a surprising pickup in growth rates in the developed world such as Europe and Japan. One of the most interesting questions is, "Will emerging market economies such as China continue to outpace developed market economies?"

While general consensus among macro-economic experts is rather mixed (Chow, 2015), we expect Chinese economic growth to slow down in the coming years as the Chinese centrally planned economy continues its reforms along its path of transforming its focus from a global manufacturing export based powerhouse to a service-driven domestic consumption based economy, with much emphasis on domestic businesses. All of these will have an impact on the global economy as well as global supply chains, but we argue that the effects to the US MNEs will be modest. As a key player in global supply chains, China presents itself as one of highest interest given its new stature

as the world's second largest economy in the world at roughly $10.4 trillion, second only to the United States that dominates with an economic might of roughly $17.4 trillion (Akaev, 2015). China has surprised the world by contributing over half of the world's total GDP growth rate on the margin in recent years, and has quadrupled in size of its economy in just a decade. While capital market and economic based reforms started 30 years ago, a combination of central planning and selective capitalism has yielded astonishing results. Now, a slowdown has made investors jittery worldwide, crashed the commodities markets, severely damaged the fortunes of commodity exporting countries including the once mighty Brazil, and forced analysts to reconsider the ramifications of all of this. China remains of great interest, also because the once high soaring BRIC economies (Brazil, Russia, India, and China) quickly saw their fates change with both Russia and Brazil running into severe economic challenges: highly inflationary, recessionary, high levels of corruption, and political turmoil – leaving just China and India as hopes for the future of emerging markets.

One of the important aspects of supply chain risk management is supply chain finance. A company's suppliers having difficulty obtaining working capital will certainly weaken its supply chain. Supply chain costs and risks will significantly increase if suppliers lack stable access to efficient and cost-effective capital, or if suppliers rapidly lose credit. Also, Supply chain disruptions will have the long-term negative stock price and equity risk effects that may not be recovered quickly (Hendricks and Singhai, 2005). The Shanghai Composite Index in China's equity market jumped about 60 percent in the first half of 2015, as global investors took advantage of loose constraints on market access. But over the following month or so,

the index was down about 30 percent. While global investors were not much affected directly since they collectively own only about 1.5 percent of the Chinese outstanding shares, the long-term consequences could severely impact global consumers' spending levels and global economic growth well beyond China. Many emerging countries have heavily relied upon China's economic growth and success for their own prosperity, and they are now hurting because China's imports from those emerging countries have slowed in recent months. China's GDP growth rate has been falling, and many challenges to sustained growth exist including perceived real-estate price inflation, an increasingly expensive labor market, the need to reduce overcapacity in major industries, and growing levels of debts by provincial and local governments.

A robust global supply chain also needs to better manage disruption risks such as currency volatility (Kleindorfer and Saad, 2005). Some argue that the recent devaluation of the Chinese Yuan resembles the Asian financial crisis from 1997 – 1998 (Chow, 2015). If China were to experience such a similar debacle, analysts and investors worry about the economic and financial fallout that could impact the rest of the world economies. Will slowing growth in China have major impact on the global economy? Exactly how exposed is the U.S. economy to China? In particular, in this paper we investigate whether China's economic slowdown will be a real threat to the global supply chain management among the top US multinational enterprises (MNEs).

II. BACKGROUND

2.1. Global Economic Outlook and Currency Impacts

Global financial markets in 2015 have been volatile ever since news of China's slowdown

became apparent and when the Chinese government began a process of currency devaluation in August, 2015. However, largely unnoticed by many investors, has been the slow depreciation of most other Asian currencies that has been underway since May 2013 when the Federal Reserve signaled about "tapering" of quantitative easing. Since that time, the Korean *won* and the Philippine *peso* have each weakened by approximately 10 percent versus the U.S. dollar, while the Thai *baht* is down more than 15 percent. The Chinese devaluation of the *yuan* has further added to the selling pressure on these other Asian currencies. Many of these countries are net importing countries and hence weaker currencies add to their economic challenges.

Many argue that there are many similarities, as well as many differences between the recent China's economic slowdown in 2015 and the Asian Financial crisis in 1997 (Nolan, 2014). The significant currency depreciations that have occurred across Asia in recent months will raise the servicing costs of any foreign currency-denominated debt that households, businesses and government may have in those countries. The economic contractions that occurred in most Asian countries in the aftermath of the 1997-1998 financial crises were worsened by bankruptcies that resulted from the inability of some debtors to service their foreign currency-denominated debt. A vicious circle of currency depreciation, debt-servicing challenges, further currency depreciation, more expensive imports, and trade deficits can result in today's environment. Should investors be worried about a repeat of 1997-1998?

This paper examines the economic linkages between China and the US in an attempt to analyze the impact on top US MNEs that heavily depend on running robust supply chains in China. In particular, will the capital market volatility and the devaluation of the Chinese currency positively or negatively

impact the global supply chain management of the US MNEs as captured by the market risk-adjusted returns (Fama and French, 1992) of their stocks?

TABLE 1. REAL GDP GROWTH (%).

Aggregates/Economies	2013	2014e	2015f	2016f	2017f
Aggregates					
Developing economies	5.1	4.6	4.4	5.2	5.4
Developing economies, excl. BRICS	4.2	3.7	4.3	4.6	4.7
High-income economies	1.4	1.8	2	2.4	2.2
Low income economies	6.2	6.2	6.2	6.6	6.6
World	2.5	2.6	2.8	3.3	3.2
BRICS	5.4	5	4.7	5.5	5.6
Developing Europe and Central Asia	3.7	2.4	1.8	3.4	3.6
East Asia and Pacific	7.1	6.9	6.7	6.7	6.6
Latin America and the Caribbean	2.7	0.9	0.4	2	2.8
Middle East and N. Africa	0.5	2.2	2.2	3.7	3.8
South Asia	6.3	6.9	7.1	7.3	7.5
Sub-Saharan Africa	4.2	4.6	4.2	4.6	5
Economies					
Chile	4.2	1.9	2.9	3.3	3.5
Czech Republic	-0.7	2	2.4	2.5	2.8
Euro area (17)	-0.4	0.9	1.5	1.8	1.6
Japan	1.6	0	1.1	1.7	1.2
Poland	1.7	3.4	3.6	3.6	3.6
Russian Federation	1.3	0.6	-2.7	0.7	2.5
United Kingdom	1.7	2.8	2.6	2.6	2.2
United States	2.2	2.4	2.7	2.8	2.4
Brazil	2.7	0.1	-1.3	1.1	2
China	7.7	7.4	7.1	7	6.9
India	6.9	7.3	7.5	7.9	8
Indonesia	5.6	5	4.7	5.5	5.5
Malaysia	4.7	6	4.7	5	5.1
Mexico	1.4	2.1	2.6	3.2	3.5
Pakistan	4.4	5.4	6	3.7	4.5
South Africa	1.9	1.5	2	2.1	2.4
Swaziland	2.8	1.7	2	1.8	1.6
Thailand	2.8	0.9	3.5	4	4
Turkey	4.2	2.9	3	3.9	3.7
Venezuela, R.B.	1.3	-4	-5.1	-1	1.1
Vietnam	5.5	6	6	6.2	6.5

Source: Global Economic Prospects, World Bank
http://www.worldbank.org/en/publication/global-economic-prospects/data
Note: Real GDP growth (%) by economy, region, and income level.

2.2. Who Loses Most from Slow Growth in Global Trade?

Developing countries have been on the center stage lately with many emerging market currencies falling sharply versus the U.S. dollar and stock markets in those countries encountering strong selling pressure. The recent study examines and has found some spillover effects of the US financial crisis on financial markets of some emerging Asian countries (Kim et. al, 2015). Some of this turmoil in emerging markets reflects prospects for slower growth in many developing economies. Currency depreciation could put upward pressure on consumer price index (CPI) inflation rates in the developing world. If central banks in developing economies hike interest rates in a bid to stabilize inflation expectations, economic growth in the developing world could slow even further.

Does slower growth in many developing countries threaten the economic outlook for advanced economies? Due to strong economic growth over the past two decades, developing economies accounted for about 20 percent of global GDP at the turn of the century, but that ratio has more than doubled over the past 15 years to about 57 percent in 2014 (IMF, 2015). Further, developing countries account for roughly 38 percent of global exports of goods and services in 2014.

Recent research has shown that the trade associated with global supply chains is affected by some significant global economic changes (Baldwin and Lopez-Gonzalez, 2015). Global trade, which had been growing in excess of global production in the two decades leading up to the global financial crisis, has decelerated in recent years. It is well recognized that developing economies, specifically China, have grown rapidly in recent decades by importing intermediate inputs, assembling them, and then re-exporting finished products to the developed world (Chow, 2015). Developing economies consistently posted double-digit export growth rates from 2003 through 2007, which was well above export growth rates of the advanced economies as well as global industrial production growth during that period. However, developing economy export growth has slowed sharply in recent years. Export growth in the developing world is currently lagging export growth in advanced economies.

Not only are developing economies struggling more at present in terms of export growth, but they are also more exposed to international trade than advanced economies. Participation in global supply chains is also found to be an important factor determining trade policy in response to economic changes, for example, the most recent 2008 crisis (Gadande et al, 2014). Many emerging market economies achieved rapid rates of economic growth during the past two decades due to the proliferation of global trade that occurred during that period. However, global economic growth is slower today than it was in the years immediately preceding the global financial crisis and growth in global trade has also downshifted significantly. It stands to reason that developing economies, which benefited from the proliferation of global trade, would have more to lose than their advanced economy counterparts from slower growth in trade today (IMF, 2015). Developing economies generally derive a higher percentage of their value added from final spending in the rest of the world than do advanced economies. Consequently, these economies have the most to lose from continued sluggish growth in global economic activity and trade.

TABLE 2. CLASSIFICATION BY WORLD ECONOMIC OUTLOOK – GROUPS AND THEIR SHARES IN AGGREGATE GDP, EXPORTS OF GOODS AND SERVICES, 2014 (% OF TOTAL FOR GROUP OR WORLD).

	# of Economies	GDP		Exports of Goods and Services	
		Adv. Economies	World	Adv. Economies	World
Advanced Economies	37	100	42.9	100	62.2
USA		37.2	15.9	16	10
Europ Area	19	28.4	12.2	41.2	25.7
Germany		8	3.4	12.1	7.5
France		5.6	2.4	5.9	3.7
Italy		4.6	2	4.3	2.7
Spain		3.4	1.4	3.1	1.9
Japan		10.2	4.4	5.9	3.7
United Kingdom		5.5	2.4	5.7	3.6
Canada		3.4	1.5	3.9	2.4
Other Advanced Economies	14	15.2	6.5	27.3	17
Major Advanced Economies	7	74.6	32	53.8	33.5
Emerging Market and Developing Economies	152	100	57.1	100	37.8
Russia		5.8	3.3	6.3	2.4
Emerging and Developing Asia	29	52.3	29.9	45.4	17.1
China		29.1	16.6	27.9	10.5
India		11.9	6.8	5.3	2
Excluding China and India	27	11.3	6.4	12.2	4.6
Emerging and Developing Europe	12	5.7	3.3	8.9	3.3
Latin America and the Carribbean	32	15.1	8.6	13.8	5.2
Brazil		5.3	3	1.1	3.3
Mexico		3.5	2	4.7	1.8

Source: IMF, World Economic Outlook, 2015. Statistical Appendix Table A (Page 147)

2.3. How Important is China to Other Asian Economies and the US?

The recent financial volatility witnessed from China has spilled over to other Asian economies. As Baele (2005) investigated the relationships between regional economic integration and European equity market interdependence, China has clearly become more economically integrated with its Asian neighbors over the past two decades through global trade, and deceleration in the world's second largest economy undoubtedly will exert a slowing effect on other Asian economies. Exactly how exposed are these economies to China? The volatility in the Chinese stock market in recent weeks and continued signs of slowing growth in that country raise questions about which Asian economies would be most negatively affected by economic fallout from China. Since the Asian economic crisis in 1997, China's economy which used to be the seventh largest in the world at the time, has evolved from being one-tenth the size of the American economy to now being the second largest economy in the world at $10.4 trillion.

Not only has China increased its importance in terms of global GDP, but it is a much more important trading partner for many economies, especially those in Asia, than it was two decades ago. According to Bloomberg's China Trade Monitor (McDonough, 2015), 7 out of China's top 10 largest import partners (almost half of the total imports) are Asia-Pacific Economic Cooperation (APEC) member economies, including South Korea, Japan, US, Taiwan, Australia, Malaysia, and Thailand. In regard to its export destinations, 6 out of China's top 10 largest export partners (again almost half of the total exports) are APEC member economies, including US, Hong Kong, Japan, South Korea, Vietnam, and Singapore.

Interestingly, China is becoming a global trading hub of many economies in Asia. For example, many of Hong Kong's exports to China are assembled into finished products on the mainland and then subsequently re-exported. At the other end of the spectrum, Japan and India have much less direct exposure to China. What sets Japan and India apart from Taiwan and Hong Kong is that the former are relatively large economies based on large domestic based consumption in their own right.

Increasingly China has become much more important and relevant to several Asian economies compared to the United States. China has become the major importer of raw materials and intermediate inputs. These raw materials and intermediate inputs are assembled into finished goods in China and then re-exported to the United States and other countries. The consumer in the United States contributes 70% to the US GDP, and has relied heavily on cheaper imports from China. The US is about twice as important to the global economy as China. Specifically, final spending in the United States accounts for roughly 3 percent of global value added compared to China's 1.5 percent. China has been the world's largest factory, but the United States remains the world's consumer at the present time. Both India and China have huge emerging middle classes that promise to change the consumption landscape, with a potential to be larger in size than the entire population of the United States. On the other hand, China's slowdown, potentially inflated real estate, and increasingly expensive labor has the potential to present challenges for the world economy, including MNEs with huge supply chain exposures to China.

III. METHODOLOGY AND ANALYSIS TO MEASURE IMPACT ON US MNES

Twenty-one (21) US MNEs from the latest Fortune 100 list are selected for our analysis to measure the impact of Chinese slowdown. The list is presented in Table 5. These large MNEs are industrial leaders in the manufacturing (mostly original equipment manufacturers (OEMs)) and retail sectors that heavily rely on running supply chains in China to support their global business. A number of them are in fact identified by Gartner to run the best supply chains in the world (Monroe, 2014). We exclude firms from financial and energy sectors, as well as technology services companies that have a strong presence in China, but having a strong physical supply chain in China is not imperative for their global business. We also exclude pharmaceutical, food and beverage companies that heavily manufacture in China mainly for their local Chinese markets with rigid demands.

TABLE 3. KEY COUNTRIES' EXPORT TO CHINA/IMPORT BY CHINA – 2014.

	Export Ranking	% of China Exports	Import Ranking	% of China Imports
US	1	17.0%	3	8.2%
Japan	3	6.4%	2	8.3%
Germany	5	3.1%	6	5.4%
Spain	25	0.9%	44	0.3%
Italy	22	1.2%	27	1.0%
South Korea	4	4.3%	1	9.7%
Australia	14	1.7%	7	5.0%

Source: UN Comtrade Database (http://comtrade.un.org)

TABLE 4. CHINA'S FDI IN THE US VS. US FDI IN CHINA (IN USD MILLIONS).

China's FDI in the US (in USD millions)					
Year	2010	2011	2012	2013	2014
Position (UBO)	5415	9172	14276	8521	10169
Flow	1037	1105	3415	2821	968
US FDI in China (in USD millions)					
Position (UBO)	58996	53661	54514	59886	65767
Flow	5420	-1720	-1223	6596	6333

Source: Bureau of Economic Analysis (latest available as of September 2015)
http://www.SelectUSA.gov

TABLE 5. TOP MNES THAT HEAVILY RELY ON SUPPLY CHAINS IN CHINA.

Company Name	Stock Code	Industry	Gartner Top Supply Chain?
Walmart	WMT	Retailer: General	Yes
Apple	AAPL	Mfg: Computer/Electronics	Yes
General Motors	GM	Mfg: Automobile	
General Electric	GE	Mfg: Diversified	
Ford Motor	F	Mfg: Automobile	Yes
Costco	COST	Retailer: Specialty	
HP	HPQ	Mfg: Computer/Electronics	
Amazon.com	AMZN	Retailer: General	Yes
Procter & Gamble	PG	Mfg: Consumer Products	Yes
Home Depot	HD	Retailer: Specialty	Yes
Target	TGT	Retailer: General	
United Technologies	UTX	Mfg: Equipment	
Dow Chemical	DOW	Mfg: Chemicals	
Lowe's	LOW	Retailer: Specialty	
Caterpillar	CAT	Mfg: Equipment	Yes
Cisco	CSCO	Mfg: Electronics/Telecom	Yes
Johnson Controls	JCI	Mfg: Equipment	
Best Buy	BBY	Retailer: Specialty	
Honeywell	HON	Mfg: Diversified	
Halliburton	HAL	Mfg: Equipment	
3M	MMM	Mfg: Diversified	Yes

Since these are publicly-held companies, their daily stock return data are retrieved for the entire year of 2015. These publicly listed MNEs heavily rely on successfully running their global supply chains in order to deliver satisfactory financial performance to their shareholders. A company's stock return data endogenizes operational information on the expectation and riskiness of earnings (Wu and Birge, 2014), and has a higher frequency than available operational measures such as sales and profit that are only reported quarterly. This gives us a sufficient sample size in the chosen horizon for statistical tests. An extension of the standard alpha-beta analysis is performed for each of the stocks to fit the following multiple regression model. The alpha part of this analysis measures a company's long-term stock performance on a risk-adjusted basis. The beta part measures the volatility, or systematic risk, of a company's stock in comparison to the market as a whole. As a key component of the capital asset pricing model, the beta has an impact on the company's valuation since a higher beta implies a higher cost of capital in the form of a discount rate that decreases the present value of the company's future cash flow. The selected MNEs are known to be strict market followers

with their betas (β_1's) all being statistically significant. While the US market as a whole is affected by global economic conditions, we focus on measuring whether the most recent news regarding China's economic slowdown has introduced a statistically significant change to these selected alphas and betas vis-a-vis the market rather than trying to predict short-term price changes. This research is NOT an attempt to guide investors' investment decisions. We make a contribution to the literature by discovering whether the supply chain-based industry sectors as a whole, as represented by the selected large MNEs, are largely affected by the recent deceleration of China's economy by analyzing a whole year of capital market data.

$$R^i = \beta_0^i + \beta_1^i R_m + \beta_2^i I_1 + \beta_3^i I_1 R_m + \varepsilon^i$$

Notation:

R^i — Daily Return of Stock i (adjusted by a risk-free return)

R_m — Daily Return of the Market (adjusted by a risk-free return) as represented by the daily return of the S&P 500 index.

I_1 — Indicator that indicates whether the data point is from a date that is after China official announced its below 7% GDP growth on October 18, 2015, first time since 2009. ($I_1 = 1$ if after October 18, 2015; $I_1 = 0$ otherwise.)

β_0^i — The "alpha" coefficient that measures the stock i's performance compared to the market benchmark.

β_1^i — The "beta" coefficient that measures the systematic risk of the stock i that depends on how related it is with the overall market.

β_2^i — The coefficient that measures how much the binary indicator I_1 is affecting the value of β_0. If β_2 is statistically insignificant, then I_1 has no effect on the return of the stock based off idiosyncratic risk.

β_3^i — The coefficient that measures how much the binary indicator I_1 is affecting the value of β_1. If β_3 is statistically insignificant, then I_1 has no interactive effect on the systematic risk of the stock.

ε^i — Random residuals that measures the idiosyncratic risk of the stock.

The tests of significance for the coefficients $\beta_2^{\ i}$ and $\beta_3^{\ i}$ in the regression analysis are to test the following hypothesis:

H_1: *The official announcement of China's economic slowdown has a significant effect on the selected MNE's perceived value and systematic risk.*

Table 6 lists the β's and their corresponding p-values (PVs) in the regression analyses. We choose to report the PVs because it is of greater interest to find out whether the indicator I_1 has a statistically significant effect on the alphas and betas of the stocks. Table 6 shows that, all of the selected MNEs are market followers - that their stock prices move with the overall market with a significant β_1. However, for the majority of the selected MNEs, there is no evidence that China's slowdown has a significant effect on their risk-adjusted stock performance and systematic risks. There are only a few exceptions. Only a few β_1's are affected by the binary indicator I_1 as the corresponding β_3's are significant. The negative β_3's decrease the corresponding β_1's and show that the stocks have become significantly less risky. This may be attributed to the fact that many MNEs have been more cautious about doing business in China (Chu, 2014) as the world had been concerned about China's potential slowdown for years. In

general, there is no strong evidence to support H_1 and American MNEs that heavily rely on strong supply chains in China are largely unaffected by the official slowdown of the Chinese economy.

TABLE 6. EFFECT OF CHINA'S ECONOMIC SLOWDOWN ON SELECTED STOCK BETAS.

Stock i	WMT	AAPL	GM	GE	F	COST	HPQ	AMZN	PG	HD
$\beta_0{}^i$	-	-	-	-	-	-	-	0.0033	-	0.0011
$\beta_1{}^i$	0.7249	1.1456	1.0320	1.0893	1.0547	0.7626	1.1703	1.1192	0.7615	1.0624
$\beta_2{}^i$	-	-	-	-	-	-	-	-	-	-
$\beta_3{}^i$	-	-	-	-0.4738	-	-	-	-	-	-0.3271
PV for $\beta_0{}^i$	0.0946	0.9650	0.8223	0.0830	0.8545	0.1681	0.2246	0.0041	0.4133	0.0277
PV for $\beta_1{}^i$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PV for $\beta_2{}^i$	0.1304	0.5171	0.7344	0.7488	0.2628	0.6836	0.9984	0.9696	0.0591	0.7226
PV for $\beta_3{}^i$	0.2140	0.6796	0.9646	0.0041	0.6921	0.2819	0.0914	0.8944	0.6517	0.0144
Diagnostic Check 1	Yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Diagnostic Check 2	Yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

TGT	UTX	DOW	LOW	CAT	CSCO	JCI	BBY	HON	HAL	MMM
-	-	-	-	-	-	-	-	-	-	-
0.8118	0.9177	1.3720	0.9448	1.0356	1.0808	1.1793	0.9568	1.0779	1.2993	0.8863
-	-	-	-	-	-	-	-	-	-	-
-0.3990	-	-0.5033	-	-	-	-	-	-	-	-
0.9437	0.2938	0.3709	0.3191	0.2314	0.8615	0.3465	0.6040	0.5359	0.7868	0.7061
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.7348	0.2363	0.5504	0.8168	0.6653	0.4610	0.2735	0.4474	0.2252	0.4804	0.5880
0.0276	0.0568	0.0289	0.4193	0.5179	0.5174	0.3765	0.4374	0.8239	0.4695	0.1924
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Only betas with a PV<0.05 are displayed; insignificant betas are marked with a "-".
Diagnostic Check 1: Same significant terms after stepwise regression.
Diagnostic Check 2: Final regression model passed model adequacy check.

A second set of regression analyses is performed to fit the following multiple regression model:

$$R^i = \beta_0^i + \beta_1^i R_m + \beta_4^i I_2 + \beta_5^i I_3 + \beta_6^i I_2 R_m + \beta_7^i I_3 R_m + \varepsilon^i$$

Notation:

R^i — Daily Return of Stock i (adjusted by a risk-free return)

R_m — Daily Return of the Market (adjusted by a risk-free return) as represented by the daily return of the S&P 500 index.

I_2 — (Pre-Meltdown) Indicator that indicates whether the data point is from a date that is prior to the beginning of the major Chinese stock meltdown on June 12, 2015. ($I_2 = 1$ if before June 12, 2015; $I_2 = 0$ otherwise.)

I_3 — (Post-Meltdown) Indicator that indicates whether the data point is from a date that is after to the end of the major Chinese stock meltdown on August 26, 2015. ($I_3 = 1$ if after August 26, 2015; $I_3 = 0$ otherwise.)

β_0^i — The "alpha" coefficient that measures the stock i's performance compared to the market benchmark.

β_1^i — The "beta" coefficient that measures the systematic risk of the stock i that depends on how related it is with the overall market.

β_4^i — The coefficient that measures how much the binary indicator I_2 is affecting the value of β_0. If β_4 is statistically insignificant, then I_2 has no effect on the return of the stock based off idiosyncratic risk.

β_5^i — The coefficient that measures how much the binary indicator I_3 is affecting the value of β_0. If β_5 is statistically insignificant, then I_3 has no effect on the return of the stock based off idiosyncratic risk.

β_6^i — The coefficient that measures how much the binary indicator I_2 is affecting the value of β_1. If β_6 is statistically insignificant, then I_2 has no interactive effect on the systematic risk of the stock.

β_7^i — The coefficient that measures how much the binary indicator I_3 is affecting the value of β_1. If β_7 is statistically insignificant, then I_3 has no interactive effect on the systematic risk of the stock.

ε^i — Random residuals that measures the idiosyncratic risk of the stock.

The tests of significance for the coefficients β_4^i, β_5^i, β_6^i and β_7^i in the regression analysis are to test the following hypothesis as the capital market volatility in China may be expected to affect Chinese suppliers' capability of accessing capital resources.

H_2: The 2015 China stock meltdown has a significant effect on the selected MNE's perceived value and systematic risk.

Table 7 lists the p-values for the corresponding β's in this set of regression analyses. We choose to do this as a separate set of analyses because the p-values in the regression analysis are dependent of what explanatory variables are included in the modeling and therefore including the previous I_1 and $I_1 R_m$ terms may introduce additional noise for this set of tests.

TABLE 7. EFFECT OF CHINA'S STOCK MELTDOWN ON SELECTED STOCK BETAS.

Stock i	WMT	AAPL	GM	GE	F	COST	HPQ	AMZN	PG	HD
β_0^i	-	-	-	-	-	-	-	0.0033	-0.0011	0.0011
β_1^i	0.7249	1.1456	1.0320	0.9989	1.0547	0.7626	1.1703	1.1192	0.7569	0.8793
β_4^i	-	-	-	-	-	-	-	-	-	-
β_5^i	-	-	-	-	-	-	-	-	0.0020	-
β_6^i	-	-	-	-	-	-	-	-	-	0.4409
β_7^i	-	-	-	-	-	-	-	-	-	-
PV for β_0^i	0.0946	0.9650	0.8223	0.0912	0.8545	0.1681	0.2246	0.0041	0.0475	0.0312
PV for β_1^i	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PV for β_4^i	0.6672	0.1460	0.8898	0.6905	0.8999	0.2648	0.6966	0.8180	0.6998	0.3310
PV for β_5^i	0.7692	0.3312	0.0872	0.0770	0.6287	0.3870	0.6118	0.7597	0.0261	0.9700
PV for β_6^i	0.3535	0.9637	0.2924	0.6141	0.6259	0.9592	0.5638	0.3178	0.2613	0.0002
PV for β_7^i	0.3522	0.4517	0.7453	0.3133	0.9644	0.0764	0.3304	0.8770	0.1503	0.5430
Diagnostic Check 1	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Diagnostic Check 2	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

	TGT	UTX	DOW	LOW	CAT	CSCO	JCI	BBY	HON	HAL	MMM
β_0^i	-	-	-	-	-	-	-	-	-	-	-
β_1^i	0.7356	0.8443	1.2759	0.8513	1.0356	1.0808	1.1793	0.9568	1.0779	1.2993	0.8069
β_4^i	-	-	-	-	-	-	-	-	-	-	-
β_5^i	-	-	-	-	-	-	-	-	-	-	-
β_6^i	-	0.2682	-	0.3416	-	-	-	-	-	-	0.2899
β_7^i	-	-	-	-	-	-	-	-	-	-	-
PV for β_0^i	0.9562	0.2731	0.3827	0.3358	0.2314	0.8615	0.3465	0.6040	0.5359	0.7868	0.6696
PV for β_1^i	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PV for β_4^i	0.5307	0.2233	0.7529	0.4827	0.4958	0.8234	0.0583	0.8471	0.9806	0.2164	0.7601
PV for β_5^i	0.3142	0.3082	0.2246	0.8366	0.7260	0.9829	0.9088	0.3964	0.7966	0.8709	0.4878
PV for β_6^i	0.5658	0.0294	0.5021	0.0114	0.2295	0.3354	0.3191	0.4669	0.9824	0.8801	0.0103
PV for β_7^i	0.0640	0.7197	0.8133	0.3721	0.7940	0.7515	0.4514	0.4955	0.8482	0.5136	0.7754
Diagnostic Check 1	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Diagnostic Check 2	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Only betas with a PV<0.05 are displayed; insignificant betas are marked with a "-".
Diagnostic Check 1: Same significant terms after stepwise regression.
Diagnostic Check 2: Final regression model passed model adequacy check.

Table 7 shows that, for the majority of the selected MNEs, there is no evidence that China's stock market crash in 2015 has a significant effect on their risk-adjusted stock performance and systematic risks with only a few exceptional cases. The fact that the few companies that have a higher systematic risk pre-China meltdown (with positive β_6's) are mainly manufacturers is in line with the financial "bullwhip" effect in supply chains (Osadchiy et al., 2011). Since then the companies have diversified their global supply chain structures to reduce systematic risk (Wu and Birge, 2014).

The third set of analyses fits the following regression model to test the impact of the drop of the Chinese Yuan – US Dollar Exchange Rate.

$$R^i = \beta_0^i + \beta_1^i R_m + \beta_8^i I_4 + \beta_9^i I_4 R_m + \varepsilon^i$$

Notation:

R^i Daily Return of Stock i (adjusted by a risk-free return)

R_m Daily Return of the Market (adjusted by a risk-free return) as represented by the daily return of the S&P 500 index.

I_4 Indicator that indicates whether the data point is from a date that is after China's central bank central bank cut its daily reference rate by 1.9% on August 10, 2015 that triggered the yuan's biggest one-day drop since 1994. ($I_4 = 1$ if after August 10, 2015; $I_4 = 0$ otherwise.)

β_0^i The "alpha" coefficient that measures the stock i's performance compared to the market benchmark.

β_1^i The "beta" coefficient that measures the systematic risk of the stock i that depends on how related it is with the overall market.

β_8^i The coefficient that measures how much the binary indicator I_4 is affecting the value of β_0. If β_8 is statistically insignificant, then I_4 has no effect on the return of the stock based off idiosyncratic risk.

β_9^i The coefficient that measures how much the binary indicator I_4 is affecting the value of β_1. If β_9 is statistically insignificant, then I_4 has no interactive effect on the systematic risk of the stock.

ε^i Random residuals that measures the idiosyncratic risk of the stock.

The tests of significance for the coefficients β_8^i and β_9^i in the regression analysis are to test the following hypothesis as the currency rate changes could affect international trade.

H₃: *The recent China Yuan exchange rate drop has a significant effect on the selected MNE's perceived value and systematic risk.*

Table 8 reports the p-values for the corresponding β's from this set of regression tests and shows that, for the majority of the selected MNEs, there is no evidence that China's currency drop has a significant effect on their risk-adjusted stock performance and systematic risks with only very few exceptions. Contrary to popular belief, in all three sets of analyses, the few companies that display a statistical significance had either an improved market performance or a reduced systematic risk after the negative news regarding China's economy. In general, the US manufacturing and retail sectors as represented by the selected MNEs are not significantly affected by the worst news regarding China's economic slowdown, capital market volatility and currency devaluation.

TABLE 8. EFFECT OF CHINA'S RECENT CURRENCY DROP ON SELECTED STOCK BETAS.

Stock i	WMT	AAPL	GM	GE	F	COST	HPQ	AMZN	PG	HD
$\beta_0{}^i$	-	-	-	-	-	-	-	0.0033	-	0.0011
$\beta_1{}^i$	0.7249	1.1456	1.0320	0.9989	1.0547	0.7626	1.1703	1.1192	0.7623	1.2193
$\beta_8{}^i$	-	-	-	-	-	-	-	-	0.0018	-
$\beta_9{}^i$	-	-	-	-	-	-	-	-	-	-0.3409
PV for $\beta_0{}^i$	0.0946	0.9650	0.8223	0.0830	0.8545	0.1681	0.2246	0.0041	0.4133	0.0277
PV for $\beta_1{}^i$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PV for $\beta_8{}^i$	0.1304	0.5171	0.7344	0.7488	0.2628	0.6836	0.9984	0.9696	0.0591	0.7226
PV for $\beta_9{}^i$	0.2140	0.6796	0.9646	0.0041	0.6921	0.2819	0.0914	0.8944	0.6517	0.0144
Diagnostic Check 1	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Diagnostic Check 2	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
TGT	**UTX**	**DOW**	**LOW**	**CAT**	**CSCO**	**JCI**	**BBY**	**HON**	**HAL**	**MMM**
-	-	-	-	-	-	-	-	-	-	-
0.7356	1.0795	1.2759	0.9448	1.0356	1.0808	1.1793	0.9568	1.0779	1.2993	1.0973
-	-	-	-	-	-	-	-	-	-	-
-	-0.2514	-	-	-	-	-	-	-	-	-0.3280
0.9437	0.2938	0.3709	0.3191	0.2314	0.8615	0.3465	0.6040	0.5359	0.7868	0.7061
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.7348	0.2363	0.5504	0.8168	0.6653	0.4610	0.2735	0.4474	0.2252	0.4804	0.5880
0.0276	0.0568	0.0289	0.4193	0.5179	0.5174	0.3765	0.4374	0.8239	0.4695	0.1924
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Only betas with a PV<0.05 are displayed; insignificant betas are marked with a "-".
Diagnostic Check 1: Same significant terms after stepwise regression.
Diagnostic Check 2: Final regression model passed model adequacy check.

IV. CONCLUSION

Overall, we find no strong tendency towards statistical significance that largely supports H_1, H_2, or H_3 from a capital market's perspective. We conclude that China's economic slowdown, market volatility, and currency devaluation have little or no effect on the perceived values and risks of American MNEs in the manufacturing and retail sectors that heavily rely on a strong supply chain management in China, and did not weaken the supply chain for the US market. The direct economic (as well as financial) exposure of the US to China is going to be somewhat limited since China accounts for less than 10% of total

US exports, according to the US Census Bureau data (2014). In other words, China represents less than 1 percent of the US GDP (US Census Bureau data, 2014) and the US MNEs derive only 2 percent of their net income from China. Additionally, the Chinese government has strived for economic stability as part of its economic policy, well thought out long term reforms, and China's Central Bank is known to maintain a steady pace of currency adjustments to ensure a stable foreign exchange reserve. We conclude that the economic fallout on the U.S. economy from the slowdown in China and downward adjustment in the value of the Chinese currency will be limited. As a result, the profitability outlook for the US MNEs will be intact, especially for the US MNEs' global supply chain management. On the other hand, as China has become more integrated with the Asian economy, it is worthwhile to perform similar analyses on the impact of China's economic change on international supply chains in Asia as a future research topic.

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