

PRIVATE EQUITY REVIEW

GOSS INSTITUTE OF RESEARCH
MANAGEMENT LIMITED

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ACADEMIC INSIGHTS

A Dynamic Mean-Variance Analysis with Application to
Robo-Advising

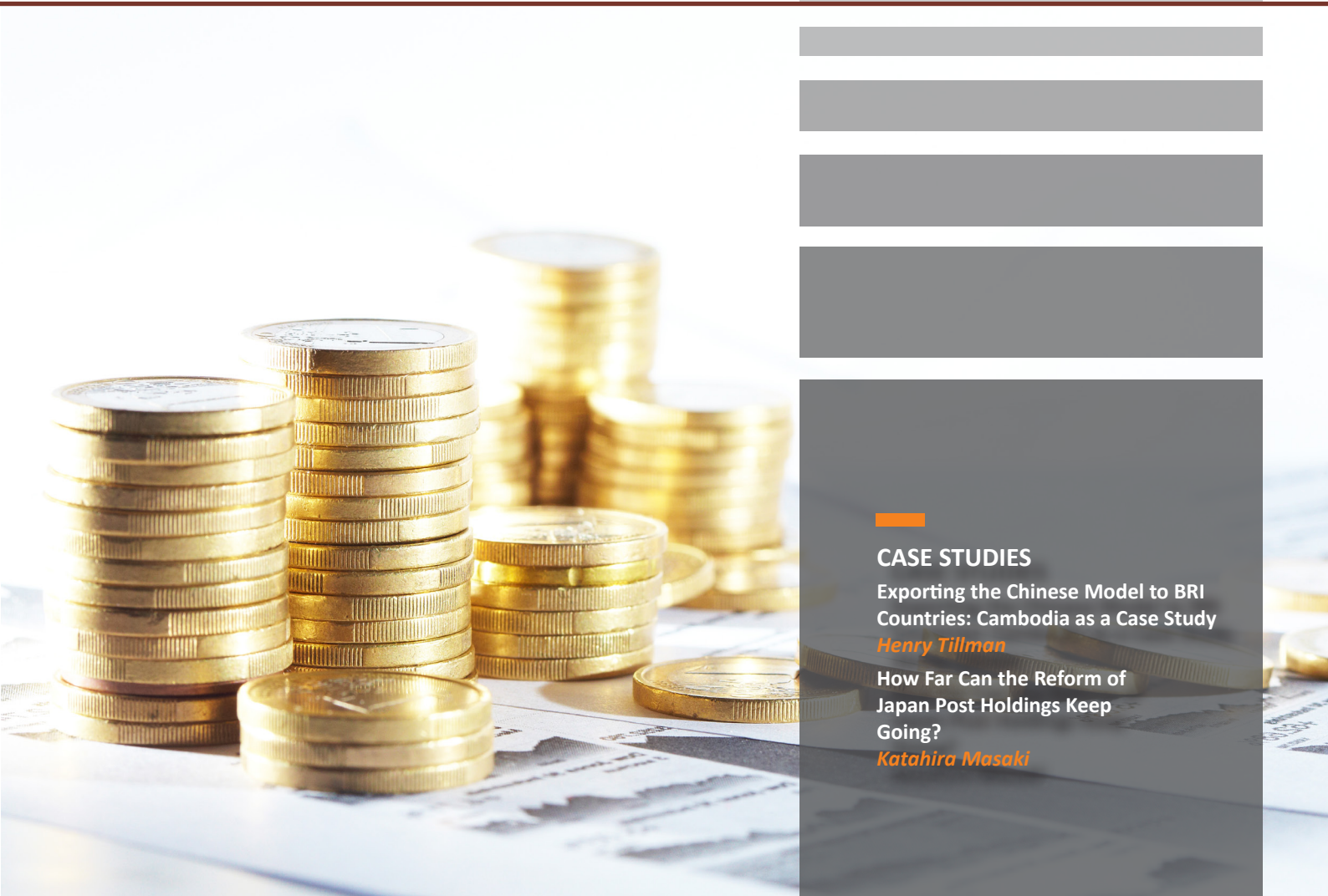
Min Dai, Hanqing Jin, Steven Kou, and Yuhong Xu

Designing Stable Coins

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CURRENT TRENDS IN PRIVATE EQUITY

Dennis Wu and Lily Yang



CASE STUDIES

Exporting the Chinese Model to BRI
Countries: Cambodia as a Case Study

Henry Tillman

How Far Can the Reform of
Japan Post Holdings Keep
Going?

Katahira Masaki

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A MESSAGE FROM THE EDITORS

The cover article of this issue, which is written by Dr. Dennis Wu and Ms. Lily Yang of GOSS Institute of Research Management, discusses the private equity (PE) sector and analyzes current PE trends of record fundraising, mounting dry powder, lack of good projects, and innovative ways of post-investment management and exit strategies.

Following this, academic advancement in the new frontiers of AI and blockchain are also discussed under academic insights. Prof. Min Dai of National University of Singapore (NUS), along with his co-authors, studies a dynamic portfolio choice model with the mean-variance criterion for portfolio log-returns, applied to a robotic financial advising scenario. Inspired by dual-purpose funds popular in the US and China, Prof. Steven Kou of NUS and his co-authors propose a new way to design stable virtual coins, following an approach similar to collateralized debt obligation (CDO) with multiple tranches.

Under the case study section, Mr. Henry Tillman of China Investment Research analyzes infrastructure projects in the Belt and Road Initiative. Contrary to common perception, most of these projects are being completed on time or ahead of schedule, with flexible financing strategies such as loans on a special purpose vehicle instead of on the recipient country's balance sheet and equity investment, some from the private sector.

The second case study of this issue reviews the secondary offering of Japan Post Holdings, the former state-owned group that had announced its IPO in 2015. The stock price performance has been less than bright especially with the acquisition of the loss-making Australian logistics company Toll Holdings. Mr. Katahira Masaki of Eastasia Investment (International) Limited, discusses the concerted effort led by the Japanese government to ensure a successful secondary offering and the dilemma faced by the Japan Post Group regarding the disentanglement of the severe internal transactions among the three group members Japan Post, Japan Post Bank, and Japan Post Insurance.

Finally under the column section, Prof. Jianbo Gao of Guangxi University along with his co-authors, provides an analysis of high-speed rail, demonstrating how big data analysis can be applied to aid the development of large infrastructure projects. Cross-

border investments inevitably come with foreign currency exposure, and Mr. Bob He of Bank of China, provides first-hand advice on how to identify and manage currency risks.

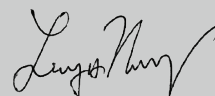
With rich insights and analyses, we hope the articles could help both policy makers and financial investors navigate through the ever-changing landscapes of global investment environments and dynamic international relationships.



Dr. Qianjian Gao
Editor-in-Chief
GOSS Institute of Research Management



Professor Steven Kou
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CURRENT TRENDS IN PRIVATE EQUITY

*Dennis Wu and Lily Yang,
GOSS Institute of Research Management*

EXCELLENT FUNDRAISING AND LARGE DRY POWDER

The private equity industry enjoyed a tremendous year of fundraising in 2017. An accumulated US\$3 trillion of capital had been raised in the past five years; particularly, the year of 2017 had the largest amount of capital (US\$453 billion) raised in any year (Preqin Global, 2018). The funds also raised larger capital in a shorter timeframe, being in the market for shorter than six months for 30% of the funds, and exceeding the fundraising target 2DNet for 79% of them (Preqin Global, 2018). However, with 322 fewer funds managing to close compared to 2016, the average fund size increased from US\$384 million to US\$535 million (Preqin Global, 2018).

HIGH VALUATION AND INEXPENSIVE DEBT

Came with the extraordinary fundraising was dry powder hitting a record high of US\$1.7 trillion in December 2017 (Bain & Company, 2018). The deal valuations have also set new records. Regionally, the average purchase price multiple for European deals rose to an average of 10.6x enterprise value/earnings before interest, tax, depreciation, and amortization (EV/EBITDA) in 2017, higher than the 2008 record of 9.7x1. About half of the companies acquired in 2017 were priced over 11 times EBITDA (Bain & Company, 2018). The average EBITDA purchase price multiple for US leveraged buyout (LBO) transactions also hit a high of 11.2x in Q3 2017 (Bain & Company, 2018).

Under the prolonged low-interest-rate environment, investors look for higher yields in speculative bonds and leveraged loans. The average debt multiple stretched toward six times EBITDA (Bain & Company, 2018). For example, in the US\$4.3 billion acquisition of USI Insurance Services, LLC, the company's leverage ratio was pushed over eight times EBITDA (Bain & Company, 2018). Since 2012 there have been an increasing number of covenant-lite loans that come with fewer borrower restrictions, and they accounted for approximately three quarters of all loan amount in the US and European markets at the end of 2017 (Bain & Company, 2018).

COMPETITION FOR DEALS

Besides over pricing, limited partners (LPs) feel that there is likely to be an imminent market correction in the next 12 months (Preqin Global, 2018). An unclear macroeconomic

outlook along with high valuation multiples and large dry powder contribute to heightened competition for attractive deals. The aggregate value of deals has been increasing but concentrated on fewer larger deals. Venture capital saw seven percent fewer transactions completed in 2017 (11,145) than in 2016, but the value of transactions increased by 28% compared to 2016 to reach an all-time high of US\$182 billion (Preqin Global, 2018). In 2017, the value of global buyout deals increased by 19% to US\$440 billion, but the worldwide deal count grew only two percent to 3,077 deals, lower by 19% from 2014, the post financial crisis peak (Bain & Company, 2018).

In addition, private equity (PE) funds are facing competition from corporate buyers. Global slowdown of economic expansion makes it difficult for many corporates to achieve growth and strategic objectives. Therefore, corporate buyers continue to look for growth via acquisition, which is reflected in the share price: companies that completed more than 11 acquisitions between 2005 and 2015 achieved 39% higher shareholder returns than those with no acquisitions during the same period (Bain & Company, 2018).

Companies enjoy several competitive advantages over PE funds such as a lower cost of capital and better acceptance of premium for synergies or strategic value (Bain & Company, 2018). The percentage of private equity among overall mergers and acquisitions (M&A) activity worldwide declined in 2017 for the fourth consecutive year (Bain & Company, 2018). In recent years, more large corporations have set up corporate venture capital (VC) teams for investment in companies that might carry strategic value. The overall value of corporate VC deals rose drastically in the past several years to US\$51 billion in 2017, and the number of corporate VCs doubled to 262 over the past four years (Bain & Company, 2018).

SLOWING EXITS AND DISTRIBUTIONS

Recent active private equity fundraising has been driven by the positive net distributions to LPs since 2011 (Preqin Global, 2018). Buyout funds' distributions globally have surpassed contributions every year since 2011 with the ratio being around 2-to-1 since 2013 (Bain & Company, 2018). Though positive net distributions remain, the momentum seems to be decreasing, as in H1 2017 LPs

received only US\$66 billion in net distributions compared to US\$149 billion during 2016 (Preqin Global, 2018).

Exits are also slowing down in recent years; there were 1,063 exits in 2017 valued at US\$366 billion, though surpassing 2016's 1,032 exits at US\$337 billion, still lay far below the peak of 1,302 exits at US\$464 billion in 2014 (Bain & Company, 2018). However, the decline after 2015 was not a surprise (Bain & Company, 2018). The peak in exits before 2015 occurred as GPs cashed out investments in companies bought before the 2008 financial crisis (Bain & Company, 2018). By 2017, the dynamic had been restored and over 80% of the exits involved strong companies that had been acquired by PE funds after 2009 (Bain & Company, 2018).

RESPONSE TO THE CHALLENGES

More Efforts and Time

More time and efforts are required for PE firms to create value in their investments (Bain & Company, 2018). Before the financial crisis, the median holding period of portfolio companies in the PE industry was shorter than four years, and 40% all buyout-backed deals were exited in shorter than three years (Bain & Company, 2018). Recently, only 20% of the buyout-backed deals were exited within three years, and the mean holding period has been extended to five years in 2017 (Bain & Company, 2018).

Tax reform also had an impact in the US (Bain & Company, 2018). Under the new regulation, proceeds from investments held for shorter than three years are taxed at the higher rate of ordinary income rather than the lower rate of capital gains (Bain & Company, 2018). Under the old regulation though, the rate changes at one year instead of three (Bain & Company, 2018). In order to achieve optimal exit time and for the best return, an increasing number of GPs are assigning the exit decision from managers who found the deals to separate exit committees for a more objective approach to exit timing (Bain & Company, 2018).

Add-On Deals and Public-to-Private Transactions

Add-on deals and growth investments are two typical ways of mitigating high valuations (Pitchbook, 2018). Add-on transactions refer to acquiring assets to be added on to current portfolio platform companies, which during the last several years are becoming an important PE activity (Bain & Company, 2018). Though add-ons accounted for about one third of the deals ten years ago, they take up half of the total today, e.g., in America add-ons have risen from 56% of buyouts in 2010 to 64% in 2017 (Bain & Company, 2018).

As high private equity price-to-EBITDA multiples catch up with valuations in the public markets, more public companies are considered take-private targets (Bain & Company, 2018). The number of public-to-private transactions in 2017 rose from 2016, and the mean deal size grew significantly (Bain & Company, 2018). As a result, the total buyout value of these conversions

reached US\$180 billion in 2017, almost double the level of the prior year, with megadeals such as the US\$6.8 billion acquisition of Staples by Sycamore and the US\$7.5 billion acquisition of Panera Bread by JAB Holding Company (Bain & Company, 2018).

REGIONAL DEVELOPMENT

Globally, the private equity asset class has been on the rise, accounting for 60% of all private capital raised in 2017, compared to 57% in 2016 (Preqin Global, 2018). In China, thanks to the influx of capital from government funds, state-owned enterprises, insurance assets, and major financial institutions, the paid-in capital of PE and VC funds rose by 2.4 trillion yuan (Fofpower, 2018). On the other hand, the paid-in capital of hedge funds shrank by 480 billion yuan last year, largely affected by the new regulations that came out in July 2016 by the funds association aiming at cleaning up zombie private funds and regulating the overall industry (Fofpower, 2018).

In terms of regional breakdown, North American deal flow dropped to the lowest level since 2010 with 4,303 financings in 2017. Greater China's share of the market rose five years in a row to 24% with 2,633 deals completed in 2017 (Preqin Global, 2018). Europe's market share is largely unchanged but the outlook in Europe seems fairly positive. First of all, the European PE market remains large and less penetrated (Preqin Global, 2018). Specifically, in recent years only 0.2% and 0.3% of total European GDP have been attributed to European PE investments, as compared to more than one percent in the US (Preqin Global, 2018). Even though there is concern over upcoming European Central Bank (ECB) tapering, it is unlikely to hinder Europe's recovery and in 2018 ECB is expected to add more than 300 billion euros to the balance sheet (Preqin Global, 2018).

However, general partners (GPs) are more cautious about the British market. Unlike the Eurozone running a sizeable current account surplus, UK is running a significant current account deficit, making it vulnerable to economic shocks (Preqin Global, 2018). In addition, the UK consumer market seems to be particularly risky as the unsecured consumer credit in the UK has risen by an insupportable 50% in the past five years (Preqin Global, 2018).

In China, after the explosive market growth in 2015 and 2016, primary market funds have basically reached saturation, and the number of newly raised funds along with the amount raised have begun to decline significantly (翠花, 2017). As of 2017, the latest data released by the Asset Management Association of China shows that there are nearly 15,000 domestic equity investment institutions (翠花, 2017). Competition in the industry has become increasingly fierce with higher and higher market saturation (翠花, 2017).

In 2017, the overall market for investment and financing had picked up in China (翠花, 2017). Capital shifted

towards early-stage funding before Series A (翠花, 2017). The number of investment and financing transactions between Pre-A and Series A+ exceeded 4,000, while the market for Series-A to Series-C transactions remained stable, showing that the venture capital market was obviously recovering with growth-stage companies attracting much attention (翠花, 2017). The year of 2017 was also a major year for strategic investment with a total of 504 strategic investment and financing transactions taking place (翠花, 2017).

Although the total number of investment and financing deals in China in the past two years has declined, early-stage investment (VC, Series A, and earlier) and financing transactions have reached new height (翠花, 2017). The average investment and financing amount also reached a record high in 2017, indicating that many enterprises in China have entered a high-growth stage (翠花, 2017). Policy funds bet heavily on business services, healthcare, and manufacturing, instead of sectors such as on-demand economy, catering, tourism, and e-commerce, where there have been quite some failed venture projects of well-known and influential brands (翠花, 2017).

ACTIVE GLOBAL INITIAL PUBLIC OFFERINGS (IPOS)

Even though exits of PE deals had been slowing down, we saw strong global IPO activity in 2017. With 1,624 IPOs raising US\$188.8 billion, 2017 became the most active year of global IPO since 2007 (EY, 2017). Compared with 2016, the deal number and proceeds raised in 2017 went up 49% and 40% respectively. Asia-Pacific is the leading engine for the 2017 global IPO activity, which accounts for more than half (58%) of deals and more than a third (38%) of capital raised globally. Within Asia-Pacific, the Greater China region contributed 36% of global deal numbers. We can also see the number of deals and proceeds raised increasing in other regions including America, Europe, Middle East, India, and Africa last year.

From figures 1 and 2, we see that in 2017, IPO activity had significant growth while M&A activity dropped.

Figure 1:
Number of global IPOs and proceeds (US\$ billion) from 2013 to 2017 | Source: EY

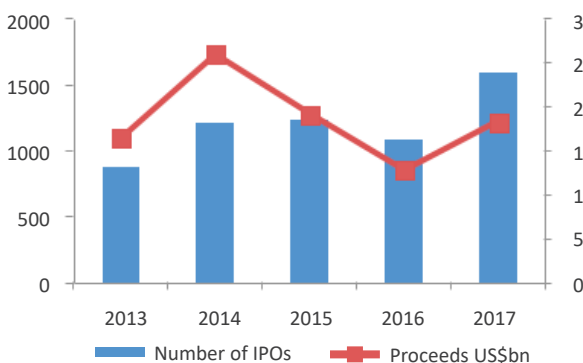
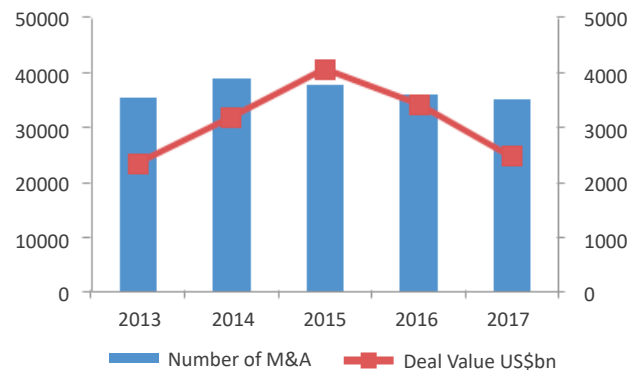


Figure 2:
Number of global M&A and deal value (US\$ billion) from 2013 to 2017 | Source: EY



According to EY, industrials and technology were the most active sectors by deal number while activities in consumer sector IPO slowed in 2017 (EY, 2017). IPOs in financial services led by proceeds, followed by technology and industrials last year.

In 2017, the proportion of cross-border IPOs increased from six percent to seven percent by deal number, and we also saw proceeds increased in cross-border IPOs, compared with 2016.

Mainland China is the top cross-border IPO issuer that had 25 IPOs listed overseas, followed by Singapore, which listed 20 IPOs overseas. Meanwhile, Hong Kong Stock Exchange and NASDAQ became the top two destinations of cross-border IPOs.

Last year, Asia Pacific region lead the 2017 IPO price and performance in all regions, which recorded 37.2% up of first-day average return in IPO and 168.5% up of share price development since IPO. The stock markets in mainland China developed rapidly, given the Shanghai and Shenzhen stock markets reached 130.6% increase in share

Figure 3:
Top 5 cross-border IPO issuers in 2017 (by number of IPOs outside home country)

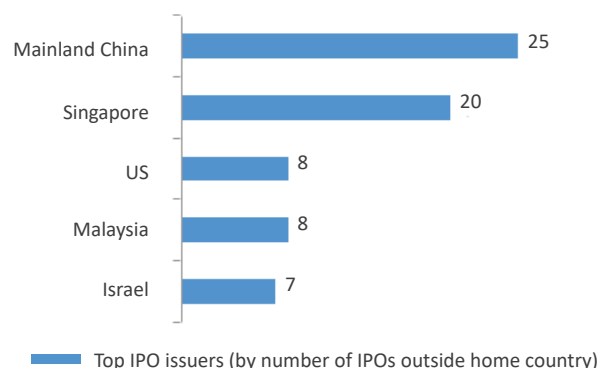


Figure 4:
Top 5 cross-border IPO destinations in 2017
(by number of IPOs)



Table 1:
The 2017 global IPO pricing and performance
by region | Source: EY

		First-day average return	Share price development since IPO
US Markets		+12.4%	+20.2%
Asia Pacific	Main markets	+24.7%	+65.4%
	Junior markets	+37.2%	+168.5%
EMEIA (Europe, Middle East, India and Africa)	Main markets	+4.6%	+13.3%
	Junior markets	+8.0%	+10.8%

Table 2:
The 2017 market volatility by region | Source: EY

	Volatility indices	Index level	Change of rate*/YTD
US Markets	CBOE VIX	11.43	-18.6%
Asia Pacific	Hang Seng Volatility	16.71	-1.1%
EMEIA (Europe, Middle East, India and Africa)	VSTOXX	16.01	-11.6%
	VDAX	16.13	-9.6%
	VFTSE 100	12.23	+5.7%

* Indicate change of rate in volatility as at 1 December 2017 compared to 31 December 2016 for year-to-date (YTD)

price since IPO. Also, there are more than 530 companies waiting to list in mainland China (EY, 2017). With the good performances and returns, the global IPO market was prosperous in 2017.

Regarding the stability in the global stock market, indices in table 2 show that volatility dropped generally, especially in the US markets. Last year, the Hang Seng Volatility index decreased slightly to 16.71, while Asia Pacific markets have been more volatile compared with other regions.

In general, the global IPO market had a remarkable performance with lower volatility and high valuation levels across regions, the outlook for 2018 is bright. Additionally, a renewed appetite for cross-border IPOs appeared, particularly in the US, Hong Kong, and London (EY, 2017). "A healthy global pipeline across a broad range of sectors and markets suggests IPO activity levels will be up and with more megadeals increasing the global proceeds in 2018," said the EY Global and EMEA IPO leader, Dr. Martin Steinbach.

CONCLUSION

Investors are turning to the private equity asset class as is made evident by the record fundraising of 2017. Meanwhile, it is becoming increasingly difficult to find good deals amid this competitive market with emerging corporate buyers. Also, more time and efforts are required to manage the deals after investment and to plan the exits, which have been slowing for PE deals even with the active global IPOs in 2017. However, with Europe's recovery on track and China's focus shifting to early-stage investment as well as policy funds betting on key infrastructure sectors, there are ample opportunities for GPs to grasp and reach fruitful returns. ■

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A DYNAMIC MEAN-VARIANCE ANALYSIS WITH APPLICATION TO ROBO-ADVISING

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Abstract:

In asset allocation for robo-advising, it is desirable to elicit investors' risk profile via several simple online questions and to provide advice consistent with conventional investment wisdom (e.g. rich people should invest more absolute amount of money in risky assets, and for long-term investment people should not short sell major stock indices whose returns are higher than the risk-free rate). We propose a dynamic portfolio choice model with the mean-variance criterion for portfolio log-returns that meets the two challenges. The model yields analytical and time-consistent optimal portfolio policies.

INTRODUCTION

Portfolio optimization has a long history in finance, dating back to celebrated works of single period mean-variance analysis by Markowitz (1952) and continuous-time expected utility maximization by Merton (1971). However, both the expected utility maximization model and the mean-variance model suffer from some disadvantages. For example, the way of estimating investors' risk profile in a utility maximization model is not straightforward, despite that the optimal trading policy of an advanced utility maximization model conforms with conventional investment wisdom. The dynamic mean variance policies in the existing literature, on the contrary, can easily elicit investors' risk profile but either are time inconsistent or have some conflicts with some conventional investment criteria.

In Dai, Jin, Kou, & Xu (2018), we study a dynamic portfolio choice model with mean-variance criterion for portfolio log-returns (hereafter log-MV criterion, for short), instead of with the standard mean-variance criteria for terminal wealth in extant literature. Our model combines the advantages of both Markowitz's and Merton's models. More precisely, our contribution is threefold:

(1) We complement the portfolio theory by proposing a dynamic log-MV criterion. As with Markowitz's single-period model, our model offers a simple

and intuitive way to identify the mean-variance preference parameter that measures the trade-off between mean and variance of portfolio log-returns. In fact, for a complete market with constant market parameters, we obtain an explicit formula to characterize the relation between the expected target annual return and the mean-variance preference parameter. As a result, we can elicit the investors' risk profile by asking investors to input their target annual returns.

(2) By extending Basak and Chabakauri (2010) and Björk, Murgoci, and Zhou (2014), our model leads to an optimal time-consistent mean-variance policy. In a complete market, the policy is the same as the well-known Merton's myopic strategy with constant relative risk aversion (CRRA) preferences. Moreover, our model is tractable even under incomplete market settings, and the resulting trading policy consists of familiar myopic and hedging components, as for CRRA preferences. Hence, our model possesses the merits of Merton's model.

(3) As two applications, we present analytical solutions for the dynamic log-MV model in two special cases, a general Heston's stochastic volatility setting and a Gaussian mean return setting. Using the analytical solutions, we prove that the optimal trading

policies in both settings conform with conventional investment wisdom, such that (i) rich people should invest more dollar amount of money in risky assets; (ii) the longer the investment horizon, the more the proportional amount of money invested in risky assets; and (iii) for long-term investment, people should not short sell major stock indices whose returns are higher than the risk-free rate.

Our model can be applied to the asset allocation part of robo-advising. Due to the very nature of general public, there are at least three distinctive requirements for the asset allocation part of robo-advising, compared to that of traditional financial advising. First, the computer asset allocation system needs to elicit investors' risk profile automatically by asking some simple questions understandable to the general public. Second, the advice provided by the computer system must be time consistent in order to avoid confusing the general public. Third, to convince the general public, the advice provided by the computer system should be in line with conventional investment criteria.

Though simple as they seem, the three requirements pose challenges to existing portfolio theories. The first requirement narrows the search for a desired model to the mean-variance framework. The second requirement rules out the *pre-committed* mean-variance strategies that are time inconsistent. The existing *time-consistent* mean-variance policies violate at least one of the investment criteria listed above. To our best knowledge, our paper is the first one focusing on dynamic portfolio choice models that can accommodate the three requirements simultaneously.

ROBO-ADVISING

In this section, we introduce the background of robo-advising and explain how to incorporate our model to robo-advising.

Background of Robo-Advising

Thanks to the rapid development of computer technology and mobile IT applications, there is a growing trend for major companies to start to build robo-advising systems and attempt to reproduce or beat the results from the traditional financial advising, as part of efforts to serve more customers effectively and to reduce costs.¹ While traditional, person to person, financial advisors aim at

providing tailored and comprehensive (often including tax and estate planning and advising on insurance needs) financial advice to (perhaps mostly rich) investors, robo-advisors attempt to give automatic financial advice in cost efficient ways, targeting thousands of, if not millions of, ordinary investors.² There are some commonalities between traditional financial advisors and robo-advisors. For example, both need some clients' information, such as risk profile, investment horizon, investment amount, educational and retirement needs, estate planning, etc., before providing investment advice.

Although our dynamic mean-variance analysis can be applied to the asset allocation part for both traditional financial advising and robo-advising, our analysis is more suitable for the latter pattern, due to three distinct requirements related to robo-advising. First, a robo-advisor must effectively identify clients' risk profile based on simple inputs of clients. A robo-advisor does not have the luxury like a traditional financial advisor, who can talk to clients personally for an extended period (e.g. one hour) and can ask many questions to engage the clients to extract their risk profile. Furthermore, many times clients of traditional advisors may even have substantial financial knowledge, e.g., the meaning of utility functions. A typical robo-advisor can only ask clients to input answers (via the Internet) to some questions understandable to the general public. In this paper, for robo-advising we propose to ask clients several simple questions such as expected portfolio returns and investment time horizon.

Second, to avoid confusing the general public, the asset allocation advice provided by robo-advisors should be time consistent. In fact, a robo-advising system should contain outputs that may be helpful to educate investors. For example, the outputs may give guidelines of (1) the portfolio strategy across time for a particular investor; (2) the cross-sectional portfolio strategies for investors with different investment horizons at time 0; (3) the changes in the portfolio strategy for a particular investor, should the estimated stock returns vary. For Items (1) and (2) it is very useful to consider time-consistent portfolio strategies, as for these strategies, *ceteris paribus*, Items (1) and (2) will be identical. However, for *pre-committed* mean-variance strategies, the two may not be identical at any time, thus creating potential confusions for the general public. The time-consistent strategies presented in this paper can avoid such confusions.

¹ *Robo-advising first appeared in 2008 (according to Investor's Business Daily, June 27, 2016), and has grown rapidly since then. As estimated by the US News & World Report (October 5, 2017), as of October 2017 robo-advisors had US\$224 billion in assets under management. For example, Vanguard Group and Charles Schwab Corporation had about US\$83 billion and US\$19 billion in assets under management related to robo-advising in September 2017, respectively (Forbes Magazine, September 12, 2017).*

² *We shall not study another related automatic investor service, namely trading stations, which help ordinary investors to design algorithms to trade assets automatically either in low or high frequencies.*



Third, to convince the general public, a robo-advising system needs to provide recommendations that tally with the conventional investment wisdom, as clients can easily change their inputs on the Internet in order to test the effectiveness of the system. For example, suppose that the system suggests 60% of the total money in stocks and 40% in bonds when a client inputs 5 years investment horizon. However, if the client immediately changes the online input of the investment horizon to 15 years and the system adjusts the recommendation to 50% in stocks and 50% in bonds, then the client may lose trust in the system, as the conventional investment wisdom suggests that, to the contrary, people having longer investment horizon should invest more proportion of their wealth in stocks.

Note that under incomplete market settings, as in the stochastic volatility model and in the Gaussian mean return model, the relation between the mean-variance preference parameter and the expected target annual return is not straightforward. For example, in the time-varying Gaussian mean return model, given a mean-variance preference parameter and reasonable market parameter values, the target annual return associated with our optimal strategy is increasing with the market price of risk. Intuitively, this is because investors request a higher target return when the market has an overall good performance. However, assuming that the mean-variance preference parameter in our dynamic mean-variance model is fixed for an individual investor, we are able to identify the parameter through the target annual return in a hypothetical complete market with constant market parameters (namely, the standard geometric Brownian motion model).

A Computer Asset Allocation System Based on Our Model: An Example

For illustration, we assume that the true market consists of one riskfree bond and one stock whose price is governed by a time-varying Gaussian mean-return model. The true market parameter values are assumed to be the same as the first numerical example in Section below. Figure 1 on the next page, illustrates the mechanism of our computer asset allocation system based on our model, which we elaborate below.

Inputs

There will be two sets of inputs needed from a client.

Input 1: An expected portfolio annual return for the system to identify the risk profile.

For this input, a simple question being posted online for the client to answer can be as follows:

Given the historical annual return of the stock index, the volatility, and the risk-free rate are 5.8%, 15%, and 1.7%, respectively, what is your expected targeted annual return in the future?

Note that in the above question the annual return of the stock index is calculated as $\mu_0 = r + \sigma X_0 = 5.8\%$. In the endnote of the investment brochure, we should mention that when asking this question, we are assuming a hypothetical geometric Brownian motion model with $\mu = 5.8\%$, $\sigma = 15\%$, and $r = 1.7\%$ estimated from the historical data.³

The client then inputs his/her target annual return, e.g., $\hat{a} = 3.8\%$. Based on the formula (11) in Dai, Jin, Kou, & Xu (2018), we obtain the client's risk preference $\gamma = 3$, assuming the above hypothetical geometric Brownian motion model. Then the system asks for the second input.

Input 2: The client's investment horizon.

Suppose the client's investment horizon is 20 years ($T = 20$).

Outputs

Based on our result, the system then solves the dynamic portfolio choice model with the log-MV criterion under the Gaussian mean returns setting, using the estimated mean-variance preference parameter $\gamma = 3$, the client's put $T = 20$, as well as those true market parameter values $\rho = -0.93$, $r = 0.017$, $\sigma = 0.15$, $X_t = X^- = 0.273$, $\lambda = 0.27$, and $\nu = 0.065$. Substituting these parameters into equation (24) in Dai, Jin, Kou, & Xu (2018) gives recommendations for asset allocation.

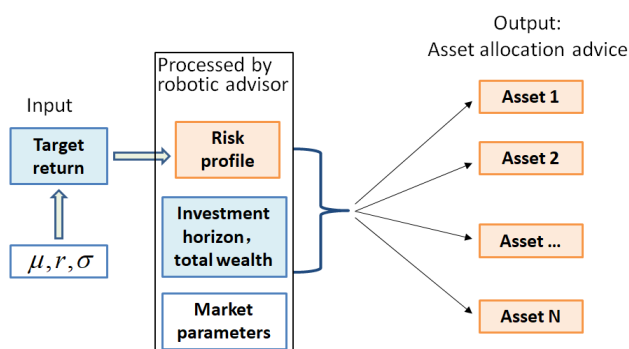
It should be emphasized that asset allocation is only part of financial advising (including both traditional, person to person, advising and robo-advising) as an intermediate step. An asset allocation model focuses on giving a quantitative recommendation of the portfolio weights mainly based on two factors of financial advising, namely the risk profile and the investment horizon of investors. Typically such a model stems from either expected utility maximization or mean variance analysis, motivated by professional trading of fund managers. However, the real life financial advising for individual investors needs more than asset allocation based on just two factors. Indeed, the age, labor income, family conditions, the educational, retirement and insurance needs, and estate planning of an investor all play important roles to design a suitable individual plan for the investor.

Since so many factors affect financial advising, the above computer asset allocation system is only part of a complete robo-advising system. Afterwards, there are several ways that one can proceed further. For example, one may run a statistical fitting algorithm (either linear regression, nonlinear regression, non-parametric regression, or

³ We assume that the investor using our system knows the meaning of the average and the standard deviation, and understands the basic trade-off between risk and return; otherwise, it is perhaps better for the investor to seek advice from a professional financial advisor directly or to buy other financial products such as fixed annuity contracts, rather than using the robo-advising.

Figure 1:

The asset allocation part for robo-advising. The robo-advising system estimates the true market parameters and generates a hypothetical complete market with constant parameters μ , r , and σ . Given the information of the hypothetical market, the users are required to input their target annual return. Then the system elicits the risk aversion level of the users by formula (11) in Dai, Jin, Kou, & Xu (2018) and provides asset allocation advice through equation (24) in Dai, Jin, Kou, & Xu (2018), based on the risk aversion level, the investment horizon and wealth that the users input, and the estimated market parameters.



even machine learning) to combine the output from the asset allocation part with other variables (e.g., age, labor income, family conditions, the educational, retirement and insurance needs, and estate planning) to best match the historical records of traditional financial advising, yielding a way to do robo-advising at a lower cost than that by traditional financial advising. Alternatively, one can treat the output from a statistical fitting algorithm as an expert opinion and the output from the asset allocation part as another one; and then use Bayesian expert systems to combine the two opinions together automatically in a mathematical way. This paper only focuses on the asset allocation part of financial advising. How to combine the output from this paper with other input information in an efficient way is an interesting open problem for future research.

CONCLUSION

Financial advising needs a comprehensive treatment of information submitted by a retail investor. Asset allocation serves as an important intermediate step toward this goal, by focusing on information related to the risk profile and investment time horizon. For robo-advising, there are three distinctive requirements, due to the very natural of general clients. First, a robo-advisor must effectively identify clients' risk profile based on simple inputs of clients. Second, to avoid confusing the general public, a robo-advisor must provide time-consistent advice. Third, to convince clients, a robo-advising system needs to provide recommendations that are consistent with the conventional investment wisdom, such that (1) rich people should invest more dollar amount in risky assets; (2) the

longer the investment horizon, the more proportional amount of money should be invested in risky assets; (3) for long-term investment, people should not short sell major stock indices, whose returns are higher than the risk-free rate. These three requirements pose challenges to existing portfolio theories.

To accommodate the three requirements simultaneously, we propose a dynamic portfolio choice model with the mean-variance criterion for portfolio log-returns that is tailored to the asset allocation part of robo-advising. First, the model can elicit the risk profile by asking investors to input their desired expected returns. Second, the asset allocation policy derived from the portfolio model is time-consistent. Third, we prove that the asset allocation policy satisfies the investment criteria from the conventional wisdom mentioned above.

Moreover, the optimal policy is obtained analytically even in some incomplete markets. Further, our baseline analysis can be easily extended to alternative economic environments, including portfolio constraints and multiple stocks. ■

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DESIGNING STABLE COINS

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Abstract:

Stable coins, which are cryptocurrencies pegged to other stable financial assets such as US dollar, are desirable for payments within blockchain networks, whereby being often called the “Holy Grail of cryptocurrency.” However, existing cryptocurrencies are too volatile for these purposes. By using the option pricing theory, we design several dual-class structures that offer fixed income stable coins (class A and A’ coins) pegged to a traditional currency as well as leveraged investment instruments (class B and B’ coins). When combined with insurance from a government, the design can also serve as a basis for issuing a sovereign cryptocurrency.

INTRODUCTION

How to create a digital currency was a long-standing open problem for many years, due to two main challenges: First, as people can easily copy music and movie files, how to prevent people from copying digital currency token electronically? Secondly, how to avoid the double spending problem in which a single digital currency token can be spent more than once to settle liabilities. A revolution in FinTech was that the two problems can be solved by using blockchains.

A blockchain is a decentralized (peer to peer) and distributed network that is used to record, after miners’ verification, all transactions which can be viewed by every users, thus allowing people to verify and audit transactions in a transparent and inexpensive way. The records cannot be easily altered retroactively.¹ Furthermore, a blockchain confirms with very high probability that each unit of value was transferred only once, solving the double spending problem without a trusted authority. The first blockchain was conceptualized in Nakamoto (2008), and was implemented in 2009 as the core component of the first cryptocurrency, Bitcoin.

Another breakthrough came in late 2013 when Vitalik Buterin extends the idea of Bitcoin to create the Ethereum

platform on which people can write smart contracts. This is a very important technology advance, as many types of clerk works, such as public notary, import and export paper works, certain legal and accounting documentations, can be programmed as smart contracts which can be tracked and executed automatically on the Ethereum platform. The cryptocurrency generated and circulated on the Ethereum platform is Ether (with the trading symbol ETH).

Currently, there are over 1000 cryptocurrencies traded in exchanges; see, e.g, the list on coinmarketcap.com. Some of them are based on public blockchains, such as Bitcoin and Ether, and others on private blockchains, such as Ripple. In fact, one can buy cryptocurrencies from online exchanges or at ATM machines worldwide, just like buying standard financial securities or foreign currencies. All cryptocurrencies share three important features. First, a payment from one user to another is processed in a



¹ In fact, any alteration of the records will trigger the alteration of all subsequent blocks, and unless there is a collusion of majority users of the network, it is impossible to change the records.

decentralized way without any intermediary. Second, all transaction records are stored in the networks and can be viewed by every user. Third, they allow anonymous payments.

Cao, Dai, Kou, Li, and Yang (2018) attempts to design stable coins, which are cryptocurrencies pegged to other stable financial assets such as US dollars, by using concepts from the option pricing theory. Stable coins are desirable to be used as public accounting ledgers for payment transactions within blockchain networks, and as crypto money market accounts for asset allocation involving cryptocurrencies.

Stable Coins

One major characteristic (or drawback) of cryptocurrencies is their extreme volatility. Figure 1 illustrates the price of Ether in US dollars, ETH/USD, from October 1, 2017 to February 28, 2018. During this period, ETH/USD has an annualized return volatility of 120%, which is more than nine times that of S&P 500 during the same period (13%).

The extremely large volatility means that a cryptocurrency like ETH cannot be used as a reliable means to store value. It is risky to hold the currency even for a single day due to this fluctuation. Even if retailers accept the cryptocurrency for payments, they may have to exchange it immediately into traditional currencies to avoid risk.

A stable coin is a crypto coin that keeps stable market value against a specific index or asset, most noticeably US dollar. Stable coins are desirable for at least three reasons:

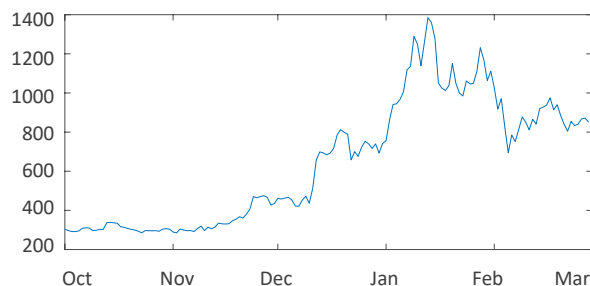
- They can be used within blockchain systems to settle payments. For example, lawyer or accountants can exchange their stable coins generated by smart contracts automatically for the services they provide within the system, without being bothered by the exchange fees from a cryptocurrency to US dollar, which can range from 0.7% to 5%.
- They can be used to form crypto money market accounts, for the purpose of doing asset allocation for hundreds cryptocurrencies.
- They can be used by miners or other people who provide essential services to maintain blockchain systems to store values, as it may be difficult and expensive for them to convert mined coins into traditional currencies.

However, as we can see, existing cryptocurrencies are too volatile to be served as stable coins.

In fact, how to create a good stable coin is called the “Holy Grail of Cryptocurrency” in the media (Forbes, March 12, 2018, Sydney Morning Herald, Feb 22, 2018, Yahoo Finance, Oct 14, 2017)

There are four existing types of issuance of stable coins. The first type is an issuance backed by accounts in real

Figure 1:
ETH/USD Price from 1 Oct 2017 to 28 Feb 2018



assets such as US dollars, gold, oil, etc. More precisely, these stable coins represent claims on the underlying assets. For example, Tether coin is claimed to be backed by USD, with the conversion rate 1 Tether to 1 USD (see Tether (2016)). However, it is very difficult to verify the claim that Tether has enough reserve in US dollar, especially on a daily basis.² There are other tokens claimed to link to gold (e.g. Digix, GoldMint, Royal Mint Gold, OzCoinGold, and ONEGRAM), although the claims are also hard to verify. Recently in February 2018, the government of Venezuela issued Petro, a cryptocurrency claimed to be backed by one barrel of oil.

The second type is the seigniorage shares system, which has automatic adjustment of the quantity of coin supply: When the coin price is too high, new coins are issued; when the coin price is too low, bonds are issued to remove tokens from circulation. A typical example of this type is Basecoin (see Al-Naji (2018)). However, the difficulty of maintaining the right balance of supply and demand of a stable coin is at the same level of difficulty faced by a central bank issuing fiat currency.

The third type is an issuance backed by over-collateralized cryptocurrencies with automatic exogenous liquidation. For example, one can generate US\$100 worth of stable coins by depositing US\$150 worth of Ether. The collateral will be sold automatically by a smart contract, if the Ether price reaches US\$110. One can also combine the idea of over-collateralization and seigniorage by issuing more coins if the coin price is too high, and allow people to borrow the coin, which gives borrower to buy back the coin if the coin price is too low, thus pushing the price higher. Examples of this type include the DAI token issued by MakerDAO; see MakerTeam (2017). A drawback of this type is the relative large collateral size.

The last type is government-backed stable coins. Besides Venezuela, other countries are considering issuing cryptocurrencies, including Russia and China. Canadian government also did Project Jasper involving the “CAD-coin”, in which a Blockchain network is built for domestic

² In fact, US regulators issued a subpoena to Tether on December 6, 2017, on whether US\$2.3 billion of the tokens outstanding are backed by US dollars held in reserve (Bloomberg news, January 31, 2018).

interbank payment settlements. There is a virtual currency working group under the Federal Reserve System in US, which uses the “Fedcoin” internally. As commented by Garratt (2016), “The goal is to create a stable (less price volatility) and dependable cryptocurrency that delivers the practical advantages of Bitcoin even if this means involving the central government and abandoning the Libertarian principles that many believe underlay Bitcoin’s creation.”

There are several advantages of issuing stable coins by governments. They are cheaper to produce than the cash in bills or coins, and they are never worn out. They can be tracked and taxed automatically by the blockchain technology. They can facilitate statistical works, such as GDP calculation and collecting consumer data. Furthermore, they can simplify legal money transfers inside and outside blockchains. Finally, as pointed out by Bech and Garratt (2017), the main benefit of a retail central bank backed cryptocurrency is that it would have the potential to provide the anonymity of cash. The first countries that adopt stable coins will likely see the inflow of money from people who want stable currencies on blockchains.

However, a main drawback of issuing stable coins purely by governments is the cost. More precisely, does a government have enough expertise in maintaining a computer system, is a government willing to put enough reserve to back up a stable coin fully, and how does a government control supply and demand of a stable coin in a global anonymous blockchain network (which can be quite different from a fiat currency network)?

THE MAIN DESIGN

We use the option pricing theory to design several dual-class structures that offer entitlements to fixed income stable coins (Class A coins) pegged to a traditional currency as well as leveraged investment opportunities (Class B coins). The design is inspired by the dual-purpose funds popular in the US and China. More precisely, due to downward resets, a vanilla A coin behaves like a bond with the collateral amount being reset automatically. To reduce volatility, the vanilla A coin can be further split into additional coins, A’ and B’. Unlike traditional currencies, these new class A coins record all transactions on a blockchain without centralized counterparties.

We show that the proposed stable coins have very low volatility; indeed the volatility of class A’ coin is so low that it is essentially pegged to the US dollar. Table 1

reports the volatility of ETH, S&P 500 index, Gold price, US Dollar index, class A and A’ coins, respectively.

The design of stable coins can be used alone in most cases, except in the case of Black Swan events, when the underlying cryptocurrency suddenly drops close to zero within an extremely short time period.³ Therefore, to be truly stable, stable coins need a guarantee in Black Swan events.

A policy implication of this paper is that a public-private partnership may be formed to issue stable coins backed by a government. More precisely, by designing a set of stable coins using the option pricing theory via private market forces, the government only needs to back up the stable coins in extreme cases of Black swan events, just like what the US government does for the FDIC insurance for private money market accounts in US.

Although our design of stable coins is inspired by dual-purpose funds, it is different from dual-purpose funds in US and China in the aspects shown in Panel A of Table 2, on the following page. These differences require a different modeling, which is summarized in Panel B of Table 2.

There are many papers and media articles discussed pros and cons of cryptocurrencies. Using cryptocurrencies as a payment method has several benefits. First, as pointed out in Harvey (2016), the core innovation of cryptocurrencies like Bitcoin is the ability to publicly verify ownership, instantly transfer the ownership, and to do that without any trusted intermediary. Therefore, cryptocurrencies reduce the cost of transferring ownership. Also, the blockchain technology makes the ledger easy to maintain, reduces the cost of networking (see Catalini and Gans (2016)), and is robust against attackers. The distributed ledger can result in a fast settlement that reduces counterparty risk and improves market quality (see Khapko and Zoican (2018)). Furthermore, since the transaction is recorded to the blockchain anonymously, cryptocurrencies help to protect the privacy of their users. The underlying technology of cryptocurrencies may one day strengthen the menu of electronic payments options, while the use of paper currency is phased out (see Rogoff (2015)).

³ The intuition here is similar to that of the risk of the top tranche of a CDO contract. If the correlations of all firms covered within the CDO are close to 1, then one firm’s default leads to almost all other firms’ default, resulting in a significant drop of the top tranche value.

Table 1:
Annualized Volatility of Our Stable Coins versus Common Market Indices

Index	ETH	S&P 500	Gold	US\$ Index	Class A Coin	Class A’ Coin
Volatility	120.49%	13.15%	9.44%	5.76%	2.37%	0.87%

Annualized volatility is calculated from 1 Oct 2017 to 28 Feb 2018

There are also some criticisms of cryptocurrencies. First, a payment system with cryptocurrencies lacks a key feature, the confidence that one can get his money back if he is not satisfied with the goods he purchased. As pointed out in Grinberg (2011), Bitcoin is unlikely to play an important role in the traditional e-commerce market, since consumers typically do not care about the anonymity that Bitcoin provides; instead, they prefer a currency they are familiar with for most goods and services, and they want fraud protection. Second, unlike government-backed systems, Bitcoin does not have identity verification, audit standards, or an investigation system in case something bad happens. For instance, one may lose all his deposit in cryptocurrencies should his password get stolen, and there is no remedy. Furthermore, Blockchain systems are not as trustworthy as they seem to be. Without an intermediate, individuals are responsible for their own security precautions. Finally, it is difficult to value cryptocurrencies like Bitcoin.

Here we want to point out that despite significant drawbacks of cryptocurrencies, it is generally agreed that the blockchain technologies are here to stay. However, blockchain technologies automatically generate cryptocurrencies for the purpose of charging the services provided by the system (such as fees incurred by all programming codes which are run on the Ethereum

network), crediting essential services to the system (such as the verification services provided by miners), and of exchanging credits for services. Therefore, cryptocurrencies will not disappear as long as blockchain technologies exist. Thus, designing suitable stable coins is essential for the blockchain system to perform financial functions efficiently and for doing asset allocation across different cryptocurrencies generated by different blockchain systems. In this regard, governments can provide an essential role in helping design a better financial ecosystem of blockchains.

NUMERICAL EXAMPLES

For illustration, we use Ethereum (ETH) as the underlying cryptocurrency, during the period from 1 Oct 2017 to 28 Feb 2018.⁴ We further assume that the price is monitored on a daily basis, and the upward and downward resets are performed according to the end-of-day prices.

The default model parameters are given as follows.

$$\begin{aligned}
 R &= 0.02\% \text{ (7.3\% p.a.)} \\
 R' &= 0.0082\% \text{ (3\% p.a.)} \\
 H_u &= 2 \\
 H_d &= 0.25 \\
 r &= 0.0082\% \text{ (3\% p.a.)} \\
 \sigma &= 0.0628 \text{ (120\% p.a.)} \\
 T &= 100.
 \end{aligned}$$

Market Values of Class A and Class B

We first compute the market values of Class A and Class B coins, based on the geometric Brownian motion

⁴ The dual class structure of the stable coin is independent of the choice of underlying cryptocurrency; however, the liquidity and popularity of the underlying price pair do impact the viability of the structure as market arbitrage is important to ensure the structure trades as designed. In this paper, ETH/USD is used as the underlying price pair, but other popular ERC20 tokens, such as EOS, ADA, paired with major fiat other than USD, can also be considered.

Table 2:
Contract and Model Comparison of Our Stable Coins and Dual-Purpose Fund in US and China

Panel A: Contract Comparison					
	Payment Style of A Share	Payment Style of B Share	Reset Barriers	Lifespan	Underlying Asset
Dual-Purpose Fund in US	Dividend	Single payment at wind-up date	No	Finite	Stock/ Stock Index
Dual-Purpose Fund in China	Fixed Income	Payments affect the underlying asset but not the exchange ratio	Yes	Infinite	Stock Index
Our Vanilla A and B Coins	Fixed Income	Payments affect the exchange ratio but not the underlying asset	Yes	Infinite	USD denominated cryptocurrency

Panel B: Model Comparison	
	Pricing Model
Dual-Purpose Fund in US (Ingersoll (1976) Jarrow and O’Hara (1989))	Black-Scholes PDE
Dual-Purpose Fund in China (Dai, Kou, Yang, and Ye (2018))	Periodic PDE, constant upper barrier
Our Vanilla A and B Coins	Periodic PDE, time-dependent upper barrier

The dual-purpose funds in US include those studied in Ingersoll (1976) and the prime and scores studied in Jarrow and O’Hara (1989).

assumption and on the historical prices of ETH. Figure 2 shows that, although Class A has a fixed coupon rate, and its coupon payment is periodic and protected by the resets, its value is still volatile on non-coupon dates. This should be compared to the behavior of a junk bond, whose value is influenced by its issuer’s credit risk. In contrast, the main risk of Class A is not credit risk, but the risk of a downward reset. On a downward reset, a portion of Class A coins will be liquidated, so the investor will lose the value of future coupons that would be generated from this portion. Therefore, an approaching downward reset will pull down the value of Class A. This is illustrated in Figure 2 at the end of January: as the downward reset approaches, the value of Class A also goes down, especially when the model underestimates the ETH volatility (by setting $\sigma = 0.0262$ per day (annualized 0.5)).

Figure 3 shows the simulated paths from Class B coins. Note that Class B has upward resets (on 24 Nov 2017, 17 Dec 2017, and 7 Jan 2018) with dividend payments US\$1.0846, US\$1.0467, and US\$1.1106 and downward resets on (7 Jan 2018).

Market Value of Class A’ and B’

We can see from Figure 4 that the market value of Class A’ coins is very stable during our sample period, with a value close to 1, except for four downward jumps. These downward jumps correspond to the coupon payment of Class A’ on the reset dates of Class A. If we de-trend the value of Class A’ by its net asset value and consider $W_{A'} - V_{A'}$, it has an annualized standard deviation of 5.4×10^{-5} , which is much smaller than that of $W_A - V_A$ (0.0178). Even without de-trending, Class A’ has an annualized return volatility of 0.87%, which is comparable to that of the short term US treasury bill, 0.96% (912828K2 Govt, from April 2015 to February 2018).

Black Swan Events

Assume that at time η , an extreme event happens, and there is a 80% sudden drop in the ETH price. Assuming $\beta_{\eta} = 1$, $P_{\eta} = P_0 = 500$ (so that the relative price $S_{\eta} = 1$), and P suddenly drops to $P_{\eta} = 100$. Then the net asset value of Class A coins $V_A^{\eta} = 2S_{\eta} \cdot (1 - 80\%) = 0.4$, while the net asset value of Class A’ coins is $V_{A'}^{\eta} = 2 \cdot V_A^{\eta} = 0.8$. A downward reset is triggered, Class A and Class A’ are fully liquidated, and they receive \$0.4 and \$0.8 payout, respectively. Therefore, when a sudden drop in ETH price occurs, although both Class A and A’ take a loss, A’ still recovers a larger value than A.

Now we assume that this kind of downward jump occurs in a jump diffusion model. Specifically, $dP_v/P_t = rdt + \sigma dB_t + dJ_v$ where J is a compound Poisson process with constant intensity 0.2 (per 100 days) and constant jump size -80%. Using simulation, we have at time 0, $W_A(0, 1) = 0.888$ and $W_{A'}(0, 1) = 0.962$; in contrast, if there is no jump risk (intensity equals 0), $W_A(0, 1) = 1.013$, $W_{A'}(0, 1) = 1.000$. Therefore, the presence of extreme jump risk has a smaller impact on Class A’ coins.

Figure 2: Simulated class A Market Value. $\sigma = 0.0628$ for the blue solid curve, $\sigma = 0.0262$ for the red dashed curve. Parameters: $R = 0.02\%$, $H_d = 0.25$, $H_u = 2$, $T = 100$, $r = 0.0082\%$ per day (3% per year). Upward reset takes place on 24 Nov 2017, 17 Dec 2017, and 7 Jan 2018. Downward reset takes place on 5 Feb 2018.

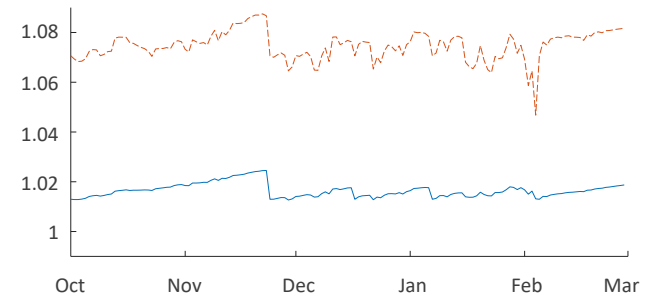


Figure 3: Class B Market Value. $\sigma = 0.0628$ for the blue solid curve, $\sigma = 0.0262$ for the red dashed curve. Parameters: $R = 0.02\%$, $H_d = 0.25$, $H_u = 2$, $T = 100$, $r = 0.0082\%$ per day (3% per year). Upward reset takes place on 24 Nov 2017, 17 Dec 2017, and 7 Jan 2018. Downward reset takes place on 5 Feb 2018.

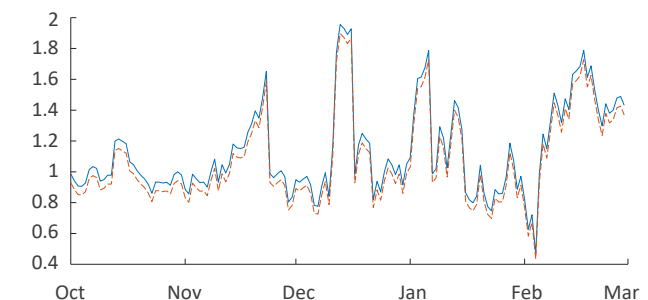
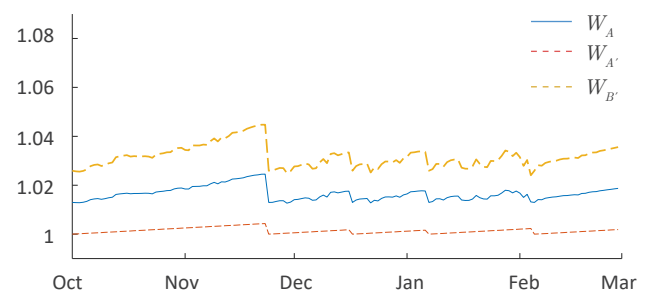


Figure 4: Market Value of Class A’ (red) and B’ (yellow), compared with Class A (blue). Annualized volatility of Class A’ and B’ are 0.0087 and 0.0403, respectively. Parameters: $R = 0.02\%$ per day, $H_d = 0.25$, $H_u = 2$, $R' = 0.0082\%$ (3% per year), $T = 100$, $\sigma = 120\%$ per year, $r = 0.0082\%$ per day. Upward reset takes place on 24 Nov 2017, 17 Dec 2017, and 7 Jan 2018. Downward reset takes place on 5 Feb 2018.



CONCLUSION

Stable coins, which are cryptocurrencies pegged to other stable financial assets, are desirable for blockchain networks to be used as public accounting ledgers for payment transactions and as crypto money market accounts for asset allocation involving cryptocurrencies, whereby being often called the “Holy Grail of cryptocurrency.” However, existing cryptocurrencies, such as Bitcoins, are too volatile for these purposes. By using option pricing theory, this paper designs, for the first time to our best knowledge, several dual-class structures that offer entitlements to either fixed income stable coins (class A funds) pegged to a traditional currency or leveraged investment opportunities (class B funds). The design is inspired by the dual-purpose funds popular in the US and China. Unlike traditional currencies, the new class A funds record all transactions on a blockchain without centralized counterparties. By using the option pricing theory, we show that the proposed stable coins indeed have very low volatility. Indeed, the class A coin has a volatility comparable to that of the exchange rate of world currencies against US dollar, and the class A’ coin essentially is pegged to US dollar. When combined with insurance from a government, the design can also serve as a basis for issuing a sovereign cryptocurrency. ■

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EXPORTING THE CHINESE MODEL TO BRI COUNTRIES: CAMBODIA AS A CASE STUDY

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EXECUTIVE SUMMARY

This paper examines how China and Cambodia, a key Southeast Asian Belt and Road Initiative (BRI) country, have collaborated in an almost textbook fashion to implement a small scale version of the Chinese economic growth model. Within a decade, Cambodia now has sufficient energy to support an already growing economy as well as sufficient infrastructure to begin to attract corporate investments, initially from China and then across a number of other countries and sectors.

This paper initially analyses 16 of the Phase 1 projects (defined below) including six renewable energy projects and 10 infrastructure projects, during the period of 2011-2017, all funded by Chinese partners. We then analyse the Chinese Government related funding used in these projects through which we conclude that Cambodia's debt to GDP increased from circa 28% in 2008 to circa 35% in 2015, via a carefully managed mixture of good to go (G2G) loans and grants, Mekong Delta regional fund pledges, policy bank loans and Chinese corporate investments.

The combination of efficiently managed Chinese infrastructure spend to further lift an economy already ranked 6th globally in average growth and possessing a stable government has produced an even more attractive environment for corporate investors across countries and industries. Foreign direct investment (FDI) increased by 25% during 2016; momentum which continued into

2017. While China has represented the lead FDI investor (we analyse Chinese corporate investments by sector and by specific investments over US\$1 billion) there has also been increased investment from major corporates based in Japan, Korea, Hong Kong, Singapore and France.

Predictably, this recent surge in FDI has now moved beyond (Cambodia's garment) manufacturing, but into construction and real estate (which has led to credit expansion), consumer and tourism, sectors which can meet private equity return thresholds.

Our analysis is disaggregated into two phases:

PHASE 1 – ENERGY, INFRASTRUCTURE

1. Starts with sufficient energy to power the country, with some percent of renewable energy
2. Portable water
3. Infrastructure (roads, bridges, rail, ports and logistics)

All of which needed and to be built and funded (ideally) without harming the country's balance sheet.

PHASE 2 – COMMERCIAL EQUITY INVESTMENTS

- Once infrastructure is sufficiently operational, the initial sector investment play is real estate
- Followed by manufacturing increases (garment industry in Cambodia)
- Special Economic Zones (SEZ) are added to help fuel small and medium enterprise (SME) growth
- Leading to increases in the consumer segment
- GDP growth also powered by increase
- cxs in FDI, not just by Chinese companies but across a number of countries and industries

ENERGY COMPONENT

In the early 2000s, Cambodia had total electric power capacity of 790 MWs, of which Cambodia bought 196 MW from Vietnam, 95 MW from Thailand and 2 MW from Laos. Less than 50% of Cambodian households had access to reliable electricity and electricity demand had been increasing each year. Cambodia then signed 12 agreements on the development of electricity with total generation capacity of 2,123 MWs with China. By 2016, the 928 MW annually generated from the six operational



hydroelectric plants set out below, five of which were 100% funded by China, currently represents about 47% of available electricity in Cambodia.

INFRASTRUCTURE COMPONENT

Table 2, on the following page, sets out a number of Cambodian infrastructure projects built by and funded by China during the years 2012-2017. The table also sets out the type of financing deployed for each project. Total Chinese financing allocated to Cambodia for such projects was US\$6.7 billion, although US\$2.3 billion was our calculation of Cambodia's allocation for Mekong Basin countries. As seen, uses of the funds were varied across a number of infrastructure projects.

In July 2017, with only 40% of the country's roads being tarmacked, the Cambodian Government said that construction and improvement of about 910 km of national and provincial roads are under way with financial aid from China, Japan, South Korea and the Asian Development Bank. Infrastructure remains particularly bad in rural areas. According to the country's transport secretary, the priority for the government's infrastructure development program would be roads, bridges, railways, ports and airports.

CHINESE GOVERNMENT RELATED FUNDING

The initial two sections of this analysis elaborate Chinese involved energy and infrastructure projects during this period (only), including:

- 6 hydroelectric power plants (most completed on or ahead of schedule)
- 7 national roads (including numerous bridges)
- 1 oil refinery (1st ever in Cambodia)
- 1 port (funding for 1st phase)
- 1 suburb of Phnom Penh (see below)

All were funded by the following sources:

- US\$1 billion actual Government Loans
- US\$0.6 billion actual Government Grants
- US\$4.3 billion Government Pledges (including pro rata portion of the Mekong Delta US\$11.5 billion fund)
- US\$2.7 billion Policy Bank loans
- US\$2.4 billion corporate investments

Such finance packaging is important as Cambodia's debt to GDP rose only from 27.8% in 2008 to circa 35% in 2015 via the mixing of the components of the packages. While

Table 1:
Chinese Investments in Cambodia Hydroelectric Power (2011-2017)

Project/Description	Size/Metrics			Dates		On Time
	Power (MW)	Amount (\$m)	Debt/Equity (%)	Start	Operational	Y/N
(1) Kamchai Dam	193	280	100%/0%	2007	2011	Y
(2) Kirirom III Hydro Power Plant	30	47	0%/100%	2010	2013	Y
(3) (Stung) Atay River Hydro Power Plant	120	558	0%/100%	2008	2014	N
(4) Russei Chrum Krom River Hydroelectric Dam	338	493	0%/100%	2010	2015	Y
(5) Tatay River Hydro Power Plant	248	540	100%/0%	2010	2015	Y
(6) Lower Se San II Dam	400	781	70%/30%	2014	2018	N
Total	1,329	2,699				

Footnotes:

- 1) In December 2011, the hydropower facility constructed by Sinohydro Corporation for a cost of US\$280 million under a 44-year BOT contract became operational. Under terms of the agreement, Sinohydro will sell power to the Electricity of Cambodia. Loan was provided by The Export-Import Bank of China (CEXIM).
- 2) In February 2013, the Kirirom III Hydro Power Plant was inaugurated. It has a capacity of 18 megawatts and can produce 78 million KWH/year. State Grid Corporation of China invested and was responsible for building the plant, which cost US\$47.1 million. Electricity from the plant will be sold to Electricity of Cambodia (Kirirom 1 producing 12 MW, became operational in 2002). Tariff: US\$0.0791/KWH.
- 3) In March 2014, the (Stung) Atay River 120 MW hydropower dam was inaugurated. Construction was started in 2008 and was to have been completed in May 2013, but there was an incident (accident) in late 2012. The US\$255 million project was undertaken by China Datang Corporation under a 34-year BOT arrangement.
- 4) In January 2015, the 338-MW Russei Chrum Krom hydropower plant was inaugurated. The US\$500 million plant, located in western part of Koh Kong province, is Cambodia's largest hydroelectric project, and was developed by China Huadian Corp. under a 35-year BOT contract. The power generated by Russei Chrum Krom will be sold to Electricity of Cambodia. Tariff: US\$0.0735/KWH, generates US\$12.5 million/yr in tax.
- 5) In December 2015, the US\$540 million 246 MW Tatay River hydropower plant, located across the Tatay River in Koh Kong Province, about 300 km to the west of Phnom Penh., was inaugurated. The Tatay project was constructed under a BOT contract by China National Heavy Machinery Corp (CNMC) and Cambodian Tatay Hydropower Ltd. Electricity generated from the dam sold to Electricity of Cambodia. CEXIM provided a US\$540 million loan to Cambodia for the construction. Tariff: US\$ 0.0745/KWH, generates US\$12 million/yr tax.
- 6) In progress (2017) The Lower Se San 2, located on the Se San River, with a cost of US\$781 million, is a joint venture involving Chinese, Cambodian and Vietnamese companies; China's Lancang Hydropower International Energy owns 51%, Cambodia's Royal Group 39% and Vietnam's EVN International 10%. By October 2016, construction was 70% complete.

these are low relative to western standards, the share of bilateral debt in Cambodia's total external public debt rose from 50% in 2009 to 70% by year end 2015; China accounted for 90% of all new bilateral loan disbursements over the past three years ending 2016.

MAJOR CORPORATE CHINESE INVESTMENTS – BY SECTOR

In this section, we set out Chinese investment in five key sectors. Not surprisingly, China's interests are aligned with Cambodia's in that the Cambodian economy has been driven by garment exports and tourism (Table 1 sets out energy investment). Agriculture, mining and real estate are also no real surprises. The Sihanoukville Special Economic Zone (SEZ) is somewhat surprising in light of the number of existing SEZs in Cambodia (discussed later).

- **Energy** - China is the largest foreign investor in the energy sector in Cambodia, with accumulated capital of more than US\$7.5 billion in hydropower plants and about US\$4 billion in coal power plants. Chinese companies invested in nine electricity power stations with a capacity of 1,733 MW – there are seven hydropower projects with a capacity of 1,328 MW and two coal energy projects with a capacity of 405 MW.
- **Garment and textile sector** - a leading source of Cambodian exports. The garment industry is essentially dominated by foreign firms, mainly from the neighbouring countries such as China, Hong Kong, Singapore, Malaysia and Korea. Over 60% of Cambodia's garment factories are located in or near

Table 2:
Chinese Loans/Grants Cambodia Infrastructure (2012-2017)

	Date	Amount (\$m)	Lender/Investor	Use	Comments
(1)	04/17	160	Chinese Government	Grants for 2023 SEA Games	To build a stadium
(2)	10/16	2,000	Chinese Government	Multiple uses: US\$90m plus debt forgiveness for 2015 interest charges	National Road 11: US\$157m; Sihanoukville Road US\$1.6bn
(3)	06/16	800	Chinese Government	Grants to Cambodia	2016-2018 aid to support election infrastructure, health and education
(4)	06/14	3	Chinese Government	Closed circuit TV	Public Security Ministry
(5)	03/14	2,300	Chinese Government	Mekong Basin countries	\$10bn line of credit plus US\$1.5 preferential loans
(6)	10/13	121	CEXIM	Irrigation system, electrical transmission line	Infrastructure, energy
(7)	10/13	1	Chinese Government	Flood aid	Purchase 2,000 tons of milled rice/ relief kits
(8)	04/13	548	Chinese Government	Infrastructure/Roads	US\$500m soft loans, US\$48m grant
(9)	06/12	430	Chinese Government	National Road 6: US\$250m; plus two other projects	National Road 6 completed early 2017-on schedule
(10)	02/12	302	CEXIM	National Road 124, National Road 76, Viaco irrigation system	Three infrastructure projects
	Total	6,665			

Footnotes:

- 1) In April 2017, China committed US\$160 million (as a grant) to build a stadium for Cambodia to host the 2023 Southeast Asian (SEA) Games. The stadium will be built by China IPPR International Engineering Company and is expected to be completed by 2020.
- 2) During President Xi's visit to Cambodia in October 2016, Beijing forgave US\$90 million debt Cambodia incurred in 2015, loaned Hun Sen's Government another US\$60 million, provided an incremental US\$237 million in direct aid and 2 days later announced it would build a US\$16 million National Assembly hall in Phnom Penh. It is thought that some of this grant was to be allocated to Cambodian SMEs.
- 3) In 2006, China provided a similar US\$600 million aid and loan package to Cambodia for infrastructure development.
- 4) The Chinese Government donated US\$3 million to Cambodia to set up a closed-circuit television (CCTV) surveillance system across Phnom Penh for the study, research and monitoring of traffic and security in Phnom Penh.
- 5) Total of US\$11.5 billion for all five countries; Grisons Peak number represents 20% of total.
- 6) In October, 2013 CEXIM signed two agreements to provide a total of US\$121 million in loans to Cambodia to develop the A Chang irrigation system in Kompong Chhnang province and the project to build the 115 kilovolt electrical transmission line from Phnom Penh to Bavet City.
- 7) The Cambodia floods in autumn 2013 saw 113,260 hectares of rice paddies, or 4.4% of the total rice fields completely destroyed while some 440 km of national roads and 3,693 km of gravel roads were damaged. In late October 2013 China donated US\$1 million to Cambodia for the relief of the flood-affected people. In early December 2013, China's Yunnan province provided 200 agricultural engines to Cambodia's Banteay Meanchey province for post-flood rehabilitation.
- 8) Agreements covering US\$500 million in soft loans and \$48 million in grants which will be used to improve infrastructure as well as help build 400 km (250 miles) of new roads/year over several years.
- 9) In June 2012, Cambodia signed agreements for US\$430 million in loans from CEXIM. The bulk of the loans are for two national road projects and a multipurpose dam in Battambang. An extension on the rehabilitation of National Road 6 alone was set to cost about US\$250 million, constructed by Shanghai Construction Group.
- 10) Cost of Phase one of the Viaco Irrigation Development Project, thought to be the biggest water resources irrigation project under the cooperation of Cambodia and China, is US\$99 million. It will be constructed by two phases; total cost of both phases US\$200 million. Total cost for project of 178 km extension National Road 76 was US\$89 million.

Phnom Penh. The finished products are transported from the factories by train to the sea.

- **Agriculture** - By 2016 there were about 30 Chinese investment projects relating to agriculture and the agro-industry, covering about 237,406 hectares of land, in which 21 projects are in operation on 173,904 hectares. So far, only about 42,081 hectares have been cultivated and rubber plantations consume most of the cultivated land. In addition, there are seven Chinese investment projects in rice mills with a production capacity of 669,816 tonnes per year.
- **Tourism** - China has invested in five main projects – an international resort complex in Koh Kong province (discussed later) and a resort complex and five-star hotel in Preah Sihanouk province.
- **Mining** - Of the 23 companies investing in the mining industry including iron ore and gold, 10 are from China. In 2016, there were two Chinese investment projects in granite mining in Kratie province.
- **Real Estate** - 2015 and 2016 saw very positive investment returns on residential real estate. For 2017, it was thought that foreign investment would move towards entertainment, hotels, condo-hotels, (pre China outbound constraints). From a geographical perspective, the next real estate boom could be in Sihanoukville which is known for its beaches and the rapid growth in tourism numbers. While Phnom Penh and Sihanoukville could continue as the primary beneficiaries of real estate development, mid-tier cities like Poipet and Battambang could also see increased interest.
- **The Sihanoukville Special Economic Zone (SEZ)** - the first special economic zone funded by the Chinese government in Asia. The Cambodia International Investment Development Group and Jiangsu Taihu Cambodia International Economic Cooperation Investment co-manage the project. There are 108 enterprises and companies located in the zone with a total investment capital of more than US\$3 billion.

SPECIFIC MAJOR CHINESE EQUITY INVESTMENTS (2016-2017)

We now highlight five major Chinese investments over US\$1 billion which are equity related. Again, they are aligned to key sectors of future development: energy, infrastructure/tourism, manufacturing/agriculture and a new suburb situated close to the country's capital. Most of these have local partners/investors – and are long term in nature. Due to the recent timing of these investments, it is too early to calculate returns to the investors.

- In 2016, Tianjin Union Development Group (UDG), a subsidiary of Chinese developer Wanlong Group, has committed to an investment of US\$3.8 billion to build a deep water port, an airport and the largest resort in Cambodia as well as Southeast Asia. As of January 2017, the deep water port was nearly finished (Japanese International Cooperation Agency

(JICA) purchased a stake in the existing largest port in August). The international airport to be built for the Dara Sakor Seashore Resort is expected to be built in three phases, with phase one commencing in January 2018 at a projected cost of between US\$300-US\$350 million (total cost of circa US\$500 million). The airport would be able to receive medium-sized airplanes once phase one was completed over the course of the next two and a half years. A casino, hotels, restaurants and a golf course have been erected, along with an artificial lake to supply water but little has happened on guest numbers.

- Heng Fu Sugar is one of China's largest sugar producers. In 2016, it opened its new Cambodian sugar production facility, the largest Chinese sugar facility in Cambodia, via an investment of more than US\$360 million. In the second and third stages of the project, the company has planned to invest more than US\$1 billion to construct a modern agricultural development zone.
- In December 2016, Cambodian conglomerate LYP Group and the China Minsheng Investment Group (CMIG) signed a memorandum of understanding (MoU) to develop a 550-hectare "Cambodia-Chinese Friendship City". The US\$1.5 billion joint venture deal allows for CMIG, China's largest investment company, to develop the residential area within the 2,000 hectare Garden City satellite city being built by LYP Group 10km north of Phnom Penh. Construction on the "Cambodia-Chinese Friendship City" is expected to start in 2017 with the project including a convention centre, logistics centres, schools and other facilities.
- In May 2017, after years of delays and setbacks, the Cambodian private firm set to operate the Kinlandmark oil refinery, Cambodia Petrochemical Company (CPC), finally broke ground on a US\$1.62 billion project with an updated completion date set for mid-2019. The oil refinery, was first expected to be completed in 2014 after securing a 100% committed loan from CEXIM in December 2013. However, the refinery plans did not move forward until May of 2016 when CPC granted a US\$620 million first phase construction contract to China National Petroleum Corporation (CNPC). Construction was then outsourced to China's Sino Great Wall International Engineering Group. Upon completion, the facility is expected to have an annual refining capacity of 5 million tonnes of crude oil.
- In December 2016, a consortium led by Sino Great Wall International won a US\$2.7 billion contract to build 133-story twin commercial skyscrapers in Phnom Penh, a five-year project that would make them among the world's tallest buildings. The Phnom Penh contract will come into effect once the consortium, which includes Sino Great Wall and Wuchang Shipbuilding Industry, finalizes the

funding. In a filing to the Chinese stock exchange in Shenzhen, Sino Great Wall said construction was expected to take about 60 months.

- In August 2017, Worldbridge Land (Cambodia) and China's Sino Great Wall International Engineering signed an agreement focused on further developing Cambodia's public infrastructure. Under the agreement, Sino Great Wall would own 60% while and Worldbridge would own 40%. The joint venture would look to invest US\$3 billion in terms for public infrastructure projects.

GDP GROWTH/ECONOMIC CONDITIONS

Over the past two decades (1994-2015), the Cambodian economy grew at an average annual growth rate of 7.6%, ranking it number six in the world. Through such growth, Cambodia attained the lower middle-income status as of 2015, with gross national income (GNI) per capita reaching US\$1,070. Economic growth is expected to remain strong over the next two years (6.8% in 2017 and 6.9% in 2018). Keys to future growth include political stability and security, open policies for investment, and a young labour force, 72% of which is under the age of 35.

OVERALL FDI INTO CAMBODIA

Foreign direct investment (FDI) in Cambodia increased from an average of US\$644 million a year from 2005 to 2008 to an average of US\$1.5 billion annually from 2009 to 2014, according to data from the United Nations Conference on Trade and Development.

Since 2005, Cambodia has approved more than 30 SEZs, although only around a dozen are in operation at this time. The SEZs are being created along a corridor that runs from the Vietnamese border in the southeast to the capital Phnom Penh and northwest toward Thailand.

Whereas Chinese investment has been centered on energy, infrastructure and the garment industry, Japan is leading a shift to investment in manufacturing. A small number of Japanese automotive parts makers are operating at the Phnom Penh Special Economic Zone, including Denso, a wiring unit of Japan's Sumitomo Corp. and Minebea, a producer of machinery components and electronic devices which is now Cambodia's second-largest private sector employer, behind ACLEDA Bank.

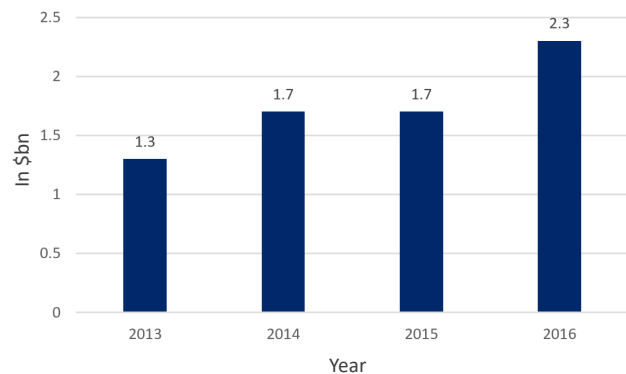
Japan has also been investing in Cambodian real estate. Aeon built a sizeable mall, at a cost of US\$250 million, which opened in Phnom Penh in 2014 and announced plans to build a second mall by 2018. A 23-floor, US\$14 million Toyoko Inn hotel opened last year in Phnom Penh. It is the city's first Japanese hotel.

By 2015, China led with 1,055 firms operating in Cambodia, South Korea followed with 278, while Japan was third with 250. The 250 Japanese companies registered with

Cambodia's Ministry of Commerce in 2015 is a major increase from 19 in 2010 and 179 in 2013.

South Korea replaced the UK as the largest investor in Cambodia in 2011, but has seen its ranking in inbound investment decline over the past several years due to series of poor returns on ill-timed real estate investment, nearly a decade ago.

Figure 2:
Cambodian FDI (2013-2016)



2016

According to the National Bank of Cambodia FDI into Cambodia increased by 25% in 2016 amounting to US\$2.15 billion; US\$539 million into the banking sector, US\$390 million to the manufacturing sector, US\$370 million to real estate, US\$232 million to agriculture and US\$228 million for food and accommodation. China was the largest foreign investor, with an inflow of US\$511 million, followed by Hong Kong at US\$237 million, Vietnam at US\$192 million, Japan at US\$185 million and US\$169 million from Singapore.

In addition, Japan also announced two grants/loans (one of which was not signed until 2017): a US\$35 million grant from Japan to implement the fourth phase of a JICA-sponsored flood-protection project in Phnom Penh and a concessional loan from JICA of approximately US\$209 million to implement a container terminal project at Cambodia's principal deep sea port in Sihanoukville.

H1 2017

FDI into the banking sector amounted to US\$439 million during H1 2017, an 89 percent increase compared to the same period one year earlier. (BRED) Banque Populaire – France – officially launched operations in Cambodia in March, while Mizuho Bank, one of Japan's largest financial institutions, entered in April.

In August 2017, the JICA US\$209 million concessional loan was signed. In addition, Japan signed an agreement offering a US\$800 million concessional loan to complete the skytrain to link central Phnom Penh to the airport.

During his state visit to Japan, Mr Hun Sen pointed to expanding operations by Aeon Mall and Minebea, a Japanese electronics subsidiary, reflects strong confidence in the Cambodian government. “In the last five years, big Japanese companies that invested in Cambodia’s neighbouring countries have stepped in for investment in our country, establishing factories to produce electronic, automotive, and other technical materials for export. Mr. Hun Sen added that the investment of these companies would make other Japanese companies in other sectors, including banking, hotels, and airlines, decide to invest in Cambodia.

Meanwhile, Chinese investment during the first nine months of 2017 grew 80% compared to the same period in 2016.

CONCLUSIONS

Cambodia and China signed a MoU on strengthening cooperation and investment on industries in 2015. As recently as October 2017, Cambodia was labelled as “an integral constituent of President Xi Jinping’s Belt and Road Initiative (BRI)”.

While there is no panacea of exporting the Chinese economic miracle to BRI countries, we believe that this analysis represents an excellent example of how China can be helpful to its BRI friends in transforming their economies and positioning them for additional future growth. We also believe that by China spending vast sums to fund Phase one projects at yields of 10% or less on most of those projects, China is actually helping the recipient country unlock investment from other countries/ corporates on projects with much higher financial return potential. ■

AS RECENTLY AS OCTOBER 2017, CAMBODIA WAS LABELLED AS “AN INTEGRAL CONSTITUENT OF PRESIDENT XI JINPING’S BELT AND ROAD INITIATIVE (BRI)”.



HOW FAR CAN THE REFORM OF JAPAN POST HOLDINGS KEEP GOING?

A PEEK INTO THE GAIN AND LOSS OF THE SECOND TIME SHARES-REDUCTION OF JAPAN POST GROUP SINCE THE REFORM

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Preface:

A special coverage of the topic about Japan Post Group reform of privatization through capital market was published in the third issue of **PE REVIEW**. With eight years of trying, Japan Post—the giant state-owned conglomerate finally completed its task of privatization under the administration of Prime Minister Shinzo Abe. The old corporation has been disassembled into three independent share-holding companies, which all have been listed for public trading.

Over two years have passed since the listing, and given their market performances how do we reassess the companies and analyze the significance of the weigh-in of the capital market?

This article, continuing the last case study, is a deeper and further analysis specialized in the market performances of the companies with the help of financial tools since the reform.

In November 2015, Japan Post Group (Japan Post Holdings) finally completed its task of disassembling the giant state-owned corporation into three independent share-holding companies engaging postal, postal saving and postal insurance, and the three companies got listed on the stock market with the help from the capital market. Their public prices had gone up on a large scale, which had set a good start for the rebirth of Japan Post. Now, over two years have passed since the listing and it is necessary to conduct a follow up research and study of the three companies so that we have a better look into their future development.

THE PROGRESS OF JAPAN POST SINCE THE LISTING

According to the most recent published quarterly report, for the third quarter of the fiscal year of 2017, the actual GDP grows 0.6% (2.5% for CAGR) more than the second quarter. The progress was made based on the adjustment to the first quarter performance, and it showed that the economy of Japan is steadily moving forward also given a strong global stock market performance which lifted up investors' confidence and passion.

In the year of 2015, Japan Post, a subsidiary of Japan Post Holdings, performed poorly since the purchase of the Australian logistic company Toll Holdings Limited.

Therefore, Japan Post decided to pay the total amount of goodwill at one time (goodwill is the premium paid by an acquiring company over and above the acquired company's tangible book value. Under Japanese accounting rules, goodwill is normally to be distributed over 20 years, but due to the poor performance of the acquired company, Japan Post decided to list the entire goodwill as a onetime loss.), which amounted to nearly 403 billion JPY and resulted in a net loss of 40 billion JPY in current profit. The market reacted to this onetime payment with divided views and opinions.

For those who were against it, the onetime payment not only caused huge loss but also affected the company's development goals, and meanwhile increased the market value of other state-owned companies than average premium (the premium was five percent comparing to three percent as average); and for supporters even though the installment payment could avoid the deficit for the bookkeeping balance purpose, the installment would have been a long-term financial burden for the company and surely would have affect the company's financial status and the company's future strategy and development. As a matter of fact, a few other Japanese corporations had encountered such issues before like Sony, Rakuten,

Westinghouse of Toshiba etc. The above companies might have various operating issues, but were once facing the same debt problem. The coincidence was that during the acquisition of the Toll holdings, the board director of Japan Post was Nishimura Taizō who used to be with Toshiba previously.

Since the listing, and given the size and market influence, Japan Post was added into the (Tokyo Price Index) TOPIX 100 of Tokyo Stock Exchange and its price has been rather stable since 2015. However, due to the loss caused by the acquisition of Toll Holdings Limited, and Japan Post's intended plan of purchasing Nomura's hard asset Nomura Holdings was leaked, Japan Post stock price has gone down for a period of time. What should Japan Post do to gain market's confidence and drive up its price again? With deliberate consideration of the caliber of the economic development of Japan and the general situation of the Korean Peninsula, including the potential risk possibility in the area, the Japanese government made the decision of the second time reduction of its shares of the company which also include stock shares worth 1.4 trillion yen held by the Japanese government.

THE SECOND TIME REDUCTION OF SHARES — THE SECONDARY REFORM AND ITS CHARACTERISTICS

In order to pursue the success of the second time reduction of the government held shares of Japan Post which is almost regarded as a “national policy”, the Japanese government has taken means to make it happen.

- 1) During the second time public reduction, the Japanese government gave out its 929,169,200 shares (with 182,787,500 held by foreign investors), which is close to almost two percent of the total shares issued by Japan Post, and the company bought back approximately 100 million shares worth 10 billion yen from the market.
- 2) In September 2017, ten months after the second time reduction, Nikkei re-evaluated the listed companies based on their prices, and Japan Post once again was listed as Index Company on the TOPIX 100.
- 3) Japan Post bought back its own shares before the second time public trading and the positive act by Nikkei are strong methods to stabilize the price and to stimulate the public to buy.
- 4) Also, in terms of pricing, during 25 to 27 September, which are first three initial days of the selling, dividend interest is set in reference to the price of the first day, 25 September, in order to attract more institutional investors as well as individual investors.
- 5) In November 2015, Japan Post for the first time issued stocks at 1,400 yen per share to the public at the Tokyo Stock Exchange (TSE), and the price has gone all the way up to 1,999 yen/share, which was recorded the highest price of the day. Nonetheless, in the later two years due the poor operation, the price has gone down. Thus, for the second time listing given a thoughtful consideration and study of the market, the price of each share was 1,322 yen, which has been adjusted six percent lower than the first time IPO two years ago. With a well functioning financial system, the interest costs/EBITDA (earnings before interest, tax, depreciation, and amortization) has been adjusted to 1.6 times compared with the five times adjustment two years ago.
- 6) Though Japan Post was regarded as the first company with the highest market value, century reduced its price before the second listing in the 21st century Japan, from the perspectives of the securities institutions and investors no single financial policy or government regulation alone can help make the

Chart generated on 2018年1月18日 at 6:02 pm



investment decision with all market rules and values left behind (the early case of Nippon Telegraph and Telephone Public Corporation [NTT] makes the point). Japan Post only published Nikkei's ranking of average weighted index for component stocks to its institutional investors, rather than detailed future development or business plans. Except for the market volume of this stock (5.8 trillion yen by 29 December 2016, ranking 14th), there were not any persuasive investment highlights for investors to carry on the co-investment. However, for individual investors, the stock price of Japan Post was rather stable and was the too big to fail company. Thus, the second time listing attracted more individual investors who had contributed 76% of the purchases.

- 7) After the second time listing, share holders were adjusted as government holding 56.8%, outstanding shares 9.4%, foreign investors 6.6%, institutional investors 0.7%, majority investors 14.7% and funds holding 11.8%.
- 8) The difference between the second listing and the first one in 2015 was that only Japan Post issued stock shares, the other two, JP Post Bank and JP Post Insurance did not issue stocks. The reason was that among the three businesses, Japan Post performance was the poorest; other than that the Japanese privatization regulation states that when the shares held by the government exceeded, one third of the total issued shares should be sold as soon as possible; and the regulation would also apply to the other two companies. The regulation did not state exact time and amount, but it provided the legal reference for the sell; meanwhile the correlation between the three companies restrained the other two companies from selling shares.

The design and utilization of financial tools and means were simply for the moment that the stock price bounced back to where it was of the first IPO, so that it could mark a success of the second IPO which had almost been a national policy.

THE PRIVATIZATION REFORM OF JAPAN POST IS NOT COMPLETE

The Single Business Model of Japan Post

The regulation requires that the government's holding in Japan Post shall be lowered to one third as soon as possible, and Japan Post's shareholdings in JP Post Bank and JP Post Insurance shall be liquidated as soon as possible, with 50% shareholding proportions set as the targets for the current stage. If the regulation requirement to sell the shares as soon as possible is strictly followed, then it would cause the loss of Japan Post's managing power even before it fully realizes its business development goals. Thus it could lead to the fall of the services, qualities and dividends that the three companies have been delivering. In other words, Japan Post strategy for development was not simply to sell

out the government-owned shares of JP Post Bank and JP Post Insurance, but to maintain a sustainable development of the three companies with the help of capital market in order to show the necessity of the privatization of Japan Post and inevitability of the economic development of Japan. Japan Post, JP Post Bank and JP Post Insurance are complimentary to each other's business development, for Japan Post is the front business while JP Post Bank and JP Post Insurance are middle and back stage which makes a complete industry chain for the group. The business model can be described as the front business (Japan Post) functioning as the window desk and charging handling fees for both of the banking and insurance services, which cover 27% of their annual income. According to the annual financial report published in March 2017, JP Post Bank paid 612.4 billion yen handling fee to Japan Post, and JP Post Insurance paid 392.8 billion yen, together contributed 1 trillion yen handling fee to Japan Post for the fiscal year of 2017. If strictly adhered to the Japan Post Privatization Bill, which requires Japan Post to relinquish its stakes when share held reached 50%, then it would have overthrown the profit model it has had for now. In other words, the successful execution of the bill would have been the failure of Japan Post's business operation. This is what is ironic and incomplete about the reform of Japan Post.

Serious Internal Transactions

In terms of the post-listing structure and operation model, the "complementarity" among the three companies was nothing but internal transactions. In the fiscal year of 2017, JP Post Bank alone contributed 442 billion yen, nearly 56%, to the total profit of the entire group, which was 795 billion yen. Nearly 93% of JP Post Bank's 1.88 trillion JPY annual revenue, namely 1.77 trillion JPY, comes from the profits of securities-related businesses and investment activities. That is to say, Japan Post gained its profits through internal transactions among its three affiliated companies, and it showed that Japan Post had largely relied on its financial arm and capital market to make profit. If Japan Post had strictly implemented the section on selling shares of the Japan Post Privatization Bill, would it have maintained a profitable performance? This question is like the sword hanging on top of Japan Post Group. If the corporation is dedicated to a complete reform and to getting out of this ambiguous model, the application of a laissez-faire model and innovation are its only means.

The Asset Quality of Japan Post Group

After the second reduction of shares, Japan Post's future development was put on the spotlight. Both of institutional and individual investors were concerned if there will be enough funding for the company's growth because the cash collected by selling shares was submitted to the Finance department of Japan rather than used for self-development. Thus, the second time privatization was not significantly meaningful for the company in terms of raising fund. Japan Post avoided the decrease of its stock price by redeeming its shares using nearly 100 billion yen,

approximately one third of the company's total cash reserve of 328 billion yen. The act of hedging actually diminished the volume of shares for sell, and meanwhile improved the return on equity (ROE). However, will this redemption cause the cancellation of market shares in order to rewrite the ROE on the company's balance sheet? (HKSE requires companies to write off the equivalent amount of market shares after redemption of its own shares.) If the company refused to write off the equivalent amount of market shares at the stock exchange but through other options like merger and acquisition, stock option or so, then the improvement of shareholders' equity ROE would be only temporary, and would not do good to the valuation of the company's assets and have little help walking out of the bottle neck.

The Short Sight of Japan Post Group's Second Shares Reduction

In order to stimulate the market to purchase, Japan Post set the annual return of each share at three percent, which means that investors can make 50 yen profit per share at the end of the year. However, the market was quite doubtful about whether or not Japan Post can hold up on such high return per share. It is very unwise to attract investors by higher than the average return, and it is as short sighted as killing the goose that laid the golden egg. This case is very similar to the Otsukakagu furniture company case, which also adopted the fast speed but unsustainable development which had led to the failure of paying off high returns promised to their investors. The second time Japan Post reduced its shares at the price of 1,322 yen, which was lower than the price at 1,400 yen when they reduced their shares back in 2015 for the first time, given a low interest rate and rather low cost investment friendly market; investors were still reluctant to buy Japan Post stocks. And during the same period of the second reduction, other stocks had strong performances. The reason was that there was not a clear blueprint for Japan Post future development, and the shares-reduction itself was seen as a way to stimulate the capital market to gain more cash rather than a real and strategic move for the company.

HERE COMES THE THIRD TIME

Although the second time shares reduction has just concluded, there is a plan in place for a third time shares reduction. The market predicted that the Japanese Finance Department is very likely to pass the third time shares reduction proposal. The government will keep reducing its shares of Japan Post, and it will be seen as its third dive into privatization. However, this round of share reduction will only be meaningful and helpful if the third time reform can change the old managing model and mind set and present to the public the company's determination and direction of going forward on a clear path. The result will come out no different than the second time, if a change in reform is not seen.

CONCLUSION

Japan Post is now preparing for the implementing of The Mid-term Business Operation of the Three-year Plan from April 2018 to April 2021. The plan revealed that maximizing the profit for shareholders is the major target for future development, and to reach the goal the group is going to broaden its sales scale, work with financial industry and strengthen reforms among the existing 24,000 branches and stores including increasing charges over postcards, packages and changing commercial styles which can increase income up to 20 billion yen. Affected by the rapid growing of internet and new technology, conventional postal business in Japan has decreased and given the decrease of the birthrate, low interest rate, growing labor cost, the rough time with Australia toll since the merge etc all made JP Post Bank and JP Post Insurance weaken their financial advantages. On the other hand, considering the shares reduction might be taken by JP Postal and JP Post Insurance in near future and the possible capital gain, which is predicted to be 1.5 trillion yen and by then the cash flow of the company will be tremendous. The size of the hard assets of Japan Post ranks at number six falling behind Mitsubishi Estate, Sumitomo Realty & Development, Mitsui Fudosan Co, JR East, and Central Japan Railway Company, but Japan Post intends to enlarge its hard asset volume by broadening the internet coverage over the areas like electronic mails and internet logistics to fully dig the resources to enhance the urbanization postal service construction. And it is believed to be a great profit potential. However, Japan Post is not on the right track for hard assets development, for instance, the merger and acquisition with Nomura is still uncertain. All the above will be standing in the way of the three-year plan going smoothly. Given the not so positive reviews, the market keeps holding on its observation toward the Plan, and the majority of securities are standing neutral. So, given institutional and individual investors' laid back attitude to Japan Post, the company's on-going reform and business style are not going in the right direction yet.

In summary, there is still a long way to go for Japan Post, and how well it goes, all depends on the completeness of the reform. If it adapts it businesses based on market needs, and simultaneously synchronizes with internet, big data, electronic payment and all these emerging technologies, Japan Post will surely win more customers and revolutionize the postal business. In other words, Japan Post is expected to create a new style of life and value as well for the country. The market is looking forward to the return of Japan Post's old days' of glory when its stock price was at a historical record of 1,999 yen. ■

REDUCING RISKS OF OVERSEAS HIGH-SPEED RAIL INVESTMENT THROUGH BIG DATA ANALYSIS

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Abstract:

Construction of overseas high-speed railways is an important part of China's massive "Belt and Road" initiative to increase trade and infrastructure links with countries from Asia to Africa. However, most of China's planned rail projects have met with enormous obstacles. To fundamentally understand why setbacks in high-speed railway construction have emerged one after another, we advocate an integrated study by synthesizing all available data, including massive media reports, demographic, and all kinds of macroeconomic data. Employing such an approach, we show that the main reason for the stalling of China's overseas railway projects is that many of the planned high-speed rails are not needed in the host countries at all, as the total railway passengers in those countries have been steadily decreasing in more than the past 10 or 20 years, while the total railway mileage has been increasing significantly in some of those countries. A few different mechanisms responsible for this behavior have been identified. We also find that for railway (and more general, infrastructure development) projects to be successfully completed, it is important to un-entangle infrastructure development from political power struggle in the host countries. A necessary condition for a project to be successfully completed is that its completion time is shorter than the average time for policy changes in the country. The latter time scale can be readily estimated from analysis of massive media reports data, through a complexity measure called Hurst parameter which characterizes the long-range correlations of political processes.

INTRODUCTION

China's investment in overseas high-speed rail is one of the biggest infrastructure undertakings in the modern world history. The total estimated value of the 18 overseas high-speed lines — including the completed Ankara-Istanbul service, five under way and 12 more announced — amounts to US\$143 billion, according to a study by the Center for Strategic and International Studies, a Washington-based think-tank (Kynge, Peel, & Bland, 2017). In contrast, the US-led Marshall Plan, which successfully revived Europe after the Second World War through American donations, was completed with US\$13 billion, a number equivalent to US\$130 billion today. Unfortunately, enormous setbacks to China's grand initiative have occurred, and many more new challenges are likely to arise (Zhou, 2017), (Chaitrong, 2017), (Zheng, 2017), (Merrett, 2017), (The Straits Times, 2017), (Hayes, 2017), (Wongcha-um, 2017), & (Rujivanarom, 2017). Among the more eye-catching setbacks include:

1. The partially built Venezuela's Tinaco-Anaco line, the first Latin America's high-speed railway, estimated to cost US\$7.5 billion, is now abandoned, due to collapse of Venezuela's economy.
2. The Libya's Tripoli-Sirte line, a project worth US\$3.6 billion, was forced to suspend indefinitely due to the 2011 Libya civil war.
3. Mexico revoked China Railway Construction Corporation's contract worth of US\$3.7 billion, due to concerns about transparency in Chinese company's bidding process.
4. The contract between China and Myanmar, for a high-speed rail between southwest China and the Bay of Bengal, including the Mandalay-Yangon line, is no longer active, due to opposition in Myanmar.
5. The Los Angeles-Las Vegas 370 km high-speed rail scheme, estimated to cost US\$12.7 billion, was cancelled by XpressWest, the US client, partly due to

a perception of difficulty in securing US government's regulatory approval.

6. Amidst the delay caused by land and financing issues of the Jakarta-Bandung line, a US\$5.1 billion project in Indonesia, anti-China sentiments have been increasing alarmingly (Pan, 2017).
7. After clearing the seemingly final barrier, an environmental assessment by the Thai environmental agency of the Chinese-Thailand high-speed railway, another setback has emerged, as Thailand is now pushing the rail to be used for freight, due to lack of passengers (Wu, 2017).

Could the setbacks in China's effort of constructing overseas high-speed rails been reduced through careful risk assessment? Standard risk assessment considers many variables, including loan terms, labour regulations, financing, land-use rules, environmental protection regulations, social impacts of the project, and most importantly, the demand for the project. Taking for example, the Study on the Development of High Speed Commuter Railway and Station Area Development in Thailand (between Eastern Line Bangkok and Pattaya), completed in February 2017 by Fujita Corporation, Itochu Corporation, Daiwa House Industry Co., Ltd., and Oriental Consultants Global Co., Ltd (Fujita Corporation, et al., 2017). It is a document of more than 150 pages with 11 chapters and a few appendices, which has discussed most of the variables mentioned above. Furthermore, by surveying the local people and using statistical models, the study projected that with proper development in eastern Thailand and good connectivity with the Suvarnabhumi airport, the number of passengers per day will reach more than 26,200 when the high speed rail is open. This amounts to more than 9.5 million passengers per year just at the opening of the high speed rail. The Bangkok to Pattaya line may be roughly considered a section of the China-Thailand high-speed railway. Therefore, the number at 9.5 million passengers per year at the opening of the high speed rail may also be considered to be applicable to China-Thailand high-speed railway. Is this number realistic? Unfortunately, it is way too optimistic, when compared with a speech by Mr. Vallobh Muangkeo, secretary general of the National Assembly of Thailand, at the World Internet Conference in Wuzhen, Zhejiang province, on 6 December, 2017 (Wu, 2017). For the project to be worth billions of US dollars, Mr. Vallobh Muangkeo stated that there have to be at least 9 to 10 million passengers a year; however, he did not think that to be impossible, as there are only 60 to 70 million people in Thailand. Mr. Vallobh Muangkeo thus called for the high speed rail to be used for freight instead, as we mentioned earlier.

The inconsistency between Japanese optimistic assessment of the feasibility of constructing a high-speed rail in Thailand and the statement by a high level Thai official is startling, and this can easily make one to jump to a conclusion that many of the assumptions employed by the Japanese researchers for the statistical analysis cannot

hold. This is certainly true. However, a more important factor for the inconsistency is the bias or lack of relevant data suitable for assessing the feasibility of the project. To this end, an integrated study synthesizing all available data, including massive media reports, the demographic, and all kinds of macroeconomic data has to be carried out. In this article, we show that such an approach can indeed lead to a fundamental understanding on the (lack of) demand of high-speed rail in certain countries around the world. Concretely, we have found that the main reason for the stalling of China's overseas railway projects is that many of the planned high-speed rails are not needed in the host countries at all, as the total railway passengers in those countries have been steadily decreasing in the past couple of decades or more, although the total railway mileage has in fact been increasing in those countries. We also have found that for railway projects to be successfully completed, it is important to un-entangle the project development from political power struggle in the host countries. An important condition for the successful completion of a project is that the completion time is shorter than the average time for policy changes in the country. The latter time scale can be readily estimated from analysis of massive media reports data, through a complexity measure called Hurst parameter which characterizes long-range correlations of political processes.

The remainder of the paper is organized as follows. In the next section, we examine causes of and mechanisms for the stalling of China's overseas high-speed railway construction. In the section following that, we discuss estimation of a time scale necessary for the un-entanglement of infrastructure development from political power struggles. In the final section, we make concluding discussions.

ASSESSING THE DEMAND FOR HIGH-SPEED RAIL BY CONSIDERING DEMOGRAPHIC DYNAMICS

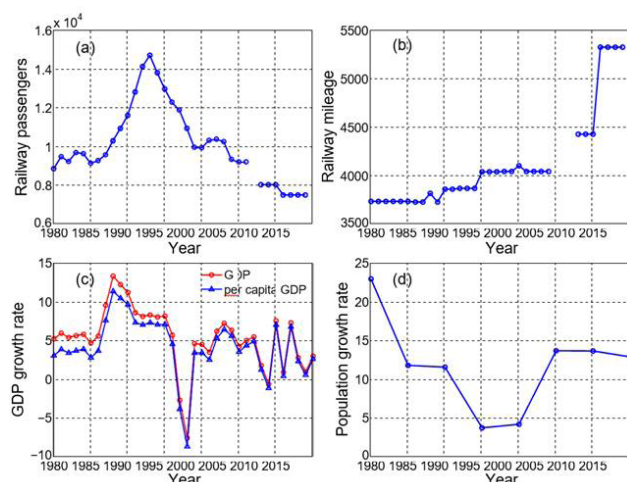
Among China's five overseas high-speed rails planned and 12 more announced, the China-Thailand one has the most hurdles of all. Therefore, we choose it to discuss first. As the joint study by four Japanese companies considered many variables but did not produce realistic assessment on the demand for the high-speed rail in Thailand (Fujita Corporation, et al., 2017), we have to turn to other variables. The major variable we focus on here is the total number of railway passengers in Thailand in a year. We hope that this variable can lead us to a deep understanding of the demographic dynamics in Thailand.

To better appreciate the importance of considering demographic dynamics, we digress to discuss an authors' personal experience. There used to be a farmer's market in the east campus of Guangxi University. The campus is an interesting community with almost 100 thousand people living there, including most of the University employees and students. The farmer's market was in a great location. Every day a lot of customers came to

buy fresh meat, live fishes, vegetables, fruits, and so on. The best pork seller normally would finish selling out all the meat within 2.5 hours, starting from 8:45 am. Recently, the market was torn down, as the location was re-planned for building a square. So the farmer's market has been moved to a location north of the original one. As the new location is only about seven minutes walk from the original market, no one foresaw that more than half of the customers would stop visiting the new one. As a result, the best pork seller now would still be selling meat at around 1-2 pm. After that, the seller would simply take the meat to some express food restaurants, as otherwise the pork would no longer be fresh. Such dramatic change in customer behavior is very difficult to capture by statistical analysis, no matter how sophisticated the model is. Therefore, it is not surprising that the joint assessment about the feasibility of high-speed rail in Thailand by the four Japanese companies turns out to be too optimistic.

Let us now focus on the basic data indispensable for assessing the feasibility of the high-speed rail in Thailand. Figure 1(a) shows the yearly variation of railway passengers (in unit of million people by kilometer). We observe that it had been rapidly increasing till 1993, then has been steadily decreasing. Next, let us examine the temporal variation of the total railway mileage in Thailand in the past thirty plus years. It is shown in Figure 1(b). Clearly it has been increasing, meaning that the Thai government has been investing in railway construction (specifically around 1994, 2004, and 2011). The contrast between the increasing of the total railway mileage and the sharp decrease in railway passengers makes the latter all the more intriguing. What exactly has caused this?

Figure 1: Basic data for assessing the demand for high-speed rail in Thailand: (a) the variation of railway passengers with time, (b) the variation of railway mileage with time, (c) the GDP growth rate, and (d) the population growth rate of Bangkok.



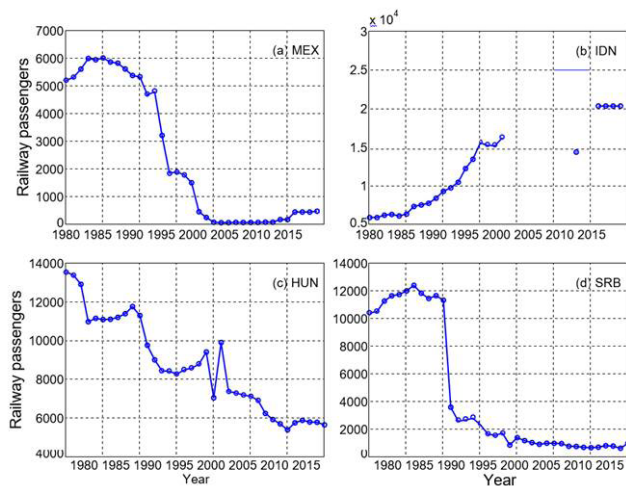
We have examined whether the decrease in railway passenger may be caused by financial crises. Based on the GDP growth rates shown in Figure 1(c), we have to conclude that financial crises, including the 1998 Southeast Asian and the 2008 global crises, played little role. So what exactly is responsible for the decrease in railway passengers since 1993?

The answer lies in the urbanization of Bangkok. Before 1993, Bangkok was a great city very much like Beijing and Shanghai in that it offered tremendous opportunities for people to find jobs. More concretely, before 1993, people flocked to Bangkok to chase job opportunities, driving Bangkok's urbanization. In fact, many of them did not have to go back to their hometown, instead, they simply stayed there as permanent residents. Such a one-way migration effectively eliminated the need for railway travel, dramatically reducing railway passengers' traffic. Indeed, Bangkok's population growth was tremendous before 1993, as shown in Figure 1(d). But soon the population growth reached the limit that the city of Bangkok could accommodate, and between 1997-2005 Bangkok's administrative region was forced to expand. This characteristic of urbanization not only applies to Bangkok, but also to other developing and developed countries. In fact, much of Bangkok's recent growth has occurred outside the city, in suburban (and exurban) areas. Between 2000 and 2010, the city grew by 30%, while the suburban provinces grew more than twice as quickly, at 66% (New Geography, 2017). Land-wise, the Bangkok urban area grew from 1,900 square kilometers to 2,100 square kilometers between 2000 and 2010 (World Bank, 2017). Overall, Thailand does not need any new railways, though upgrading low-speed rail to high-speed ones is welcome, if the cost is low.

While a mechanism responsible for the decrease in the number of railway passengers is important, for practical purposes, the most important is to know how the number of railway passengers varies with time in a country. We have examined all the countries along the Belt and Road initiative, and found that there are as many as a few dozen countries whose number of railway passengers has been decreasing in the past two decades or more. Four more examples are shown in Figure 2, on the following page. This group includes most of the countries which spun out of the former Soviet Union, for the straightforward reason that many of the railways constructed during the Soviet periods are much less used after those countries have won independency. This mechanism also explains the situation in Serbia, which is shown in Figure 2(d). Another mechanism for the decrease in the number of railway passengers is due to financial crisis, as evidenced in the case of Indonesia shown in Figure 2(b). While we can conclude that the mechanism for the decrease in the number of railway passengers may vary from one country to another, it is critical to realize that steady decrease in the number of railway passengers in a country simply highlights the lack of demand for more

railway construction, including high-speed ones. The fact that Mexico is also in this group explains that the reason for Mexico to revoke China Railway Construction Corporation's contract worth of US\$3.7 billion is more due to lack of demand on high-speed rail than issues related to transparency in the Chinese company's bidding process.

Figure 2:
Temporal variations of railway passengers for four countries: (a) Mexico, (b) Indonesia, (c) Turkey, and (d) Serbia.



IMPORTANCE OF UN-ENTANGLEMENT BETWEEN HIGH-SPEED RAIL CONSTRUCTION AND POLITICS

As mentioned earlier, amidst the delay caused by land and financing issues of the Jakarta-Bandung line, a US\$5.1 billion project in Indonesia, anti-China sentiments have been increasing substantially. Although such sentiments might not be severe enough to derail the project, it nevertheless will surely tarnish the image of China and make implementation of the Belt and Road initiative increasingly difficult world-wide. It is important to realize that for a project to be successfully completed, the execution time has to be short. Exactly how short should the execution time be? It has to be shorter than the average time for policy changes in a country. This is a necessary condition for preventing overseas high-speed rail construction from being politicized.

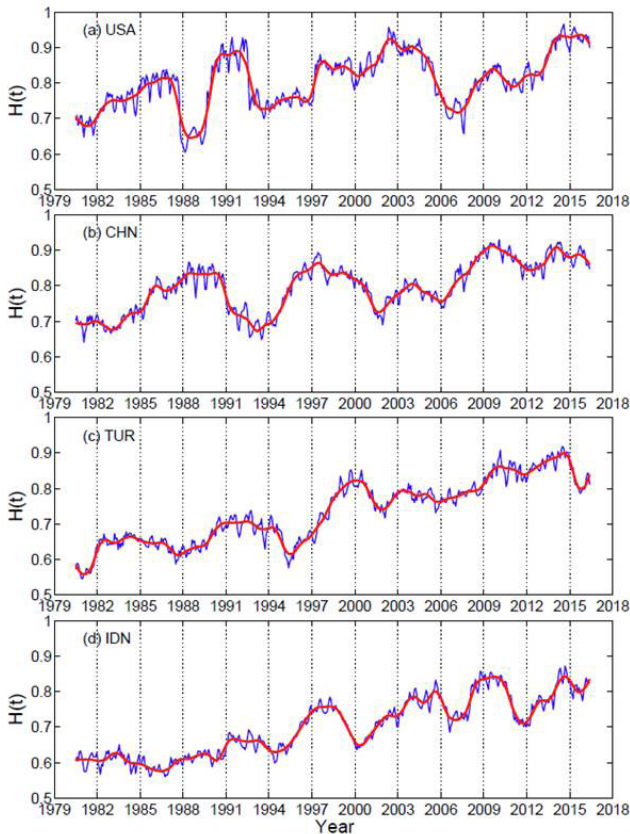
One might think that it would be extremely difficult, if not impossible, to estimate the desired time scale. Fortunately, this is not the case. Dictated by three fundamental patterns of world-wide political events: significant continuity and momentum (i.e., most days are similar to previous days), sometimes lack of predictability, and strong similarities across time and space, political processes can be aptly quantified and modeled by random fractal theory (Cao, Gao, Hu, & Tung, 2007). Concretely, here we show that this time scale can be estimated from massive media reports data, through a complexity measure called Hurst parameter H , which characterizes the long-range correlations of political processes. Depending on whether $0 < H < 1/2$,

$H = 1/2$, or $1/2 < H < 1$, a process is said respectively, to have anti-persistent correlations, is memoryless or only have short-range correlations, or have persistent, long-range correlations. Hurst parameter is the most widely used complexity measure from complexity science. It has found interesting and important applications in as diverse subjects as DNA sequences (Voss, 1992) and (Peng et al., 1992), human cognition (Gilden, Mallon, & Thornton, 1995) and coordination (Chen, Ding, & Scott Kelso, 1997), posture (Collins & De Luca, 1996), cardiac dynamics (Ivanov et al., 1996), (Amaral, Goldberger, Ivanov, & Stanley, 1996), (Ivanov et al., 1999), & (Bernaola-Galvan, Ivanov, Amaral, & Stanley, 2001), vision (Furstenau, 2010) & (Gao et al., 2006), and the distribution of prime numbers (Wolf, 1997), to name a few.

The political events data analyzed here is called Global Database of Events, Location, and Tone (GDEL). It includes nearly 500 million distinct events across all countries, during the period from 1979 to the present. GDEL events are drawn from a wide variety of news media, both in English and non-English, from across the world, ranging from local to international sources in nearly every country. These data are produced by the TABARI automated coding software (<http://eventdata.psu.edu/software.dir/tabari.html>) and a series of ancillary programs used to establish geolocation and improve the named entity recognition of TABARI. TABARI works with a very large set of verb-phrase (>15,000 phrases) and noun-phrase (>40,000 phrases) dictionaries in combination with shallow parsing of English-language sentences to identify grammatical structures such as subject-verb-object phrases, compound subjects and objects, and compound sentences. CAMEO is an update of earlier (1960s) event coding taxonomies, with changes introduced by automated coding and new behaviors, such as suicide bombings. CAMEO provides a detailed and systematic taxonomy for coding contemporary political actors, including international, supranational, transnational, and internal actors. An earlier version of this system recently was successfully employed in the DARPA ICEWS project (O'Brien, 2010) to code 25 gigabytes of Asian news reports involving more than 6.7 million stories, which provided the key input for forecasting models with accuracy, sensitivity, and specificity all exceeding DARPA's pre-set criteria. The data are updated every 15 minutes and are open access at <http://gdelt.utdallas.edu>; tools for working with the data are discussed both on that website and at <http://gdeltblog.wordpress.com>.

One of the most important attributes of the political events data is the Goldstein scale (Goldstein, 1992), which characterizes the degree of conflict or cooperation between the two actors of the event. As on each single day, for each country, there are many events. Therefore, one can readily compute the daily average of the Goldstein scale for the country. This daily average changes with time, i.e., it is a time series. We analyze this time series by computing the Hurst parameter using the most robust method, the adaptive fractal analysis (Gao, Hu, Mao, &

Figure 3: Long-range correlations (or inertia) of political processes in four countries: (a) USA, (b) China, (c) Turkey, and (d) Indonesia. The blue curve has a temporal resolution of 1 month, while the red one has a temporal resolution of 1 year.



Perc, 2012) & (Gao, Hu, & Tung, 2011). Four examples of the variation of H with time are shown in Figure 3, for USA, China, Turkey, and Indonesia. In fact, in each subplot, two curves are plotted. The blue curve has a temporal resolution of one month, while the red one has a temporal resolution of one year. To better understand these curves, we focus on the red curves. First, we observe that all curves lie between 0.5 and 1, meaning that all political processes are characterized by long-range correlations. Second, we observe that the variation of $H(t)$ is different for different countries. In fact, this variation is dictated by the major political events that occurred in the respective countries. In the case of USA, for example, there are three large decreases in $H(t)$. The last two can be easily associated with the two Iraq wars. The most interesting is the first sharp drop in $H(t)$ that occurred around 1987. This suggests that the cold war between USA and former Soviet Union also had greatly strained the USA. As another example, let us examine China. The sharpest variation in $H(t)$, around 1990, was caused by the Tianmen Square event. The second, more gradual decrease in $H(t)$, occurred around 1997, when Deng Xiaoping died. Since then, $H(t)$ has continued to decrease, coinciding with a lot of conflictual events. $H(t)$ reached a local minimum

around 2002, when leadership was relegated from Jiang Zemin to Hu Jintao. We also note several epochs when $H(t)$ increased. One started around 1982, coinciding with the initiation of economic reform in China. The other occurred around 1992, which led to enhanced economic reform after the Tianmen Square event. The third occurred during the reign of Hu Jintao, around 2006. The enhancement in $H(t)$ during this recent episode, while consistent with some notable achievements by China, including completion of the structural work in the Three Gorges Dam in 2006, success of Lunar Exploration Program in 2007, and the 2008 Summer Olympics, may also reflect enhanced control by the Chinese government. As with the power switch between Jiang Zemin and Hu Jintao, the power switch between Hu Jintao and Xi Jinping produced a local minimum of the curve in 2012.

In general, $H(t)$ will increase when policies in a country are enhanced and will decrease when internal/external conditions change such that many policies of a country have to be modified or replaced by new ones. With this understanding, we can now understand why the Ankara-Istanbul line, even though constructed for 11 years, from 2003 to 2014, was successfully completed. It was in an increasing $H(t)$ episode. Such long episodes are rare among all the countries in the world though. In contrast, the $H(t)$ curve for Indonesia varies with a much higher frequency. This is very reason that has caused the anti-China sentiments mentioned earlier.

To summarize, the average time scale for policy changes can be readily estimated from the $H(t)$ curves, which quantifies how policies in a country is executed or changed.

CONCLUDING DISCUSSIONS

After the Belt and Road initiative has evolved to the current stage, it is important to make every effort to make it a great success so that the entire world and mankind can be greatly benefited. Overseas high-speed railway investment is an important element of the Belt and Road initiative, therefore, it is fundamental to understand why setbacks to many planned or announced lines have occurred, and even more importantly, to adjust the investment strategy so that risks can be reduced and profits can be increased. To achieve this goal, we have advocated an integrated study by synthesizing all available data, including massive media reports, demographic, and all kinds of macroeconomic data. In particular, we have shown that the main reason for the stalling of China's overseas railway projects is that many of the planned high-speed rails are not needed in the host countries at all, as the total railway passengers in those countries have been steadily decreasing in the past couple of decades or more, while the total railway mileage has been increasing significantly in some of those countries. A few different mechanisms responsible for this behavior have been identified. We have also found that for railway projects to be successfully completed, it is important to prevent infrastructure development from politicization in the host countries. A necessary condition for a project to be

successfully completed is that its completion time is shorter than the average time for policy changes in the country. The latter time scale can be readily estimated from analysis of massive media reports data, through a complexity measure called Hurst parameter which characterizes the long-range correlations of political processes.

The approach developed here not only applies to overseas high-speed railway investment, but also to other infrastructure investments. It may also shed light on more general investments, including merger and acquisition. This point is very important, considering that China's investments on the countries along the Belt and Road have been expanding steadily. The numbers speak more loudly: the direct investment along the Belt and Road in 2016 reached US\$14.5 billion, counting for 8.5% of the total direct investment in 2016. The merger and acquisition in 2016 reached US\$300 billion. The three year total direct investment along the Belt and Road, from 2014 to 2016, exceeded US\$50 billion, as pronounced by President Xi Jinping in the opening keynote speech of the Belt and Road Summit held on 14 May 2017. While some of the investments will likely be profitable, some have been not. Some of the latter have even been entangled with power struggles in certain countries. The last is clearly undesired. To make effective adjustments, demographic dynamics have to be carefully studied, and best efforts have to be made to prevent any projects from being politicized. ■

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Content: On the Bangkok to Nakhon Ratchasima route, there are already three governmental projects: The high-speed train, the dual train tracks project and the new motorway
 Comment: Can someone clarify if this is freight or passenger? Who would take a high speed train from Bangkok to Korat? It is only a 2.30 hour drive and mostly it is Hi So Thais who go there in the Khao Yai season, and they are never going to lug their families to a train station instead of driving (you need a car when in Korat anyway to get around). Workers going back to Korat or deeper Issan would not pay for it and will just get cheap buses the once or twice a year they go home. So who exactly is going to use this train?

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HOW TO RECOGNIZE AND DEAL WITH CURRENCY RISKS DURING INVESTMENT

Bob He, Bank of China

As the trend of globalization has been growing, the capital flows more frequently and widely and investment becomes more global. Thus, to reduce currency risks during investment has become a more focused issue. Since the 2008 financial crisis, the volatility of currency market has increased. Investors would face the issue of how to recognize and deal with the risk of currency loss. The changes of currency rate could directly cause losses when profits or dividends from an investment are converted from foreign currency, and then lead to unpredictable outcomes of the investment. So, to recognize and scientifically manage currency risks is vital for stable returns and value creation.

RECOGNITION OF CURRENCY RISKS DURING INVESTMENT

Currency risks majorly come from investors or equity and liability portfolios that are poorly managed and are a combination of currencies or terms of FX, which is a leakage to risks and could affect the market-to-market value of

assets and liabilities caused by the exchange rate volatility. And to most of the investments, the currency exchange rate is an external variable, which makes the value of return on investment unpredictable, especially when financial leverage is added into the investment currency and cause the risks to be magnified. Hence, to recognize currency risks efficiently is rather important to the entire process of investment.

The Mis-Match of Currencies and Equities and Liabilities

If investors conduct investments in local currency then there are no currency risks. However, when it comes to global investment, the investment targets and capital are usually from different regions and in the beginning the capital has to be converted to the investment target's regional currency and then exchanged back to the original currency through various channels when exiting, and hence the loss or gain is created during the process of the exchange of currencies and the exchange rate would affect the ultimate investment return. In this way, the mis-match of currencies of the regions where the capital is raised and the investment is targeted, becomes one of the major sources of currency risks.

Table 1:

The rate of return of Chinese yuan vs. other currencies from Jan, 2017 to Jan, 2018 | Source: Bloomberg

Currency	Interest Return	Ex Rate of Return	Overall Return
Brazilian Real	8.43%	-8.51%	-0.08%
Japanese Yen	-0.12%	-3.50%	-3.62%
Canadian Dollar	1.15%	-1.86%	-0.71%
Taiwan New Dollar	0.67%	-0.84%	-0.17%
Euro	-0.36%	6.89%	6.53%
South African Rand	7.48%	4.18%	11.66%
US Dollar	1.40%	-7.67%	-6.26%
British Pound	0.39%	4.01%	4.40%
Norwegian Krone	0.86%	-0.48%	0.38%
Singapore Dollar	1.04%	0.10%	1.14%
New Zealand Dollar	2.31%	-7.06%	-4.75%
Swiss Franc	-0.76%	-1.95%	-2.72%
Swedish Krona	-0.53%	3.42%	2.89%
Mexican Peso	7.43%	3.17%	10.60%
Australian Dollar	1.92%	-1.09%	0.83%
South Korean Won	0.98%	0.11%	1.09%

The Timing of Currency Cash Flow in the Investment Portfolio

Another risk is caused by the mis-matched time of currency cash flow in the portfolio. For instance, if the investor has an expected income of foreign capital and an expenditure in foreign currency in the current period, even though the portfolio might look balanced, the exchange rate during the actual time period of cash flow could cause gain or loss, and still would affect the portfolio. Thus, timing could also lead to currency risk.

The Correlation Between the Value of the Investment Target and Currency Exchange Rate

The correlation between the value of investment target and currency exchange rate is rather a hidden risk and, thus, easily ignored by investors. Nonetheless, investors can effectively offset currency-related gains or losses by using hedges or other techniques when dealing with large category of assets. When the investment target is overseas, if the price of the target negatively relates to the local currency rate then, with hedging inclusive of the correlation, the risk decreases, and vice versa.

THE IMPORTANCE OF MANAGEMENT OF CURRENCY RISKS EFFICIENTLY

To identify currency risks is the first condition of scientifically managing and dealing with the risk so that investment return is maximized and volatility is minimized. Also, it leaves for more space for investors to exert their talent and energy on the investment itself instead of distracting too much by external variables.

To Effectively Reduce the Volatility of the Return on Investment

According to the modern investment theory, the risk-adjusted rate of return is an appropriate index for both investment return and investment risk to measure the maximized return with certain risks taken into consideration. The risk-adjusted rate of return can also be utilized for portfolios comparison to evaluate investment performance. Risk adjustment can lower the instability during the process of investment and bring decent return to investors.

To Make Investors More Focused

There is an old Chinese saying which goes “One specializes in one profession”, emphasizing on the professionalism creating greater value in every industry. It certainly applies to the financial industry. Financial investors should allocate more time and energy to the investment target itself and leave the risk control work to the management company in order to deliver better outcomes from the investment portfolio.

To Actively Convert Currency Risks to Value Creation

For those investors with professional capability and resources, to actively approach value creation through transferring currency risks can also improve the portfolio

performance. Currency trading is one of the important trading markets, and it is an essential investment target as well. In portfolios with large portions of currency trading, mainly through which professional managers deliver investment return.

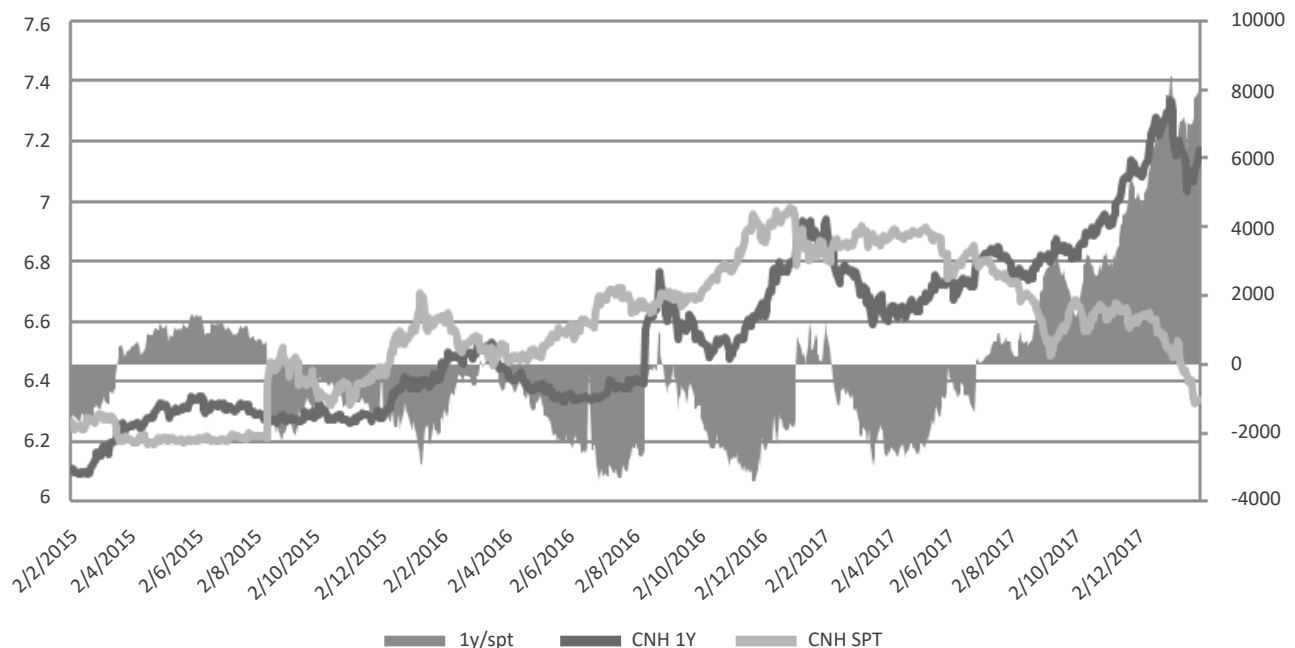
MAJOR METHODS FOR CURRENCY RISK MANAGEMENT

Major sources of currency risks have been discussed above, known as mis-match of assets and liabilities and timing. Thus, to control currency risks is mainly about narrowing down the mis-match to the best tolerable value. Based on past experiences, hedging, generates cost and can be categorized into two methods: to internally hedge timing with the allocation of assets and liabilities currency costs less but is harder to practice, or, to hedge externally through currency derivatives, which costs more but is easier to practice. In addition, currency risk management depends on fast decision making system, without much to explain, due to the instantaneously changing market.

Allocation of Assets and Liabilities - Internal Hedging

This method costs less, and the basic practice can be described as fundraising in the investment target region and match the fundraising period with investment term, and after the investment life cycle exchange the return from local currency back to the investors’ country currency at one time. This method can avoid losses created by exchanging currencies during the investment process, and bear the one time loss, if any, at exit when converting back to original currency. Nonetheless, in reality, for any long-term investment it is not easy to raise low cost fund in a foreign country and thus this method usually gets many restrictions when put into application, but can be used as a theory to risk control.

Figure 1:
One Year Long Term Currency Hedging Outcomes | Source: Bloomberg



Fully Utilize Currency Trading Derivatives - External Hedging

This method better suits modern day financial market, leaving the work to those who are specialized in. The currency exchange market is one of the markets with best capital flow. According to the world clearance bank, in the year of 2016 the deal scale of each trading day in the currency exchange market reached 5.1 trillion US dollars. Meanwhile, the currency exchange derivatives market is rather active and well developed. The main stream products are currency forwards, currency swaps, currency options and currency futures. The prices are transparent and deals are easily made. Investors can simply make deals through commercial banks or exchange markets with relatively reasonable fees charged, and the process is very standardized with rules easy to follow. Commercial banks also designed OTA products to satisfy requirements by various investors.

Building Up Efficient Decision-Making System to Manage Risks

A healthy and well established decision-making process is necessary to risk management. The currency trading market changes instantaneously and it not only requires fast and flexible traders to be at every check point but also responsible professionals to be authorized and with incentives to be able to make decisions in the first hand. A good management team could catch the best timing of the market to hedge to reduce the risks and cost and enhance the outcomes.

All in all, investors need to recognize currency risks when conducting international investment activities, and fully realize the sources of causing them. And to establish efficient risk control system by selecting external or internal hedging methods, and above all to form a fast and accountable decision making management process to better deliver greater values to investors. ■

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