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China

RMB Hedging Forex Risk

By HERBERT POENISCH*

In the January issue of the International Monetary Review I described the financial use of RMB overtaking the use for international trade.

In this issue I take the recent decision by SAFE[1] to allow foreigner institutional investors access to derivatives products for hedging their investment in the onshore interbank RMB bond market.

The weak side of internationalization of RMB was always the third function of money, the storage of value. While central banks and sovereign wealth funds have been allowed into the RMB interbank bond market, allowing non-government foreigners, mostly in form of institutional investors under the QFII scheme to participate is relatively new. The next logical step is to allow these foreign institutional investors to hedge their investments in onshore RMB.

This short article first looks at the size of the global institutional investors, who are searching for yields around the globe and the availability of debt securities. Secondly, what does the recent decision by SAFE mean for these global investors and thirdly what are the risks involved.

1. Size of Institutional Investors and China Interbank Bond Market

The OECD has been collecting data on institutional investors in member countries for many years. It is only recently that this exercise has been fully appreciated as the total funds available to these institutional investors in 2014 were close to USD 100tr, compared with USD 12 tr in official foreign exchange reserves and a global GDP of USD 70bn.

Even a small shift in these funds causes major forex and asset market reverberations. Most of these funds are constrained by strict investment guidelines which allow them to move only marginally.

As shown in figure 1, investments funds, insurance companies and pension funds make up the lion share of the total, some 75% of the total in 2011. They invested mainly in eligible publicly quoted equities and debt securities. The investment and holding periods of different institutional investors vary at any point of time and over time. Investment Funds and Pension Funds allocate a larger share into equity whereas insurance companies have a preference for debt securities.

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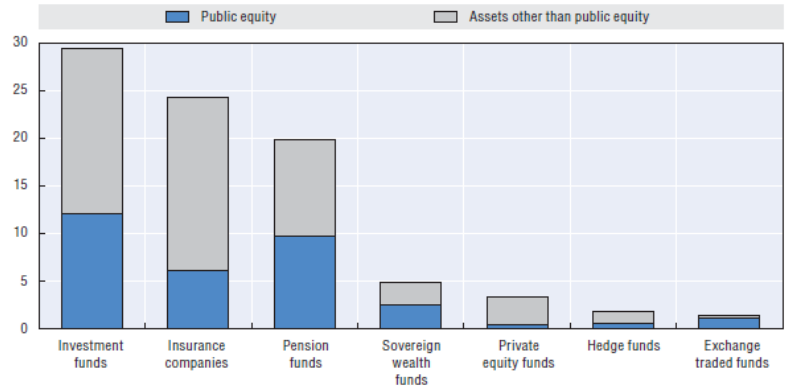
[1] Decision of 27 February 2017(in Chinese):国家外汇管理局关于银行间债券市场境外机构投资者外汇风险管理有关问题的通知书(汇发表 17 年 5 号)www.safe.com.cn

Figure 1. **Total assets under management and allocation to public equity by different types of institutional investors**

In trillion USD, 2011



Note: Investment funds, insurance companies and pension funds data do not cover non-OECD economies. Since institutional investors also invest in other institutional investors, for instance pension funds' investments in mutual funds and private equity, the comparability of different data cannot be verified.
Source: *OECD Institutional Investors Database*, SWF Institute, IMF, Preqin, BlackRock, McKinsey Global Institute.

For comparison, the size of global debt markets in mid-2016 is USD 93 tr, mainly made up USD 72tr of domestic bonds and USD 21 tr of international bonds[2]. The China onshore interbank bond markets amounted to RMB 56.3 tr or USD 8 tr, third in size after the USA and Japan (see table below).

Of this total only RMB 852.6 bn or 1.5% of the onshore interbank bond market are held by overseas investors. This share is much smaller than 9% of Japanese securities and 38% of US issued securities[3]. There is a huge potential from both sides, supply and demand to increase the share of foreign holdings in China's interbank bond market.

A boost of capital inflows is welcome at present when Chinese authorities are struggling to stem capital outflows.

Table 1. Summary of Debt Securities Outstanding 2Q2016 in bn USD

Country	Total debt securities	Domestic debt sec	International debt sec
USA	37,614	35,272	2,342
Japan	13,849	13,582	290
China	8,073	7,874	112

Source: BIS Securities statistics Table C 1

2. Recent SAFE decision on hedging in the interbank bond market[4]

The recent decision to allow foreigners buying onshore bonds in China to hedge their currency risk is a major step forward to attracting international investment in its booming debt markets[5]. These hedging transactions can be concluded with Chinese residents (banks foremost) and include forward contracts, swaps and options.

[2] Bank for International Settlements (2017): Summary of outstanding domestic and international securities 2 Quarter 2016 www.bis.org/statistics/securities

[3] Deutsche Bank (2016):Investing in China's Bondmarket: an overview for global investors, July www.db.com

[4] Interbank bond market is a misnomer as it covers more than 90% of all traded bonds.

[5] Financial Times (2017): China opens up currency hedging for foreign bond investors, 27 February www.ft.com

These measures are targeted at non-central banks, foreign institutional investors, including pension funds, charities and other investors who invest in China's bond market through the Qualified Institutional Investor (QFII) programme. Foreign investors must trade the derivatives through a qualified onshore financial institution and conduct such trading based on 'real needs' for risk hedging[6]. This requires verification to avoid speculative hedging.

Until now many foreign investors have been using derivatives available in the RMB offshore market, which is a costly and time consuming practice. In future China might be easing administrative measures, such as favourable tax policies, extended trading hours and shorter settlement periods. This will prove a challenge for the China International Payment System which will have to include settlement of bonds and derivatives with a central securities depository set (CSD) up.

3. Risks for foreign investors

Foreigners can now hedge their foreign exchange risk at a cost, bearing in mind the widely expected depreciation of RMB. Furthermore foreign investors still carry the interest risk, which in an environment of expected globally rising interest rates from which China cannot exclude itself, is not negligible. This step is also important as in most advanced bond markets the interest swap rate serves as a benchmark[7].

"Much remains to do with designing and operating a Chinese Government Bond market that will provide an efficient yield curve to find out the optimal interest rates from one year to fifty years"[8]. At present this is a captive market as Chinese banks hold the bulk of CGBs. Furthermore, the absence of institutional investors diminishes the urgency to create a yield curve and for the PBOC to use this as basis for its operations.

Recent improvement in monetary operating procedures by introducing an interest corridor should facilitate the use of interest rate derivatives[9]. The PBOC should be the leading institution to shape an 'optimal' structure for the CGBs yield curve. "In order to fulfill this societal responsibility, PBOC should design, develop and operate an effective and efficient monetary policy to manage RMB as an international currency"[10].

It therefore remains to be seen how much these measures help to attract foreign capital at a time when China is facing massive capital outflows. Selling more domestic debt securities to foreigners is a double edged sword, the inflows are welcome but reversals can cause stress for monetary policy. Enforcing strict capital controls is a return to administrative measures which is a temporary setback for the internationalisation of RMB. The outside world expected more market determined exchange rates and interest rates.

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6 Caixin English (2017): China allows foreign bond investors to trade derivatives for hedging 28 Feb www.caixinglobal.com

7 Kreicher, Lawrence L, McCauley, Robert N and Wooldridge, Philip (2017): The bond benchmark continues to tip to swaps. In: BIS Review, March www.bis.org/publications

8 Gormez, Yuksel and Ben, Shenglin (2016): PBOC should practice simple central banking to help RMB Internationalisation. In: Journal of Chinese Economics, Vol 4, No2 p 41www.journals.sfu.ca

9 Xia Le (2017): New tools allow for shrewder Chinese monetary policy. In IMI Review April 2017

10 Gormez, Yuksel and Ben, Shenglin (2016), ibid, p 45.

IMI International Monetary Review

China should not Interfere at the Foreign Exchange Reserve Redline

By TU YONGHONG*

Concern about dwindling foreign exchange (forex) reserves has been rekindled after data from China's central bank showed lately that the country's forex reserve dropped far more than expected to $3.05 trillion in November, its lowest level since March 2011. Given the expectation of yuan depreciation in the face of a stronger dollar and ongoing capital outflows, there is a risk that China's forex reserve may fall below the $3 trillion mark in coming months. As such, voices have emerged suggesting that China should interfere at the $3 trillion redline to prevent the reserves from falling further.

But this is based on a misconception about the function of a country's forex reserve. For a long time, the belief has been that the more forex reserves, the better. The country even prided itself when China's forex reserve exceeded the $3 trillion mark in 2011, far ahead of Japan, the world's second largest forex reserve holder with $1.3 trillion in foreign reserve assets. But in fact, the $3 trillion level has never been the bottom line.

To explain, we need to understand the basic function of forex reserves. A country hoards its forex reserve largely to cushion itself from external crises. The rule of thumb for holding an adequate amount of forex reserve is that it should be sufficient to pay for three months of a country's imports. Additionally, a country should hold a certain amount of forex reserve to repay foreign debt and interest. Lastly, the country should prepare for intervention in the foreign exchange market through market operations. These three basic functions that determined the $3 trillion level of forex reserve should not be viewed as a benchmark or a bottom line.

First, China's imports totaled around $1.4 trillion at the end of November, which means that $400 billion is sufficient to cover three months of import bills. Besides, China has long held a trade surplus, which reached $44.61 billion in November. This means China does not need large forex reserves to pay for imports. Second, China is a net capital exporter with its outbound direct investment surpassing its inbound foreign direct investment. Its external debt-to-GDP ratio remained low at 13 percent at the end of 2015, the second-lowest globally, according to Moody's. That means the need to repay foreign debt is not huge. In addition, on August 11, 2015 China launched a reform to change its calculation method of the yuan central parity rate by basing it on the closing rate of the inter-bank foreign exchange market of the previous day. This reform allowed the central parity rate to closely reflect the real market situation and made the yuan's exchange rate formation mechanism more flexible and transparent. The more market-oriented exchange rate formation requires minimum government intervention, reducing the need to hold a large forex reserve for market intervention.

China's economic rise and changes in its trade and currency pattern means it does not need a significant level of forex reserves. The yuan's inclusion into the IMF's Special Drawing Rights basket makes yuan assets recognized globally and as a reserve currency issuer, China has the chance to use its own currency more freely to cope with a crisis. Besides, the dollar cannot strengthen forever even if President-elect Donald Trump does bring jobs back to the US and focuses more on the national interest, which may help push up the dollar's value momentarily. His proposed policy will likely harm the interest of American industrial workers and exporters,

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which will cause his support to decline along with the dollar's value, reducing the need for holding excessive forex reserve to intervene in the forex market.

Holding a high level of forex reserve increases the opportunity cost. The yield on the benchmark 10-year US Treasury bonds is no more than 2.5 percent while yields on some government bonds in the eurozone register negative values. As a country's asset, low-yield forex reserves are less worthy than high-yield assets such as oil and natural gas and assets whose value does not fluctuate frequently. Holding too much forex reserve is no better than holding a hot potato. In this sense, China's forex reserves are bound to fall, and a level of $2 trillion or below is also considered acceptable given the need for holding a more significant amount has shrunk.

Due to historical reasons, we hold a considerable level of forex reserves. The question now is how to distance itself without causing panic. China does have a lot of options to efficiently use its forex reserve, including to support the country's One Belt, One Road initiative and Chinese firms' drive to go global.

Therefore, we need to abandon the outdated concept of the more, the better regarding forex reserve holding. Defending the $3 trillion mark means non-market based government intervention, which is a result of a planned-economy mindset rather than a market-based mindset.

IMI International Monetary Review

Trumping the Renminbi*

By ANDREW SHENG AND XIAO GENG*

At the recently concluded World Economic Forum Annual Meeting in Davos, Switzerland, Chinese President Xi Jinping mounted a robust defense of globalization, reaffirming his country's "open door" policy and pledging never to seek to start a trade war or to benefit from devaluation of its currency. Soon after, US President Donald Trump, in his inaugural address, effectively made the opposite pledge: using the word "protect" seven times, he confirmed that his "America first" doctrine means protectionism.

Trump speaks of the United States as an economy in decline that must be revitalized. But the reality is that the US economy has been performing rather well in the last two years. Its recovery has outpaced that of other advanced economies; job creation has been impressive; and the dollar has been strong.

The dollar's value has risen particularly high in the last few months, as Trump's promises to increase government spending, lower business taxes, and cut regulation have inspired a flight to quality by investors. By contrast, the Chinese renminbi has weakened significantly – from CN¥6.2 per dollar at the end of 2014 to CN¥6.95 at the end of last year – owing largely to declining investment and exports.

Trump has accused China of intentionally devaluing the renminbi, in order to boost its export competitiveness. But the truth is quite the opposite: in the face of strong downward pressure on the renminbi, China has sought to keep the renminbi-dollar exchange rate relatively stable, – an effort that has contributed to a decline of more than $1 trillion in official foreign-currency reserves.

China does not want the renminbi to depreciate any more than Trump does. But no country has full control over its exchange rate. From technological developments to geopolitical rivalries to policy shifts among major trading partners, the causes of the renminbi's decline – and, thus, the factors influencing China's exchange-rate policy – are varied and complex.

One factor affecting exchange rates is a rapidly changing global supply chain. Evolving consumption patterns, regulatory regimes, and digital technologies have lately encouraged more domestic production. In the US, manufacturing has received a boost from technologies like robotics and 3D printing. That has supported economic recovery, without increasing its imports from Asia.

Meanwhile, China is already shifting from an export-driven growth model to one based on higher domestic consumption, so a stronger renminbi might serve its economy better. China's current-account surplus fell to just 2.1% of GDP in 2016, and the International Monetary Fund projects it to narrow further, as exports continue to fall.

But the current account is not the only relevant factor. Given the role of capital flows in exchange rates, BIS economist Claudio Borio argues for looking at the financial account as well. Here, too, a depreciating renminbi doesn't serve China.

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* This article first appeared on Project Syndicate on January 27, 2017.

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According to the IMF, by 2021, the US net investment position will probably deteriorate – with net liabilities rising from of 41% of GDP to 63% – while China's net investment position remains flat. This means that other surplus countries like Germany and Japan are likely to be financing the growing US deficit position, from both their current and financial accounts. (The expanding interest-rate differentials between the US and its advanced-country counterparts reinforce this expectation.)

But perhaps the biggest challenge for China today lies in its capital account. Since the renminbi began its downward slide in 2015, the incentive to reduce foreign debts and increase overseas assets has intensified.

China's total foreign debts (public and private), already very low by international standards, have fallen from 9.4% of GDP ($975.2 billion) at the end of 2014 to 6.4% of GDP ($701.0 billion) by the end of last year. And this trend seems set to continue, as Chinese citizens continue to diversify their asset portfolios to suit their increasingly international lifestyles. A weaker renminbi will only bolster this trend.

Of course, Trump, who has repeatedly threatened to impose tariffs on China, could also influence China's exchange-rate policy. But, in a sense, Trump's irreverence makes him practically irrelevant. After all, judging by his past behavior, it seems likely that he will accuse China of currency manipulation, regardless of the policy path it chooses: a completely free float with full convertibility, the current managed float, or a pegged exchange rate.

So what is China's best option? A free-floating exchange rate can be ruled out right away. In the current dollar-driven international monetary regime, such an approach would produce too much volatility.

But even the current regime is becoming difficult to manage. Considering the cost of recent efforts to maintain some semblance of exchange-rate stability, it seems that not even the equivalent of $3 trillion in foreign-exchange reserves is enough to manage a currency float.

To be sure, China can – and should – broaden and deepen its international investment position, in order to support currency stability. At the end of 2015, China's gross foreign assets were relatively low, at 57.2% of GDP, compared to about 180% for Japan and many European countries and around 130% for the US. Meanwhile, China's net foreign assets amounted to only 14.7% of GDP, compared to 67.5% for Japan and 48.3% for Germany (negative 41% of GDP for the US). Reforms in the real and financial sectors would enable this level to rise.

For now, however, the best option may be for China to peg the renminbi to the dollar, with an adjustment band of 5%, within which the central bank would intervene only lightly, to guide the market back to parity over the long term. Investors are, after all, focused almost exclusively on the renminbi-dollar exchange rate.

Whatever path it chooses, China will pay a heavy price for advocating globalization and pursuing currency stability. In a world in which announcing new policies – and thus moving markets –is as easy as sending a tweet, politics will trump rational economic discussion.

IMI International Monetary Review

Two Important Trends in Banking Supervision after the Global Financial Crisis and Practices in China

By LI WENHONG*

In the aftermath of the global financial crisis, a comprehensive set of policy recommendations have been initiated by the Financial Stability Board (FSB) and Basel Committee on Banking Supervision to improve the effectiveness of banking supervision and enhance financial stability. Among them, two important trends, from my observation, have been transforming the landscape of banking supervision, which, I believe, will contribute to a more stable financial system at both the international and national levels. This paper is organised as follows: Section I discusses the rethinking of the relationship between banking supervision and banks' risk management, argued from both microprudential and macroprudential perspective. Section II discusses two important trends in banking supervision after the crisis. One is to reduce the reliance of banking supervision on banks' internal risk assessments. The other is to reinforce the current regulatory framework with a greater emphasis on macroprudential supervision. Section III discusses, from the bank regulator's perspective, the macroprudential supervision practices in China. Section IV discusses the challenges faced by authorities to build up an effective macroprudential supervision framework.

1. Rethinking of the relationship between banking supervision and banks' risk management, argued from both microprudential and macroprudential perspectives

Before the global financial crisis, it was widely believed that banking supervision should establish an incentive-compatible structure, to encourage banks to improve the effectiveness of their risk management. The more effective banks' risk management is, the more bank supervisors could rely on their internal risk assessments.

This rationale was highly emphasized in Basel II, where using internal models to bring the regulatory capital closer to banks' economic capital was taken as an important step of improvement before the crisis. Banks, subject to supervisory approval, can choose between standardized approaches and the use of internal models to determine their regulatory capital requirement. For banks using internal models, capital requirement, in most cases, may be lower, sometimes much lower than those using standardized methods. This supervisory approach was regarded as more risk sensitive, more flexible and more aligned with industry best practices. It was also taken as a desirable way to incentivise banks to improve risk management.

From microprudential perspective

However, after the crisis, bank supervisors started to challenge the inherent drawbacks of banks' internal model, thereby raising concerns on the rationale of the existing architecture of the regulatory capital framework.

First, models may have fundamental errors and produce inaccurate outputs when viewed against its designed objective. Running a model involves complex process, which includes application of theory, choice of samples, selection of inputs and estimation of outputs. Errors can occur at any point from design through implementation. Furthermore, some asset classes are inherently difficult to model. Empirical studies have suggested that simpler metrics are at times

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more robust than complex ones, and the use of internal models may not always measure and differentiate risk accurately and appropriately for all portfolios and risk types.

Second, models may be used or interpreted incorrectly or inappropriately. Models by their nature are simplification of reality. But real-world events may prove those simplifications inappropriate. When assuming things happen in a way of normal distribution, we bear risks to use the past to predict the future. All these can lead to financial losses, as well as poor business and strategic decision making.

Third, the use of internal models can provide unintended incentives for banks to underestimate risks and hence capital requirements, as they may have incentives to use models to produce lower risk-weighted assets, and hence higher capital adequacy ratios.

Forth, allowing banks to use internal models to calculate capital requirement has substantially increased the complexity of the regulatory framework while reducing the comparability across banks and jurisdictions. The complexity associated with the use of internal models, the degree of discretion provided to banks in modelling risk parameters and the use of national discretions have all contributed to the excessive variability in risk-weighted assets and eroded the comparability of the capital adequacy ratios across banks.

To address the above issues, it has been agreed after the crisis that, banking supervision should not overly rely on banks' internal risk management. Supervisors need to challenge the process and results of banks' internal risk assessments, not only the design of models, but also the way how models are used. They should not only review whether there is solid model validation process in place, but also review the data quality and assumptions behind models.

From macroprudential perspective

From macroprudential perspective, three issues have emerged as top agenda of banking supervision.

First, procyclicality of the financial system

It has been widely acknowledged that financial system is highly procyclical. The system-wide risks can be amplified by interactions within the financial system and between the financial system and the real economy. Actions that seem reasonable from the perspective of individual institutions may result in undesirable aggregate outcomes if they behave collectively, therefore destabilising the whole system. While each financial crisis is different, a shared feature is that most crises were preceded by an upswing period with the build-up of financial imbalances, characterized by excess liquidity, excessive risk-taking, strong credit growth and asset price increases, and rising leverage and systemic concentrations across the financial system, which often led to further expansion of the economy. During the downturn period, however, banks that experienced substantial losses often faced growing difficulties in replenishing capital. This, in turn, induced them to cut credit and dispose of assets, therefore resulting in further weakening of the economic activities.

In addition, the increasing use of banks' internal models for regulatory capital purposes has been criticized for amplifying the inherent procyclicality of the financial system, and hence being regarded as an important source for the build-up of financial imbalances and vulnerabilities leading up to the global financial crisis. This is because the measures of risk and the assumptions underlying risk measurement tend to be highly procyclical. Near-horizon estimates of quantitative inputs, such as probability of default (PD), loss given default (LGD), short-term volatility, asset and default correlations tend to decrease in the upswing phase and increase in the downturn period, which can lead to decrease or increase in the regulatory capital requirements.

Second, externality of too-big-to-fail

The crisis also highlighted the importance of the too-big-to-fail (TBTF) issue. The large and complex financial institutions, termed as systemically important financial institutions (SIFIs), imposed extensive negative externalities on the financial system and real economy during the crisis. In maximizing their private benefits, individual institutions may rationally choose outcomes that, from a system-wide perspective, are suboptimal because they do not take into account the externalities. These negative externalities include the impact of the failure of large and interconnected global financial institutions that can send shocks through the financial system which in turn harm the real economy. In addition, the moral hazard costs associated with explicit or implicit government guarantees encouraged risk-taking, reduced market discipline, created competitive distortions, and further increased the probability of financial instability in the future.

Third, shadow banking driven by regulatory arbitrage

Shadow banking has been identified as one of the major sources of financial stability concerns, thereby having attracted a lot of attention after the crisis. Partly driven by regulatory arbitrage, recent years have witnessed the rapid growth of the shadow banking system worldwide. These credit intermediaries, which are mainly outside of the regular banking system, are parallel to the traditional banking system and conduct bank-like activities, thereby involving leverage, liquidity and maturity transformation, and imperfect credit risk transfer. Although the shadow banking system has provided an alternative source of funding to corporates and market participants, it could also become a source of systemic risk, both directly and through interconnectedness with the regular banking system. Now it is widely agreed that, shadow banking entities and activities should be brought into the regulatory scope and subject to appropriate form of regulation and supervision.

2. Two important trends in banking supervision after the crisis

The above issues identified from either microprudential or macroprudential perspectives can not be adequately addressed by banks' internal risk management. Therefore, we can see two important trends in banking supervision to deal with the confronted challenges. One is to reduce the reliance of banking supervision on banks' internal risk assessments. The other is to reinforce the current regulatory framework with a greater emphasis on macroprudential supervision. These two trends, from my observation, have been transforming the landscape of banking supervision, contributing to more effective supervision, and in turn leading to better risk management with broader views and forward-looking approach.

(1) Reduce the reliance of banking supervision on banks' internal risk assessments

The crisis experience has precipitated new thinking on the relationship between economic and regulatory capital. It has been realized that banks' internal models can differ in their objectives from those used to calculate regulatory capital. Banks' internal models are tools to maximize risk-adjusted return to shareholders, and intended to capture risks consistent with the risk appetite of the bank. In comparison, the regulatory capital requirement seeks to estimate tail risks to creditors and to the system as a whole. A model that is suitable for one purpose may not be entirely so for the other.

As a result of this rethinking, initiatives have been made to reduce the over-reliance on internal models. Leverage ratio, which is a simple, non-risk based measure, was introduced in 2010 as an integral component of Basel III. It has been emphasized as an important safeguard against model risks and is intended to be a backstop to the risk-based capital regime. First, it provides a floor to the outcome of risk-based capital requirements guarding against model risks and the reduction of capital requirements via the optimistic use of models; second, it mitigates procylicality of financial system by setting a hard limit over the excessive expansion of banks' balance sheet; third, it is simple and could serve as a more transparent metric that investors and counterparties can use to make comparisons between banks over time (BCBS 2010a).

Meanwhile, the Basel Committee has decided to remove the use of internal models for regulatory capital purposes in certain cases. It issued a consultative document - Standardised Measurement Approach for operational risk - in March 2016, where the option to use an internal model-based approach for measuring operational risk - the advanced measurement approaches (AMA) – was removed, as the Basel Committee believes that modelling of operational risk for regulatory capital purposes is unduly complex, and that the AMA has resulted in excessive variability in risk-weighted assets and insufficient levels of capital for some banks. It also released a consultative document - Reducing variation in credit risk-weighted assets - constraints on the use of internal model approaches in March 2016, which proposes removing the option to use the advanced IRB approach for certain exposure categories, such as loans to financial institutions, and completely removing the IRB approaches for equity investment, as the Basel Committee views the model inputs required to calculate regulatory capital for such exposures cannot be estimated with sufficient reliability.

The use of capital floors will also be increased to prevent capital requirement from falling too low due to over-optimistic model estimation. In addition to the current Basel I output floor and some input floors in the internal ratings-based (IRB) approach, the Basel committee is considering introducing more input floors (constraints on input parameters of internal models such as PDs and LGDs) and/or output floors (a minimum risk weighted assets based on standardized approaches). These floors, which have the same benefits as leverage ratio, are meant to mitigate model risk and measurement error stemming from internal model approaches. They can provide additional comfort that banks' risks are adequately covered by capital, help reduce excessive variability in risk weighted assets and make capital adequacy ratios more comparable across banks. In December 2014, the Basel Committee issued a consultative document - Capital floors: the design of a framework based on standardised approaches, which outlines its proposals to design a capital floor based on standardised, non-internal modelled approaches to replace the existing transitional capital floor based on the Basel I framework. In the consultative document - Reducing variation in credit risk-weighted assets - constraints on the use of internal model approaches, exposure-level and model-parameter floors are also proposed to ensure a minimum level of conservatism for portfolios where the IRB approaches remain available.

Last but not least, the Basel Committee has engaged in a strategic review of the overall architecture of its regulatory capital framework, in order to balance risk sensitivity, simplicity and comparability. This will also mean less reliance on banks' internal risk assessment for regulatory purposes. As discussed above, reviewing the role of internal models in the capital framework and finalising the design and calibration of the leverage ratio and capital floors are all part of the Basel Committee's policy package aimed at addressing the concerns on the undue complexity, lack of comparison and excessive variability of its regulatory capital framework.

(2) Reinforce the current regulatory framework with a greater emphasis on macroprudential supervision

Macroprudential supervision: concept and rationale

With the deepening of the global financial crisis, there has been an increasing consensus that banking supervision, which used to be mainly microprudential oriented, should be enhanced by taking a macroprudential perspective. On one hand, since the 1990s, we have entered a period of low and stable inflation across most of the world. But a number of crises, including this one, still happened. This shows that price stability has not been sufficient to ensure financial stability. On the other hand, these crises, especially the recent one, show that effective supervision at the individual firm level is not sufficient to safeguard the soundness of the financial system as a whole. This points to the need for financial regulators to supplement microprudential supervision

with a macroprudential approach to better address the externalities and mitigate the build-up of systemic risks in the banking system, as they can not be adequately addressed by banks' internal risk management. Building a regulatory framework that effectively combines macroprudential with microprudential polices has been a major trend in the aftermath of the crisis (G20 2009，IMF 2009, BIS 2009，FSA 2009a，De Larosiere et al.2009, Brunnermerier et al. 2009, Borio and Shim 2007, White 2006).

As defined by the FSB/IMF/BIS report to the G20 in 2011 (FSB et al. 2011), macroprudential policy is characterized by reference to three defining elements. First, its objective is to limit systemic or system-wide financial risk, thereby limiting the incidence of disruptions in the provision of key financial services that can have serious consequences for the real economy. Second, its focus is on the financial system as a whole, including the interaction between the financial and real sectors, as opposed to individual institutions; Third, it uses primarily prudential tools to target the sources of systemic risk. Any non-prudential tools that are part of the framework need to clearly target systemic risk. In order to better understand macroprudential supervision, we need to clarify its role in the financial stability framework and how it differs from and interacts with the traditional microprudential supervision.

Some people regard the macro-prudential supervision framework as equivalent to the overall framework for maintaining financial stability. However, macroprudential Supervision is a key but only one element to safeguard financial stability. Other essential elements include sound and sustainable macroeconomic policies, safe and sound financial institutions, efficient financial markets, sound financial infrastructure, efficient crisis management and effective financial supervision. Macro-prudential supervision is just an added component to the financial supervision element which, however, has traditionally focused too much on the microprudential objective. While it remains highly controversial on whether monetary policy should aim at achieving both price and financial stability by incorporating asset prices and/or credit growth into inflationary targets and how, there has been a clear consensus that macroprudential tools should be developed and used to limit the build-up of systemic vulnerabilities resulted from rapid growth in credit and asset prices.

Macroprudential and microprudential supervision differ in terms of objectives and characterisation of risk while working together to improve the effectiveness of banking supervision and enhance financial stability. Microprudential supervision mainly focuses on the safety and soundness of individual institutions, largely taking the rest of the financial system and the economy as given. As for policy toolkit, macroprudential and microprudential supervision often use similar tools, such as capital, provisioning and liquidity requirements. But the motivation and calibration of such policy tools are somewhat different. For example, under a microprudential approach, the regulatory capital requirement mainly concerns the risk profile of an individual institution, whereas under a macroprudential approach, the capital also needs to cover its contribution to system-wide risk and the systemic risks that build up during the economic upswing. Notwithstanding these differences, macroprudential and microprudential supervision should not be segregated as they complement and interact with each other, and work hand-in-hand to improve the effectiveness of banking supervision and enhance financial stability. Many views argue that the difference between these two perspectives is largely semantic as long as existing prudential policy frameworks address explicitly systemic risk, adopt a system-wide analytical perspective and target tools at systemic risk (FSB et al. 2011).

It is worth noting that after the crisis, macroprudential issues have been incorporated into the core principles for effective supervision in banking, securities and insurance sectors respectively. The IOSCO Securities Core Principles have been revised to enhance the focus on systemic risk as one of the three objectives of securities regulation, together with investor protection and

market integrity. The revised Insurance Core Principles have added a new Principle (ICP24), which is about macroprudential surveillance and insurance supervision. As for the revision to the Core Principles for Effective Banking Supervision (Basel Core Principles), the Basel Committee believes that macro overlay is integral to many of the core principles. So it is preferable not to introduce a single specific principle on macro-prudential supervision, but rather to include the macro focus, directly alongside the micro focus, within each relevant principle, such as the principles on supervisory objectives, supervisory approach, supervisory techniques and tools, capital adequacy and various core principles related to risk management. Meanwhile, it is specified in the Preconditions for Effective Banking Supervision that an overall macro-prudential policy framework should be put in place to mitigate system risk and contribute to financial stability. Along this line, the Basel Core Principles revised in September 2012, for the first time, specifies that the primary objective of banking supervision should be to promote the safety and soundness of banks and the banking system. This emphasizes that banking supervision should not only guard against the risks on an individual institution basis, but also maintain the stability of the banking system as a whole. Therefore, an effective banking supervision framework should comprise of two components: microprudential as well as macroprudential supervision.

Key elements in the macroprudential supervision framework

The macroprudential supervision framework should have three key elements, ie. macroprudential analysis, macroprudential policy tools and institutional arrangements. Macro-prudential analysis, or systemic risk analysis, is aimed at identifying, assessing and monitoring systemic vulnerabilities so as to inform the macroprudential policy decisions. The IMF, World Bank, BIS and central banks and supervisory agencies in various countries have made lots of efforts in this area before and after the crisis.

The macroprudential policy tools can be characterised as consisting of two dimensions: a time dimension and a cross-sectional dimension. As discussed earlier, this is because that experience shows that two externalities are central to systemic risks: one is procyclicality, the other is the externality of the TBTF issue and joint failures of institutions resulting from their common exposures. So the key issue in the time dimension is how to mitigate the procyclicality of the financial system, while the key issue in the cross-sectional dimension is how to address the TBTF problem and deal with common exposures across financial institutions. After the global financial crisis, substantial progress has been made in countercyclical policies, SIFI supervision and policies to address shadow banking risks.

Basel III represents a fundamental turning point in the design of financial regulation, with an explicit macroprudential dimension supplementing the microprudential elements of the regulatory framework. It provides a strong macroprudential framework that takes account of both sources of systemic risk. On the time dimension, as an important part of Basel III, banks are required to establish capital conservation and countercyclcial capital buffers above the minimum capital requirement. The introduction of the innovative buffer mechanism is aimed at promoting the build-up of additional capital cushions in good times to further enhance resilience and limit procyclicality. These buffers can be drawn down in times of stress to absorb losses and help maintain credit to the real economy (BCBS 2010a and 2010b). It has also been recommended that more forward-looking provisions, Loan-to-Value (LTV) and loan-to-Income (LTI) limits could be useful tools to address threats to financial stability arising from excessive credit expansion and asset price boom. On the cross-sectional dimension, the supervision of systemically important financial institutions (SIFIs) has been substantially strengthened, which include the higher loss absorbency requirement for SIFIs, enhanced supervision and establishment of effective recovery and resolution framework. The objective of the SIFIs

supervision policies is to reduce both the probability and external impact caused by the failure of SIFIs (FSB 2010, BCBS 2010a). More recently in 2015, the FSB introduced an international standard for total loss absorption capacity (TLAC) in resolution, requiring the G-SIBs to have in place a sufficient amount of debt or capital that could be credibly and feasibly exposed to loss, so that the bank in resolution could continue to provide key financial services without exposing taxpayers to losses.

It should be emphasized that the primary objective of the countercyclical capital buffer regime is to achieve the broader macroprudential goal of protecting the banking sector from periods of excess aggregate credit growth that has often been associated with the build- up of system-wide risks. The countercyclical capital buffer may also help to constrain the excess credit growth in the build-up phase of the cycle, as the capital buffer can raise the cost of credit, and hence dampen its demand. However, this potential moderating effect should be regarded as a positive side benefit, rather than the primary objective of the countercyclical capital buffer regime (BCBS 2010b). Therefore, the countercyclical capital buffer is to protect the banking system rather than managing the economic, credit cycle or asset price booms. This makes the macroprudential policy different from the monetary policy, with different objectives, instruments and analytical framework.

With regard to shadow banking, the G20 leaders requested the FSB, in collaboration with other international standard setting bodies, to develop policy measures to strengthen the oversight and regulation of the shadow banking system. To these ends, the FSB has created a monitoring framework to track developments in the shadow banking system in order to identify the build-up of systemic risks and enable corrective actions if necessary. It has also coordinated the development of policies in five areas i.e. banks' interactions with shadow banking entities, money market funds, securitization, securities financing transactions such as repos and securities lending, as well as other shadow banking entities and activities, and published the Policy Framework for Strengthening Oversight and Regulation of Shadow Banking Entities in August 2013. As for other shadow banking entities and activities, the FSB proposed assessing the sources of financial stability risks based on five economic functions or activities, ie. collective investment vehicles, loan provision, market intermediation activities dependent on short-term funding, facilitation of credit creation through credit insurance and securitization-based credit intermediation and funding of financial entities, and apply appropriate policy measures where necessary to mitigate these risks.

3. Macroprudential Supervision practices in China, discussed from the bank regulator's perspective

The Law on Banking Regulation and Supervision promulgated in China in 2003 provides that the objective of banking regulation and supervision is to ensure the safety and soundness of the banking industry, which essentially requires the China Banking regulatory Commission (CBRC) to take a macroprudential approach to banking supervision. This was before the revised *Basel Core Principles* set out the objective of banking supervision is to ensure the safety and soundness of banks and banking industry. The supervisory measures that the CBRC, along with other relevant authorities, has taken from the macroprudential perspective, are summarized as follows:

Systemic risk analysis and assessment

The CBRC conducts risk analysis of both individual banks and the banking sector as a whole. It continuously monitors and assesses the build-up of risks, common risk exposures, trends, and concentrations within and across the banking system, analyzing aggregate data, conducting horizontal reviews and producing various macroprudential analysis reports on a regular basis. Great efforts have been made to build a system risk early warning system for the banking sector.

Meanwhile, it closely follows the developments and changes in the economic sectors and financial markets, both domestic and overseas, which have had or may have material impact on the banking system, and evaluates this impact. Systemic risk analysis has been communicated to banks on a regular basis, through regular meetings attended by the Chairmen and CEOs of all major banks, as well as monthly, quarterly and annual risk analysis reports discussing the common risks and vulnerabilities across banks.

Stress testing has been conducted as part of systemic risk analysis. On one hand, stress test is required to become an integral component of banks' risk management and internal capital and liquidity adequacy assessment process. On the other hand, the CBRC also carries out stress tests at the macro level and for targeted sectors. For instance, in 2010, it required banks to stress test, using common scenarios, their exposures to the property sector in major cities with relatively rapid increase in housing prices. In 2014, it conducted bottom-up and top-down stress tests of 19 major banks，i.e. stress tests of credit risk, liquidity risk and bank exposures to the property market, to analyze the impact of macroeconomic situations, property market conditions and changes in the financial market on the asset quality, capital adequacy and liquidity conditions of the banking sector (FSB 2015).

Macroprudential policy tools, from both time dimension and cross-sectional dimension

The Ministry of Finance (MOF), People's Bank of China (PBC) and CBRC, as members of the FSB and Basel Committee representing China, have actively participated in the international standard-setting on both dimensions of the macroprudential polices, including developing the countercyclical capital framework as well as the policy framework for global systemically important banks (G-SIBs) and domestic systemically important banks (D-SIBs) to address the TBTF issues. In recent years, a series of countercyclical measures have been taken to mitigate systemic risks in the banking system, focusing on the interaction between financial institutions, markets and the wider economy. Actions have also been taken to enhance the regulation and supervision of G-SIBs and D-SIBs, and address the shadow banking risks in China.

(1) Countercyclical tools: capital, provisioning, liquidity and LTV requirements

Capital and leverage ratio requirements

In view of the rapid credit growth starting in late 2008, the CBRC introduced a capital buffer requirement of 2% for all banks and a capital surcharge of 1% for large banks in 2009, even before the Basel Committee finalized its countercyclical buffer and G-SIB and D-SIB policy framework. This means that before the *Basel III* was issued, the capital buffer requirement and D-SIB capital surcharge had already been implemented in China.

In June 2012, the *new Capital Rules for Commercial Banks* was issued in China to implement both Basel II and III. Banks are required to meet a minimum core tire 1 (CET1) capital requirement of 5%, which is higher than the 4.5% Basel III requirement, together with a minimum Tier 1 capital requirement of 6% and total minimum capital requirement of 8%. The *New Capital Rules* also introduced a capital conservation buffer of 2.5%, a countercyclical capital buffer of 0-2.5% and a 1% capital surcharge for D-SIBs. Therefore, when the countercyclical capital buffer requirement is set at 0%, the total capital requirement for D-SIBs is 11.5% and that for other banks is 10.5%. In 2013, the Basel committee conducted the regulatory compliance assessment program (RCAP) to evaluate the regulatory consistency of the *new Capital Rules* in China and graded it as 'compliant'.

The *Supervisory Rules on Leverage Ratio* was issued in June 2011 according to the Basel III leverage ratio standards, and updated in March 2015 according to the revised Basel leverage ratio standards. The minimum standard for leverage ratio is set at 4%, which is 1 percentage point higher than the 3% Basel III requirement. China is the first country in the world to introduce the Basel leverage ratio rules as a minimum regulatory standard.

Since 2010, by referring to the *Basel Guidance on Operating the Countercyclical Capital Buffer*, the CBRC has also conducted empirical analysis of the credit/GDP indicator on a quarterly basis using data starting from 1998, where the credit includes both bank and non-bank credit, in order to evaluate the build-up of systemic risk and the role of the credit/GDP Gap in informing the countercyclical capital buffer decision. The Credit/GDP Gap is calculated as the difference between the Credit/GDP ratio and its long-term trend produced using the hp filter. Currently the CBRC is working together with other relevant authorities to formulate the *Supervisory Guidelines for Countercyclical Capital Buffer*, which will set out the policy framework for activating and releasing countercyclical buffer.

Dynamic provisioning requirement

The CBRC requires banks to take a more forward looking approach when making loan loss provisions, thereby promoting the build-up of provisions during the upswing period. In 2009, in order to mitigate risks arising from the rapid credit growth, banks were required to increase their provisioning coverage ratio, which is the ratio of provisions over NPLs, to 150% by the end of 2009. The *Supervisory Rules on Loan Loss Provisioning* was updated in July 2011, requiring banks to meet both a 150% minimum provisioning coverage ratio requirement and a 2.5% minimum provisioning/loan ratio requirement.

Liquidity risk management requirement

The *Rules on Liquidity Risk Management* was issued by the CBRC in February 2014, which combines both qualitative and quantitative requirements for liquidity risk management. On the qualitative side, the requirements cover liquidity risk management governance, policies, procedures and tools, which are consistent with the Basel *Principles for Sound Liquidity Risk Management and Supervision*. On the quantitative side, the *Liquidity Rules* incorporate the liquidity coverage ratio (LCR) and Basel III liquidity monitoring tools while maintaining the traditional liquidity standards such as liquidity ratio in China. The LCR requirement is generally consistent with the Basel III standards but is more stringent as for the definition of high quality liquid assets (HQLA). Neither RMBS nor equities are qualified as Level 2B assets. The *liquidity Rules* also introduced a macroprudential perspective by requiring banks and supervisors to closely monitor market liquidity conditions, and allowing banks to use their stock of HQLA during periods of financial stress.

LTV requirement

The LTV requirement for mortgage loans has been a very important macroprudential tool in China. In 2004, the CBRC introduced an 80% LTV limit for mortgage loans, together with a 50% monthly debt service ratio limit. In the past ten years, the LTV limit has been adjusted several times in response to the changing property market situations. In May 2006, given rising housing prices, the LTV limit was lowered from 80% to 70%. In September 2007, in response to continuously rising housing prices, the LTV limit for the second home mortgages was lowered further from 70% to 60%, together with tightened risk management criteria for property lending. In October 2008, with the deepening of the global financial crisis, the LTV limit for the first home mortgages was raised from 70% to 80%. However, housing prices picked up rapidly since late 2009. Therefore, in April 2010, the LTV limit for the first home mortgages was lowered again from 80% to 70% and that for the second home mortgages was lowered from 60% to 50%. In January 2011, the LTV limit for the second home mortgages was lowered further to 40%. Since 2015, given the adjustment of the housing market, the LTV limits have been changed upwards, with the LTV limit for the second home mortgages increased to 60% in March 2015. For cities not subject to restrictions on the purchase of housing, the LTV limit for the second home mortgages was increased further to 70% in February 2016, and the LTV limit for the first home mortgages was increased to 75% in September 2015 and then 80% as decided on a

city-by-city basis in February 2016. However, since the first quarter of 2016, the housing prices in the first tire cities experienced rapid increase. Hence, the LTV limit in 16 first tire cities have been reduced since the end of September 2016.

(2) Policy Framework for systemically important banks (SIBs)

The Chinese banks have participated in the Basel Committee's G-SIB quantitative impact study (QIS) exercise since 2009. Four Chinese banks, the Bank of China, Industrial and Commercial Bank of China, Agricultural Bank of China and China Construction Bank, have been identified as G-SIBs consecutively among a total of 30 G-SIBs in the world.

The supervision of SIBs has been a priority on the supervisory agenda. In addition to a 1% capital surcharge requirement, the CBRC has also taken a number of measures to enhance and intensify its supervision of D-SIBs. More emphasis has been placed on high quality corporate governance and risk management in large banks. More supervisory resources have been allocated to conduct more frequent and intensified off-site and on-site supervision, focusing on risk governance, consolidated risk management and risk data aggregation capacity, etc. Consolidated supervision of banking groups have also been enhanced from both cross-sector and cross-border perspectives.

Meanwhile, higher disclosure requirements have been implemented for large and medium-sized banks in China. In January 2014, the CBRC issued the *Guidelines on the Disclosure of G-SIB Assessment Indicators*, requiring banks with a leverage ratio exposure measure exceeding RMB 1.6 trillion, or Euro 200 billion, and banks identified as a G-SIB in the previous year, to disclose the 12 indicators used in the G-SIB assessment methodology in five broad categories, ie. size, interconnectedness, substitutability, complexity and cross-jurisdictional activities. Banks should make the disclosure no later than four months after the financial year-end – and, in any case, no later than end-July. A total of 15 Chinese banks disclosed the 12 indicators as required by *the Guidelines* in 2014 and 2015.

The CBRC is, together with other relevant authorities, in the process of formulating a policy framework for D-SIBs, including the methodology for identifying D-SIBs which will consider four categories of systemic importance, i.e. size, interconnectedness, substitutability and complexity. Banks' systemic importance will be determined according to their systemic importance score, together with supervisory judgment based on additional quantitative and qualitative analysis. This assessment will not only inform higher loss absorbency requirement, but also inform supervisory intensity and resource allocation, which means differentiated regulatory and supervisory measures will be taken according to banks' systemic importance.

Meanwhile, the relevant Chinese authorities have been working together to improve the recovery and resolution regime and tools. The large banks have been required to formulate and submit recovery plans. The Crisis Management Groups (CMGs) for each of the G-SIBs in China have been established with the participation of the MOF, PBC, CBRC and relevant overseas authorities. The CMGs have met on an annual basis, to review the recovery and resolution plans (RRPs), conduct resolvability assessment and discuss other relevant issues to improve the resilience and resolvability of the G-SIBs in China.

In addition, structural measures such as activity restrictions and firewalls have been implemented for a long time to reduce the complexity and interconnectedness in the financial sector. In China, banks are prohibited by law to conduct non-banking businesses, such as insurance and capital market activities. Only in the past few years, some banks have been allowed, on a trial basis and with approval by the State Council, to establish or acquire subsidiaries to conduct non-banking financial businesses, such as fund management, financial leasing and insurance. Moreover, in order to reduce risk contagion across different financial sectors, as well as the level of interconnectedness and complexity in the financial system, the

activity restrictions are reinforced by supervisory rules, such as the rules prohibiting banks from guaranteeing corporate bonds and those prohibiting bank lending from financing stock trading activities.

(3) Addressing shadow banking risks

The MOF, PBC and CBRC, as the FSB members representing China, have actively participated in the discussion of the policy framework to address the shadow banking risks. Meanwhile, non-bank credit intermediation has grown rapidly in China in the past several years. We acknowledge that it's a result of financial deepening and provides the real economy with an alternative source of finance. However, we also recognize that it poses new challenges to risk management and financial supervision.

The non-bank credit intermediation activities are supervised by different regulatory authorities in China. Therefore, in response to its rapid development, the supervisory responsibilities have been further clarified with cooperation and coordination among different regulators enhanced to prevent regulatory arbitrage. Also, to effectively oversee the non-bank credit intermediation, supervisors have focused on the nature and underlying risks in addition to legal forms, to ensure that the activities with similar nature and underlying risks are subject to consistent regulation and supervision.

(4) Cross-sector and cross-border coordination and cooperation

There are a number of formal and informal mechanisms among the various authorities relevant for financial stability in China, which play a crucial role in enhancing information sharing and policy coordination. These mechanisms have helped the relevant authorities to better identify, analyze and assess the emerging risks in the financial sector, and ensure measures are taken in a timely manner to address these risks to maintain financial stability in China.

The Financial Crisis Response Group (FCRG) led by the State Council has been the highest level of forum for the discussion, coordination and decision of financial stability issues in China. At the second level is the Financial Regulatory Coordination Joint Ministerial Conference (JMC) among the central bank, three financial regulators and State Administration of Foreign Exchange (SAFE) established in 2013. The JMC has met on a quarterly basis and mainly focused on cross-sector cooperation and coordination. At the third level are the supervisory MOUs. On matters related to specific supervisory cooperation and coordination, the three financial regulators operate according to the tripartite *MOU on Supervisory Cooperation and Coordination* signed in April 2004, as well as subsequent bilateral MOUs sighed in 2008 and onwards (FSB 2015).

In practice, the PBC and three regulators jointly issue supervisory rules, guidelines and other policies on issues that need joint efforts from relevant agencies. They also share information and conduct joint on-site examinations on cross-sector activities. The extent and frequency of information sharing and cooperation have been enhanced in emergency situations.

With respect to cross-border cooperation in the banking sector, the CBRC has signed MOUs and Exchange of Letters (EOLs) with supervisory authorities in 68 countries and regions. It conducts bilateral consultations regularly with US, UK, Canada, Japan, Korea, Singapore and Hong Kong counterparts, etc. Since 2009, the CBRC has held supervisory colleges for large banks on a regular basis, with the supervisory colleges for the G-SIBs in China taking place once a year. Meanwhile, the CMGs for the G-SIBs in China have and will continue to play an important role in strenghtening both cross-sector and cross-border cooperation and coordination.

4. Challenges faced by authorities to build up an effective macroprudential supervision framework

Even though after the crisis, lots of efforts have been made to enhance macroprudential supervision, recent experiences have shown that authorities are facing great challenges to build up an effective macroprudential supervision framework.

First, it is difficult to identify systemic vulnerabilities in an accurate and timely way. Recent crisis has defeated our belief that systemic risk could be identified easily beforehand. Although we have a lot of models at hand, we find that none of them is sufficiently robust to predict crisis in advance. My view is that assessment of systemic risk should not be limited to develop and utilize quantitative models and early warning indicators, but needs to involve qualitative discussions even debates among relevant agencies, and making judgments and decisions based on credible knowledge and experiences. It will only work effectively if there is intense joint working by central banks and supervisory agencies to bring together macroeconomic analysis as well as insights from specific institutions, and from sectoral and business model analysis. It is also important to close data gaps that hinder systemic risk assessment, and to enhance data infrastructure to improve the capability of identifying, analyzing and monitoring systemic risks.

Second, as for the use of macroprudential tools, the uncertainty of the measurement of systemic risk and the transmission channels of macroprudential tools would support a discretionary use of the toolkit. However, rules have the benefits to overcome the bias for inaction, especially given potentially strong market resistance. In my view, it would be desirable, to the extent possible, to introduce simple, transparent and easy-to-implement rules. This can help relieve market pressures on authorities to take unpopular actions, especially during the upswing period. If carefully designed, rules can serve as built-in stablisers which depend much less on the ex- ante risk assessment. Having said that, we should be fully aware that in the real world, due to practical constraints, we will always have to face the trade-off between rules and discretion, and need to apply expert judgement for policy decisions.

Third, as financial stability is harder to measure than the price stability objective of monetary policy, it is difficult to define the macroprudential accountability of agencies. Furthermore, sound macroprudential policies mean that authorities will need to make unpopular decisions. My view is that macroprudential institutional arrangement should balance independence and accountability to encourage authorities to act in a responsible and timely way. In essence, macroprudential supervision is a shared responsibility of central banks and supervisory agencies. They should all strengthen the macroprudential orientation, i.e. take account of financial system stability in carrying out their mandates. In particular, assessment of systemic vulnerabilities need be jointly conducted by the central bank and supervisory agencies, with policy responses coordinated to mitigate the build-up in systemic risks. In this regard, effective cooperation and coordination among the central bank and supervisory agencies will be more important than ever. We notice that the Financial Stability Oversight Council (FSOC) established in the US and the European Systemic Risk Board (ESRB) in the EU are essentially formalized/enhanced coordination mechanisms for assessing systemic vulnerabilities and making policy recommendations. In addition, mechanism should also be put in place to enhance the coordination between macroprudential and other policies such as microprudential and monetary policies.

Finally, it remains to be seen how effective the macroprudential policies would be in practice. Since 2009, the FSB, along with national authorities, has taken great efforts to address the TBTF problem. However, the recent IMF analysis shows that this TBTF problem is far from being solved. The implicit subsidies have fallen but are still huge for SIBs, and the expected probability that SIBs will be bailed out remains high in all regions. We should be aware that the TBTF problem remains to be a threat to the global financial stability and more efforts still need to be made in the years to come.

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New Direction of Bond Market*

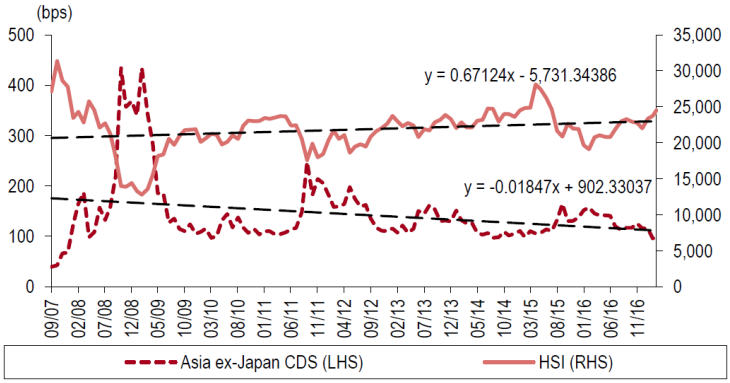
By STEVE WANG, WU QIONG AND ZOE CHUANG*

Stock-credit Relationship

Credits and stocks are two interdependent "wheels" of the financial vehicle for an enterprise at the micro level and for the overall economy at the macro level. The relationship between the credit market and the equity market evolves with time at different stages of an economic cycle, but the general trend is that an improving economy offers fundamental support to the credit market, while the rising equity value of an enterprise offers a boost to the credit quality of the company. However, when the rising-equity-value and declining-credit-spread party comes to an end, the two wheels will reverse gears together to embark on a journey in different directions that is often marked by financial or economic crisis. Of course, there are transitional phases during the movement from the good time to bad time.

We illustrate such a stock-credit relationship for the Hong Kong market below. Figure 1 shows nearly 10-year history (since 2007) of HK's Hang Seng Index (HSI) and the Asia Ex-Japan 5-year CDS Index. The Hang Seng Index represents both a stock market dominated by Chinese companies and the overall equity market sentiment of the Asia region, as China is a very important factor to the other Asian economies in the region. The Asia ex-Japan CDS represents the condition of the credit market of the region, and China and HK credits currently make up 1/4 of the index membership.

Figure 1. Hang Seng Index (HSI) and Asia Ex-Japan 5-year CDS Index



Source: Bloomberg, BOCI Research

There are two clear relationship patterns between the stock and credit indices. First, the long-term trend lines of the two (Figure 1) indicate the higher the stock index, the lower the

* This is an excerpt from *China's Rising Certainty at an Uncertain Time – A Cross-market and Cross-asset View* by BOCI Macro and Strategy Research. Disclaimer: This article is for information only and does not constitute investment advice. None of BOCI Macro and Strategy Research, IMI or the authors themselves is responsible for any losses.

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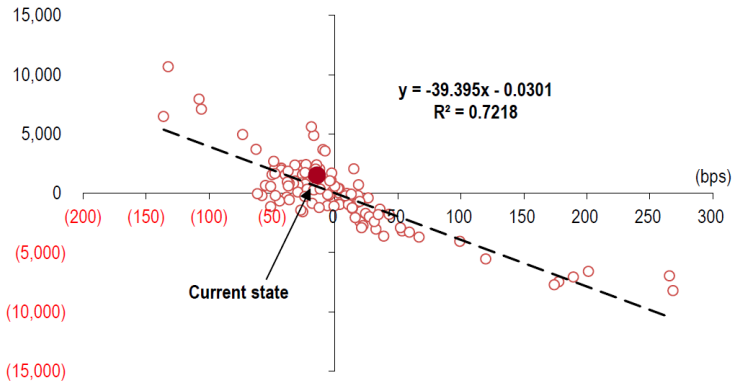
credit spread. Such a relationship is more obvious in a regression analysis on de-trended data. If we take the long-term secular trend out from the data sets and focus on the movements around this secular trend only (de-trending), we can find a statistically-significant negative relationship (R2=72%) between the stock index and the credit index, i.e. higher stock prices correlate to lower credit spreads (Figure 2).

The recent trend patterns of these two indices hold up this relationship well. The stock index has been going up while the credit spread has been coming down. Over the data length, the current state of the relationship is still very close to the trend level, which means the two indices have ample room to extend their recent trends to reach higher grounds.

Figure 2. Relationship between Stock and Credit Indices

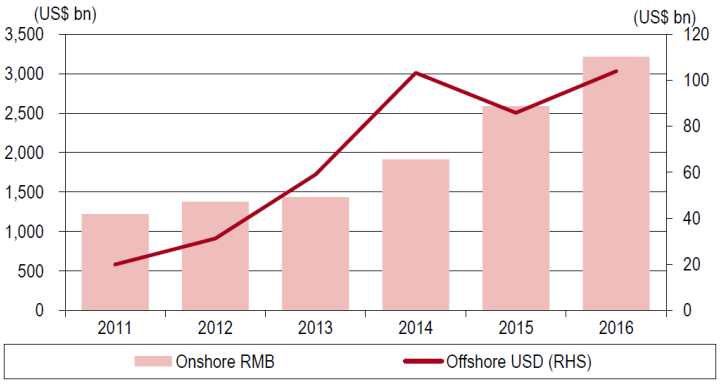


Source: Bloomberg, BOCI Research

As we have mentioned earlier, the two markets can positively enforce each other in an up-cycle (or negatively in a down-cycle). If the stock market moves further higher, we will see further reduction of credit risks in the market and in the economy. Moreover, a further reduction in credit risks will encourage more credit extensions from lenders and investors to corporations and to the economy. Increased credit resources will fuel further corporate investment and expansion, until the "music" stops on over-loaded debt burdens.

The Chinese bond market has remained sizzling in 2017 after a record year in 2016 (Figure 3). The offshore USD bond issuance from Chinese borrowers has been very active YTD, as Chinese credit spreads are getting tighter and overseas investors have shown more appetite for Chinese bonds. Bond issuance in the domestic bond market also recorded a new high in 2016, and more foreign investors have been attracted to the market in recent years. This, in part, reflects the fact that the Chinese economy appears to have stabilised and is possibly making a turn for the better, and foreign investors are showing more confidence in the Chinese market, including the domestic bond market.

Figure 3. Annual Chinese Bond Issuance Volume Onshore and Offshore



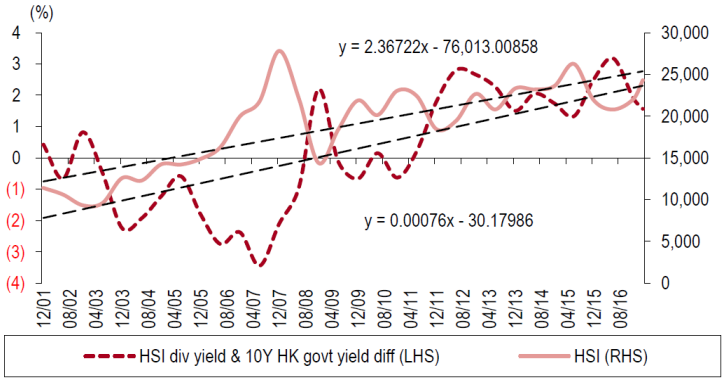
Source: Bloomberg, WIND Database, BOCI Research

Stock-bond Relationship

We can show another stock-bond relationship to demonstrate that the HK stock market may have found a strong base to continue the current uptrend. The stock index value and the bond yield have established a classic relative value relationship between stocks and bonds. Figure 4 shows the history of HSI and the yield gap between the stock index dividend yield and the 10-year Hong Kong government bond yield (since 2001). If we take out their long-term trends that may reflect certain structural shifts in the two data histories and instead focus on their multi-year cycles, we find a significant but inverse statistic relationship between the two (Figure 5). Such an inverse relationship means a rising stock price corresponds to a decreasing attraction of stock dividend yield versus bond yield. This makes perfect sense, as a rising stock price will normally reduce the stock's dividend yield, and at the same time a rising stock market usually corresponds to a growing economy and therefore rising inflation expectations, which in turn push up the bond yield.

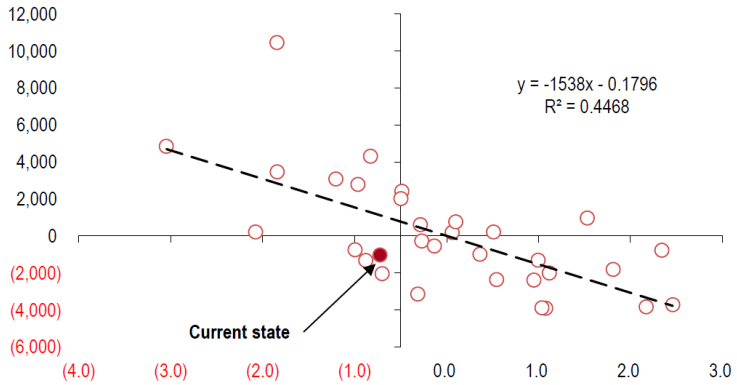
The current state of this stock-bond relationship is also close to the trend level, which means both have the potential to continue further with the current trend pattern. In other words, the stock prices can move further up and the government bond yield could also rise higher. With the US Fed now settled into a rate hiking path, the HK government bond yield is likely to eventually move to a higher ground with the Fed. When the attractiveness of stock dividend becomes lower, investors will look more for capital gains on a stock. This forms another positive feedback to enforce the up-cycle of the Hong Kong stock market.

Figure 4. Hang Seng Index and Yield Gap between Stock Index Dividend Yield and 10-Year Hong Kong Government Bond Yield



Source: Bloomberg, BOCI Research

Figure 5. De-trending Relationship between HSI and the Gap of Stock Index Dividend Yield vs. 10-year HK Government Bond Yield



Source: Bloomberg, BOCI Research

Relative Value of Chinese Credits

Chinese USD bonds now make up a large share of the Asia USD bond market. In 2016, Chinese issuers contributed over 60% of the total new issuance volume of the Asia ex-Japan region. The continuous growth in the size and depth of this segment in the global credit market has attracted increasing participation from international investors.

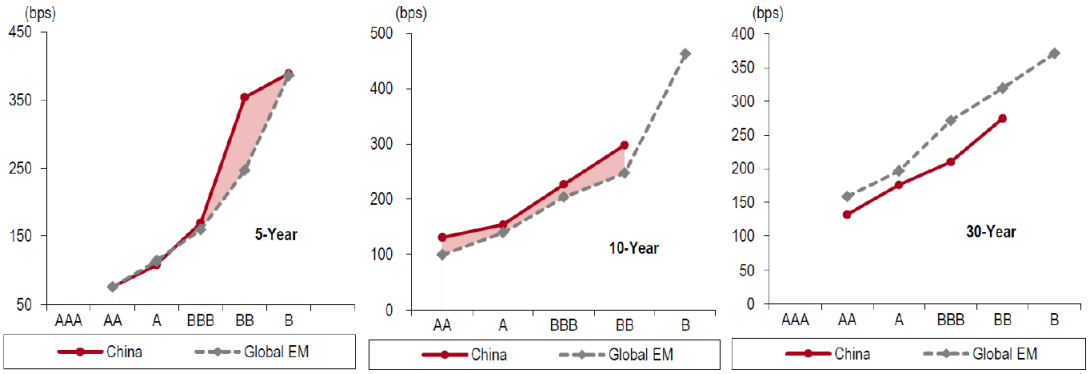
We compare the current relative values of Chinese USD bonds with the global EM (emerging market) bonds (see Figure 6). In the 5-year space, the IG Chinese USD bonds trade essentially in line with the overall IG EM bonds, while the HY Chinese bonds trade much cheaper. The 5-year tenor has been the most popular issuance sector for Chinese issuers, and the good liquidity and variety in this sector, particularly in the IG space, have drawn the highest interest and focus from international investors. Meanwhile, the continually-cautious approach of many international investors towards Chinese credit investment has also driven their investment choices largely in

the IG segment of the market, making this part of the Chinese credit curve crowded and quite comparable to the global EM credit market.

In the 10-year space, Chinese bonds overall trade cheaper than their EM peers across the curve. Most of the 10-year supply from Chinese issuers is in the IG sector. However, demand for 10-year bonds is relatively low as compared to 5-year Chinese bonds. This is particularly acute for credit investors from China, who have become a very important investor force for Chinese USD bonds in the recent years. Their investment interests in 10-year bonds are still limited. We think it is the relatively low investment interests in the 10-year Chinese bonds that have resulted in the cheapness of this sector.

In the 30-year space, there is very limited supply from Chinese issuers. Only the high-quality Chinese issuers issue 30-year bonds, plus a few perpetual bonds from lower-rated issuers. On the other hand, demand for high-quality Chinese 30-year USD bonds has been on the rise in recent years, from both Asian insurance funds and China's own insurance investors as well. The demand/supply imbalance both on global and regional basis probably has contributed to the relatively richness of the Chinese 30-year curve over the global EM curve.

Figure 6. Comparison of Z-spread Credit Curve of USD Bonds in 5-, 10- and 30-year Maturity Buckets: China vs. Rest of Asia



Sources: Bloomberg, BOCI Research

Xiongan New Area Announced*

By XIA LE AND CARLOS CASANOVA*

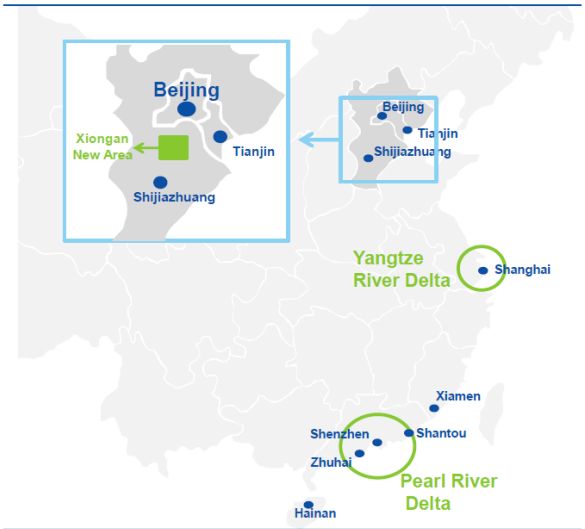
China's latest Special Economic Zone (SEZ)

On April 2, China announced the establishment of a new economic zone 100km south of the capital, Beijing. The Xiongan New Area will encompass three counties, including Xiongxian, Rongcheng and Anxin. The area will sit at the center of a triangle formed by the capital, Beijing; one of North China's busiest port cities, Tianjin; and the capital of Hebei province, Shijiazhuang. While the SEZ has been capped at 100 km2 for now, the plan is to extend this to 2000 km2, connecting all major urban clusters in a new mega-city. All property-related transactions in the three counties were halted on Saturday in order to avoid speculative pressures.

Politically motivated decision with economic benefits

The new area is of national significance, and will form part of the consortia of SEZs like Shenzhen and Pudong New Zone. Shenzhen was established by Deng Xiaoping in the 1980s to experiment with capitalist models of business, while Pudong was created in the 1990s by Jiang Zemin. Rather than marking a strategic shift in China's urbanization plan, the move constitutes a commitment towards China's long-term urbanization goals. Xi Jinping pledged that 60% of China's population would live in cities by 2020. It would therefore be more appropriate to compare the initiative to other urban clusters such as the Pearl River Delta and the Yangtze River Delta. While Beijing will remain central in terms of its political and cultural significance, the objective is to, with time, build the area into North China's economic hub, housing manufacturing and corporate facilities as well as non-government facilities such as universities, hospitals and research institutions.

Figure 1. Map of China's SEZs



Source: BBVA Research

* This article first appeared on BBVA Research on April 3, 2017.

* Xia Le, Senior Research Fellow of IMI, Chief Economist for Asia, BBVA. Carlos Casanova, BBVA.

While the outcomes of the move will only be fully apparent in the long-term, the initiative offers clear short-term economic gains, i.e. facilitating the revamp of Northern China's economy. Urban planning at this scale requires significant infrastructure spending. Light rail, high-speed rail and a bridge have already been completed. More is expected to follow. Limiting the growth of Beijing's population will also help to alleviate some of the existing pressures, including overcrowding, pollution and inadequate water supplies. Finally, it's part of a strategic plan to promote innovation in areas related to technology (Beijing) and manufacturing research (Tianjin).

In sum, the announcement of the establishment of a new SEZ in Xiongan has important implications as it would, on the international front, facilitate a shift up global value chains, while domestically, it prevents the North from lagging too far behind other powerhouses in the South, reducing regional disparities.

IMI International Monetary Review

Controlling the Looming Economic Risks

China should strengthen communication about its policies and take steps to stabilize its exchange rate

By SONG KE*

According to the latest Central Economic Work Conference of China, preventing and controlling risks is a very important part of its policies. While the global market is in a period of flux, preventing and controlling financial risks in China is more meaningful than ever.

Developed countries, such as European countries and the US, have seen the effects of globalization and are taking steps to encourage overseas capital and manufacturing industries to come back to the developed economies.

Meanwhile, many countries, including China, no longer have the advantage of cheaper labor costs. These factors could result in some changes in the global industrial chain's specialization and then influence international capital flows. To the emerging markets, including China, this can mean capital outflows and more challenges to exports. The differentiation of global monetary policies and the expected rise of interest rates would help drive capital to flow from emerging markets to the developed countries.

China should prevent the risks brought by both the real estate industry and RMB exchange rate at the same time. In the past few years, a large amount of global capital entered the emerging markets in different ways and gathered at the real estate industry and stock market, where the profit rates were relatively high. As China's own currency was not the international reserve currency, there are problems with currency and maturity mismatch.

Once policies change, the previously in-flowed capital will be evacuated rapidly, which could cause the collapse of assets value, depreciation of the RMB, the slump of the stock market and other systemic risks. At present, the US dollar is becoming stronger, and the RMB is under great pressure of depreciation. Meanwhile, the domestic real estate market is under stricter control and capital outflow is growing stronger.

If the real estate market is over-cooled or causing individuals to sell their properties and invest overseas, this will aggravate the depreciation of the RMB. Under these circumstances, the control policies over real estate should be tailored for different cities, rather than being the same throughout all of China.

A certain degree of capital control needs to be maintained, especially the supervision of capital outflow of companies that are following China's "going out" strategies. For example, some companies are disregarding cost when doing overseas acquisitions, paying high prices for no reason. China should strengthen communication about its policies and take steps to stabilize its exchange rate.

China should also be cautious of unexpected, rapid inflation. Since last year, the producer price index (PPI) of industrial products has been much higher due to supply-side reform and exchange rate fluctuation. The consistent rise of the PPI will affect the consumer price index (CPI).

If we take international factors into account, Donald Trump's policies to help with the US' inflation and economic recovery could also lead to global expectation of inflation, which would indirectly influence China's domestic bonds, stock market and commodities prices.

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Moreover, if the inflation exceeds expectation, it would restrict what China's monetary policies could do, making it difficult to prevent and control future financial risks.

It is also crucial to prevent global sources from spreading financial risks to China in the current global political and economic environment.

In Europe, political turbulence has affected the financial market in the Eurozone. Several important elections will be held this year, including those of the French president and German chancellor, and Brexit is to be carried out soon. The banking system in the eurozone also faces challenges, especially the fragile banking system in Italy, which could affect other banks in the eurozone. These factors will affect the eurozone, even global trade and monetary policies, and have a huge impact on the global financial market.

In the US, new President Donald Trump's policies could raise uncertainties and influence global expectations for inflation and the global financial market. Trump might make big changes to the US' current macro policies. Trump's stated policies on trade are a form of de-globalization, which may, in a short time, affect China's exports and apply more pressure to the RMB.

At present, it seems China has underestimated the changes that might take place in the China-US relationship after Trump takes office. As many low-income people in developed countries didn't benefit much from globalization, Trump's policies will cater to their desires.

China should negotiate on that, should the free trade process be blocked. If Trump's fiscal policy is carried out, it will encourage the rising expectation of inflation, likely causing the Federal Reserve to increase interest rates to deal with inflation, further pressuring China's RMB depreciation.

IMI International Monetary Review

Outside Investors Play an Essential Role*

By QU QIANG*

As technology develops and new opportunities arise, there will always be a demand for capital from overseas.

The first wave of venture capital came in 1991. Investors intrigued by China's reform and bright future brought in $16 million that year. Just a year later, total funds jumped to $583 million, a multiple of 30 times. This batch of VC investment peaked in 1995, when a total of $678 million was raised. The first international VC firms accounted for more than 95 percent of the total funds raised in China in the first half of 1990s and came to dominate the country's capital funds at the time.

They came to China because the opening up process was restarting and they saw the country's great potential, despite its lack of capital.

Crucially, investors were seeing opportunities to make profits from their investments. In October 1992, Brilliance Automotive became the first Chinese firm listed on the New York Stock Exchange. Its share price appreciated 30 percent within three months of its IPO. The new Shenzhen and Shanghai stock exchanges and the more open financial market also provided early investors a promising vision.

At that time, China did not allow private fundraising or limited partnerships. Moreover, there were no mature market institutions or a legal system.

A few funds incorporated overseas. Most of them were in form of joint venture enterprises, usually in partnership with Chinese SOEs, to help get access to more deal flows, better-secured control over VC-backed firms and "inside connections" with government.

VCs' interest at that time was not in private or high-tech companies, but rather non-privates and low-tech firms in the areas of textiles/clothing, food/beverages or industrial manufacturing. Of the 45 international VC funds between 1991 and 1997, only IDG, H&Q Asia and Walden Group were interested in high-techs. Manufacturing and consumer products accounted for about 78 percent of all VC-backed companies.

However, the Nasdaq boom in the late 1990s, excited VCs who saw IPOs like the legendary Netscape, Yahoo and Amazon. Even the Chinese government was lured by the high-tech boom and started to formulate national programs to support tech firms.

In the 2000s, with China's entry into the WTO, more iconic Chinese IT and high-tech companies were listed in overseas stock markets, including Netease, Sina, Sohu, Tencent, Baidu and Alibaba. China's skyrocketing GDP and the ever-growing capitalization of those VC-backed firms pushed international VCs in China to the top.

However, with success comes criticism. As those once-insignificant small IT firms became commercial giants with strategic importance, more questions started to be asked about the international VCs behind them. As the biggest winners in the Chinese internet story, foreign VCs not only harvested unimaginable wealth but also had controlling rights in those "Chinese" companies. Many feared that foreign owners might act against the interests of China.

However, we should wholeheartedly acknowledge and pay tribute to the international VCs who helped make China a world player in the IT revolution. VCs, like all businesses, are not

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* This article appeared in China Daily on April 7, 2017.

* Qu Qiang, Assistant Director and Research Fellow of IMI. The views do not necessarily reflect those of China Daily.

heaven-sent Samaritans with a mission to nurture and grow the private and high-tech sectors in China. Nor are they evil masterminds who desire to weaken China. They are profit-making businesses.

Let us not forget that the macroeconomic environment and government policies decide market climates and direction of trends, not the players.

A stable and pro-active attitude toward international investors will be continued by the Chinese government. As Premier Li Keqiang remarked: "China is creating a fairer, more transparent and predictable environment for investment."

After 16 years as a member of the WTO, China had attracted around $2 trillion (14 trillion RMB or 1.8 trillion euros) of foreign investment by the end of last year, achieved the fastest growth in the world and was a great beneficiary of globalization. In 2016 alone, there were more than 23,000 foreign-funded companies newly established in China. Foreign investment created 27 percent of Chinese employment and more than 30 percent of its GDP in the past 30 years.

China's reforms are progressively allowing more access for foreign investment, with less red tape and streamlined approval procedures. With the new stock market regulations and GEM board, more companies funded by international VCs will be able to list on Chinese stock exchanges.

However, staying open does not necessarily mean China will not have a bottom line. As better regulations for national security and interests become increasingly accepted global practice, in developed and developing countries alike, China will understandably be more cautious in the areas regarding sovereignty, security and the fundamental well-being of its people. And, it will try to neutralize the potential impacts of global hot money.

Amid the current trend of anti-globalization, we should applaud China's role as a steadfast counterforce, a firm supporter of international investment. With half of the Chinese population still living in rural areas - and with 50 million suffering absolute poverty - this country is still on a long march toward a modern and prosperous future. New growth points and new dynamism will bring new opportunities for innovators.

The opened-up China won't be closed again and will continue to be a hot destination for foreign investors.

IMI International Monetary Review

Asia

Putting Asia's Savings to Work in Asia*

By ANDREW SHENG AND XIAO GENG*

For more than three decades, Asia has experienced faster economic growth than any other region. As it has developed, Asia has been exporting its savings, through a trade surplus with the United States, and re-importing them, in the form of direct and portfolio investment via New York and London – a process that has created severe, though largely overlooked, financial tensions.

At the end of 2015, the combined net asset position of China, Hong Kong, Japan, Korea, Singapore, and Taiwan amounted to $7.3 trillion – almost exactly equivalent to the net international investment liability of the US. And this imbalance is not likely to go away any time soon. In fact, the US's net liabilities have grown lately – to $7.8 trillion at the end of September 2016 – owing largely to its continuing current-account deficit and stronger exchange-rate effects.

Why don't Asian countries invest their savings within their own region? An obvious reason is that the US dominates global finance, particularly in the capital and currency markets. In a 2005 paper, Pierre-Olivier Gourinchas and Hélène Rey argued that the US, once the world's banker, had become its venture capitalist, investing internationally, especially in Asia, instead of just borrowing and lending.

But that doesn't mean that Asian countries are better off investing in the West – not least because of the carry trade that took root after the 2008 financial crisis. As Hyun Shin and other economists at the Bank for International Settlements have argued, low developed-country interest rates and a weak dollar drove financial markets, led by the New York and London hubs, to borrow money in low-interest-rate currencies and invest in higher-interest-rate currencies.

This financial game has had a far-reaching impact. While the conventional view is that trade imbalances drive exchange rates and capital flows, financial accounting in Japan, for example, tells a different story.

From 2010 to 2015, the cumulative external surplus accounted for just 44% of the net change in Japan's investment position. Financial-account transactions caused 32% of that change, while valuation changes relating to exchange and interest rates accounted for the rest.

Japan's persistent current-account surpluses should have strengthened its net international asset positions. But, thanks to the appreciation of foreign holdings of Japanese equities, the country's net international asset position actually deteriorated, from a peak of $3.8 trillion at the end of 2012 to $2.8 trillion at the end of 2015. As Bank of Japan economists point out, Japanese holdings of foreign assets are less profitable than foreign holdings of Japanese assets.

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* This article first appeared on Project Syndicate on February 21, 2017.

* Andrew Sheng, Distinguished Fellow of the Asia Global Institute at the University of Hong Kong and a member of the UNEP Advisory Council on Sustainable Finance, is a former chairman of the Hong Kong Securities and Futures Commission, and is currently an adjunct professor at Tsinghua University. Xiao Geng, Member of IMI Academic Committee, President of the Hong Kong Institution for International Finance, Professor at the University of Hong Kong

What Japan should be doing is investing more in high-growth Asia. At the end of 2015, only 10.1% of ¥574.8 trillion ($4.8 trillion) in gross outward investment remained in Asia, with 70% going to North America, Europe, and Oceania.

The composition of Japan's portfolio investments, which comprised 73.6% of the country's total outward investment at the end of 2015, is even more uneven, with only 3.5% invested in Asia and 72.4% invested in North America, Europe, and Oceania. Even Central and Latin America received one-third more Japanese portfolio investment than Asia.

This preference for investing outside Asia is shared by the region's other major savers – namely, China, Hong Kong, South Korea, Taiwan, and Singapore – even though returns within Asia are generally higher than elsewhere. As a result, the region has been made hostage to volatility in capital flows, exchange rates, and interest rates.

The problem is that, two decades after the Asian financial crisis, there has been little progress in institutionalizing Asian financial intermediaries that will channel savings to high-return projects within the region. In India, for example, the top ten investment banks are from the US and Europe. The situation is not much different in Hong Kong and Singapore. Even in China, where local investment institutions are growing rapidly, the ability to channel funds to the high-return real sector remains limited.

Now that US and European banks – driven by capital and regulatory constraints, as well as the prospects of higher US interest rates and a strengthening dollar – are beginning to move away from Asia, the pressure to remedy the situation is stronger than ever. But, instead of supporting Asian financial institutions' capacity to take over the intermediation of the region's savings, Asian financial regulators are focused on adopting the new global financial regulatory standards being pushed by their American and European counterparts – standards that American and European politicians are threatening to unwind.

The imperative to change this approach is magnified by US President Donald Trump's "America first" credo, which is almost certain to translate into protectionist policies. Such policies will push Asian investment further into the dollar trap, because Asian savings will be used to chase speculative dollar-denominated assets outside the region, instead of to meet Asia's own needs.

To be sure, in the longer term, China's "one belt, one road" initiative, together with the internationalization of the renminbi, will help to weaken the dollar's grip on Asia. But that remains a distant prospect.

In the meantime, the central banks of leading Asian surplus economies (particularly China and Japan) need to work with other major central banks (especially the European Central Bank and the Bank of England) to change how excess savings in high-growth regions are used. The goal should be to ensure that savings in surplus countries – including, say, Germany, which has a larger current-account surplus than China and Japan – are used wisely, to help sustain growth throughout the world economy.

Trump's plan to put America first may sound straightforward. But it fails to recognize that, if the emerging economies falter, everyone will lose. With Trump seemingly unwilling to rethink his approach, it is up to Asia and its international partners to gird themselves – and the entire global economy.

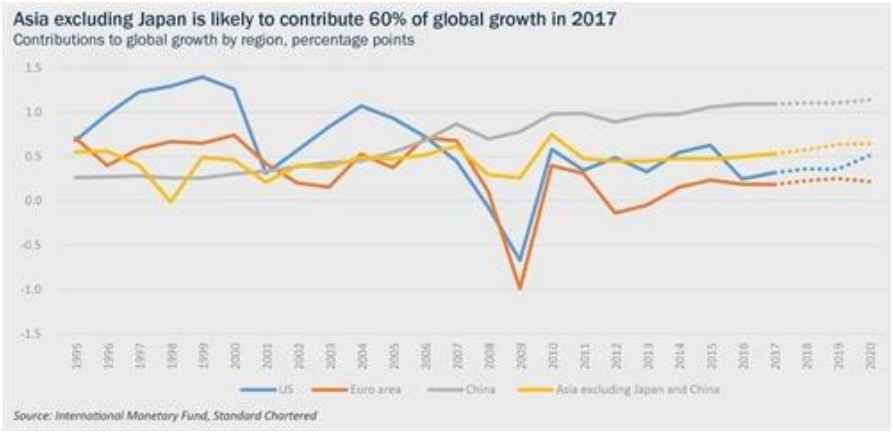
IMI International Monetary Review

Asia to Contribute 60% of Global Growth *

By DAVID MANN*

Asia has reduced its economic exposure to the West, but financial linkages remain. The region has achieved relatively strong growth since the 2008-09 financial crisis, in contrast to persistently weak growth in the US and Europe.

Domestic demand from both consumers and investment is supporting the resilience, cushioning the region against its high exposure to external trade. All this should continue in 2017, helping Asia account for around 60% of global growth, according to Standard Chartered calculations.



Economic outlook

Markets are wary of the uncertain outlook for private sector investment and trade in the light of Donald Trump's election. Asia's economic linkages to the US are much weaker compared with a decade ago, yet remaining linkages may prevent Asian central banks from easing policy in the short term. It will be difficult to diverge from US monetary policy, especially if exchange rates remain as vulnerable as they have been since the 8 November election.

On external trade, there is room for positive surprises in Asia's 2017 export data because of base and price effects. Last year's low base should flatter year-on-year export growth in 2017. In addition, a partial recovery in export prices is likely to boost exports in nominal terms. Even with no further price rises, export values are likely to return to growth in 2017. These factors should start to materialise by the second quarter. This is also when emerging market Asian currencies are expected to be at their weakest in response to US reflation, further boosting exports.

China's growth will remain steady in the run-up to the National Party Congress in late 2017. Many longer-term challenges remain, including excess leverage, overcapacity and the demographic drag that will become more problematic in the 2020s. However, these issues are

* This article first appeared in *The Bulletin (January 2017)* published by the Official Monetary and Financial Institutions Forum (OMFIF), a global financial think tank headquartered in London.

* Chief Economist for Asia at Standard Chartered

not expected to reduce growth below the current rate of above 6% ahead of such a politically important event for the Chinese Communist party. This, however, may mean more pain later

Monetary easing has run its course

Monetary easing is over across Asia, mainly because of higher inflation and pressure to avoid divergence with the US. Standard Chartered forecasts project still-sluggish external demand in 2017, and tighter financial conditions due to upward pressure on dollar funding costs and dollar strength. While inflation is likely to rise, it is expected to remain below longer-term averages.

Exchange rates have typically been Asia's main mechanism of adjustment to higher US rates, and this is expected to be repeated in 2017. The loosening of monetary conditions may therefore happen via the exchange rate channel, rather than policy rate cuts.

India is a significant exception. The shock announcement in early November that it will eliminate 85% of currency in circulation to crack down on the informal economy is causing a cash crunch and hindering economic activity. Expectations for India's policy rate and GDP growth over the next two years have been adjusted down to reflect the consequences.

Assuming a large portion of the cash in the untaxed economy simply vanishes, this could be worth as much as 2-3% of GDP – a major shock to the system. In this context, the recent public sector salary rise and good monsoon rains are unlikely to be as supportive of growth as originally anticipated. Markets are on the lookout for more surprise announcements.

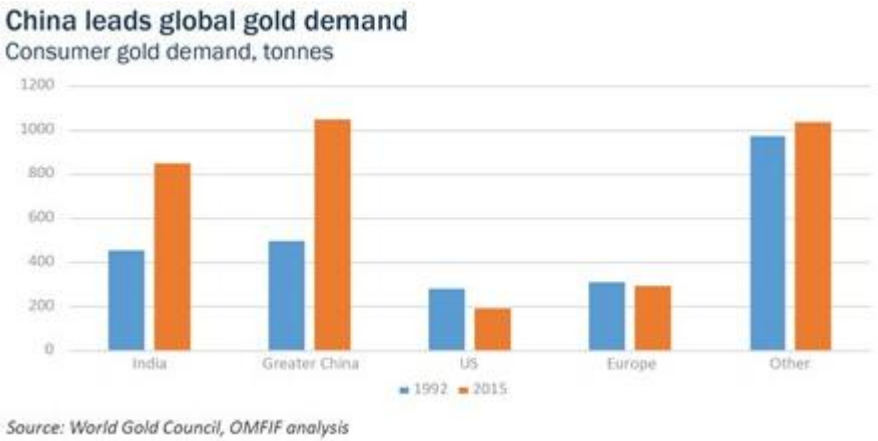
IMI International Monetary Review

Gold's New Frontiers in Asia *

By SHAOKAI FAN*

As the world's centre of economic gravity shifts eastward, Asia's importance to the world gold market continues to grow. While east Asia and India combined accounted for 35% of global demand in 1970, China alone accounted for 29% in 2015, and India 25%.

Asian consumers' rising prosperity has increased demand for both jewellery and gold as an investment. Moreover, much official sector demand for gold is originating in Asia as regional central banks build and diversify their reserve holdings. Asia has transformed global gold demand, and new opportunities could strengthen the continent's role further.



Islamic investors

Gold remains popular with global investors as a result of unconventional monetary policies, political uncertainty and market volatility. However, several investor groups, for differing reasons, have had limited contact with gold as an asset class. Islamic investors, who historically have had little exposure to gold investment, represent one such group. Gold is subject to special Islamic rules, while existing guidance is limited and fragmented.

To address this, the World Gold Council and the Accounting and Auditing Organisation of Islamic Financial Institutions, the global standard setter in Islamic finance, are developing a new Sharia (Islamic law) standard for gold, to be launched before the end of 2016. The standard will provide definitive guidance on Islamic rules pertaining to gold investment and the permissibility of individual products.

Asian gold demand could benefit significantly. Malaysia, already a vanguard in Islamic finance, has a prosperous middle class seeking greater investment options. Indonesia, the world's largest Muslim country, is beginning to promote Islamic finance, making it ripe for new

* This article first appeared in *The Bulletin (November 2016)* published by the Official Monetary and Financial Institutions Forum (OMFIF).

* Director, Central Banks and Public Policy, at the World Gold Council. This article is for information only and does not constitute investment advice. The World Gold Council is not responsible for any losses.

investment opportunities. Standardising gold transactions will bolster gold's accessibility to Asian investors seeking Sharia-compliant products and asset classes.

Gold can offer sovereign funds an important solution as they seek to diversify their investments in a low rate environment. The metal's role as a long-term store of value complements sovereign funds' mandate to sustain intergenerational wealth. There is also an opportunity to present gold's benefits through direct engagement, as sovereign funds are increasingly making their investment decisions internally.

Asia's sovereign funds are largely funded through foreign exchange reserves or fiscal surpluses, and require a different investment approach to resource-based funds. They have been less affected by the decline in oil prices, giving them more flexibility to determine their investment mix. Gold can be a useful portfolio component because of its diversification benefits.

Changing macro trends are deepening the case for gold holdings by central banks. Unconventional monetary policies have rendered almost 40% of developed country sovereign debt either zero- or negative-yielding, limiting central bank investment options. Asia's reserve managers are finding it difficult to find suitable assets for the region's reserve stockpiles.

Reserve diversification

Aside from the impact of negative interest rate policies, central bank gold-buying goes hand-in-hand with reserve diversification away from the dollar. This is particularly relevant in Asia, where the renminbi's internationalisation has had a pronounced impact on trade and reserves.

Research by the World Gold Council indicates that, for every one percentage point increase in renminbi reserve holdings, central banks should increase their gold holdings by 0.5 percentage points, to hedge their portfolios against uncertainty stemming from structural changes in currency allocations. As Asian central banks embrace the renminbi, official gold holdings are likely to increase.

Demand for gold is likely to continue to rise as Asia becomes more prosperous. However, the narrative for gold is shifting too, as investors contend with continuing global political and financial uncertainty. Gold's unique qualities offer a safe haven for new Asian investor groups such as Islamic investors and sovereign funds, while Asian central banks can be expected to continue to turn to gold.

IMI International Monetary Review

Monetary Policy

It's Time to Dump Most Central Banks*

By STEVE H. HANKE*

On March 16th, the *New York Times* carried reportage by Peter S. Goodman, Keith Bradsher and Neil Gough, which was titled "The Fed Acts. Workers in Mexico and Merchants in Malaysia Suffer." The theme of their extensive reportage is that U.S. monetary policy is the elephant in the room. It is the elephant that swings exchange rates and capital flows to and fro in emerging-market countries, causing considerable pain.

The real problem that all of the countries mentioned in the *New York Times* reportage face is the fact that they have central banks that issue half-baked local currencies. Although widespread today, central banks are relatively new institutional arrangements. In 1900, there were only 18 central banks in the world. By 1940, the number had grown to 40. Today, there are over 150.

Before the rise of central banking the world was dominated by unified currency areas, or blocs, the largest of which was the sterling bloc. As early as 1937, the great Austrian economist Friedrich von Hayek warned that the central banking fad, if it continued, would lead to currency chaos and the spread of banking crises. His forebodings were justified. With the proliferation of central banking and independent local currencies, currency and banking crises have engulfed the international financial system with ever-increasing severity and frequency. What to do?

The obvious answer is for vulnerable emerging-market countries to do away with their central banks and domestic currencies, replacing them with a sound foreign currency. Panama is a prime example of the benefits from employing this type of monetary system. Since 1904, it has used the U.S. dollar as its official currency. Panama's dollarized economy is, therefore, officially part of the world's largest currency bloc.

The results of Panama's dollarized monetary system and internationally integrated banking system have been excellent (see accompanying table).

- Panama's GDP growth rates have been relatively high. Since 1994, when the Mexican tequila crisis commenced, real GDP growth has averaged 5.8% per year.
- Inflation rates have been somewhat lower than those in the U.S. Since 1994, CPI inflation has averaged 2.3% per year.
- Since Panama's fiscal authorities can't borrow from a central bank, the fiscal accounts face a "hard" budget constraint dictated by the bond markets. In consequence, fiscal discipline is imposed, and since 1994, Panama's fiscal deficit as percent of GDP has averaged 1.7% per year.
- Interest rates have mirrored world market rates, adjusted for transaction costs and risk.
- Panama's real exchange rate has been very stable and on a slightly depreciating trend vis-à-vis that of the U.S.

* This article appeared on Forbes on March 22, 2017.

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- Panama's banking system, which operates without a central bank lender of last resort, has proven to be extremely resilient. Indeed, it weathered a major political crisis between Panama and the United States in 1988 and made a strong comeback by early 2000.

Panama - Selected Economic Data

Year	Real GDP Growth (%)	CPI Inflation (%)	Fiscal Balance as % of GDP
1994	2.8	1.3	-3.4
1995	1.8	0.9	-2.7
1996	7.4	1.3	1.7
1997	6.5	1.3	-0.8
1998	7.3	0.6	-2.6
1999	3.9	1.3	-1.0
2000	2.7	1.4	-0.6
2001	0.6	0.3	-2.2
2002	2.2	1.0	-3.1
2003	4.2	0.1	-4.4
2004	7.5	0.5	-4.6
2005	7.2	2.9	-2.5
2006	8.5	2.5	0.5
2007	12.1	4.2	3.3
2008	8.6	8.8	0.4
2009	1.6	2.4	-0.9
2010	5.8	3.5	-1.7
2011	11.8	5.9	-1.9
2012	9.2	5.7	-1.4
2013	6.6	4.0	-2.3
2014	6.1	2.6	-3.3
2015	5.8	0.1	-2.3
2016	5.2	0.7	-2.5
2017	5.8	1.5	-1.7

Note: Shaded cells indicate IMF staff estimates.
Source: IMF World Economic Outlook (October 2016).
Prepared by Prof. Steve H. Hanke, The Johns Hopkins University.

To avoid the pain described in the *New York Times* reportage, emerging-market countries should dump their central banks and local currencies. They should follow Panama's lead and adopt a stable foreign currency. Or, they could install a competitive currency regime, which would allow for more than one foreign currency to be used.

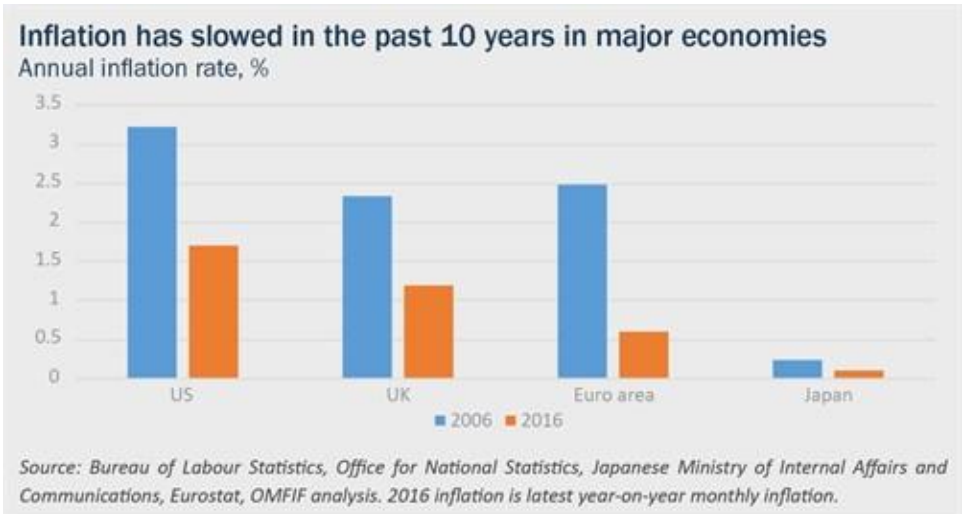
IMI International Monetary Review

Central Banks in an Unconventional Era *

By JOHN MOURMOURAS *

The intellectual roots of central bank independence can be traced back to the rational expectations revolution. This put forward the idea that people base choices on their rational outlook, past experiences and available information. Rational expectations played a pivotal role in breaking the intellectual deadlock with addressing the 'stagflation' phenomenon of the 1970s, when high inflation was combined with high unemployment and slow growth.

Under discretionary monetary policy in a rational expectations framework, the interaction of private agents with the government generates an inflation bias, without any sustainable output gains. This bias increases with governments' displeasure at the size of the output gap. As a result of this perceived bias, governments and central banks around the world moved to conduct monetary policy with a credible commitment to low inflation, anchoring inflation expectations to equally low levels.



Monetary policy in the post-crisis period

The financial crisis of 2008 and the ensuing European sovereign debt crisis have fundamentally changed the operational framework of independent central banks. Central banks have been given new macroprudential tasks, such as the supervision of systemic banks in economic and monetary union, conducted by the European Central Bank since 2014.

Another important change is that in the post-crisis era price stability is about preventing deflation, rather than halting excessive inflation. As a result, all major central banks have employed unconventional monetary policy tools in recent years. These include the provision of

* This is an abridged version of two speeches made in Tokyo at the JCER seminar and in Kuala Lumpur at the SEACEN Policy Summit, jointly organised with the Official Monetary and Financial Institutions Forum (OMFIF), in November 2016. This article first appeared on *The Bulletin (January 2017)* published by OMFIF.

* Deputy Governor of the Bank of Greece and a former Deputy Finance Minister

emergency liquidity and credit support to banks and extending the definition of assets accepted as eligible collateral when providing loans on a short- or medium-term basis.

To help raise inflation to targeted levels, central banks have turned to negative base rates and quantitative easing, considerably expanding central bank balance sheets. Since 2008 the Fed's balance sheet has more than doubled, while the Bank of England's has tripled. The ECB's balance sheet has grown 66% since its QE programme started in 2015.

Central bank challenges for independence

The legacy of the 2008 crisis and subsequent low inflation have brought challenges for central bank independence. First, external parties have questioned the independence of central bank policy instruments. Second, even if these policies are not formally challenged, they may be less likely to achieve their objectives because of the altered conditions. Such questioning is arguably aimed at the wrong target. I believe criticism should not be directed against the very concept of independence, but rather against the current economic mix of ultra-loose monetary policy with tight fiscal policy.

Monetary policy naturally interacts with fiscal, structural and financial policies. The separate authorities that conduct these policies may be formally independent, but they are also interdependent. The risk of such interdependence is that, if one independent policy authority does not take appropriate action to meet its mandated objectives, the other authorities may be obliged to overreact to persistent shocks to meet their own objectives. This may result in a regime of 'weak dominance' of other policies over monetary policy, effectively destabilising the regime of monetary dominance that central bank independence is meant to establish.

When interest rates are kept negative for too long, both the redistribution effects of monetary policy and the perceived degree of success of meeting the mandated objectives become more pronounced. This leads to greater demands for scrutiny of central bank independence. Concerns naturally arise about whether a monetary authority with an extended mandate of objectives can operate transparently and with appropriate accountability in a democratic political and economic system.

An independent central bank subject to checks and balances and democratic accountability needs public backing. When negative rates persist, central banks almost inevitably lose major parts of the necessary broad constituency of support.

There is still a strong overriding need for Independent central banks focused on price stability, capable of creating policy room for necessary structural adjustments, appropriate fiscal policies and macroprudential stability. All the theoretical and empirical arguments point in this direction: this approach offers the most promising path for the ultimate objective of restoring normal growth conditions and creating jobs. Controversy about the means and goals of central banking independence is no reason why the world should water down a concept that has served the global economy well over 40 years.

IMI International Monetary Review

Inflation: A Chance for Central Bankers*

Return to traditional arguments will suit policy-makers

By MIROSLAV SINGER*

The consensus that inflationary pressures are returning to the global economy grows ever stronger. If this becomes manifest, central banks may need to tighten monetary policy and end the use of unconventional tools for easing monetary policy.

Politicians in many economies are unlikely to welcome this tightening. Donald Trump, for one, would not relish the associated strengthening of the dollar, as it would reduce the competitiveness of the US manufacturing sector that he promised to revive. In the euro area, the fragile state of some members' financial sectors and unfinished euro area institution-building are likely to complicate withdrawing from unconventional policies. As the recovery gains pace, the erosion of labour market slack and the narrowing of the euro area-wide output gap will exacerbate inflationary pressures.

This is all happening in a setting where popular resentment against elites – among whom central bankers are certainly counted – is changing the political make-up of many major economies. Central banks may find themselves attractive targets for political point-scoring.

It is reasonable to expect a host of proposals to allow inflation to rise above targets, and possibly even pressure to increase the targets. The same logic that prevented central banks from lowering targets during the deflationary period, namely their reluctance to loosen mid-term expectations, should prevent central bankers from heeding such advice. Otherwise, they would act procyclically, which would negate the ultimate reason why they are independent.

Still, politicians who have been recently elected, like Trump, and others who are proving popular, such as right-wing figures Marine Le Pen in France and Geert Wilders in the Netherlands, tend toward stridency. Politicians and central bankers face increasingly candid squabbles.

In the short term, expect more orthodox argument among central banks about why it is necessary to keep inflation low. That will be a great improvement over recent times when central banks found themselves explaining why it is necessary to use unorthodox policies like quantitative easing to avoid deflationary threats.

Central banks have shown themselves over many years quite efficient in this type of dialogue. Moreover, in this environment, conventional monetary tools are more efficient. Central banks will rightly welcome a return to more traditional monetary policy. Operating the instruments for these circumstances, and taking part in the associated arguments and discussions, will suit them much better.

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* This article first appeared on OMFIF Commentary on January 24, 2017.

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New Tools Allow for Shrewder Chinese Monetary Policy *

Central bank must improve market communications to avoid increased confusion

By XIA LE*

In defending Beijing's official economic growth target of "around 6.5%" for 2017, Chinese Premier Li Keqiang pointed out to the National People's Congress last Sunday that the authorities now have more options in their policy toolkit to offset potential negative economic or financial shocks.

While this year's growth target may be challenging given escalating external risks and domestic financial vulnerabilities, Li is right about the greater availability of policy tools, at least monetary ones.

Over the past few years, the People's Bank of China, the central bank, has established a new interest rate corridor system along with an accompanying set of policy instruments. These are starting to take center stage in China's monetary policy, pushing to the side traditional tools such as benchmark lending and deposit rates and required reserved ratios.

As revealed in the PBOC's last two quarterly monetary policy reports, the upper boundary of the new interest rate corridor is formed by the interest rates the central bank charges on its overnight, 7-day and 1-month standing lending facility to qualified commercial banks. The central bank also now has medium-term lending facilities for three and six months, as well as one year, for injecting liquidity.

At the bottom boundary of the rate corridor is the interest rate which the central bank pays on banks' excess deposit reserves, currently 0.72%. Banks can withdraw liquidity from the money market at the bottom of the corridor when the money market interest rate falls below this level.

The new policy rate is the pledged 7-day interbank market rate, which is the interest rate for bank-to-bank borrowings. By design, the policy rate will fluctuate only within the new corridor. When the policy rate target rises to the upper bounds of the corridor, banks can directly resort to the PBOC to meet their short-term liquidity demand instead of borrowing in the interbank market. Similarly, banks can deposit their liquidity as excess reserves on the PBOC's books if they find the policy rate falling to the bottom of the corridor.

The central bank is expected to frequently conduct open market operations to align the policy rate with the authorities' desired level. Currently the main open-market policy tools include 7-day, 14-day and 28-day repurchases, known as repo, and reverse repo, operations.

These repo agreements allow the central bank to withdraw liquidity from, or inject it into, the money market. The PBOC announced last year that it would conduct open-market operations daily, up from twice a week.

Not Shibor

Some had expected the 7-day repo or 3-month Shanghai Interbank Offered Rate to become the new policy rate. Both of these important money market rates are used as benchmarks for large amounts of financial products.

But the pledged 7-day interbank market rate applies only to bank-to-bank transactions while the other two rates also apply to transactions between banks and other financial institutions. Given that only banks are eligible for the standing lending facility and the medium-term lending

* This article first appeared on Nikkei Asian Review.

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facility, it makes sense to target a policy rate purely for bank-to-bank transactions so that its movements can be effectively confined to the corridor.

The corridor system features a diversity of policy tools and flexibility for pursuing multiple policy objectives. The standing lending facility and medium-term lending facility rates at the top of the rate corridor almost form a yield curve. In conducting monetary policy, the PBOC can choose to adjust the amount of liquidity injection via open-market operations or by moving lending facility rates.

The central bank can select the term of its lending facilities to indicate its policy stance. In this respect, the PBOC has frequently used the 6-month and 1-year medium-term lending facilities to inject liquidity into the money market since last August, attempting to raise financing costs for small banks to discourage them from building up leverage.

The flexibility of the corridor system lies in the fact that the policy rate, or the pledged 7-day interbank market rate, is dictated by market forces. The central bank can guide it up and down, albeit within the corridor, to achieve monetary policy objectives other than economic growth and price stability, for example, the management of stable capital flows.

When pressure for capital outflows rises, the central bank can swiftly raise the upper bound of the rate corridor or withdraw liquidity from the money market via open-market operations so as to lift the policy rate and discourage further outflows. This is a useful tool as China still faces enormous pressure for capital flight despite the announcement Tuesday that foreign reserves are on the rise again.

Mixed signals

The corridor system however can send confusing signals to the market, due in part to its multiplicity of tools and policy objectives. The market could misinterpret the central bank's intentions if signaling is not improved. For example, policymakers might guide the policy rate higher to try to attract more capital inflows, but domestic investors might misread this as a signal of further policy tightening, leading potentially to a major market selloff. The launch of the corridor system has thus increased the need for the authorities to improve their capacity and skills in market communication.

Traditional monetary policy tools remain however as potential useful supplements to the corridor system. If needed, the authorities can give a clearer, stronger policy signals to the market by deploying such instruments.

The authorities are likely to continue tinkering with the corridor system. The PBOC may gradually narrow the height of the corridor, most likely by raising the lower boundary, as the authorities want to keep a prudent monetary policy stance. Second, the authorities will likely promote the policy rate as the new benchmark for pricing financial products to enhance the efficiency of policy transmission.

Despite the PBOC's enlarged toolkit, China's monetary policy stance is constrained. Central bank officials recently identified obstacles to further policy easing including: growing asset bubbles, especially in the housing market; continued expectations of yuan depreciation; rising inflation expectations, especially with the producer price index climbing; and the country's unbalanced economic structure.

Room for the further tightening of monetary policy is also limited this year because although growth momentum has visibly picked up, its sustainability remains a question. With the authorities apparently drawing up ambitious plans to curb the huge shadow banking sector to contain rising financial risk, such regulation could exert significant tightening effects on the banking sector and the entire economy.

On balance, the country's monetary policy stance this year is likely to be prudent as stated by Premier Li. In the face of enormous uncertainties externally and domestically, the authorities

have to walk a fine line between containing financial risks and averting a sharp deceleration in economic growth. Even with a more flexible monetary policy framework, this year's growth target could still be missed.

IMI International Monetary Review

Working Paper

Indexing Mergers and Acquisitions*

By GANG JIANHUA, GUO JIE AND LI XI*

This paper introduces an index to measure the efficiency of mergers and acquisitions. The Merger and Acquisition Index is able to evaluate and forecast merger outcomes for acquiring firms. It is calculated for each takeover deal based on the stochastic frontier analysis. The value of the M&A index is standardized between 0 and 1, and a deal with a higher index encompasses higher efficiency. Empirical results suggest takeover bids with higher M&A indices are more likely to succeed. Moreover, M&A index shows strong and positive relation with acquirers' short-run stock performance and long-run operating performance. After constructing three portfolios under a buy-and-hold strategy, efficient portfolios with the highest indices earn higher equity returns and monthly alphas than inefficient portfolios with the lowest indices.

Keywords: Mergers and Acquisitions; Stochastic Frontier Analysis (SFA); Efficiency

JEL Classification: G34, G11

1. Introduction

Does an acquirer efficiently take over the target? Does the efficiency of acquisition imply any significant post-acquisition performance in the short-run or in the long-run, and how? Questions as such have strong economic and trading implications. It is therefore a necessity to re-evaluate acquisition from a bird's eye view. However, past literature presents little evidence on takeover efficiency and its potential relationship with merger outcomes[1].The majority of M&A literature concentrates on partial acquisition issues[2] (such as probability of deal completion, bid premium, announcement return) but lacks overall evaluations of takeover activities. In this paper, we redefine the concept of takeover efficiency[3] and build a composite index, the M&A index, in order to provide a comprehensive understanding on the subject of takeover quality[4].

Consolidating and simplifying information from a complex process into a certain composite index is a superior approach when researchers are to standardize diverse empirical results so as

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[1]Merger outcomes include takeover deal completion, acquisition premium, and post-acquisition stock performance.

[2]Previous literatures on mergers and acquisitions segregate takeover process and investigate each segment and its determinant respectively (such as the probability of deal completion; bid premium; post-acquisition performance during announcement period or stock performance in the long-run).

[3]"Efficiency" in recent M&A studies refers to the "efficiency gain" --- acquirers'/ targets' announcement returns, which are whether acquisition partner earn abnormal return during announcement period. In this paper, however, efficiency is related with whole takeover process and used to measure the overall acquisition quality.

[4]Tehranian et al. (2013) illustrate that acquisition with high quality is the deal when bidding firms earn higher announcement return, pay less premium and have higher trading volume.

to do comparisons. Therefore, the approach of indexing to analyse economic behaviour attracts more and more public attention and interest (Sharpe, 2004). In the field of corporate finance, composite indicators are increasingly recognized and adopted. For example, the KZ index is constructed to measure financial situations (Kaplan and Zingales, 1997), and Governance index (Gompers et al.,2003) and Entrenchment index (Bebchuk et al.,2009) are to evaluate corporate governance. Both of the concepts of financial situation and corporate governance are subjective, abstract and multi-dimensional. Researchers often need a basket of various financial ratios and descriptions so as to capture their own ideas of the general conditions. Hence, it is practically important to build a standardized and meaningful indicator to make it easier to measure these issues quantitatively so as to be investigated in econometric models as a variable.

In general, as one of the largest corporate investment behaviours, M&A deals tend to exert strong and long-lasting influence on firms' operating and financial performance. Recent academic studies and financial practices tend to focus on understanding deal characteristics as well as corporate fundamentals, and pay closer attention to market reaction in order to predict possible outcomes both in the short run and long run. However, documented empirical results in this field are mixed due to the complication of takeover activities. Therefore, an indicator, which is able to accurately gauge an overall takeover quality, is needed to effectively evaluate and forecast financial consequences of acquisitions. This study is among very few studies that try to fulfil this task and hence enrich literature in this field.

We start the M&A indexing by firstly introducing the concept of "takeover efficiency" to assess the overall takeover quality[5]. Specifically, a deal is regard "efficient" if and only if acquisition could maximize the acquirer's gain[6] when announced to public. In a market of strong-form efficiency (Fama, 1965), stock price on announcement day reflects market reaction and expectation to the takeover transaction. Higher announcement return indicates market is optimistic towards the deal. Acquisition is an efficient and quick tactic for acquirers to develop and expand their business. Acquirers could benefit from synergy gain, including financial and operational improvement (Devos et al., 2009; Houston et al., 2001; Hoberg and Phillips, 2010). Therefore, acquirers should get good feedback from the market, which is an optimal and maximized announcement return of bidders. However, the actual announcement return is sometimes less than the optimal gain due to various factors of inefficiencies, including agency problem in acquirers and resistance from targets' management etc.[7]. Takeover efficiency is then used to estimate the gap between the actual and optimal announcement returns. Higher takeover efficiency suggests the actual announcement return is closer to optimal market reaction, implying that acquirers can gain better post-acquisition performance. Accordingly, the M&A index is developed in order to directly and quantitatively scoring the degree of efficiency of each takeover deal. By design, the M&A index is forward-looking and includes information of the probability of deal completion, announcement return in the short run and post-acquisition operating performance in the long run.

To build the M&A index, the stochastic frontier analysis (SFA) approach[8] is adopted. In this paper, the SFA is implemented to measure the deviation from an optimal market reaction to

[5]Tehranian et al. (2013) illustrate that acquisition with high quality is the deal when bidding firms earn higher announcement return, pay less premium and have higher trading volume. Herein, we adjust the standards for good quality acquisition and relate the deal quality with takeover efficiency.

[6] The reason why we adopt acquirers' announcement return rather than target's or combined firms' return is that acquirer generally has much larger size than target. The value-weighted announcement returns for combined firms are heavily affected by acquirer's stock performance on announcement day. Moreover, the post-acquisition performance in the long-run is mainly determined by bidding firms since acquirers take control of targets.

[7]Take an analogy, pasta is delicious and can be scored at 10 (optimal). The score of pasta will be lower, say 7 if too much salt is added or the pasta is overly boiled. "Pasta" the dish is takeover. "Too much salt" and "overly boiled" is the inefficiency.

[8]See Aigner et al., 1977; Meeusen and van den Broeck, 1977.

acquirers' takeover announcement. Hence, the SFA provides a benchmark of takeover efficiency. In our SFA approach, the acquirer's announcement return is examined as an output to quantify possible acquisition impact. Specifically, market optimism towards the takeover deal would realize high announcement return for acquirers (positive impact).Inputs of the M&A index include pre-bid characteristics of acquisition partners (bidders and targets) and the information revealed on the announcement day. This paper only considers public acquisitions in which both acquirers and targets are public firms. Strong-form market efficiency is assumed, so that all public and private information regarding the deal is reflected in the stock price on the announcement day.

In essence, the M&A index is a technical efficiency[9] of frontier models and can be regarded as a ratio of the actual acquirer's return against optimal return on the announcement day. The optimal announcement return represents a maximum feasible announcement return that a bidder could reach by assuming the absence of any of the inefficiency factors. The value of the M&A index ranges from 0 to 1[10]. A higher value indicates a smaller disparity between the actual and optimal announcement returns, and it therefore implies a better takeover quality.

Empirical results show the M&A index accurately measures the takeover efficiency and forecasts the post-acquisition performance. Particularly, the spectrum of its prediction includes the probability of deal completion and duration of the deal. Surprisingly, the M&A index positively correlates with the completion rate, signalling deals with higher indices are more likely to be successful. Additionally, deals with higher M&A indices tend to have better post-acquisition performance and this is statistically significant at 1% significance level.

Furthermore, we develop a buy-and-hold trading strategy based on the M&A index over the post-acquisition period. We construct three different portfolios: A. Portfolio of most efficient deals; B. Portfolio of least efficient deals; C. Portfolio of the deals of moderate efficiency. Results show that acquirers in Portfolio A earn much higher returns and monthly alphas than the ones in Portfolio B. This superior performance is significant and also robust to different asset pricing models[11]. Specifically, Portfolio A earns 7% higher than Portfolio B for one to six-month holding periods. Monthly alpha of Portfolio A also dominates B by 9.08% for a holding period of one month. And the persistence of this pattern proves to be statistically significant at 1% significance level.

To our knowledge, this paper is the very first one to develop a methodology to score the efficiency for takeovers. The M&A index may also be used to forecast merger outcomes, and thereby financial practitioners can evaluate acquisitions in a much simpler way and researchers can treat the M&A index as a factor of measuring the impact of acquisitions in asset pricing models.

The contribution of this paper is four-folded: first, this paper introduces an effective and forward-looking composite index of the M&A quality; second, this paper provides an alternative indicator for market reaction to acquisition announcement which is proved to be efficient; third, the index may be useful to create trading strategies based on anticipations of M&A outcomes; fourth, this paper implements the stochastic frontier analysis (SFA) in the M&A field, which enriches the application of SFA in event studies.

[9]Technical efficiency in SFA is measured as firm's actual output over maximum output value.

[10]Stochastic frontier analysis assumes that optimal output is the maximum value that a firm could realize. The actual output is less than optimal output. The technical efficiency $\frac{actual\ \ output}{optiamal\ \ output}$ is therefore less than 1. In this paper, we also assume that acquirers 'optimalannouncement return is larger than the actual announcement return. Therefore, M&A index which equals to $\frac{acquirer\ s'actual\ \ announcement\ \ \ return}{acquirer\ s'optiamal\ \ announcement\ \ \ return}$, is limited to 1.

[11] We employ four asset pricing models to estimate monthly alpha, including CAPM model, Fama-French 3 factors model, Fama-French 4 factors model and Fama-French 5 factors.

The paper is structured as follows: Section 2 presents our hypothesis; Section 3 describes the methodology and variables to construct the M&A index; Section 4 describes the dataset and the M&A indices; Section 5 reports empirical results and the corresponding interpretations; Section 7 concludes the paper.

2. Hypothesis

Luo (2005) illustrates that the probability of deal completion is affected by market reaction to takeover announcement since managements of acquiring firms learn from market to determine whether to consummate takeover transactions. The M&A index by design may be regarded as an alternative indicator for market perspective to announced deal, because it is a ratio of actual acquirer announcement return to the optimal return on the announcement day. The announcement return is the market response to an acquisition deal before and immediately after the public release. The optimal announcement return is the highest level that a bidder could reach if the takeover is completely efficient. A higher ratio indicates that the acquisition is close to an efficient deal and therefore has a better takeover quality. It is likely that acquiring firms would be motivated to complete the deal if market appraisal were to be significant. Therefore, we propose the following hypotheses:

H1: Higher values of the index (of a bidding firm) indicate higher probability of dealcompletion.

Olson and Pagano (2005) illustrate that short-term stock reaction reflect the investors' expectation of takeover deals. Therefore, acquisition partners would benefit from higher stock return if investors have better reaction and expectation for takeover transactions. M&A index measures the shortfall between actual acquirers' return and optimal return at announcement, which shows market response to acquisition between acquirers and targets. A higher index implies that the market positively responds to the acquisition. Therefore, more efficient deal (with higher index) is expected to have better stock performance in the short run. Hence, we assume:

H2: Acquirers with higher M&A indices earn more cumulative abnormal return than the firms with lower indices in the short term after acquisition.

Andrade et al. (2001) indicate that post-merger operating performance reflects whether acquirers eventually obtain expected gain at announcement. Therefore, long-run operating performance signifies the takeover quality and synergy gain to acquirers. Deals with higher M&A index represent that market participants are optimistic towards merger outcomes. Therefore, more efficient deals are expected to generate more synergy gain in the acquisition, which would be realized in the form of post-merger profitability. Higher M&A index implies better long-run operating performance. . Therefore, we assume:

H3: M&A indices are positively related to the post-merger operating performance in the long run.

3. Methodology

3.1 The M&A index

3.1.1 Takeover efficiency and acquirers' announcement return

In an efficient market, security price would adjust fully and immediately after information is released. Therefore, acquirers' stock prices[12] on the announcement day would reflect the market

[12]The reason why acquirers' stock performance is considered not combined firms is that acquirers generally have much larger firm-size than targets. On average, acquirer' firm-size is 32.9044 times larger than targets' in the full sample. The value-weighted returns of combined firms are strongly affected by acquirers'announcement return. Additionally, we limit the takeover sample to the deals in which acquirers take control of target after acquisition.

reaction and expectation to the acquisition, including the probability of deal completion and the post-acquisition performance.

Higher acquirers' announcement returns suggest that market is optimistic towards the merger outcomes. Takeover is an efficient investment strategy for acquirers to grow business and enhance competiveness. Acquirers could benefit from synergy gain, including financial and operational improvement (Devos et al., 2009; Houston et al., 2001; Hoberg and Phillips, 2010).Hence, acquirers should have received good market reaction to the takeover announcements, which is the optimal announcement return for bidding firms. However, the actual stock return is not as large as optimal announcement return since market anticipation would be reduced by the concern of acquirers' agency cost, such as CEO hubris problem, agency problem in acquirers, resistance from targets' management and overpayment for the target[13]. A smaller difference between the actual and optimal announcement returns indicates less agency problems in takeover transactions, and therefore implies a better merger quality.

In this paper, we define the takeover efficiency as that acquisition maximizes the acquirers' announcement return. High-efficiency deals often suggest smaller deviation of actual acquirers' return from the optimal stock performance. Hence, they imply less agency cost and better takeover qualities.

3.1.2 Constructing a benchmark for takeover efficiency

To estimate the takeover efficiency, we start with an optimal acquirers' announcement return, which is obtained by the production function in the stochastic frontier analysis (SFA) (Aigner et al., 1977).The optimal acquirers' announcement return can be estimated as follows:

$$ACQ\_RET_i = f(\mathrm{X}_i, \beta)\exp(\varepsilon_i) \quad (1)$$

where $\mathrm{ACQ\_RET_i}$ measures the acquirer's announcement return of the $\mathrm{i^{th}}$firm.$\mathrm{X_i}$ is an input vector which affects the acquirer's return.$\beta$is a vector of the estimated coefficients.$\varepsilon_\mathrm{i}$is a composite error component.

$$ACQ\_RET_i = \frac{Ret_i}{E(R_{it})} \quad (2)$$

$$E(R_{it}) = \beta_0 + \beta_i R_{mt} + \xi_i \quad (3)$$

where $E(R_{it})$is the expectation of return calculated by the market model (Brown and Warner, 1985).R_{it} is the rate ofreturn for thei^{th} ith.Firm on day t from CRSP, R_{mt} is the market value-weighted excess return on day t from CRSP. We obtain the abnormal return by subtracting the estimated return from the actual rate of return for firm ion day t.

Herein, ACQ_RET_i[14]is the output of production frontier, computed as a ratio of the acquirer's return on announcement day over the predicted return. The predicted return is calculated by the market model (Brown and Warner, 1985) with estimation period starting from 200 trading days to 20 trading days before the announcement day. We then regress firm's daily return on value-weighted market return over estimation period to obtain coefficients. Next, we select a vector of inputs which affects the acquirers' announcement return to consider different characteristics of acquisition partners and acquisition transactions. These inputs are often included in the previous M&A literatures as control variables. Definitions of our input variables

[13]Take an analogy, pasta is delicious and can be scored at 10 (optimal). The score of pasta will be lower, say 7 if too much salt is added or the pasta is overly boiled. "Pasta" the dish is takeover. "Too much salt" and "overly boiled" is the inefficiency.

[14]The reason why we do not use abnormal return (difference between actual return and the return predicted by asset pricing model) is that SFA requires the log transformation of output. Therefore, output is limited to positive value. To include more takeover transactions, we use the ratio of actual announcement return over predicted return instead of abnormal return.

are listed in the Appendix A. We then take a logarithmic transformation[15] of equation (1) and include dummy variables to characterize deals.

Specifically, a frontier function for takeover efficiency can be written as:

$$\ln(ACQ\_RET_i) = \beta_0 + \beta_1 \ln(Acquirer\ M/B_i) + \beta_2 \ln(Acquirer\ leverage_i) + \beta_3 \ln(Acquirer\ MV_i) + \beta_4 \ln(Target\ M/B_i) + +\beta_5 \ln(Target\ leverage_i) + \beta_6 \ln(TransactionValue_i) + \beta_7\ Hostile + \beta_8\ Tender + \beta_9\ Toehold + \beta_{10}\ Stock + \beta_{11} Competing + \beta_{12}\ Diversification + \varepsilon_i \quad (4)$$

$$\varepsilon_i = v_i - \mu_i \quad (5)$$

Where ε_i is error term, v_i isthe idiosyncratic component for the i^{th} deal, u_i is a one-side error with one-side distribution for inefficiency in the i^{th} deal. v_i is systematically distributed with Gaussian $v_i \sim N(0, \sigma_v^2)$. In SFA, error term ε_i is decomposed into two components, a random error v_i and deviation from the optimal value u_i. Deviation from the optimal estimation u_i represents the inefficiency which is attributed to human error andcan be reduced or even eliminated. In this paper, we assume an inefficiency component, $u_i \geq 0$, and is distributed as exponential distribution (Meeusen and van denk Broeck, 1977). For takeover transactions, inefficiencies are mainly due to agency problems, such as acquirers' hubris CEO, empire building[16], and overpayment etc. When inefficiency exits ($u_i > 0$), actual acquirers'announcement return would be reduced, less than the optimal value. When acquisition is fully efficient ($u_i = 0$), actual acquirers' stock performances are equal to the optimal announcement return. We then estimate the above model by maximum likelihood estimation (MLE) and ordinary least square (OLS). A likelihood-ratio test is then conducted to examine whether inefficiency exists in the takeover transactions.

Table 1 Estimation of M&A index

Estimation method	Stochastic Frontier Analysis (SFA)	Ordinary Least Square (OLS)
Acquirer Tobin's Q	0.0001	0.0001
	(0.86)	(0.67)
Acquirer leverage	0.0108**	0.0104**
	(2.20)	(2.08)
Acquirer MV	-0.0010**	0.0001
	(-2.03)	(0.08)
Target Tobin's Q	0.0001	0.0001
	(0.82)	(0.60)
Target leverage	-0.0028	-0.0011
	(-0.67)	(-0.24)
Transaction Value	-0.0037***	-0.0046***
	(-7.25)	(-9.05)

[15] In SFA, log transformation is commonlyapplied due to the concern of skewness in the sample.

[16] Empire building refers to the situation that acquirers' management initiate acquisition attempt in the interest of management since their compensation is positively associated with firm size.

Hostile	-0.0118***	-0.0084**
	(-2.97)	(-2.07)
Tender offer	0.0229***	0.0222***
	(12.73)	(12.11)
Toehold	-0.0023	-0.0008
	(-1.46)	(-0.51)
Stock	-0.0148**	-0.0157***
	(-8.45)	(-8.77)
Competing	-0.0028	-0.0028
	(-0.78)	(-0.78)
Diversification	-0.0097***	-0.0098***
	(-5.68)	(-5.57)
Constant	0.0483***	0.0235***
	(16.76)	(8.77)
Observation:	6254	6254
Log likelihood	9527.1399	N/A
Adjusted R-square	N/A	0.0876

Note: Table 1 shows the estimation results of M&A index estimated by maximum likelihood method (MLE) and ordinary least square (OLS). The table tabulates the coefficient for input variables for production function in stochastic frontier analysis (SFA). The variables are same in the ordinary least square (OLS). M/B is a ratio of market value over book value of firms' asset (Lang et al., 1989). Leverage ratio is total debt, which is the sum of long-term debt and short-term debt, divided by firm's total asset. Transaction value ($million) is total value that acquirers pay for the deal, deducting expenses and fees (Thomson One). Hostile is a dummy variable that equals 1 when the deal attitude is hostile (Thomson One). Tender offer is a dummy variable that equals 1 when the acquisition is tender offer (Thomson One). Toehold is a dummy variable that equals 1 when bidder owns target shares before takeover transaction. Stock is a dummy variable that equals to 1 when the deal is paid 100% with stocks. Competing is a dummy variable that equals 1 when acquisition is involved with multiple bidders. Diversification is a dummy variable that equals 1 when the first-two digits of acquirer SIC are different from the first-two digits of target SIC. T-values are showed in the table. ***, ** and * represents significant at 1%, 5% and 10%, respectively.

Table 1 tabulates coefficients of the independent variables for the production function. We also include estimation results estimated by OLS for comparison purpose. The remarkable difference between SFA and OLS is the error component. SFA decompose the error term into random error and inefficiency component while OLS regards error as idiosyncratic error. The OLS method assumes that all takeover deals achieve the optimal (maximum) return on the announcement day. Therefore, estimation results should be identical to the results by the SFA if and only if the inefficiency component does not exit. A series of likelihood-ratio tests are then conducted to examine the existence of any inefficiency. The null hypothesis that inefficiency does not exist is rejected at 1% level. Moreover, a ratio of lambda,$\lambda = \sigma_u/\sigma_v$,is calculated standing forthe standard deviation of inefficiency against the standard deviation of a random shock. Herein, lambda λ equals 0.4371. That is, the standard deviation of inefficiency component is 43.71% of the standard error of idiosyncratic component, which indicates that the inefficiency in the acquisitions should not be neglected. Therefore, the SFA is a more appropriate method to estimate the M&A index than the OLS.

We then calculate M&A index to score the degree of efficiency of each transaction. A takeover deal is defined as efficient if acquisition maximizes the acquirer's return on the announcement day. Therefore, the M&A index gauges the takeover efficiency by estimating the distance between the actual acquirer's return and optimal return when deal is announced to the public. The optimal announcement return is the maximized feasible return for the acquirer, and it can be reached by reducing the inefficiency issues (agency cost in acquisitions). Specifically, the M&A index is calculated as a ratio of the actual announcement return to optimal return for acquirers, which in nature is a technical efficiency. We specify the formula for M&A index as follows:

$$M\&A\ Index = \exp\{-u_i\} = \frac{E(\ ACQ\_RET_i|\widehat{\mu_i}\ ,\ \ X_i\ )}{E(\ ACQ\_RET_i^*|\widehat{\mu_i} = 0,\ X_i\ )} = \frac{ACQ\_RET_i}{ACQ\_RET_i^*}$$

where u_i represents a one-side error for inefficiency in thei^{th}deal, ACQ_RET_i is the observed acquirer's announcement return, $ACQ\_RET_i^*$ is the optimal acquirers' announcement return on the announcement day，ceteris paribus. Due to the existence of inefficiency, $ACQ_RET_i$is less than $ACQ\_RET_i^*$. Therefore, merger efficiency index (M&A index) is normalized, ranging from 0 to 1. If the index equals one exactly, then the bid is on the frontier, which indicates the acquirer receives the highest abnormal return on the announcement day.

4. Data

Data is collected from several databases. We collect takeover events and relevant information from Thomson ONE. Our combined data covers the period from January 1, 1980 to December 31, 2012. Due to data availability, only public acquisitions are considered, in which acquirers and targets are public firms. The original sample are 28,065 including both successful and failed transactions. We drop the takeover deals worth less than $1 million. We also require that acquirer take over control of targets (own more than 50% of targets' stake) after acquisitions. And it leaves us with14,706 deals. Financial information and price/return data are obtained from COMPUSTAT and CRSP, respectively. We merger the takeover sample with the COMPUSTAT and CRSP by excluding missing values. Finally, we have a sample of 6,254 deals after the above selection procedure.

Table 2 descriptive data

Panel A: M&A index for the full sample

	Observation	Mean	Median	Standard deviation	Min	25%	75%	Max
M&A Index	6254	0.9795	0.9814	0.0125	0.6928	0.9786	0.9837	0.9969

Panel B: M&A index classified by year

Year	Observation	Percent	Mean	Median	Sd	Min	25%	75%	Max
1980	4	0.06%	0.9790	0.9781	0.0029	0.9767	0.9768	0.9812	0.9830
1981	25	0.40%	0.9781	0.9796	0.0077	0.9496	0.9768	0.9818	0.9889
1982	46	0.74%	0.9797	0.9804	0.0046	0.9664	0.9772	0.9817	0.9905
1983	86	1.38%	0.9796	0.9804	0.0048	0.9570	0.9782	0.9821	0.9906
1984	206	3.29%	0.9800	0.9814	0.0086	0.9121	0.9787	0.9836	0.9926
1985	97	1.55%	0.9796	0.9809	0.0083	0.9141	0.9783	0.9828	0.9911
1986	98	1.57%	0.9784	0.9808	0.0124	0.8988	0.9778	0.9831	0.9891
1987	136	2.17%	0.9799	0.9816	0.0103	0.8950	0.9786	0.9847	0.9947

1988	143	2.29%	0.9797	0.9810	0.0110	0.8694	0.9784	0.9838	0.9944
1989	163	2.61%	0.9806	0.9813	0.0059	0.9570	0.9784	0.9841	0.9964
1990	153	2.45%	0.9794	0.9810	0.0076	0.9469	0.9780	0.9836	0.9935
1991	113	1.81%	0.9800	0.9813	0.0050	0.9632	0.9777	0.9828	0.9903
1992	98	1.57%	0.9804	0.9819	0.0081	0.9318	0.9786	0.9846	0.9934
1993	134	2.14%	0.9808	0.9821	0.0074	0.9238	0.9795	0.9840	0.9923
1994	304	4.86%	0.9810	0.9817	0.0057	0.9296	0.9789	0.9836	0.9969
1995	331	5.29%	0.9802	0.9812	0.0059	0.9178	0.9785	0.9830	0.9949
1996	401	6.41%	0.9799	0.9812	0.0122	0.7933	0.9790	0.9834	0.9967
1997	370	5.92%	0.9799	0.9814	0.0150	0.7205	0.9789	0.9838	0.9924
1998	406	6.49%	0.9796	0.9813	0.0107	0.8306	0.9783	0.9838	0.9937
1999	421	6.73%	0.9799	0.9817	0.0105	0.8872	0.9784	0.9845	0.9960
2000	471	7.53%	0.9769	0.9816	0.0206	0.6928	0.9776	0.9846	0.9946
2001	274	4.38%	0.9783	0.9810	0.0150	0.8065	0.9778	0.9837	0.9946
2002	147	2.35%	0.9793	0.9808	0.0090	0.9176	0.9768	0.9837	0.9944
2003	193	3.09%	0.9764	0.9808	0.0220	0.8220	0.9773	0.9830	0.9931
2004	194	3.10%	0.9788	0.9810	0.0108	0.8824	0.9787	0.9833	0.9930
2005	177	2.83%	0.9794	0.9817	0.0163	0.8262	0.9797	0.9834	0.9920
2006	187	2.99%	0.9804	0.9820	0.0090	0.9028	0.9796	0.9838	0.9921
2007	196	3.13%	0.9790	0.9817	0.0233	0.7286	0.9796	0.9834	0.9916
2008	163	2.61%	0.9792	0.9810	0.0107	0.8925	0.9781	0.9838	0.9939
2009	112	1.79%	0.9794	0.9807	0.0090	0.9344	0.9774	0.9836	0.9953
2010	136	2.17%	0.9805	0.9816	0.0062	0.9337	0.9785	0.9835	0.9913
2011	131	2.09%	0.9802	0.9819	0.0097	0.9082	0.9796	0.9840	0.9940
2012	138	2.21%	0.9812	0.9824	0.0066	0.9483	0.9797	0.9797	0.9931

Panel C: M&A index classified by industry

Industry	Observation	Percent	Mean	Median	Sd	Min	25%	75%	Max
Consumer durables	118	1.89%	0.9800	0.9812	0.0102	0.895	0.9812	0.9842	0.9930
Consumer nondurables	315	5.04%	0.9809	0.9819	0.0074	0.9176	0.9819	0.9842	0.9927
Business equipment	1203	19.24%	0.9775	0.9815	0.0198	0.6928	0.9815	0.9839	0.9946
Chemical products	173	2.77%	0.9816	0.9815	0.0039	0.9684	0.9815	0.9845	0.9927
Oil, Gas, and Coal	216	3.45%	0.9768	0.9804	0.0175	0.8262	0.9804	0.9831	0.9924
Healthcare	502	8.03%	0.9785	0.9815	0.014	0.8601	0.9815	0.9838	0.9940
Manufacturing	546	8.73%	0.9792	0.9811	0.0144	0.7808	0.9811	0.9836	0.9930
Finance	1875	29.98%	0.9806	0.9814	0.0059	0.8755	0.9814	0.9832	0.9964
Wholesale and retail	470	7.52%	0.9799	0.9813	0.0097	0.8851	0.9813	0.9838	0.9969
Telephone and television	188	3.01%	0.9799	0.9818	0.012	0.8857	0.9818	0.984	0.9953
Utilities	108	1.73%	0.9795	0.9817	0.0111	0.8927	0.9817	0.9833	0.9926
Others	540	8.63%	0.9801	0.9812	0.0082	0.9187	0.9812	0.9843	0.9960

Note: Table 2 lists the descriptive data for M&A index. Specifically, table shows the observation (number of M&A indices), mean, median, Sd (standard deviation), minimum, quintile and maximum for M&A indices. We also tabulate the distribution of M&A indices classified by industry and year. The industry classification is according to Fama-French 12 industry classification.

We then estimate the M&A index for each takeover deals. Table 2 reports the M&A index for the full sample and the distribution of M&A indices across industries (Fama-French industry classification). On average, the M&A index for the full sample is as high as 0.9795 with a minimum of 0.6928 and maximum of 0.9969. Among 6,254 deals, only 30 bids have indices less than 0.90. This fact[17] indicates that acquisitions are usually quite efficient. This could be explained by the nature of public deals reinforced by market efficiency. Compared to acquisitions involving private targets, acquiring firms in public transactions get complete information and therefore identify better takeover deals, resulting in more accurate valuations and better market responses. However, M&A indices are all significantly different from 1 (at 1% level), suggesting that deals are not completely efficient.

Panel B shows M&A index and the number of acquisition distributed by year. In general, the difference of the M&A index is little among deals for each year. There is a merger"boom"between1994 and2000, during which the number of takeover transactions is above 300. The average efficiency degree gradually decreases. In the early years of the boom (1994 and 1995), acquisitions are more efficient than the ones occur before the boom. Conversely, the M&A indices in the later period (1996 to 2000) are generally much lower, indicating that acquisitions driven by the merger boom are less efficient due to more irrational decision made by acquirers. Moreover, takeover efficiency is negatively affected by financial crisis. Lower M&A indices are very frequently around the year 2008.

In panel C, acquisitions are classified according to different industries. Transactions are concentrated in the business equipment and financial industries. Interestingly, statistics show that takeover deals in the financial industry yield to relatively higher values of the M&A index than of the other industries.

Table 3 presents the summary statistics of corporate fundamentals and deal characteristics. We further divide the full sample based on the M&A index and test the difference between the low- and high-efficiency deals. Results confirm the difference to be statistically significant, and the M&A index to be positively monotonic to the level of efficiency. However, acquirers in high-efficiency deals pay lower premium than bidding firms in deals with low efficiency. Our findings suggest that the M&A index performs as a measurement for merger outcomes. Moreover, acquirers in high-efficiency deals have better financial and operating performance than those in low-efficiency ones.

[17] The high average M&A indices are also due to the limitation of SFA since SFA requires the log transformation for variables. This restriction of SFA limits our sample to deals with positive return on announcement day.

Table 3 Descriptive statistics

Variables	Full sample (I)		Low-efficiencydeals (II)		High-efficiency deals (III)		Difference
	Mean (Number)	Standard deviation (percent)	Mean (Number)	Standard deviation (percent)	Mean (Number)	Standard deviation (percent)	(III)- (II)
Panel A: Acquirer related							
Market Value	8562.2610	30415.9600	5410.0420	22071.1100	11713.5800	36652.3800	6303.5330***
M/B	3.0026	23.9070	2.5716	10.6347	3.4334	32.0883	-0.8618
Leverage	0.1610	0.1705	0.1678	0.1751	0.1542	0.1655	-0.0136***
Return on Assets (ROA)	0.0350	0.1183	0.0308	0.1279	0.0392	0.1077	0.0084***
Panel B: Target related							
Market Value	2853.0660	15288.8500	1589.5170	9162.8300	4105.3370	19471.0300	2515.8200***
M/B	2.4153	15.3577	2.1075	6.9847	2.7230	20.5610	0.6155*
Leverage	0.1571	0.1924	0.1603	0.1959	0.1538	0.1888	-0.0065
Return on Assets (ROA)	-0.0120	0.6810	-0.0254	0.9320	0.0015	0.2424	0.0269*
Panel C: Deal related							
M&A index	0.9795	0.0119	0.9754	0.0153	0.9846	0.0025	0.0093***
Transaction value ($millions)	773.5128	3510.8970	709.5833	3661.0230	837.4240	3353.4130	127.8407
Premium (%)	0.1204	1.5178	0.1381	1.9352	0.1026	0.9266	-0.0355
Time to resolution (in days)	201.9520	325.5927	174.8626	256.4156	228.9165	380.3411	54.0539***
Hostile takeover	242	3.87%	124	3.97%	118	3.77%	
Tender Offer	1275	20.39%	787	25.17%	488	15.61%	
Toehold	5132	82.06%	2571	82.22%	2561	81.90%	
Competing bid	288	4.61%	142	4.54%	146	4.67%	
Diversification	1328	21.23%	614	19.64%	714	22.83%	
Cash	4032	64.47%	1975	63.16%	2057	65.78%	

Stock	1292	20.66%	560	17.91%	732	23.41%
Number of observations	6254		3127		3127	

Note: Table 3 provides the descriptive statistics of variables for takeover deals in the full sample and in the subsample classified by the value of M&A index. The table lists the mean (number) and standard deviation (percent) of variables (dummy variables) for firm and deal characteristics. M&A index is the measurement of takeover efficiency, calculated as a ratio of actual acquirers' announcement return over optimal announcement return (estimated by SFA). Market value is calculated as the number of shares outstanding multiplied by the respective stock price at 4 weeks before the official deal announcement. M/B is a ratio of market value over book value of firms' asset (Lang et al., 1989). Leverage ratio is total debt, which is the sum of long-term debt and short-term debt, divided by firm's total asset. Return on Asset (ROA) is computed as the ratio of the company's net income by the book value of total assets (Yermack, 1996) Transaction value ($million) is total value that acquirers pay for the deal, deducting expenses and fees (Thomson One). Premium is defined as the offer price, as the log percentage difference from target's share price 4 weeks before the M&A deal announcement (Baker et al. 2012). Time to resolution is the duration of deal, computed as the difference between date of deal announcement and the date when the deal completes (fails). Hostile is a dummy variable that equals 1 when the deal attitude is hostile (Thomson One). Tender offer is a dummy variable that equals to 1 when the acquisition is tender offer (Thomson One). Toehold is a dummy variable that equals to 1 when bidder owns target shares before takeover transaction. Competing bid is a dummy variable that equals 1 when acquisition is involved with multiple bidders. Diversification is a dummy variable that equals 1 when the first-two digits of acquirer SIC are different from the first-two digits of target SIC. Cash is a dummy variable that equals 1 if the M&A deal was paid entirely by cash. Stock is a dummy variable that equals 1 when the deal is paid 100% with stocks. ***, ** and * represents significant at 1%, 5% and 10%, respectively.

5. Empirical results

5.1 Deal completion

As a proxy of the takeover quality, M&A index is expected to be positively correlated with the probability of deal completion. Therefore, we implement both univariate and multivariate models to examine this relationship. Firstly, the whole sample is split into two subsamples based on whether acquisition attempts eventually complete or fail. Panel A of Table 4 shows the index for the unsuccessful subsample is 0.9778on average and this is lower than the successful subsample by 0.0019. This disparity is highly significant at 1% level. This finding indicates that acquirers with higher index are more likely to complete the takeover transactions.

Table 4 Analysis for probability of deal completion

Panel A: Univariate analysis

Classification	Failed (I)	Completion (II)	Difference (II)-(I)
Mean	0.9778***	0.9797***	0.0019***
Standard Deviation	0.0211	0.0107	
Observation	775	5479	

Panel B: Multivariate analysis

Completion	Model 1	Model 2
M&A index	5.2729***	4.5600***
	(3.53)	(2.98)
Acquirer Tobin's Q	0.0002	0.0003
	(0.86)	(1.25)
Acquirer Price To Earnings	0.0000	0.0002
	(-0.04)	(0.44)
Acquirer Leverage	-0.0514	-0.1464
	(-0.55)	(-1.46)
Acquirer Cash Flow To Asset	0.1802	0.2475
	(0.82)	(1.13)
Target Tobin's Q	-0.0029	-0.0018
	(-1.04)	(-0.61)
Target Price To Earnings	0.0001	0.0000
	(0.24)	(0.08)
Target Leverage	0.0094	-0.0166
	(0.13)	(-0.22)
Target Cash Flow To Asset	-0.1156	-0.1013
	(-0.82)	(-0.72)
Relative deal size	-0.2465***	-0.2439***
	(-6.39)	(-6.11)
Hostile takeover	-1.6988***	-1.6977***
	(-15.96)	(-15.62)
Tender offer	0.5901***	0.6383***
	(9.03)	(9.41)

Cash	-0.2846***	-0.2833***
	(-5.94)	(-5.28)
Competing bid	-0.8927***	-0.9459***
	(-9.63)	(-9.84)
Diversification	0.0164	0.0315
	(0.29)	(0.53)
Constant	-3.7407***	-3.3872**
	(-2.56)	(-2.25)
Firm-fixed-effects	No	Yes
Year-fixed-effects	No	Yes
Industry-fixed-effects	No	Yes
Observations	6254	6254
Pseudo R2	0.132	0.170

Note: Table 4 presents analysis for rate of successful deals. Panel A shows the M&A index for successful and unsuccessful transactions. Panel B tabulates the probit regression results. The dependent variable is the dummy variable which equals 1 when the takeover deal is finally completed and equals to 0 when the transactions is failed or withdrawn. The independent variable is the M&A index calculated by stochastic frontier analysis (SFA). We also control the firm and deal characteristics. Tobin's Q is computed as the ratio of market value by book value of the company's assets. Price to earnings is calculated as share price 4 weeks before announcement divided by earnings per share excluding extraordinary items. Leverage ratio is total debt, which is the sum of long-term debt and short-term debt, divided by firm's total asset. Cash flow to asset is a ratio of cash flow over total assets. Cash flow is operating income before extraordinary items, adding depreciation and subtracting dividends paid to shareholders. Relative deal size is computed as the transaction value divided by the market capitalization of the acquirer, 4 weeks before the official deal announcement. Hostile is a dummy variable that equals 1 when the deal attitude is hostile (Thomson One). Tender offer is a dummy variable that equals 1 when the acquisition is tender offer (Thomson One). Cash is a dummy variable that equals 1 if the M&A deal was paid entirely by cash. Competing is a dummy variable that equals 1 when acquisition is involved with multiple bidders. Diversification is a dummy variable that equals 1 when the first-two digits of acquirer SIC are different from the first-two digits of target SIC. T-values are showed in the table. Fixed effects are considered in model 2, including firm, industry and year fixed effects. ***, ** and * represents significant at 1%, 5% and 10%, respectively.

We then test the relationship between the index and the deal completion rate with probit regressions. Results are listed in Panel B of Table 4. The dependent variable is a dummy variable taking a value of one if deal is successfully completed, or zero otherwise. The independent variable is the M&A index. We also control variables for firm and deal characteristics, which are commonly used in previous M&A literatures. In panel B, coefficients on M&A index are positive and significant at 1% in model 1 and model 2, which supports findings in the univariate analysis. Therefore, acquisition is more likely to be successful when the actual acquirer's announcement return approaches the optimal level. A higher index, which has a smaller difference between the actual and optimal return, indicates that market appraises favourably to the acquisition deal. According to Luo (2005), acquirers' management would learn from market reactions to determine whether to consummate takeover transactions. Hence, bidding firms with a better market response are motivated to complete the takeover deal. Additionally, higher-efficiency deals suffer less resistance from targets' management, which leads to higher rate of completion.

Moreover, transactions of larger value tend to reduce the probability of success. We also observe a negative relationship between hostile deals and the likelihood of completion. Results are consistent to documented findings (Schwert, 2000; Baker et al., 2012). The completion rate

also decreases when the deal involves multiple bidders (Walkling, 1985). In contrast, the transaction is more likely to be successful when the deal is a tender offer (Baker et al.,2012).

5.2 post-acquisition stock performance

In this section, we study whether the M&A index predicts acquirers' stock performance shortly after the deal announcement. We estimate the short-run performance proxied by the cumulative abnormal returns (CARs) over the period from 3 days to 5 days after the announcement (ACAR (+3,+5))[28]. We calculate the market-model cumulative abnormal returns based on the procedure by Brown and Warner (1985). We implement the estimation period starting 220 trading days, ending 20 trading days preceding to the announcement day. Then we estimate acquirers' CARs with post-event period of three days (ACAR (+3, +5)). Table 5 reports the relationships between the M&A index and ACAR (+3, +5) in panel A (univariate) and panel B (multivariate analysis).

Table 5 Analysis for post-acquisition stock performance in the short-run

Panel A: Univariate analysis

ACAR(+3,+5)	Low-efficiency (I)	High-efficiency (II)	Difference (II)-(I)
Mean	-0.0582%	0.0563%	0.1145%***
Standard Deviation	0.0424	0.0488	
Observation	3127	3127	

Panel B: Multivariate analysis

ACAR(+3,+5)	Model 1	Model 2
M&A index	0.1704***	0.1861***
	(3.64)	(3.95)
Acquirer Tobin's Q	0.0000	0.0000
	(-0.95)	(-0.92)
Acquirer Price To Earnings	0.0000	0.0000
	(0.47)	(0.31)
Acquirer Leverage	0.0002*	0.0002*
	(1.89)	(1.72)
Acquirer Cash Flow To Asset	0.0038*	0.0041*
	(1.70)	(1.80)
Target Tobin's Q	0.0001	0.0001
	(0.71)	(0.80)
Target Price To Earnings	-0.0001	-0.0001

[28] Since the return on announcement day (day 0) is included in the M&A index, we exclude the date surrounding day 0 to avoid endogenous issue.

	(-1.56)	(-1.51)
Target Leverage	-0.0002	-0.0002
	(-0.90)	(-0.93)
Target Cash Flow To Asset	-0.0003	-0.0002
	(-0.84)	(-0.76)
Relative deal size	0.0007	0.0008
	(1.03)	(1.19)
Hostile takeover	-0.0053	-0.0056*
	(-1.62)	(-1.71)
Tender offer	-0.0008	-0.0010
	(-0.58)	(-0.68)
Cash	0.0025**	0.0023*
	(2.11)	(1.81)
Competing bid	-0.0011	-0.0014
	(-0.39)	(-0.48)
Diversification	-0.0033**	-0.0037**
	(-2.31)	(-2.53)
Constant	-0.1681***	-0.1892***
	(-3.67)	(-4.09)
Firm-fixed-effects	No	Yes
Year-fixed-effects	No	Yes
Industry-fixed-effects	No	Yes
Observations	6254	6254
Adjust R2	0.004	0.009

Note: Table 5 shows analysis for post-acquisition stock performance in the short-run. In panel A, the full sample is divided into low-efficiency and high-efficiency subsamples based on M&A index. PanelA presents short-run stock performance in low-efficiency and high-efficiency group. Panel B shows the regression results for post-acquisition performance in the short-run. The dependent variable is the cumulative abnormal return for acquirers over the period 3 days to 5 days after announcement day (ACAR (+3, +5)). ACAR(+3,+5) is calculated by market model (Brown and Warner, 1985) with value-weighted CRSP index as a benchmark for market return and a estimation period starting 200 trading days and ending 20 trading days before the M&A deal announcement. The independent variable is the M&A index calculated by stochastic frontier analysis (SFA). We also control the firm and deal characteristics. Tobin's Q is computed as the ratio of market value by book value of the company's assets. Price to earnings is calculated as share price 4 weeks before announcement divided by earnings per share excluding extraordinary items. Leverage ratio is total debt, which is the sum of long-term debt and short-term debt, divided by firm's total asset. Cash flow to asset is a ratio of cash flow over total assets. Cash flow is operating income before extraordinary items, adding depreciation and subtracting dividends paid to shareholders. Relative deal size is computed as the transaction value divided by the market capitalization of the acquirer, 4 weeks before the official deal announcement. Hostile is a dummy variable that equals 1 when the deal attitude is hostile (Thomson One). Tender offer is a dummy variable that equals 1 when the acquisition is tender offer (Thomson One). Cash is a dummy variable that equals 1 if the M&A deal was paid entirely by cash. Competing is a dummy variable that equals 1 when acquisition is involved with multiple bidders. Diversification is a dummy variable that equals 1 when the first-two digits of acquirer SIC are different from the first-two digits of target SIC. T-values are showed in the table. Fixed effects are considered in model 2, including firm, industry and year fixed effects. ***, ** and * represents significant at 1%, 5% and 10%, respectively.

In panel A, the full M&A samples are divided into low-efficiency and high-efficiency groups according to the index. On average, the ACAR (+3, +5) is 0.0563% in the group with high-efficiency deals, which is 0.1145% higher than the ACAR obtained from the low-efficiency ones. Hence, univariate analysis indicates that acquirers in higher-efficiency deals earn more return shortly after the announcement day. To check the robustness of this finding, we regress the 3-day ACAR on the M&A index. Regressions are estimated by the ordinary least square (OLS) method. Control variables are included in both models, including firm and deal characteristics. Additionally, model 2 incorporates year and industry effects. Panel B presents regression results and further supports the findings in the univariate analysis even after controlling other variables and fixed-effects. Coefficients for the index are positive, statistically significant at 1% in all the regressions. As a measurement of takeover efficiency, M&A index measures whether acquisitions maximize acquirers' return on announcement. This objective is measurable because it is modelled as a ratio of the actual announcement return against the optimal level. A smaller deviation from the optimal announcement return leads to a higher M&A index, implying market optimism towards a given M&A activity. Acquisitions with higher indices are more close to efficiency. Our findings suggest that efficient deals perform better in the short run.

5.3 post-acquisition operating performance

According to Andrade et al. (2001), the expected gains on takeover announcements are realized in a form of post-merger profitability. Long-run operating performance is therefore an indicator of takeover quality and synergy gain. In this section, we investigate the relation between the M&A index and post-merger operating performance, which is estimated as an "Industry-Adjusted Return on Asset"(Healy et al., 1992) for acquirers. The IAROA is calculated as a difference between the acquirer's ROA and the median ROA across the belonging industry.

Table 6 long-run operating performance

Average 3-year IAROA	Model 1	Model 2
M&A index	1.4712***	1.2641***
	(3.18)	(2.72)
Acquirer Tobin's Q	0.0000	0.0000
	(-0.14)	(0.49)
Acquirer Price To Earnings	0.0000	0.0000
	(-0.47)	(-0.45)
Acquirer Leverage	0.0546**	0.0591**
	(2.33)	(2.42)
Acquirer Cash Flow To Asset	0.3650***	0.3586***
	(6.74)	(6.49)
Target Tobin's Q	-0.0001	0.0001
	(-0.02)	(0.21)
Target Price To Earnings	0.0001	0.0002
	(0.38)	(0.30)
Target Leverage	0.0207	0.0236
	(1.06)	(1.20)
Target Cash Flow To Asset	0.0665**	0.0765**

	(2.07)	(2.31)
Relative deal size	-0.0091	-0.0073
	(-1.37)	(-1.09)
Hostile takeover	0.0048	0.0011
	(0.15)	(0.03)
Tender offer	0.0118	0.0114
	(0.85)	(0.80)
Pure Cash deal	0.0149	0.0215*
	(1.31)	(1.72)
Competing bid	0.0110	0.0102
	(0.39)	(0.36)
Diversification	0.0051	0.0062
	(0.37)	(0.44)
Constant	-2.153***	-1.9785***
	(-4.75)	(-4.33)
Firm-fixed-effects	No	Yes
Year-fixed-effects	No	Yes
Industry-fixed-effects	No	Yes
Observations	6254	6254
Adjust R2	0.016	0.026

Note: Table 6 reports the relation between M&A index and long-run operating performance after acquisitions. The dependent variable is average industry-adjusted ROA of acquirers for 3 years post-acquisition (IAROA). IAROA is bidder's return on assets, deducting median ROA in the industry with the same first-2 digit SIC code as acquirers'. The independent variable is the M&A index calculated by stochastic frontier analysis (SFA). We also control the firm and deal characteristics. Tobin's Q is computed as the ratio of market value by book value of the company's assets. Price to earnings is calculated as share price 4 weeks before announcement divided by earnings per share excluding extraordinary items. Leverage ratio is total debt, which is the sum of long-term debt and short-term debt, divided by firm's total asset. Cash flow to asset is a ratio of cash flow over total assets. Cash flow is operating income before extraordinary items, adding depreciation and subtracting dividends paid to shareholders. Relative deal size is computed as the transaction value divided by the market capitalization of the acquirer, 4 weeks before the official deal announcement. Hostile is a dummy variable that equals 1 when the deal attitude is hostile (Thomson One). Tender offer is a dummy variable that equals 1 when the acquisition is tender offer (Thomson One). Cash is a dummy variable that equals 1 if the M&A deal was paid entirely by cash. Competing is a dummy variable that equals 1 when acquisition is involved with multiple bidders. Diversification is a dummy variable that equals 1 when the first-two digits of acquirer SIC are different from the first-two digits of target SIC. T-values are showed in the table. Fixed effects are considered in model 2, including firm, industry and year fixed effects. ***, ** and * represents significant at 1%, 5% and 10%, respectively.

In Table 6, the dependent variable is the averaged IAROA of acquirers (A_IAROA) over a three-year window after acquisitions. Control variables are included for firm and deal characteristics in all regressions. We also control fixed effects of firm, year and industry in model 2. In table 6, coefficients of the M&A index are positive[29] and statistically significant at 1%. These findings indicate deals with higher levels of efficiency perform better in terms of post-merger profitability. Therefore, empirical evidence confirms that the M&A index is

[29] Moreover, the un-tabulated results also show that M&A index is significantly and positively associated with C_IAROA for each fiscal period over three years after announcement.

forward-looking and has a significant prediction power towards the long-run operating performance of the acquirer.

Moreover, industry-adjusted ROA is improved if acquirers have higher leverage ratio (Cai and Sevilir, 2012). Post-merger operating performance is also positively affected by acquirers' and targets' operating cash flows, deflated by firms' total assets.

5.4 trading strategy

Previous literature develops trading strategy on the spread (Elliott et al., 2005), risk (Thurner et al., 2003) and trend (James, 2003). This study enriches this thread of research by building up strategies based on efficiency (the M&A index). We construct trading strategies according to the values of the M&A indices. Specifically, the full ordered-sample[30] is divided into three subsamples (portfolios) by three quantiles (tertiles) based on the averaged M&A index. Portfolio 1 includes deals with the lowest M&A indices; Portfolio 2 includes deals with medium indices; Portfolio 3 includes deals with the highest indices. The trading strategy that we employ is to buy-and-hold the acquirers' stocks after the announcement. The holding period lasts 1, 2, 3, 4, 5, and 6 months, respectively[31].

The return, r_{it},for thei^{th}deal on day t is the acquirer's daily return obtained from CRSP. We then compound daily returns over the holding period $T.R_T = \prod_{i=1}^{T}(1 + r_{it}) - 1$. The monthly return is the geometric mean of holding period return, denoted by$R = (1 + R_T)^{30/T} - 1$. We further measure the performance by calculating alphas from a standard CAPM model (Sharpe, 1964) and the Fama-French factor models (Fama and French, 1993; Carhart, 1997; Fama and French, 2015).

Table 7 Trading strategy

Panel A: Holding period return

Holding Period Return	Portfolio (least efficient) (I)	Portfolio (II)	Portfolio (most efficient) (III)	Difference (II)-(I)	Difference (III)-(II)	Difference (III)- (I)
Holding 1 month	-0.0184***	0.0207***	0.0604***	0.0391***	0.0397***	0.0789***
Holding 2 months	-0.0082***	0.0308***	0.0676***	0.0390***	0.0369***	0.0759***
Holding 3 months	0.0067***	0.0446***	0.0797***	0.0380***	0.0351***	0.0731***
Holding 4 months	0.0067***	0.0510***	0.0864***	0.0442***	0.0354***	0.0796***
Holding 5 months	0.0299***	0.0736***	0.0969***	0.0437***	0.0233***	0.0670***
Holding 6 months	0.0365***	0.0839***	0.1057***	0.0474***	0.0217**	0.0692***
Observation	2085	2085	2084			

[30] Here, order stands for the ranking of the values of the M&A index from the minimum to maximum.

[31] To avoid possible large price swings accompanying merger announcements, we exclude the announcement day and start to hold acquirers' stocks from the day after announced date.

Panel B: Monthly alpha for various models

Monthly Alpha	Model	Portfolio (least efficient) (I)	Portfolio (II)	Portfolio (most efficient) (III)	Difference (II)-(I)	Difference (III)-(II)	Difference (III)- (I)
Holding 1 month	Alpha_CAPM	0.0264***	0.0451***	0.1173***	0.0187***	0.0721***	0.0908***
	Alpha_FF3	0.0205***	0.0459***	0.1141***	0.0254***	0.0682***	0.0936***
	Alpha_FF4	0.0202***	0.0474***	0.1172***	0.0272***	0.0698***	0.0970***
	Alpha_FF5	-0.3937***	-0.3715***	-0.3407***	0.0222***	0.0308***	0.0531***
Holding 2 months	Alpha_CAPM	0.0131***	0.0203***	0.0444***	0.0072***	0.0241***	0.0313***
	Alpha_FF3	0.0074***	0.0175***	0.0434***	0.0101***	0.0259***	0.0360***
	Alpha_FF4	0.0086***	0.0193***	0.0410***	0.0107***	0.0217***	0.0324***
	Alpha_FF5	-0.3885***	-0.3709***	-0.3481***	0.0176***	0.0229***	0.0404***
Holding 3 months	Alpha_CAPM	0.0038***	0.0101***	0.0250***	0.0063***	0.0149***	0.0212***
	Alpha_FF3	-0.0001***	0.0085***	0.0249***	0.0086***	0.0164***	0.0250***
	Alpha_FF4	0.0008***	0.0100***	0.0229***	0.0091***	0.0129***	0.0220***
	Alpha_FF5	-0.3851***	-0.3708***	-0.3497***	0.0142***	0.0212***	0.0354***
Holding 4 months	Alpha_CAPM	0.0009***	0.0062***	0.0170***	0.0053***	0.0108***	0.0161***
	Alpha_FF3	-0.0021***	0.0051***	0.0171***	0.0072***	0.0120***	0.0192***
	Alpha_FF4	-0.0013***	0.0063***	0.0154***	0.0077***	0.0091***	0.0167***
	Alpha_FF5	-0.3816***	-0.3707***	-0.3502***	0.0109***	0.0206***	0.0315***
Holding 5 months	Alpha_CAPM	-0.0002***	0.0043***	0.0127***	0.0045***	0.0084***	0.0130***
	Alpha_FF3	-0.0027***	0.0035***	0.0129***	0.0062***	0.0094***	0.0156***
	Alpha_FF4	-0.0021***	0.0045***	0.0114***	0.0066***	0.0069***	0.0135***
	Alpha_FF5	-0.3795***	-0.3699***	-0.3515***	0.0096***	0.0184***	0.0280***
Holding 6 months	Alpha_CAPM	-0.0007***	0.0032***	0.0101***	0.0039***	0.0069***	0.0109***
	Alpha_FF3	-0.0028***	0.0026***	0.0103***	0.0054***	0.0078***	0.0132***
	Alpha_FF4	-0.0023***	0.0034***	0.0090***	0.0057***	0.0056***	0.0113***
	Alpha_FF5	-0.3774***	-0.3683***	-0.3509***	0.0091***	0.0174***	0.0265***
Observation		2085	2085	2084			

Note: Table 7 shows the holding period return in panel A and monthly alpha for trading strategy in panel B for trading strategy on M&A index. The full sample is split into 3 portfolios on the basis of M&A index of each deal. The portfolio 1 is the group with lowest indices which is portfolio with inefficient deals. The portfolio 3 is the group with highest indices which is portfolio with efficient deals. The portfolio 2 is the group of those having neutral indices. To avoid the large movement in acquirers stocks due to the takeover announcement, we exclude the date announced and start to hold stocks from the day after takeover announcement. Panel A reports the average holding period return over 1 to 6 months after announced day and the mean difference between each two portfolios. To calculate the monthly alpha, we adopt four models for benchmarking, including CAPM, Fama-French 3 factors, Fama-French 4 factors and Fama-French 5 factors. Panel B shows the monthly alpha for

portfolios over different holding periods and the difference between each two groups. ***, ** and * represents significant at 1%, 5% and 10%, respectively.

In table 7, panel A presents the average return over various holding periods for the three portfolios. Strikingly, we find that the acquiring firms earn around 7% more return than the bidders with the lowest indices in the same holding period. The difference between the most efficient (Portfolio 3) and least efficient (Portfolio 1) deals is highly significant and yields to the largest value, 7.89%, when stocks of the acquiring firms are held for 1 month after the announcement. Returns monotonically increase with the length of holding periods in every portfolio but the gap between Portfolio 3 and 1 reduces from 7.59 % to 6.92%. Similarly, acquirers in Portfolio 3 profit more than bidders in Portfolio 2. The discrepancy between these two groups ranges from 2.17% (6-month holding) to 3.97% (1 month holding) and are significant at 1%.

We further examine the performance of the proposed buy-and-hold strategy relative to popular benchmark models. We regress daily (monthly return) on market premium and multiple factors to get alphas from the CAPM and Fama-French models, respectively. In general, we observe similar patterns of the alphas for the three portfolios in panel B. The alpha in Portfolio 3 is significantly larger than the one in the rest two portfolios, and the difference is statistically significant at 1%. On average, holding an acquirer's stock for 1 month yields to a monthly alpha of 11% in the case of Portfolio 3. The smallest difference of alphas between Portfolio 3 and Portfolio 1 is as large as 9.08% in the CAPM. When acquirers stocks are held for more than 1 month, bidders in Portfolio 3 keep outperforming the firms in Portfolio 2 and Portfolio 1.We further expand the holding period to 12, 24 and 36 months, respectively. Results[32] show limited consistency and confirm that the trading strategy is much more effective when the holding period is within 6 months after the takeover announcement.

Table 8 Trading strategy classified by industry

Panel A: Holding period return

Holding Period Return for Industry	Portfolio (least efficient) (I)	Portfolio (II)	Portfolio (most efficient) (III)	Difference (II)-(I)	Difference (III)-(II)	Difference (III)- (I)
Telephone and Television	-0.0607***	0.0254***	0.0731***	0.0861***	0.0477	0.1338***
observation	78	77	75			
Oil, Gas, and Coal	-0.0843***	0.0350***	0.0500***	0.1193***	0.015	0.1343***
observation	84	82	81			
Consumer Durables	-0.0184***	0.0207***	0.0604***	0.0288	0.0732**	0.1020***
observation	54	52	58			
Business Equipment	-0.0333***	0.0165***	0.0639***	0.0498***	0.0475***	0.0972***
observation	388	380	381			
Manufacturing	-0.0115***	0.0244***	0.0612***	0.0359***	0.0369***	0.0727***
observation	173	172	170			
Chemicals Products	-0.0264***	0.0189***	0.0618***	0.0453**	0.0429**	0.0882***
observation	70	68	73			
Consumer Non-Durables	-0.0071***	0.0201***	0.0734***	0.0273	0.0533***	0.0805***
observation	103	99	105			

[32] Due to the limited length of paper, we do not show the tables for 12 months, 24 months and 36 months.

Healthcare	-0.0284***	0.0173***	0.0584***	0.0457***	0.0411***	0.0868***
observation	168	174	165			
Wholesale and retail	0.0057***	0.0278***	0.0821***	0.022	0.0544***	0.0764***
observation	163	166	164			
Finance	-0.0058***	0.0170***	0.0440***	0.0228***	0.0271***	0.0498***
observation	576	589	594			
Utilities	-0.0094***	0.0154***	0.0294***	0.0249	0.014	0.0389**
observation	51	59	57			
Other	-0.0174***	0.0322***	0.0868***	0.0497***	0.0546***	0.1042***
observation	177	179	181			

Panel B: Monthly alpha

Monthly alpha for Industry	Portfolio (least efficient) (I)	Portfolio (II)	Portfolio (most efficient) (III)	Difference (II)-(I)	Difference (III)-(II)	Difference (III)- (I)
Telephone and Television	-0.2987***	0.0806***	0.0306***	0.3794***	-0.0501***	0.3293***
observation	78	77	75			
Oil, Gas, and Coal	-0.1771***	0.0296***	-0.1111***	0.2067***	-0.1406***	0.0661***
observation	84	82	81			
Consumer Durables	0.0097***	-0.0522***	0.0251***	-0.0619***	0.0773***	0.0154**
observation	54	52	58			
Business Equipment	0.0547***	0.0795***	0.1231***	0.0248***	0.0435***	0.0683***
observation	388	380	381			
Manufacturing	-0.0194***	0.0191***	0.1379***	0.0385***	0.1188***	0.1573***
observation	173	172	170			
Chemicals Products	0.0102***	0.0765***	0.0942***	0.0663***	0.0177***	0.0840***
observation	70	68	73			
Consumer Non-Durables	-0.0628***	-0.0531***	0.1320***	0.0097**	0.1851***	0.1948***
observation	103	99	105			
Healthcare	-0.0056***	0.0456***	0.1530***	0.0512***	0.1075***	0.1587***
observation	168	174	165			
Wholesale and retail	-0.0312***	0.0049***	0.1757***	0.0361***	0.0544***	0.2068***
observation	163	166	164			
Finance	0.0970***	0.0662***	0.1315***	-0.0309***	0.0654***	0.0345***
observation	576	589	594			
Utilities	0.0999***	0.0154***	-0.0569***	0.0383***	-0.1952***	-0.1568***
observation	51	59	57			
Other	0.0056***	0.0270***	0.1137***	0.0214***	0.0867***	0.1081***
observation	177	179	181			

Note: Table 8 shows holding period return in panel A and monthly alpha for trading strategy in panel B for trading strategy on M&A index, classified by industry. The full sample is split into 3 portfolios on the basis of M&A index of each deal. The portfolio 1 is the group with lowest indices which is portfolio with inefficient deals. The portfolio 3 is the group with highest indices which is portfolio with efficient deals. The portfolio 2 is the group of those having neutral indices. To avoid the large movement in acquirers stocks due to the takeover announcement, we exclude the date announced and start to hold stocks from the day after takeover announcement. Panel A reports the average holding period return over 1 to 6 months after announced day and the mean difference between each two portfolios. To calculate the monthly alpha, we adopt four models for

benchmarking, including CAPM, Fama-French 3 factors, Fama-French 4 factors and Fama-French 5 factors. Panel B shows the monthly alpha for portfolios over different holding periods and the difference between each two groups. The industry classification is according to Fama-French 12 industry classification. ***, ** and * represents significant at 1%, 5% and 10%, respectively.

We then re-categorize the full sample according to the industry classification. We further divide deals belonging to the same industry into the three subgroups based on their M&A indices. Table 11examinesthe acquirer's return and monthly alpha over 1 month after the announcement. In most industries, M&A indices are positively associated to holding period returns. Investors can profit over investing the acquirers in the most efficient deals (in the energy and telephone industry, the acquirers return in the group with the highest indices is around 13.3% more than portfolio with the lowest indices).

Table 9 Trading strategy classified by year

Panel A: Holding period return

Holding Period Return for year	Portfolio (least efficient)	Portfolio	Portfolio (most efficient)	Difference	Difference	Difference
	(I)	(II)	(III)	(II)-(I)	(III)-(II)	(III)- (I)
1980-1984	-0.0215***	-0.0095***	0.0732***	0.0121	0.0826***	0.0947***
observation	98	93	85			
1985-1989	-0.0262***	0.0246***	0.0702***	0.0508***	0.0456***	0.0964***
observation	204	202	206			
1990-1994	-0.0104***	0.0107***	0.0624***	0.0211*	0.0517***	0.0728***
observation	273	264	263			
1995-1999	-0.0112***	0.0248***	0.0556***	0.0360***	0.0308***	0.0668***
observation	621	636	626			
2000-2004	-0.0202***	0.0344***	0.0644***	0.0546	0.0300***	0.0846***
observation	441	440	448			
2005-2009	-0.0333***	0.0059***	0.0489***	0.0386***	0.0430***	0.0816***
observation	289	295	293			
2010-2012	-0.0148***	0.0191***	0.0642***	0.0339***	0.0450***	0.0789***
observation	159	154	163			

Panel B: Monthly alpha

Monthly alpha for year	Portfolio (least efficient)	Portfolio	Portfolio (most efficient)	Difference	Difference	Difference
	(I)	(II)	(III)	(II)-(I)	(III)-(II)	(III)- (I)
1980-1984	-0.0384***	0.0521***	0.1448***	0.0906***	0.0927***	0.1833***
observation	98	93	85			
1985-1989	0.0159***	0.0198***	0.1199***	0.0039	0.1001***	0.1040***
observation	204	202	206			
1990-1994	0.0422***	0.0642***	0.1716***	0.0220***	0.1074***	0.1294***
observation	273	264	263			
1995-1999	0.0367***	0.0375***	0.0900***	0.0009	0.0525***	0.0533***
observation	621	636	626			

2000-2004	0.0518***	0.1128***	0.1719***	0.0610***	0.0591***	0.1210***
observation	441	440	448			
2005-2009	-0.0624***	0.0229***	0.0353***	0.0852***	0.0124***	0.0976***
observation	289	295	293			
2010-2012	0.0287***	-0.0129***	0.1168***	-0.0416***	0.1297***	0.0881***
observation	159	154	163			

Note: Table 9 shows holding period return in panel A and monthly alpha for trading strategy in panel B for trading strategy on M&A index, classified by industry. The full sample is split into 3 portfolios on the basis of M&A index of each deal. The portfolio 1 is the group with lowest indices which is portfolio with inefficient deals. The portfolio 3 is the group with highest indices which is portfolio with efficient deals. The portfolio 2 is the group of those having neutral indices. To avoid the large movement in acquirers stocks due to the takeover announcement, we exclude the date announced and start to hold stocks from the day after takeover announcement. Panel A reports the average holding period return over 1 to 6 months after announced day and the mean difference between each two portfolios. To calculate the monthly alpha, we adopt four models for benchmarking, including CAPM, Fama-French 3 factors, Fama-French 4 factors and Fama-French 5 factors. Panel B shows the monthly alpha for portfolios over different holding periods and the difference between each two groups. ***, ** and * represents significant at 1%, 5% and 10%, respectively.

Similarly, we recompose all takeover transactions by every five years. Overall, we find that more efficient deals could bring higher return (in pre-specified holding periods) and higher monthly alpha for investors. The alpha difference between more efficient portfolios and less efficient one is the largest over the period from 1980 to 1994. Interestingly, the acquirer returns and monthly alphas are marginally significant from 2005 to 2009, during which the 1-month return is 4.89% and monthly alpha is 3.53% in the most efficient deals. The adverse stock performance could be attributed to the financial crisis in 2007-2008. However in most efficient deals(with highest M&A indices), the acquirers earn 9.76% more in return while average monthly alpha of the acquirers is 9.76% more than bidders in least efficient deals. In all, higher indices are associated with better stock performance in most industries across time. Investors could benefit the most from holding stocks of acquirers in the most efficient deals.

6. Robustness Check

Since the values of the M&A index are often above 0.90, its probability distribution may wildly deviate from Gaussian. Therefore, results of standard regressions and tests could be misleading. In this section, we employ a bootstrapping method as a robustness check. By resampling the takeover deals randomly with replacement, we manage to generate large numbers of artificial efficiency ratios. We find that the inefficiency indeed exists in the takeover samples.[33] In addition, the bootstrapping confirms that the M&A index is significantly different from 0 and 1. The full sample is further divided into 3 groups according to different values of the index. We also re-test the relationship between the M&A indices and deal completion rates, premium, short-run and long-run performance, respectively. All bootstrapping results unanimously confirm identical properties that we find in practical market observations.

7. Conclusion

In this paper, a new measurement of efficiency is introduced and applied to M&A practices. Takeover efficiency measures whether the acquirers' return is maximized on the announcement day given a set of firm and deal information. Acquirers' announcement returns are reduced due to inefficiency factors, such as agency cost in acquirers and resistance from targets' management.

[33] Due to the length restriction, results of robustness checks are not shown. They can be provided by request.

As a proxy of the takeover efficiency, the M&A index indicates a technical efficiency on the production frontier, and its value is standardizedbetween0 and1. The reason for choosing acquirers' announcement returns as the output of the SFA is that they reflect general market reaction to the acquisition events. Therefore, the M&A index measures the gap between actual investor responses (as observed from the market) and the theoretical evaluation of takeover. By construction, a deal with higher index is more efficient than the one with a lower index.

We then examine the relationship between the M&A index and the acquisition outcome, including the probability of deal completion, acquirers' short-run stock performance and post-acquisition operating performance in the long run. We observe that deals with higher indices(or to say, more efficient acquisitions) are more likely to complete. In the short run, the M&A index is positively related to cumulative abnormal returns for acquirers. In the long term, acquirers with higher M&A index perform better in terms of post-merger operating performance.

Finally, we managed to construct three portfolios based on different rankings of the M&A index by imposing buy-and-hold trading strategy to acquirers' stocks after the takeover announcement. Empirical results show that portfolios with higher M&A indices significantly outperform the portfolios with lower indices, especially for the 6-month holding period. The most efficient portfolio (with highest M&A indices) earns 7.89% higher than least efficient portfolio (with the lowest M&A indices) when holding acquirers' stocks for 1 month. We further calculate alphas from the CAPM and Fama-French multi-factor models. Monthly alphas for the most efficient portfolio are as high as 11.4% by holding acquirers' stocks for 1 month after the takeover announcement, and this result is robust to different models.

In sum, this study suggests that the M&A index is an accurate measurement for acquisition efficiency. The M&A index can effectively forecast the likelihood of deal completion and post-acquisition performance in the short run and in the long run. Trading strategies based on the M&A index are effective and profitable during the post-acquisition period. Therefore, market participants could benefit from this composite indicator by evaluating takeover deals in an outright and very simple way. Due to the strong predicating power, the M&A index can be used for investors and analysts to forecast firm performance and design trading strategies. Moreover, academic research could include M&A index in regression models to gauge the impact of acquisitions.

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Appendix A

Variables	Definitions
	Panel A: Key independent variables
M&A index	M&A index is the measurement of takeover efficiency, calculated as a ratio of actual acquirers' announcement return over optimal acquirers' announcement return (estimated by Stochastic Frontier Analysis).
	Panel B: Post-acquisition performance
ACAR(+3,+5)	ACAR (+3,+5) refers to the cumulative abnormal return for acquirers over the period 3 days to 5 days after announcement day. This variable is calculated by market model (Brown and Warner, 1985) with value-weighted CRSP index as a benchmark for market return and a estimation period starting 200 trading days and ending 20 trading days before the M&A deal announcement.
Industry-adjusted Return on Asset of acquirer (A_IAROA)	A_ IAROA is bidder's return on assets (ROA), deducting median ROA in the industry with the same first 2-digit SIC code as acquirers'.
	Panel C: Firm characteristics
Tobin's Q	Tobin's Q is computed as the ratio of market value by book value of the company's assets.
Market Value (MV)	The market value is calculated as the number of shares outstanding multiplied by the respective stock price at 4 weeks before the official deal announcement.
Leverage	Leverage ratio is total debt, which is the sum of long-term debt and short-term debt, divided by firm's total asset.
Return on Assets (ROA)	ROA is computed as the ratio of the company's net income by the book value of total assets (Yermack, 1996).
Price to earnings	Price to earnings is calculated as share price 4 weeks before announcement divided by earnings per share excluding extraordinary items.
Cash flow to asset	Cash flow to asset is a ratio of cash flow over total assets. Cash flow is operating

	income before extraordinary items, adding depreciation and subtracting dividends paid to shareholders.
	Panel D: Deal characteristics
Transaction value ($millions)	Transaction value refers to the total value of consideration paid by the acquirer in order to obtain the target. We report the total dollar value as reported by Thomson One.
Premium (%)	Premium is defined as the offer price, as the log percentage difference from target's share price 4 weeks before the M&A deal announcement (Baker et al. 2012).
Time to resolution	Time to resolution is the duration of deal, computed as the difference between date of deal announcement and the date when the deal completes (fails).
Relative deal size	Relative deal size is computed as the transaction value divided by the market capitalization of the acquirer, 4 weeks before the official deal announcement.
Hostile takeover	Dummy variable that equals 1 if the M&A deal was reported as hostile.
Tender offer	Dummy variable that equals 1 when the acquisition is reported as tender offer
Toehold	Dummy variable that equals 1 when bidder owns target shares before takeover transaction
Competing bid	Dummy variable that equals 1 if the M&A deal involves multiple bidders.
Cash	Dummy variable that equals 1 if the M&A deal was paid entirely by cash.
Stock	Dummy variable that equals 1 if the M&A deal was paid entirely by stocks.
Diversification	Dummy variable that equals 1 when the first-two digits of acquirer SIC are different from the first-two digits of target SIC.

IMI International Monetary Review

Environmental Policy, Firm Dynamics and Wage Inequality in Developing Countries*

By CHI-CHUR CHAO, MONG SHAN EE, XIANGBO LIU, AND EDEN S. H. YU*

This paper examines the short- and long-run effects of pollution taxes on wage gap, social welfare and the environment of a developing economy. Due to free entry of firms, the urban manufacturing sector tends to be over expanded with severe production-generated pollution emissions, which harm consumers. Urban firms can either abate the emissions or pay pollution taxes to emit. In the short run with a fixed number of firms, a rise in the pollution tax has an ambiguous effect of the skilled-unskilled wage gap, depending on the capital substituting and capital releasing effects of urban firms. Nonetheless, in the long run, the higher pollution tax can cause urban firms to exit. Capital is then released to the rural sector and benefits the production of rural workers, when the firm-exit effect is strong. This prediction is empirically validated. The higher pollution tax can therefore yield a double dividend in the long run by not only reducing pollution emissions but also narrowing skilled-unskilled wage gap in the economy.

Keywords: Environmental Tax; Firm Exit; Wage Inequality; Developing Economies

JEL Classification: O18, Q52, Q56

1. Introduction

Economic growth has been a priority in policy design and implementation in many developing economies. The growth target may, however, harm the country's environment via consumption- and production-generated pollution emissions. The remarkable economic growth experienced in developing countries driven largely by a rapid expansion in production and consumption consequently can result in the speedy deterioration of the environment. The serious pollution currently experienced in China and Hong Kong are two vivid examples. China's air quality has been deteriorating since 2000 and getting worse from year to year. In 2013, the urban air pollution became so severe that 71 out of 74 cities monitored by the Chinese's Ministry of Environmental Protection failed to meet the safe air quality standard recommended by the World Health Organization's (WHO). Likewise, the air quality in Hong Kong had deteriorated to its worst level in nearly a decade, and Hong Kong Environmental Protection Department has warned the public that the poor air quality in a total of 177 days out of a year posed a high risk to health.

The exposure to excessive amount of pollutants released by motor vehicles, such as nitrogen oxide and ozone, along with other primary pollutants produced by fossil fuels combustion and industry emissions, like sulfur dioxide, has caused a large number of premature deaths and

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substantial monetary losses worldwide. It is estimated that air pollution in China claimed between 350,000 and 500,000 lives prematurely each year (Moore, 2014). In addition, Hong Kong air pollution caused more than 3,000 premature deaths and an estimated the monetary loss of HK$39 billion in 2012 (Lai, 2013).

To combat the air pollution caused in particular by consumption-generated emissions, both Chinese and Hong Kong governments have implemented various measures and policies to curb pollution emissions. These measures include the traffic restrictions implemented by the local municipality of major cities in China, including Beijing, such as the odd-even car plate restrictions by Beijing municipality, to reduce the number of cars on the road (Luo, 2014), and the incentive scheme to help vehicle owners to fit old diesel vehicles with particulate reduction devices and the reduction of first-time registration tax for environment-friendly vehicles launched by the Hong Kong government. In addition, as a measure to reduce the severe air pollution problem in big cities, firms located near Beijing have been ordered to move their production facilities to a new location which is far from the city. A notable one is the reallocation of the Shijiazhuang Iron and Steel Co, a subsidiary of China's largest steelmaker, to about 70 kilometres away from its old site by the end of 2017 to reduce severe air pollution in Beijing. This company has steelmaking capacity of 2.6 million tons a year and has been emitting sulfur dioxide, nitrogen oxide, dust and smoke for nearly 60 years. The authority expects this relocation will reduce the emissions of smoke and dust, which will help improve Beijing's air quality. Other nearby steel plants, such as Bohai Group in Tangshan and Jinan Steel Group and Taihang Steel Group in Handan, have also been ordered to move from city centres to costal or special industrial zones by 2017.[1]

Although the measures to curb consumption-generated emissions have been introduced and implemented, policies on industrial emissions through production have remained veiled in China and other Asian economies.[2] Recently, a draft on pollution fees was released on the basis of the user's pay principle that companies and individuals who directly discharge pollution emissions would be subject to taxation and fine. Although this plan is expected to yield an estimated 22.8 billion to 45.7 billion yuan in annual tax revenue, the effects on emission reductions and related impacts to the economy have yet been discussed and examined.

The purpose of this paper is to fill in this gap. The main contribution of this paper is to investigate the effects of environmental controls and regulations on the economy and environment from production-side consideration. Specifically, we pay attention to firm dynamics, where favorable development policies together with lax environmental policy can make the number of urban firms in the industry to be excessive in developing economies. This causes severe production-generated pollution emissions, which harm consumers in those economies. Urban firms can then either abate emissions or pay pollution taxes to pollute. In the short run with a fixed number of urban firms, we find that an increase in pollution taxes can narrow or widen the wage gap depending on the capital substituting and capital releasing effects on urban firms. However, in the long run, the higher pollution tax on producers could cause firms to exit from the urban manufacturing sector. Capital is then released to the rural sector and can in turn benefit the production of rural workers, when the firm-exit effect is sufficiently strong. The higher pollution tax can therefore yield a double dividend in the long run by not only reducing pollution emissions, but also narrowing wage inequality between skilled and unskilled labor for the developing economy. The theoretical predictions obtained are then empirically validated. Using a sample of 37 low- and middle-income countries (including China), we provide empirical

[1] See a report, entitled "Steel Plants Told to Relocate" by Zhang Yu and Wang Wei in *China Daily*, January 18, 2016.
[2] See a report on China's pollution fees in *China Daily*, August 29, 2016.

evidence to support the predictions derived in the theoretical model regarding both the short- and long-run effects of environmental regulations (or pollution tax) on income inequality. Our results show that income inequality can be reduced by at least 3.5% when firm-exit effect is taken into account.

This paper is organized as follows. Section 2 sets up a general-equilibrium model for a dual developing economy, in which environmental taxes are imposed on urban manufacturing firms for pollution emissions. Section 3 examines the short- and long-run effects of an increase in pollution taxes on income distribution and social welfare of the economy. Section 4presents the empirical methodology and discusses the regressions results. Section 5 concludes.

2. The model

We consider a developing economy with a dual structure of production: a manufacturing good X is produced by n firms in the urban sector and the agricultural commodity Y is produced in the rural sector. During the production process of the manufacturing good X, pollutants are however emitted as by-products. Urban manufacturing firms can either abate the pollution emissions or pay pollution taxes to emit. Choosing good Y as the numeraire, the relative price of the manufacturing good X is denoted by p and the tax on pollution emissions is t.

The developing economy exports the agricultural commodity Y under the given world price, while the manufacturing good X is non-traded. Domestic consumers demand for both manufacturing and agricultural goods by DX and DY, and the utility function takes the form of quasi-linear preference as $U(DX, DY) = DY + u(DX) = DY + DX - D_X^2/2$.Utility maximization, subject to the budget constraint, $I = pDX + DY$, yields the (inverse) demand function for the manufacturing good X: $p = 1 - DX$ which gives $pX(= \partial p/\partial DX) = -1$, where I denotes income. The indirect utility function of domestic consumers is thus given by: $V = V(p, I) = I – (1 – p)2/2$, with $Vp = - DX$ and $VI = 1$ by the envelope theorem. For the goods-market equilibrium, domestic demand for the manufacturing good X is equal to its supply in the home economy, i.e., $DX = X$. Note that there are n manufacturing firms in the urban sector, by imposing a symmetry condition, we have $X = nx$, where x denotes the output per manufacturing firm.

On the supply side of the economy, by combining unskilled labor (LY) and capital (KY),the rural sector produces agricultural commodity Y with a constant-returns-to-scale production function: $Y = Y(LY, KY)$. The corresponding unit cost of producing good Y is given by g (wR, r), where wR denotes the wage rate for rural unskilled labor and r is the rental rate for capital. The demands for unskilled labor and capital in the rural sector are respectively expressed by: $LY = gw(wR, r)Y$ and $KY = gr(wR, r)Y$, where the subscript represents the partial derivative. Assuming that the agricultural good market is perfectly competitive, in equilibrium zero profit prevails:

$$g(wR, r)= 1, \tag{1}$$

where the price of the agricultural good Y is normalized to unity.

In the urban sector, under fixed equipment, management and supervision, manufacturing firms produce good X by employing unskilled production labor and physical capital. The production technology is under increasing returns to scale, with fixed cost, f(wS, r), and marginal costs, m(wU, r). The former comes from wage payment to nonproduction skilled labor and rental cost to capital, while the latter is associated with the payments to urban production unskilled labor and capital. Note that wS denotes the wage rate for skilled labor in the economy and wU is the wage rate for unskilled labor in the urban sector. Total cost for a urban manufacturing firm to produce quantity x is therefore: $c(wS, wU, r, x) = f(wS, r) + m(wU, r)x$. By utilizing the envelope property, the employments of skilled and unskilled labor for each individual firm in the

urban sector are given by$s_x = f_w(w_S, r)$ and$l_x = m_w(w_U, r)x$, and the use of capital is represented by$k_x = f_r(w_S, r) + m_r(w_U, r)x$.

In the process of production, manufacturing firms in the urban sector generate pollution emissions, which harm consumers. The pollutants generated by a firm are directly linked to the output as a by-product. Firm can either abate pollution emissions or pay a pollution tax to emit pollutants. Note that abating emissions can be either carried out internally by the firms or outsourced externally to abating firms. Assuming that the abatement technology is to use domestic skilled labor and foreign equipment/technology, the unit cost of abatements is expressed by$\alpha(w_S, r^*)$, where r^* is the given rental rate of foreign equipment/technology. In equilibrium, analogous to the no-arbitrage condition, the unit abatement cost must be equal to the pollution tax rate:

$$\alpha(w_S, r^*) = t, \tag{2}$$

with α_w expresses the requirement of skilled labor for per unit pollution abatement. Consequently, pollution emissions of individual firm is $z = x - a$, where a denotes the amount of emissions abated.

In the urban sector, the after-tax profit of urban firm is therefore given by: $\pi = p(X)x - c(w_U, w_S, r, x) - \alpha(w_S, r^*)a - t(x - a) = p(X)x - c(w_U, w_S, r, x) - tx$. By choosing firm output, profit maximization yields the equality of marginal revenue to marginal cost:

$$p(X) + p_x(X)x = m(w_U, r) + t. \tag{3}$$

Note that Cournot quantity competition between urban firms is used in deriving this first-order profit-maximization condition.

Turn next to the factor markets. Following Harris and Todaro (1970), the dual developing economy is unevenly developed: the modern urban manufacturing sector is more advanced compared to the traditional rural sector. In the urban sector, an institutionally minimum wage rate, w_U, is set for unskilled labor, which is above the market-determined rural wage rate, w_R, for unskilled labor. This leads to unemployment (L_U) in the urban sector. Moreover, the higher urban wage rate attracts rural workers to migrate to the urban sector, but with a probability of $1/(1 + \mu)$ to be employed, where μ ($= L_U/L_X$) signifies the ratio of urban unemployment by noticing that L_X is the total employment in the urban sector (i.e., $L_X = n l_x$).Therefore, labor migration from the rural to the urban sector stops until the expected urban wage rate equals the rural wage rate:

$$w_U/(1 + \mu) = w_R. \tag{4}$$

This equation is known as the Harris-Todaro (H-T) migration equilibrium.

For the factor markets, the market-clearing conditions of unskilled labor, capital and skilled labor in the home economy are required by

$$(1 + \mu)m_w(w_U, r)nx + g_w(w_R, r)Y = L, \tag{5}$$

$$n[f_r(w_S, r) + m_r(w_U, r)x] + g_r(w_R, r)Y = K, \tag{6}$$

$$f_w(w_S, r)n + \alpha_w(w_S, r^*)na = S, \tag{7}$$

where L, K and S represent respectively the exogenous supplies of unskilled labor, capital and skilled labor in the economy. Note that in (7), full employment is assumed to prevail in the market of skilled labor, which determines its wage rate w_S, with $w_S > w_U > w_R$.

Finally, to complete the setup of the model, the number of urban manufacturing firms n needs to be considered: it is fixed in the short run, while urban firms can freely enter or exit in the long run until zero profit reaches:

$$p(X)x - f(w_S, r) - m(w_U, r)x - \alpha(w_S, r^*)a - t(x - a) = 0. \tag{8}$$

The model specified in (1) – (8) describes the dual structure of a developing economy, in which (1) – (7) determine seven unknowns, w_R, w_S, r, μ, x, Y and a in the short run with a fixed

number of urban firms n, while in the long run the number of urban firms n is endogenously determined by the free entry/exit condition described in (8). The policy variable in the model is the pollution tax rate t on the urban manufacturing firms that emit pollution emissions. We will use this framework to examine the short- and long-run impacts of the changes in the pollution tax on factor returns, social welfare and the environment of the developing economy.

3. Pollution tax, wage inequality and social welfare

We begin with a study on the environmental regulation, say, a rise in the pollution tax, on factor returns and then to social welfare for the short and long runs. In the developing economy, capital tends to be located in the urban sector due to favorable development policies, including lax environmental regulations, to urban firms.[3] This can result in less capital located in the rural sector, causing low wages for unskilled labor in the rural sector. The relationship between the capital rental rate and the unskilled wage rate in the rural sector can be seen from (1). By totally differentiating (1), we have:

$$\hat{w}_R = -(\theta KY/\theta LY)\hat{r}, \tag{9}$$

where θjY represents the cost share of the jth production factor in producing good Y.[4] That is, under the given price of the agricultural good Y, to maintain the constant unit cost of production, a change in the capital rental rate r would yield an opposite effect on the unskilled wage rate wR in the rural sector. This relationship on factor returns r and wR is represented by a curve in the southwest quadrant in Figure 1.

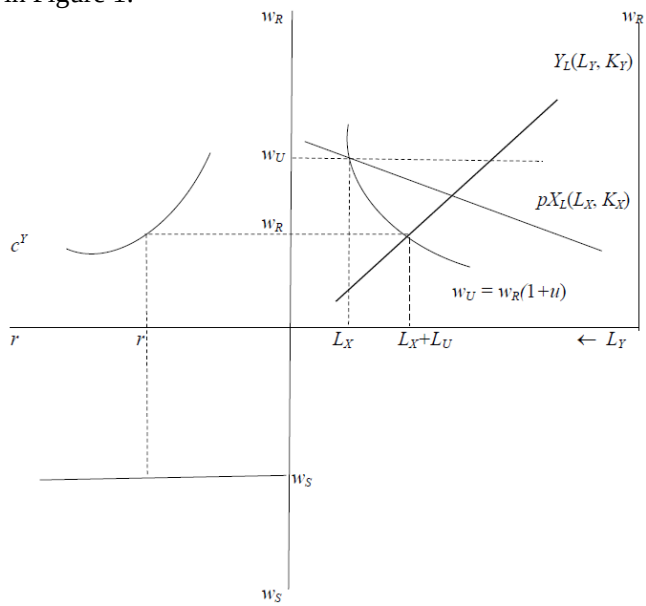

Figure 1. Labor market equilibrium

Note that by using μ = LU/LX, the H-T migration equilibrium in (3) between the rural and the urban sector can be rewritten as wULX = wR(LX + LU), which is depicted by a rectangular hyperbola in the northeast quadrant of Figure 1.[5] Since the minimum wage rate (wu) for urban

[3] See Restuccia and Rogerson (2013) for misallocation of capital in the economy.

[4] See Jones (1965) for the notation.

[5] See Corden and Findlay (1975) and Neary (1981). Also see Beladi and Marjit (1996) for a related application of the Harris-Todaro

unskilled labor is institutionally fixed, a change in the rural unskilled wage rate affects labor migration and hence the ratio of urban unemployment μ. From (3), we have:

$$\hat{\mu} = -[(1+\mu)/\mu]\hat{w}_R. \quad (10)$$

This suggests that an increase in the rural wage rate lowers the urban unemployment ratio. On the other hand, due to the given foreign rental rate r*in (2), the change in the skilled wage rate depends entirely on the price of the abatements, which is equal to the tax rate of pollution emissions. By differentiating (2), we obtain:

$$\hat{w}_S = \hat{t}/\theta SA, \quad (11)$$

where θSA is the cost share of skilled labor in abating pollution emissions. As indicated in the southeastern quadrant of Figure 1, the skilled wage rate wS can be expressed by a horizontal line, which will be shifted downwards when a stringent regulation, such as a rise in the pollution tax on emissions, takes place.

To obtain the overall impacts of the pollution tax on factor returns, the output effect is also needed to be considered. By totally differentiating (3), the change in firm output x in the urban sector is:

$$-(1+1/n)\hat{x} = \hat{n} + \varepsilon b\theta^m_{KX}\hat{r} + \varepsilon\tau\hat{t} \quad (12)$$

where b = m/pand τ = t/p. Note that ε = -p/px X signifies the price elasticity of demand for good X and θ^m_{jX} represents the variable cost share of factor j in producing good x. Therefore, from (12), an increase in the production cost via a higher capital rental rate and/or a larger pollution tax will negatively affect the production of good x. It is noted that market competition by the number of firms n can also affect firm's production of good x.

In addition, totally differentiating the factor markets of unskilled labor and capital in (5) and (6)yields:[6]

$$(1+\mu)\lambda^m_{LX}\hat{x} + \lambda LY\hat{Y} = -(1+\mu)\lambda^m_{LX}\hat{n} - [(1+\mu)s^m_{LX} + sLY]\hat{r} + [(1+\mu)\lambda^m_{LX} + sLY]\hat{w}_R, \quad (13)$$

$$\lambda^m_{KX}\hat{x} + \lambda KY\hat{Y} = -\lambda KX\hat{n} + (sKX + sKY)\hat{r} - sKY\hat{w}_R - (s^f_{KX}/\theta SA)\hat{t}, \quad (14)$$

where λ^m_{jX} and λjY are respectively the allocative shares of variable factor j in sectors X and Y. Productions of goods X and Y will be further adjusted through the changes in wage rates and capital rentals as indicated in (13) and (14).It is shown in Appendix that for stability, the urban manufacturing sector is required to be capital intensive relative to the agricultural sector in variable production inputs, i.e., $|\lambda m| = \lambda^m_{KX}\lambda LY - (1+\mu)\lambda^m_{LX}\lambda KY > 0$.[7] Note that from the last term on the right-hand side of (14), a rise in the pollution tax rate works in a similar fashion as a decrease in the supply of capital in the economy. According to the Rybczynski effect, the output of good x will be reduced and the production of good Y will be increased. The changes in outputs will be further adjusted when the changes in the factor returns and number of urban firms are taken into consideration.

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model.

[6] The unit fixed cost of urban firm is $f(w_S, r_U)$, and the elasticity of factor substitution between skilled labor and capital is defined as: $\sigma^F_X = ff_{wr}/f_w f_r$. Following Jones (1965), the factor substitution effect in demand for skilled labor is: $s^f_{SX} = \sigma^f_X \theta^f_{KX} \lambda^f_{SX}$, where θ^F_{KX} (= rf_r/f) is the cost share of capital in the fixed cost of sector *X*. Similarly, for the agricultural sector, we define: $s_{LY} = \sigma_Y\theta_{KY}\lambda_{LY}$, where $\sigma_Y = gg_{wr}/g_w g_r$.

[7] This factor intensity condition of the Harris-Todaro model was stated by Khan (1980) and used by Chao and Yu (1992).

As for urban firms, the change in the rental rate for capital can also result in a factor substitution effect between capital and skilled labor, which could affect the composition of the fixed inputs as well as the abatements of emissions. From (7), we have:

$$\lambda SA\hat{a} = (sSX + sSA)\hat{w}_S - sSX\hat{r} - \hat{n}, \quad (15)$$

Where sSX and sSA express respectively the factor substitution effects between capital and skilled labor in constituting the fixed inputs in sector X and abating pollution emissions.[8] The pollution abatements would be increased if more skilled labor (induced by the higher skilled wage rate) is employed in the abatement activity. However, the abatements could be lowered either by higher capital rentals or more urban firms because more skilled labor would be employed in the urban manufacturing sector.

3.1. Short-run effects

According to (11), a rise in the pollution tax yields a direct impact on the wage rate of skilled labor via more skilled-labor demand to carry out the activity of abatements. This leads to a factor substitution towards capital by urban firms in the composition of fixed inputs, thereby raising the rental rate for capital. On the other hand, the rise in the pollution tax reduces the production of good x. The output reduction effect caused by the rise in the pollution tax can be solved from (8) – (14) as:

$$\hat{x}/\hat{t} = -\varepsilon\{\tau[\lambda LYsKY + \lambda KYsLY + \lambda LY\theta LYsKY + (1+\mu)\lambda KY(\theta LYs^{m}_{LX} + \theta KY\lambda^{m}_{LX}] + bs^{f}_{KX}\lambda LY\theta LY\theta^{m}_{KX}/\theta SA\}/D < 0. \quad (16)$$

where $D = (1 + 1/n)[B + \lambda LY\theta LY s^{m}_{KX} + (1 + \mu)\lambda KY(\theta LY s^{m}_{LX} + \theta KY\lambda^{m}_{LX})] + \varepsilon b\theta LY\theta^{m}_{KX}|\lambda m| > 0$ and $B = \lambda KYsLY + \lambda LYsKY$. The fall in the production of good x will release capital from urban firms to the rural sector. This is referred to as the capital releasing effect.

By taking into account the capital substituting and capital releasing effects, from (8) – (14), we can solve for the overall effect of a rise in the pollution tax on the rental rate of capital:

$$\hat{r}/\hat{t} = \theta LY[(1 + 1/n)\lambda LYs^{f}_{KX}/\theta SA - \varepsilon\tau|\lambda m|]/D \gtrless 0. \quad (17)$$

Note that s^{f}_{KX} expresses the capital substituting effect and $|\lambda m|$ captures the capital releasing effect (via the reduction of output x). In Figure 1, the capital substituting effect induced by the rise in the capital tax makes the VMPL (value of marginal product of labor) curve of sector X(also the corresponding H-T migration curve) to shift leftwards, while the capital releasing effect shifts the VMPL curve of sector Y to the left. Hence, $\hat{r}/\hat{t} > (<) 0$ when the capital substituting effect is stronger (weaker) than the capital releasing effect. This accordingly yields: $\hat{w}_R/\hat{t} = -(\theta KY/\theta LY)(\hat{r}/\hat{t}) < (>) 0$.

In Figure 2, we illustrate the case for an economy with a larger capital substituting effect, in which the leftward shift of the VMPL curve for sector X exceeds that for sector Y. Consequently, skilled wage rises but unskilled wage falls. Thus, the wage gap between skilled and unskilled labor is widened. On the contrary, the rental rate for capital may fall when the capital substituting effect is smaller than the capital releasing effect. This case is depicted in Figure 3, in which a smaller leftward shift of the sector X's VMPL curve occurs, compared to the shift of the VMPL curve for sector Y. Unskilled wage can be increased and the wage gap between skilled and unskilled labor could be narrowed.

[8] We define $s_{SA} = \sigma_A\theta_{KA}\lambda_{SA}$, where $\sigma_A = \alpha\alpha_{wr}/\alpha_w\alpha_r$.

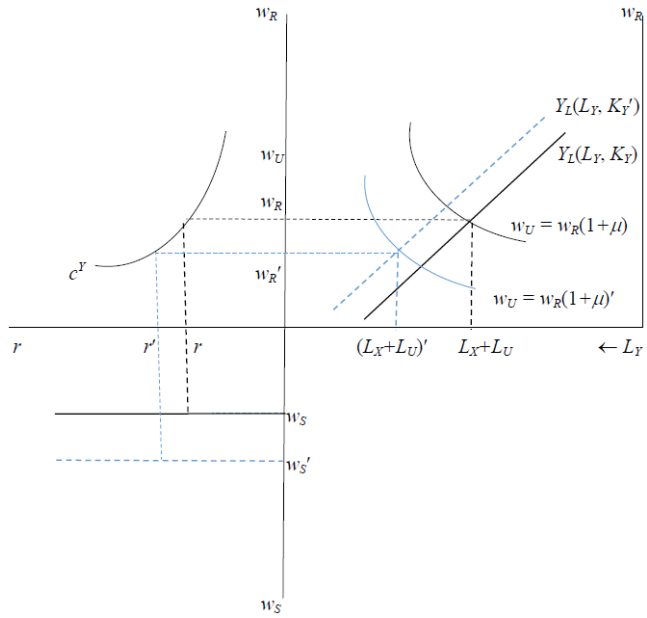

Figure 2. A rise in pollution tax: Strong capital substituting effect

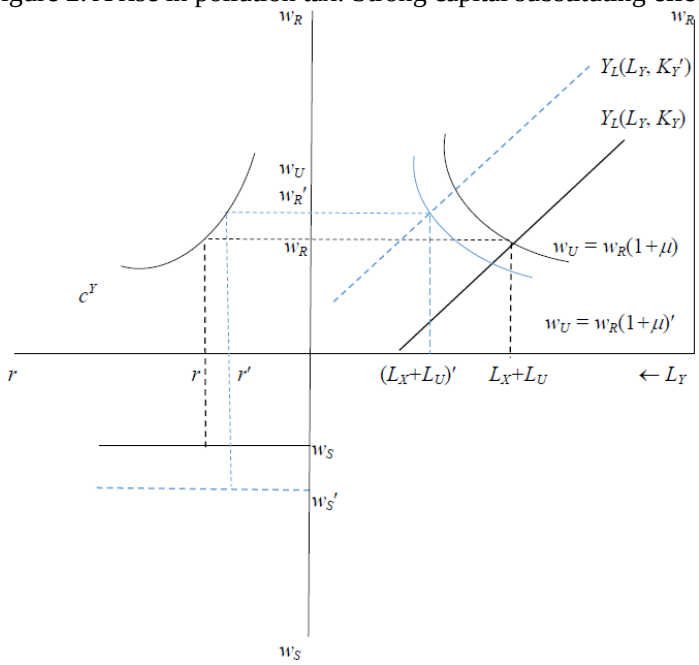

Figure 3. A rise in pollution tax: Weak capital substituting effect

In addition, changes in the rural unskilled wage rates could influence the incentive of unskilled labor for rural-urban migration and hence affect the urban unemployment ratio. From (9), we have:

$$\hat{\mu} / \hat{t} = - [(1 + \mu)/\mu](\hat{w}_R / \hat{t}) \lesseqgtr 0. \quad (18)$$

A rise in the pollution tax can reduce (increase) the rural wage rate, thereby leading to more (less) labor migration from the rural to the urban sector.

Note that production of urban good x responds negatively to the rise in the pollution tax. This can also be reflected in firm's profit:

$$d\pi/dt = - x - [fw(dwS/dt) + fr(dr/dt) + xmr(dr/dt)] \lesseqgtr 0. \quad (19)$$

Note that $d\pi/dt < 0$ in (19) if the capital substituting effect is larger in the short run (i.e., $dr/dt > 0$).

Using the results on production and unemployment in the urban sector, we can evaluate the short-run welfare impact of the pollution tax in the dual developing economy. Social welfare is represented by the indirect utility function adjusted by the environmental damage (ED), W = V(p, I) - ED, where ED = γ(X – A). Note that γ expresses the direct negative externality of pollution on consumers in the economy. In addition, national income, I, comes from factor incomes and the profits of the urban firms: I = wULX + wRLY + wSS + rK+ nπ + tn(x – a), where the tax revenue from pollution emissions is returned to consumers in a lump-sum fashion. Totally differentiating the welfare function and then using (1) – (7), we obtain the change in social welfare for the economy:

$$dW= - wRLXd\mu + n(p – m - t)dx+ n(t - \gamma)(dx – da), \quad (20)$$

where $p – m– t= - xpx> 0$ with $px= -1$. This welfare expression captures four distortions in the economy: urban unemployment, market imperfection, pollution tax and environmental damage. Given the urban minimum wage rate wu, the second-best optimal pollution tax is:

$$to = \gamma + wRLX(d\mu/dt)/n(dx/dt – da/dt)+xpx(dx/dt)/n(dx/dt – da/dt), \quad (21)$$

where $d\mu/dt \lesseqgtr 0$ and $dx/dt<0$. That is, for the developing economy, the pollution tax can be used to correct the negative externality from environmental damage to consumers, adjusted by urban unemployment and market imperfection. Hence, we have $to \lesseqgtr \gamma$, where γ signifies the direct damage of pollution to consumers and is known as the Pigovian tax rate on pollution emissions. When the capital substituting effect is large in urban firms, the optimal pollution tax rate could be lowered because $to<\gamma$ with $dr/dt> 0$ and $d\mu/dt> 0$ in (21), and vice visa.

In general, for a given fixed number of urban firms in the short run, the rise in the pollution tax has an ambiguous effect on the wage gap between skilled and unskilled workers in the economy, depending on the capital substituting and capital releasing effects of urban firms. We summarize the short-run results of the pollution tax on factor returns in the following:

Proposition 1. For a dual developing economy with urban unemployment and market imperfection in the urban manufacturing sector, the rise in the pollution tax raises the wage rate for skilled labor but can lower the wage rate for unskilled labor, when the capital substituting effect on fixed inputs of urban firms is larger compared to its capital releasing effect. Nonetheless, the rise in the pollution tax can raise the wage rates for both skilled and unskilled labor, when the capital releasing effect of urban firms is large.

This leaves the analysis of the short-run impacts of environmental regulations on wage inequality to an empirical question, which will be addressed in section 4.

3.2. Firm dynamics

In the previous section, we have considered the short-run situation in which the number of firms in the urban sector is exogenously given and shown that the rise in the pollution tax can lower profits of urban firms in (21) when the capital substituting effect is strong. This can cause urban manufacturing firms to exit, thereby releasing capital from the urban to the rural sector and hence lowering the rental rate for capital in the economy. Solving (1) – (7), we obtain:

$$\hat{r}/\hat{n}= (1 + 1/n)\theta LY|\lambda|/D > 0, \quad (22)$$

where $|\lambda| = \lambda KX\lambda LY - (1+\mu)\lambda^{m}_{LX}\lambda KY > 0$, expressing the conventional definition for factor intensity in average sense.[9] That is, the urban manufacturing sector X is more capital intensive relative to the agricultural sector Y when total use of capital in sector X, including capital as fixed and variable inputs, is considered. Note that we have $|\lambda| > |\lambda m|$ by recalling that $|\lambda m| = \lambda^{m}_{KX}\lambda LY - (1+\mu)\lambda^{m}_{LX}\lambda KY$.

On the other hand, the fall in the capital rental rate in (24) lowers the production cost of good Y and hence increases its output. This raises demand for unskilled labor since sector Y is labor intensive, thereby raising the unskilled wage rate in the rural sector:

$$\hat{w}_R/\hat{n} = -(\theta KY/\theta LY)(\hat{r}/\hat{n}) < 0. \quad (23)$$

Consequently, the urban unemployment ratio falls:

$$\hat{\mu}/\hat{n} = -[(1+\mu)/\mu](\hat{w}_R/\hat{n}) > 0. \quad (24)$$

In addition, exit of urban firms raises the output and profit of the survival firms:

$$\hat{x}/\hat{n} = -[B + \lambda LY\theta LYsKX + (1+\mu)\lambda KY(\theta LY\, s^{m}_{LX} + \theta KY\, \lambda^{m}_{LX}) + \varepsilon b\theta LY\, \theta^{m}_{KX}(|\lambda|]/D < 0, \quad (25)$$

$$d\pi/dn = -[fw(dwS/dn) + fr(dr/dn) + xmr(dr/dn)] < 0, \quad (26)$$

where noting that $dwS/dn = 0$. However, the change in industrial output X of the manufacturing good, $dX/dn = x + n(dx/dn)$, is ambiguous.

The effect of firm exit on factor returns can be illustrated in Figure 4, in which the leftward shift of the VMPL curve for sector Y is larger in reflecting the capital releasing effect from the exit of urban firms. Under this case, the rural wage rate for unskilled labor could increase while the wage rate for skilled labor remains unchanged. This is referred as the firm-exit effect in the urban manufacturing sector.

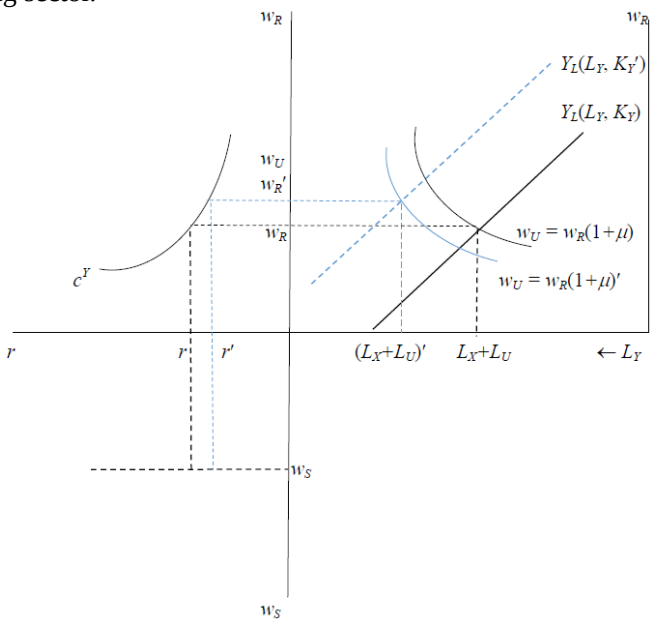

Figure 4. A decrease in the number of urban firms

[9] See Chao and Yu (1997).

As for the welfare effect of exit of firms from the urban sector, we can differentiate the welfare function, W = V(p,I)-γ(X- A), to obtain:

$$dW/dn= \pi s\text{-}wRLX(d\mu/dn) + n(p - m - t)(dx/dn) + n(t - \gamma)(dx/dn - da/dn), \quad (27)$$

where dμ/dn> 0 by (24) and dx/dn< 0 by (25), while$\pi s[= p(X)x - f(wS, r) - m(wU, r)x - \gamma(x - a)]$ denotes the social profit of urban firm. Setting dW/dn = 0 in (27) and evaluating it at the Pigouvian pollution tax, t = γ, the socially optimal number of manufacturing firms in the urban sector is determined at a positive level of social profit:

$$\pi_s^o = wRLX(d\mu/dn) - n(p - m - \gamma)(dx/dn) > 0. \quad (28)$$

This implies that due to urban unemployment and market imperfection, free entry to zero profits would result in too many firms relative to the socially optimal number of firms in the urban sector.[10]

In summary, we have the following proposition for firm dynamics to the urban sector:

Proposition 2. In a dual developing H-T economy, due to urban unemployment and market imperfection, free entry to zero profits leads to excessive number of firms in the urban sector. Hence, exit of urban firms can improve social welfare, in addition to narrow the wage gap between urban skilled and rural unskilled labor in the economy.

3.3. Long-run effects

In the long run, firms can freely enter into or exit from the urban sector.To obtain the total effect of the increase in the pollution tax rate on firm dynamics, we totally differentiate (8) to have:

$$\hat{n} = -(1 - 1/n)\hat{x} - \varepsilon[(1 - b)\theta_{KX}^f + b\theta_{KX}^m]\hat{r} - \varepsilon[\tau + (1 - b)\theta_{SX}^f/\theta SA]\hat{t}. \quad (29)$$

Equation (32) states that number of urban firms depends on firm output, capital cost and pollution tax. By solving (9) – (14) and (29), we can obtain the effect of the rise in the pollution tax on the number of urban firms:

$$\hat{n}/\hat{t} = \{\varepsilon 2(1 - b)|\lambda m|[b\theta_{SX}^f\theta_{KX}^m/\theta SA - \tau\theta LY\theta_{KX}^f] + \varepsilon C[(2\tau/n) + (1 - b)(1 + 1/n)\theta_{SX}^f/\theta SA] + (s_{KX}^f/\theta SA)[(1 - b)(1 + 1/n)\theta_{KX}^f + (2/n)b\lambda LY\theta LY\theta_{KX}^m]\}/\Delta, \quad (30)$$

Where $C = [\lambda LY(sKY + \theta LYsKX) + \lambda KY[sLY + (1 + \mu)(\theta KY\lambda_{LX}^m + \theta LYs_{LX}^m)] > 0$ and Δ< 0 by the stability condition.[11] Note that $\hat{n}/\hat{t} < 0$ in (30) if τ(= t/p)is initially not too large.Thus, in the long run with free entry or exit of firms, a rise in the pollution tax can lead to exit of manufacturing firms from the urban sector. This can correct the problem of excessive entry in the urban sector when urban unemployment and market imperfection exist in the economy.

The long-run impact of the rise in the pollution tax on the rental rate for capital can be obtained from (9) – (14) and (29)as:

$$\hat{r}/\hat{t} = -(2/n)\theta LY[\lambda LY s_{SX}^f/\theta SA - \varepsilon\tau|\lambda|]/\Delta + (1 - b)(\theta_{SX}^f/\theta SA)[(1 + 1/n)|\lambda| - |\lambda m|]/\Delta. \quad (31)$$

Compared this long-run effect in (31) with the short-run impact given in (17), the last term in (31) captures the firm-exit effect of the pollution tax on the rental rate of capital.[12] Note that the larger the cost share of skilled labor in the composition of fixed cost in urban firms (via the cost share θ_{SX}^f) in (31) is, the stronger the firm-exit effect is. Since the higher pollution tax increases the cost of skilled labor, urban firms exit and capital is thus released to the rural sector. When this firm-exit effect is strong, as illustrated in Figure 5 by a large shift of the sector Y's VMPL

[10] See Mankiw and Winston (1985) for socially optimal number of firms.

[11] See Appendix.

[12] Clementi and Palazzo (2016) find that firm entry and exit can amplify the effects of aggregate shocks.

curve to the left, we have $\hat{r}/\hat{t} < 0$ in (31) and hence $\hat{w}_R/\hat{t} > 0$.That is, through the firm-exit effect by releasing urban capital to the rural sector, the rural wage rate for unskilled labor could rise. Nonetheless, when the firm-exit effect is not strong, less firms would exit from the urban sector by the rise of the pollution tax. In this case, only a small leftward shift of the VMPL for sector Y curve can occur. This could result in $\hat{r}/\hat{t} > 0$ in (31) and hence $\hat{w}_R/\hat{t} < 0$, as illustrated in Figure 6.

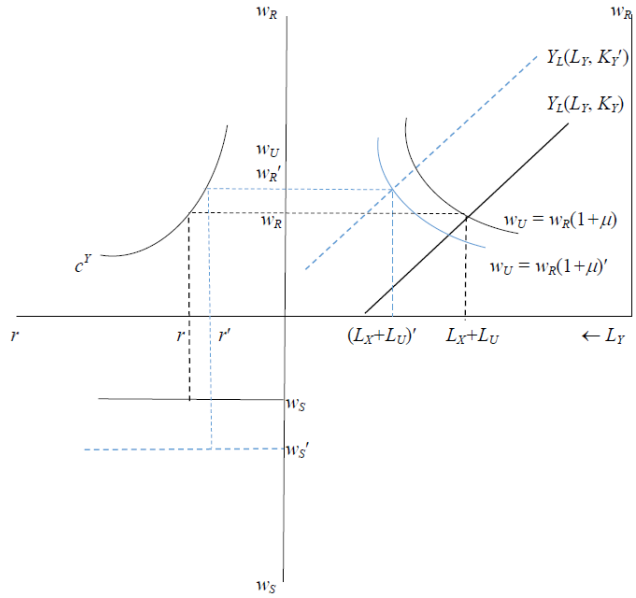

Figure 5. A rise in pollution tax: Strong firm-exit effect

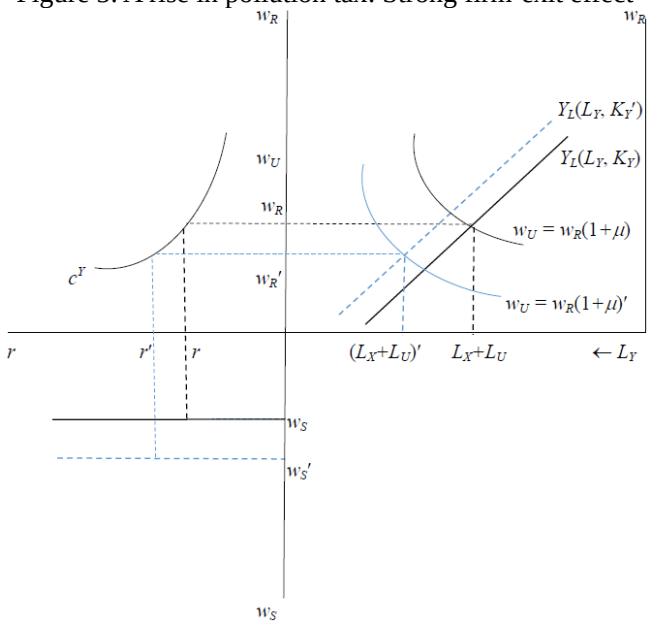

Figure 6. A rise in pollution tax: Weak firm-exit effect

In summary, we have the following long-run results when manufacturing firms exit from the urban sector:

Proposition 3.For a dual developing economy, an increase in the pollution tax can result in exit of firms from the urban sector. In the long run, the rise in the pollution tax can raise the rural wage rate for unskilled labor and thus narrow the wage gap between skilled and unskilled labor in the long run, when the firm-exit effect is strong.

The validity of the above theoretical predictions on the short- and long-run impacts of pollution tax on the skilled-unskilled wage gap of the economy will be investigated through empirical study.

4. Empirical analysis

This section empirically examines both the short- and long- run theoretical predictions obtained in Propositions 1 and 3 in Section 3. The main predictions of our theoretical model are:

In the short run with the fixed number of firms, an increase in pollution tax has an ambiguous effect on the skilled-unskilled wage gap in the economy. In other words, an increase in pollution tax can have a positive, negative and no effect on wage gap.

In the long run with free entry or exit of urban firms, an increase in pollution tax can cause urban firms to exit. If this firm-exit effect is strong, the rise of pollution tax can narrow the wage gap between skilled and unskilled workers in the economy.

4.1 Empirical specifications

We begin our empirical estimation by testing for the direct, short-run effects of pollution tax on the home country's income inequality. A high pollution tax implies effectively-enforced environmental regulations. Due to data unavailability for pollution tax in most developing countries, instead of testing the effects of pollution tax, in the section we test the relationship between environmental regulations variables (i.e., environmental regulatory enforcement and environmental regulatory stringency) and income inequality. To enable the effect on income inequality to vary according to the level of environmental regulations variable (Naughton, 2014), we include the squared term of environmental regulations variable in the equation. Thus, the baseline model includes both the environmental regulations variable and the squared term of environmental regulations variable.

$$\mathrm{INEQ}_{i,t} = \beta_0 + \beta_1 \mathrm{Reg}_{i,t} + \beta_2 (\mathrm{Reg}_{i,t})^2 + \beta'_3 \mathrm{X}_{i,t} + \gamma_i + \varphi_t + \varepsilon_{i,t}, \quad (32)$$

where the subscripts i and t denotes country and year, respectively. The $\mathrm{INEQ}_{i,t}$ is a measure of the income inequality of country i in year t, while $\mathrm{Reg}_{i,t}$ and $(\mathrm{Reg}_{i,t})^2$ represent environmental regulations variable and environmental regulations variable squared. The X is a general set of possible control variables which are often used in the income inequality empirical literature. The γ_i is the vector of dummy variables that account for the time-constant attributes of country i,φ_t is the year dummies and $\varepsilon_{i,t}$is the error term. We estimate the above equation using the robust standard errors to correct for heteroscedasticity. To test the prediction in Proposition 1 for the fixed number of firms in the short run, we examine whether the coefficients β_1 and β_2 are either statistically positive or statistically negative.

Nonetheless, to test Proposition 3 under the firm-exit effect in the long run, we introduce the interaction term for environmental regulations variable to capture the impact of firm exit on environmental regulations variable as follows:

$$\beta_1 = \alpha_1 + \alpha_3 \mathrm{Exit}_{i,t}, \quad (33)$$

$$\beta_2 = \alpha_2 + \alpha_4 \mathrm{Exit}_{i,t}, \quad (34)$$

where$\mathrm{Exit}_{i,t}$ is the measure of firm exit. Substituting Equations (33) and (34) into Equation (32), we obtain:

$$\mathrm{INEQ}_{i,t} = \beta_0 + \alpha_1 \mathrm{Reg}_{i,t} + \alpha_2 (\mathrm{Reg}_{i,t})^2 + \alpha_3 \mathrm{Exit}_{i,t} * \mathrm{Reg}_{i,t} + \alpha_4 \mathrm{Exit}_{i,t} \times (\mathrm{Reg}_{i,t})^2 + \beta'_3 \mathrm{X}_{i,t} + \gamma_i + \varphi_t + \varepsilon_{i,t}, \quad (35)$$

where $\mathrm{Exit}_{i,t} * \mathrm{Reg}_{i,t}$ and $\alpha_4 \mathrm{Exit}_{i,t} * (\mathrm{Reg}_{i,t})^2$ are the interaction term for environmental regulations variable and environmental regulations variable squared, respectively. Re-arranging Equation (35), we obtain the following specification:

$$\mathrm{INEQ}_{i,t} = \beta_0 + (\alpha_1 + \alpha_3 \mathrm{Exit}_{i,t}) * \mathrm{Reg}_{i,t} + (\alpha_2 + \alpha_4 \mathrm{Exit}_{i,t}) \times (\mathrm{Reg}_{i,t})^2 + \beta'_3 \mathrm{X}_{i,t} + \gamma_i + \varphi_t + \varepsilon_{i,t}, \quad (36)$$

where the combined coefficient of environmental regulations variable $(\alpha_1 + \alpha_3 \mathrm{Exit}_{i,t})$ consists of the direct effect α_1 and the indirect effect via firm exit $\alpha_3 \mathrm{Exit}_{i,t}$ on income inequality. Likewise, the combined coefficient of environmental regulations variable squared $(\alpha_2 + \alpha_4 \mathrm{Exit}_{i,t})$ comprises the direct effect α_2 and the indirect effect via firm exit $\alpha_4 \mathrm{Exit}_{i,t}$ on income inequality.

By taking the partial derivative of Equation (36), we obtain the total effect of environmental regulatory enforcement on income inequality. The total effect is given by $[(\alpha_1 + \alpha_3 \mathrm{Exit}_{i,t}) + 2 \times (\alpha_2 + \alpha_4 \mathrm{Exit}_{i,t}) \times \mathrm{Reg}_{i,t}]$. Thus, the main interest for testing the firm-exit effect proposed in Proposition 3 is to determine whether the total effect of environmental regulations on the income inequality is statistically negative or not, and our predict is that an increase in environmental regulations is associated with a reduction in the income inequality in the economy.

4.2 Data and variables

In this section, we describe the data used and proxy for the variables included in the estimation equations in the previous sub-section. For the empirical investigations, we focus on the low- and middle-income countries which are defined according to World Bank income level classifications. Our cross-country data set comprises a panel of 37 low- and middle-income countries over the period 2004 - 2006.

4.2.1 Dependent variable

We use Deininger and Squire's (1996) Gini coefficient of income distribution as the measure of a home country's income inequality (INEQ). The Gini coefficient falls between zero and 100 percent is derived from a Lorenz curve, where Gini coefficient of 100 represents perfect income inequality. Thus, the higher the value of Gini coefficient is, the greater the country's income inequality. The data for Gini coefficient is drawn from the World Bank's World Development Indicators database.

4.2.2 Independent variables

We employ two measures of environmental regulations, environmental regulatory enforcement consistency and environmental regulatory stringency, reported in the Global Competitiveness Report from 2004 to 2006 editions[13]. These two variables are constructed from the Executive Opinion Survey conducted by the World Economic Forum on representatives of business executives in more than 100 countries around the world. The environmental regulatory enforcement consistency measures the stability, consistency and fairness in enforcing a country' environmental regulations on a scale from zero to seven (World Economic Forum, 2004). For environmental regulatory stringency, the business executives were asked to assess the stringency of his/her country's de facto environmental regulations on a scale from one to seven, where the scale of one indicates that the home country's environmental regulations are lax compared to those of most countries, while seven means that the home country's environmental regulations are among the world's most stringent (World Economic Forum, 2004).

[13] The Global Competitiveness Report started to report the environmental related measure in mid 1990s (Kellenberg, 2009). Unfortunately, the environmental issuesrelated questions were removed from the survey from 2007.

We choose the environmental regulatory enforcement consistency as our primary proxy for environmental regulations because the effectiveness of an environmental regulation requires consistency in environmental monitoring and enforcement. Nonetheless, we consider environmental regulatory stringency as the second measure of environmental regulation to check the robustness of our results. These two environmental regulations variables have been used as the measure of the laxity of environmental regulations in the past environmental economics studies (Kellenberg, 2009; Wagner and Timmins, 2009; Manderson and Kneller, 2012; Chung, 2014). The main advantage of using these two measures is that they measure the strength of the environmental policy across many countries based on the subjective perception of business executives and thus, are related to firms' investment decisions (Kellenberg, 2009; Chung, 2014).

As the proxy of firm exit (Exit), we use the natural logarithm of resolving insolvency distance to frontier score obtained from the World Bank's Doing Business Survey for years 2004-2006.[14] The resolving insolvency distance to frontier (DTF) score is a composite business exit indicator, which provides an overall measure of a country's insolvency regulations when closing a business (Strobel, 2010). To determine the DTF, a country's current performance in terms of the efficiency of insolvency regulations is benchmarked against the best performance (or 'frontier') on an indicator across all countries surveyed since 2005. Thus, the DTF measures the distance of a country's insolvency efficiency to the 'frontier'. The closer a country to the frontier is, the higher the DTF score. The resolving insolvency DTF score is calculated by taking the simple average of the DTF scores for the recovery rate and the strength of insolvency framework (Doing Business, 2016). A high resolving insolvency DTF score indicates a highly efficient insolvency proceedings with lower exit costs, which implies a lower barrier to exit and a greater ease of closing a business.

Consistent with previous studies on income inequality, we include a number of control variables which have been shown previously to influence income inequality. These control variables are: the growth of per capita real gross domestic product (GDP), inflation, government expenditure, trade openness, human capital, unemployment and the level of financial development. Inflation is the natural logarithm of CPI growth rate and government spending is the natural logarithm of ratio of the government consumption expenditure to the GDP. As a proxy of trade liberalisation, trade openness is calculated by the logarithm of the sum of exports and imports as a percentage of GDP. Human capital is proxied by the natural logarithm of gross primary and secondary enrolment ratio for both sexes. The gross primary and secondary enrolment ratio is calculated by dividing total enrolment in primary and secondary education with the total population (UNESCO Institute for Statistics, 2016). Unemployment is measured by the natural logarithm of the number of unemployed individuals as a share of the total labor force. To measure the level of financial development, we use an indicator often used in financial development literature (Beck et al., 2007, Braun and Raddatz, 2008), that is, the natural logarithm of the ratio of credit provided to the private sector by financial intermediaries to the GDP. The data for the control variables except Human Capitalare drawn from the World Bank's World Development Indicators database. The gross primary and secondary enrolment ratio is collected from the UNESCO Institute for Statistics.

4.2.3 Summary statistics

Table 1 presents the summary statistics of the key variables. Table 1 shows that the Gini coefficient for the low- and middle-income countries in our sample ranges from 16.23% (Azerbaijan in 2004) to 64.79% (South Africa in 2006) with a mean of 41.42%. The average

[14] Although the World Bank started reporting the distance to frontier score in Doing Business 2012 report, the data for resolving insolvency distance to frontier score is available from *Doing Business Survey* from 2004.

environmental regulatory enforcement is 3.25 with a minimum of 2 for Albania in 2005 and 5.2 for Tunisia in 2006. The natural logarithm of exit DTF score is 3.08 with a minimum of -1.47 (Brazil in 2004 and 2005) and maximum of 4.23 (Jamaica in 2004).

Table 1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Income inequality (*INEQ*)	123	41.7554	9.9765	16.2300	64.7900
Enforcement	157	3.2535	0.594	2	5.2
Enforcement Squared	157	10.9359	4.0964	4	27.04
Firm exit (*Exit*)	200	3.0756	0.8546	-1.4697	4.2316
Real GDP growth	243	4.5363	4.4165	-11.1666	33.0305
Inflation	223	1.6838	0.9460	-3.2068	3.9408
Government expenditure	229	2.6019	0.4333	1.2414	4.4023
Trade openness	238	4.3630	0.4441	3.2597	5.6716
Human capital	180	4.3925	0.2329	3.3912	4.6633
Unemployment	141	2.1262	0.7337	0.1823	3.8044
Financial development	238	3.0084	0.8601	0.0910	5.0561
Stringency	157	3.3255	0.7180	2.1	5.3
Stringency Squared	157	11.5710	5.2027	4.41	28.09

Note: Income inequality is expressed in percentage. Firm exit, Inflation, Government Expenditure, trade openness, human capital, unemployment, and financial development are calculated as the natural logarithm of the original value.

4.3 Results

Table 2 reports the regressions of environmental regulations variables on income inequality. We estimate Equations (32) and (36) using both fixed and random effects models. The results obtained from the fixed- and random-effects regressions are similar. However, since Hausman test is statistically not significant in these two cases, the random effects estimations are more appropriate. Thus, we will rely on the estimation results using the random effects model for the subsequent discussions.

We first estimate Equation (32) to understand the direct relationship ofenvironmental regulations variable (environmental regulatory enforcement or environmental regulatory stringency) and environmental regulation variable squared (environmental regulatory enforcement squared or environmental regulatory stringency squared) on income inequality. The column 1 of Table 2 shows the results for the baseline model without the interaction terms for environmental regulatory enforcement. Although the sign of Reg and Reg2 are respectively, positive and negative, they are not statistically significant. This implies that both environmental regulatory enforcement and environmental regulatory enforcement squared have no statistical impacts on income inequality if the interactions with firm exit are omitted. This result confirms the predictions in Proposition 1.

Next, we introduce key interaction terms. From Column 2 we see that the sign of linear term (environmental regulatory enforcement) and squared term (environmental regulatory enforcement squared) are the same as in those in Column 1 and are statistically insignificant. This suggests that both have no impacts on income inequality. This result provides evidence that

environmental regulatory enforcement does not have a direct effect on income inequality in linear and quadratic fashions. Again, this result is consistent with the predictions in Proposition 1.

With regards to the interaction terms, the sign of the coefficients for the linear and squared terms for the enforcement level of home environmental regulations are positive and negative, respectively. The positive coefficient on the linear term and negative coefficient on the squared term for the environmental regulatory enforcement suggest the existence of an inverted U-shape relationship between environmental regulatory enforcement and income inequality.

Since the coefficients α_1 and α_{12} are statistically not significant, the total effect is then reduced to $(\alpha_3 \text{Exit}_{i,t} + 2 \times \alpha_4 \text{Exit}_{i,t} \times \text{Reg}_{i,t})$. By focusing on the statistically significant indirect impacts of the environmental regulatory enforcement into account, we can interpret the regression results as follows. Given that the average natural logarithm of firm exit and the average regulatory enforcement level are 3.076 and 3.254 respectively, for a 1 point increase in the level of environmental regulatory enforcement, income inequality decreases on average by 3.96% [i.e., 3.984×3.076 + 2×(-0.81)×3.076×3.254 = -3.96]. In other words, an increase in the environmental regulatory enforcement is associated with a decline in the gap of income inequality if the firm-exit effect is taken into account. This result is consistent with the predictions in Proposition 3.

Moreover, we test the robustness of our main findings using the second measure of environmental regulations (i.e., environmental regulatory stringency) and obtain similar results in Columns (3) and (4). We find that for a 1 point increase in the level of environmental regulatory stringency, income inequality decreases on average by 3.57% [i.e., 3.695×3.076 + 2×(-0.73)×3.076×3.325 = -3.57], with the average of environmental regulatory stringency of 3.325.

Table 2. Direct and indirect effects of environmental policy on income inequality: Random effects model

Dependent variable: Income inequality	(1) Enforcement	(2) Enforcement	(3) Stringency	(4) Stringency
Environmental regulations (*Reg*)	7.079	-5.530	4.326	-8.544
	(9.032)	(11.59)	(4.591)	(6.331)
Environmental regulations squared (Reg^2)	-1.250	1.234	-0.588	1.800
	(1.458)	(2.203)	(0.782)	(1.222)
*Reg * Exit*		3.984		3.695
		(1.441)***		(1.569)**
Reg^2*Exit*		-0.810		-0.729
		(0.377)**		(0.350)**
GDP growth	0.0189	0.0789	0.000630	0.0751
	(0.117)	(0.104)	(0.122)	(0.109)
Inflation	-0.392	-0.143	-0.506	-0.228
	(0.364)	(0.306)	(0.390)	(0.315)
Government expenditure	-3.722	-5.378	-3.617	-5.654
	(4.004)	(3.895)	(4.045)	(4.203)

	-4.884	-4.369	-5.584	-5.124
Trade openness	(3.355)	(3.203)	(3.115)*	(3.167)
	29.48	34.90	28.27	34.66
Human capital	(8.602)***	(8.998)***	(9.475)***	(11.31)***
	-2.140	-2.288	-2.076	-2.276
Unemployment	(1.980)	(2.070)	(1.972)	(2.107)
	4.247	4.075	3.730	3.561
Financial development	(2.165)**	(1.800)**	(2.123)*	(1.772)**
	-76.48	-97.75	-64.80	-87.22
Constant	(39.23)*	(40.33)**	(42.37)	(48.16)*
Country dummies	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y
R^2	0.2776	0.6280	0.2980	0.4487
Countries	34	34	34	34
Obs.	62	62	62	62
F- statistics	24.75***	31.78***	25.75***	28.26***
Hausman test	14.76	19.59	14.22	15.66
LM test for random effects	16.96***	16.28***	13.27***	11.79***

Notes: The robust standard errors are reported in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

5. Conclusions

Using a general-equilibrium framework for a dual developing economy, this paper has investigated the short- and long-run effects of the rise in pollution taxes on income distribution, social welfare and the environment. The developing economy is characterized by an imperfectly competitive urban manufacturing sector, together with a perfectly competitive rural sector. We have paid attention on firm dynamics, in which, due to the favorable development policies, together with lax environmental policy, the number of urban manufacturing firms in the industry tends to be excessive in the developing economies. The production of the urban manufacturing good however generates pollution emissions, which harm consumers. Firms can abate the emissions of pollutants or simply pay pollution taxes. In the short run with a fixed number of urban firms, an increase in pollution taxes may worsen or narrow the wage gap of skilled and unskilled labor, depending on the capital substituting or capital releasing effects of urban firms. Nonetheless, in the long run, the higher pollution tax on urban firms could cause firms to exit from the urban manufacturing sector. Capital is then released to the rural sector and benefits the production of rural workers when the firm-exit effect is strong. This result on income distribution of pollution taxes are empirically confirmed. The higher pollution tax can therefore yield a double dividend in the long run by not only reducing pollution emissions but also narrowing wage gap between skilled and unskilled labor in the developing economy.

Appendix

Letting a dot over a variable represent the time derivative (e.g., $\dot{X} = dX/dt$), the adjustments of the model in (1), (3), (5), (6) and (8) can be linearly approximated as:

$$\begin{pmatrix} \dot{X} \\ \dot{Y} \\ \dot{w}_R \\ \dot{r} \\ \dot{n} \end{pmatrix} = H \begin{pmatrix} \hat{x} \\ \hat{Y} \\ \hat{w}_R \\ \hat{r} \\ \hat{n} \end{pmatrix}$$

where the H matrix is:

$$\begin{bmatrix} -(1+1/n) & 0 & 0 & -\varepsilon b\,\theta^m_{KX} & -1 \\ 0 & 0 & -\theta_{LY} & -\theta_{KY} & 0 \\ (1+\mu)\,\lambda^m_{LX} & \lambda_{LY} & -[s_{LY}+(1+\mu)\,\lambda^m_{LX}] & s_{LY}+(1+\mu)\,s^m_{LX} & (1+\mu)\,\lambda^m_{LX} \\ \lambda^m_{KX} & \lambda_{KY} & s_{KY} & -(s_{KY}+s^m_{KX}) & \lambda_{KX} \\ -(1-1/n) & 0 & 0 & -\varepsilon[(1-b)+b\,\theta^m_{LX}] & -1 \end{bmatrix}$$

The principal minors of the above coefficient matrix are given by

$\Delta 1 = -(1 + 1/n) < 0,$

$\Delta 2 = 0,$

$\Delta 3 = -\lambda LY\theta LY(1 + 1/n) < 0,$

$\Delta 4 = D = (1 + 1/n)[A + \lambda LY\theta LY\, s^m_{KX} + (1 + \mu)\lambda KY(\theta LY\, s^m_{LX} + \theta KY\, \lambda^m_{LX})] + \varepsilon b\theta LY\, \theta^m_{KX}$ $|\lambda m| > 0,$

$\Delta 5 = \Delta.$

The stability condition requires that the odd principal minors are non-positive and the even principal minors are non-negative. Hence, for stability of the model, we need $|\lambda m| > 0$ and $\Delta < 0$.

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IMI International Monetary Review

Urbanization, Economic Development and Environmental Change *

By LI SHUSHU AND MA YONG*

This paper applies the pressure-state-response (PSR) model to establish environmental quality indices for 30 administrative regions in China from 2003 to 2011 and employs panel data analysis to study the relationships among the urbanization rate, economic development and environmental change. The results reveal a remarkable inverted-U-shaped relationship between the urbanization rate and changes in regional environmental quality; the "turning point" generally appears near an urbanization rate of 60%. In addition, the degree and mode of economic development have significant, but anisotropic effects on the regional environment. Generally, at a higher degree of economic development, the environment will tend to improve, but an extensive economic growth program that simply aims to increase GDP has a clear negative impact on the environment. Overall, the results of this paper not only further confirm the "environmental Kuznets curve hypothesis", but also expand it in a manner. The analysis in this paper implies that the inverted-U-shaped evolving relationship between environmental quality and economic growth (urbanization) is universally applicable.

Keywords: Urbanization Process; Economic Development; Environmental Change; PSR Model

1. Introduction

The harmonious progress of urbanization, economic development and the environment is an important field of research that combines the social and natural sciences. From a theoretical perspective, urbanization, economic development and the natural environment are linked by a series of positive and negative effects. In most countries, the process of urbanization is generally accompanied by rapid economic growth, relocation of populations from rural areas to cities and towns, the agglomeration of secondary and tertiary industries in urban areas and an increase in the number of towns that are becoming larger on a daily basis. The process of urbanization affects the condition of the environment by changing the levels of polluting emissions as a consequence of the shift in production and changes in the population's behavior patterns after migrating from rural to urban areas. Developing a methodology to determine and evaluate the dynamic effects of urbanization and economic development on the environment of a country or region is not only an important theoretical problem, but also a crucial practical issue.

Since the 1960s, the negative ecological and environmental consequences of urbanization have been a focus of global economic and social development. Urbanization affects more than the development of the economy and the population's health, education and socialization; it impacts and is concerned with environmental protection and remediation, in addition to the exploitation of natural resources. In recent years, as empirical research on the relationship between humans and the environment has grown, many researchers have begun to turn their attention to strategies that balance improvements in the urbanization process and the environment. The quantitative literature on this subject primarily attempts to determine the

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relationship between environmental indices and the urbanization rate by using quantitative models that focus on three issues. First, these models address the causal relationship between urbanization and its corresponding environmental pressure. In this respect, Li [1] concluded that there is a dynamic, U-shaped relationship between urbanization and the environment, by analyzing the quantitative effects of urbanization on environmental pressure, environmental quality and environmental regulation. Second, these models employ explanatory variables—such as the urbanization rate and economic development—to conduct quantitative analyses of environmental pressure. Using data from the EU, Halkos[2] observed an inverted-U-shaped relationship between regional environmental efficiency and regional per capita GDP, whereas Wang [3] discovered the same inverted U-shaped relationship; using panel data on per capita GDP, environmental deterioration and its remediation costs, it studied the empirical relationship between urbanization and air quality. Third, certain studies have considered the urbanization rate alone to explain the level of polluting emissions, such as Srinivasan[4], who analyzed the vulnerability relationship between urbanization and water resources. Applying an overall regional perspective, these scholars conducted empirical multi-factor comparative analyses on the relationship between urbanization and the environment to determine the interaction between, and the manageability of, urbanization and changes in the natural environment; they then put forth advanced urban development strategies that provided a blueprint for the harmonious and sustainable development of a region.

At the end of the 19th century, the British scholar, Howard, advanced the garden city theory, which was an attempt to employ rational planning to coordinate the development of urbanization and the urban ecological environment. Using econometric techniques, Grossman and Krueger[5] assessed panel data from 42 developed countries and found a U-shaped relationship between the development of an urban economy and the city's environmental quality; this study advanced the well-known environmental Kuznets curve (EKC) hypothesis. Selden and Song [6] and Shfik[7]posited that increased incomes and improved standards of living would lead individuals to be increasingly concerned about the quality of the environment. When a clean environment gradually becomes a "luxury", the income elasticity of environmental quality demand will be above one, which will result in a shift in the economic structure to mitigate the deterioration of the environment. On this basis, Zaim[8] discussed the quantitative relationship between economic development and the environment and developed a model to analyze this relationship, employing large samples of ecological efficiency index values from low-income countries. Martinez [9] discussed the too poor to be green problem in developing countries. Stem[10] employed a simplified methodology to investigate the relationship between per capita income and polluting emissions and suggested in 2004 that developing countries may bypass certain EKC development modes. Managi[11]discussed the quantitative relationship between economic growth and decreased environmental degradation and proposed that estimating environment quality is key to the quantitative evaluation of both factors. In 2008, Managi[12] demonstrated that there is a relationship between environmental productivity and regional income using panel data on India for the 1991–2003 period and highlighted the negative effects of income on environmental productivity. Other studies have assessed the EKC relationship between pollution emissions and per capita incomes and have concluded that a certain level of income will result in increased attention to the problems associated with environmental degradation [13,14]. Economic growth affects environment quality through changes in economic scale, technology and structure [5]. The scale effect indicates that an expansion of the scale of economic activity will lead to increased investment in resource exploitation and polluting emissions, which leads, in turn, to decreased environmental quality. The technological effect refers to increased economic efficiency through innovation and technological progress (such as more efficient

resource use and reduced emissions to improve environmental quality). Finally, the structural effect implies that economic development will eventually result in a shift in the structure of the economy to a low-pollution equilibrium. Environmental quality will change in response to the changes in the relative contributions of these three effects. The scale effect is dominant during the initial stage of economic growth. As economic development continues, the technological and structural effects will eventually dominate the scale effect and result in a gradual improvement in environmental quality [15]. In addition to econometric approaches, scholars employ system dynamics, sensitivity models and energy flow models to reveal the ways in which urbanization and changes in the ecological environment are related [16]. In the 1980s, the Organization for Economic Cooperation and Development (OECD) and the United Nations Environment Program (UNEP) jointly proposed the environmental indices for the pressure-state-response (PSR) conceptual model. Walter [17] stipulated that the key to advancing the process of urbanization while preserving and improving the ecological environment lies in the rational utilization of resources, improving the efficiency of resource use and focusing on global long-term development. In 1997, an international urban ecological symposium was held in Leipzig, Germany, concerning all aspects of the urban ecological environment. In 2002, the "Shenzhen Declaration" presented a series of summary findings on issues, such as urbanization, the development of ecologically-friendly and sustainable cities, etc., with a particular focus on population pressures, the economy and urbanization during the development of an ecologically-friendly city. This declaration also established a direction for research on the development of worldwide urbanization.

Overall, most recent studies on the relationships among urbanization, economic development and environmental change have further advanced the field, and quantitative research using econometric models has further confirmed that urbanization has had a definite impact on the environment. However, a quantitative consensus on the connection between urbanization and comprehensive environmental quality in China remains elusive. Furthermore, for economies that have enjoyed rapid urbanization and high-speed economic growth, such as China's, studies on the relationships among urbanization, economic development and environment change remain rare. To fill this gap in the literature, this paper establishes systematic environmental indices for China's 30 administrative regions to conduct a systematic empirical analysis of the relationships among urbanization, economic development and the environment. This analysis contributes to the scientific understanding of the environmental impacts of urbanization and assesses the role of legislation on the relationship between the status of the urbanization process and regional environmental conditions. The remainder of this paper is organized as follows: the second section constructs a comprehensive environmental index and partial environment index based on the PSR model; the third section empirically analyzes the relationships among urbanization, economic development and environmental change; based on the results of the analysis in the second and third sections, the fourth section predicts and assesses the potential environmental impacts of urban construction in China over the next 10 years; finally, a concluding evaluation is provided at the end of the paper.

2. Establishment of Environmental Indices

2.1. The Establishment of Set of Indices

Environmental indices used in this paper are selected based on the "A" conceptual model jointly proposed by the OECD and UNEP. Current research rarely discusses the man-land relationship in the course of environmental change, based on the environmental change evaluation index system of the PSR framework, which can compensate for the deficiency. Therefore, this paper explains the system of the PSR conception and puts forward the index

system based on the PSR model. Theoretically, when individuals migrate from rural to urban areas, their daily activities will change substantially. Generally, the volume of services and products they consume will substantially increase, and their daily emission volumes will also increase correspondingly. During the migration process, the economy's production activities will also change substantially as agricultural production activities are replaced by commercial production activities. Accordingly, the volume of polluting emissions will also change. Shifts in consumption needs that result from urbanization lead to changes in productive activities, thereby altering levels of industrial pollution. As the rate of urbanization has risen in China, all its regions are suffering from environmental problems and are attempting to use policy, legislation and capital to address the effects of both daily household consumption and industrial production.

Using "environment change" as subject words, 47,681 articles were collected from the China Journal Net database. We analyze those papers by frequency statistics. Combined with the index system of "The Construction of Ecological Province City County Index" of China, and the index structure of the China Statistical Yearbook(2003–2011), we select the index from the aspects of the environment state, environmental impact and the corresponding environment to reflect the development and trends of the urban ecological environment (the specific indices are presented in Table 1). To avoid subjective bias, the comprehensive index is calculated by summing its sub-items and assigning them equal weights. The comprehensive environmental index (E1) is the sum of three sub-items: E1=(E2+E3+E4)/3; which is intended to capture the overall environmental quality of a region. The three sub-items are the state of the environment (E2), the environmental impact (E3) and the environmental response (E4). The state of the environment (E2) refers to the current status of the urban environment and its tendency to change in response to direct or indirect pressure from the economy, society, population growth, etc., and its three constituent indices are: total emissions volume of industrial exhaust gas, particulate matter(PM10) emissions and total urban sewage emission volume. Environmental impact (E3) refers to the effects of changes in the urban environment on the eco-system and on the economic and social systems; its constituent indices are: the share of days with air quality readings above Level 2, the urban wastewater disposal rate and the green coverage rate in built-up urban areas. Environmental response (E4) refers to individual responses that cope with environmental change, as measured by the compliance rate of industrial wastewater emissions, the share of pollution reduction costs in GDP and the disposal rate of household waste.

Table 1. System of the indices for the state of the environment during the urbanization process

Variables		Index Interpretation	Index Selection
E1	Comprehensive Environment Index	Reflects the state of, impact on and response to the environment due to economic growth and social development	
E2	State of the Environment	Refers to the current urban environment and its trend given direct or indirect pressure from the economy, society, population growth, *etc.*	Total emission volume of industrial exhaust gas
			particulate matter(PM10) emissions
			Total emission volume of urban sewage
E3	Environmental Impact	Refers to the effects of changes in the urban environment on its eco-system and the economic and social systems	Share of days with air quality values above Level 2
			Urban wastewater disposal rate
			Green coverage rate in urban, built-up areas
E4	Environmental Response	Refers to human responses to cope with environmental change	Compliance rate of industrial wastewater emissions
			Share of pollution reduction costs

	in GDP
	Disposal rate of household waste (%)

2.2. The Data Sources and Standardizing the Index

The data of the paper are selected from the China Statistical Yearbook(2003–2011) and China Statistical Yearbook on Environment(2003–2011). The specific indices are presented in Table 2.

Table 2. The datasources

Index Selection	Sources of Data
Total emission volume of industrial exhaust gas	Main Pollutant Emission in Waste Gas
PM10 emissions	Ambient Air Quality in Major Cities
Total emission volume of urban sewage	Main Pollutant Emission in Waste Water in Main Cities
Share of days with air quality values above Level 2	Ambient Air Quality in Major Cities
Urban wastewater disposal rate	Discharge and Treatment of Waste Water in Major Cities
Green coverage rate in urban, built-up areas	Basic Statistics on Parks and Green Areas in Cities by Region
Compliance rate of industrial wastewater emissions	Discharge and Treatment of Industrial Waste Water by Region
Share of pollution reduction costs in GDP	Investment in the Treatment of Environmental Pollution by Region
Disposal rate of household waste (%)	Collection, Transport and Disposal of Consumption Wastes in Cities by Region

The original data used in the environmental indices differ with respect to type and unit; there is a substantial disparity in their orders of magnitude, and the standards applied in collecting them are not uniform. Consequently, direct comparisons cannot be made. Therefore, it is necessary to standardize the original data to eliminate the influence of different units of measurement in the indices. We standardize the data using min-max standardization methods. Min-max standardization is a linear transformation of original data. Suppose that $\min_A$ and $\max_A$ are the minimum and maximum values of a certain type of data A in a model index. The calculation method to standardize the original mapping of a value v in A to the range [new_ $\min_A$, new_$\max_A$] is as follows:

$$v' = \frac{v - \min_A}{\max_A - \min_A}(new\_\max_A - new\_\min_A) + new\_\min_A \quad (1)$$

If the range of the sample data can be identified as [0, 1], then the formula can be simplified as:

$$v' = \frac{v - \min_A}{\max_A - \min_A} \quad (2)$$

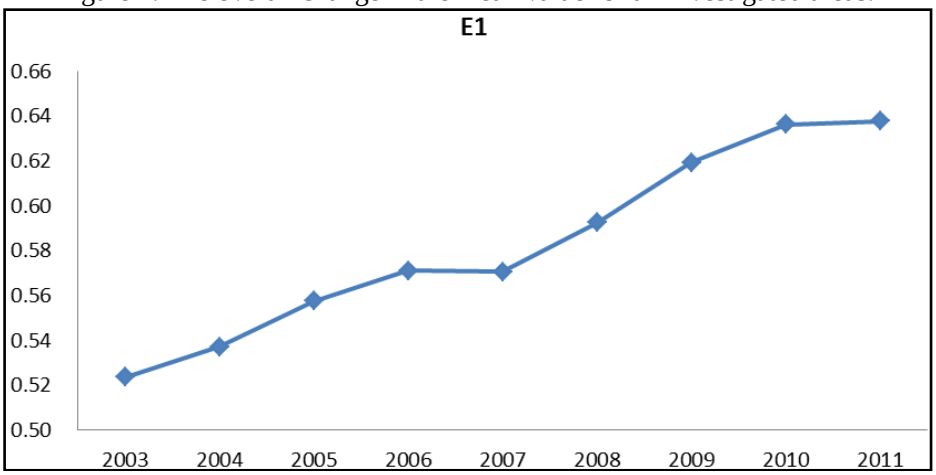
After standardization, the values of the comprehensive environment indices in 30 administrative regions across China are presented in Table 3. The overall change in mean values over the period considered is presented in Figure 1.

Table 3. Environment index values

	E1	Rank(*E1*)	*E2*	Rank(*E2*)	*E3*	Rank(*E3*)	*E4*	Rank(*E4*)
Beijing	0.68	5	0.61	18	0.63	10	0.79	1
Tianjin	0.69	3	0.72	10	0.59	15	0.76	2
Hebei	0.53	22	0.38	28	0.64	9	0.59	10
Shanxi	0.51	26	0.56	23	0.48	24	0.50	21
Inner Mongolia	0.58	14	0.71	11	0.52	18	0.51	19
Liaoning	0.54	20	0.44	26	0.62	12	0.57	11
Jilin	0.55	19	0.76	7	0.52	18	0.36	27
Heilongjiang	0.49	27	0.68	13	0.40	28	0.39	25
Shanghai	0.63	10	0.61	18	0.73	4	0.54	15
Jiangsu	0.64	9	0.38	28	0.79	1	0.74	3
Zhejiang	0.62	12	0.55	25	0.63	10	0.69	6
Anhui	0.58	13	0.63	17	0.59	15	0.53	16
Fujian	0.73	2	0.78	5	0.76	3	0.64	7
Jiangxi	0.66	6	0.77	6	0.65	8	0.56	14
Shandong	0.58	15	0.37	30	0.67	6	0.70	5
Henan	0.56	17	0.57	22	0.60	13	0.51	19
Hubei	0.52	24	0.56	23	0.54	17	0.47	22
Hunan	0.52	23	0.65	16	0.49	22	0.43	24
Guangdong	0.51	25	0.41	27	0.67	6	0.46	23
Guangxi	0.66	7	0.76	7	0.60	13	0.61	8
Hainan	0.78	1	0.99	1	0.77	2	0.57	11
Chongqing	0.62	11	0.69	12	0.48	24	0.71	4
Sichuan	0.55	18	0.61	18	0.52	18	0.52	18
Guizhou	0.54	21	0.81	2	0.46	27	0.35	28
Yunnan	0.68	4	0.81	2	0.72	5	0.53	16
Shaanxi	0.57	16	0.67	14	0.49	22	0.57	11
Gansu	0.36	30	0.61	18	0.18	30	0.29	30
Qinghai	0.45	29	0.75	9	0.22	29	0.38	26
Ningxia	0.64	8	0.79	4	0.52	18	0.61	8
Xinjiang	0.48	28	0.67	14	0.48	24	0.31	29

* Allof the data is form the“China Statistical Yearbook on Environment (2003–2011)”.

Figure 1. The overall change in the mean value for all investigated areas.



According to Figure 1, the comprehensive environment index has risen since 2003. The index’s mean value rose by 23% by 2011 and 4.5% in 2009, whereas the difference in the index’s mean

value between 2007 and 2006 is relatively small. According to time series data for all regions, areas, such as Hainan, Fujian, Tianjin, Yunnan and Beijing, perform better on the comprehensive environmental index than other regions, whereas areas, such as Shanxi, Heilongjiang, Xinjiang, Qinghai and Gansu, perform worse than other regions; Jiangxi Province has experienced a rise in performance in recent years and ranks first among the provinces in 2011. The results for Chongqing, Mongolia and Shanxi indicate that these regions have all enjoyed increases in index values, albeit to different extents, whereas, in recent years, Shanghai's comprehensive environmental index ranking declined somewhat to rank 26th among the 30 investigated areas in 2011.

3. Empirical Analysis

To analyze the dynamic correlations among urbanization, economic development and environmental change, this section includes a statistical evaluation of the correlations among all of the variables by constructing an empirical model and assessing panel data from the 30 administrative regions of China during the period 2003–2011; this section then analyzes the regions' experiences and interprets the relevant results.

3.1. Model Setup and Summary Statistics

The data employed in this paper include pooled time series and cross-sectional data, which are convenient for use in a panel data model. A panel data model can identify changes in relationships in two dimensions while accounting for time-specific and cross-sectional effects, which is more effective than the common OLS (ordinary least squares)model and can extract more polymorphic features from the data. We specified a fixed-effects model, because we only study data from the 30 administrative regions of China (and the Hausman test rejected the original hypothesis that would have supported a random-effects model).With respect to the econometric methodology, we selected generalized least squares (GLS) for the analysis based on the data characteristics to minimize the impact of heteroscedasticity that might be caused by cross-sectional data.

To address the research object of this paper, the regression equation is specified as follows:

$$[\, E_{i,t} = \alpha_{it} + \beta_1 E_{i,t-1} + \beta_2 C_{i,t} + \beta_3 C_{i,t}^2 + \beta_4 X_{i,t} + \varepsilon_{i,t} \,] \tag{3}$$

On the left-hand side of the regression equation above, $E_{i,t}$, which is the dependent variable, represents the environmental indices in different regions in different years. On the right-hand side of the regression equation, α_{it} is the intercept, $E_{i,t-1}$ is the environmental index value lagged by one period and $C_{i,t}$ and $C_{i,t}^2$ are the urbanization rate and its squared term, respectively. The squared term is included to investigate the potential inverted-U-shaped relationship between environmental change and urbanization. The vector $X_{i,t}$ represents other control variables. In the index selection, city development level in China is different according to the different conditions and environment.

We choose the provincial data in the research object in order to maintain the consistency of data sources. We choose environmental indices as the core index to build assessment system, because the city level data sources have varied widely. Environmental indicators are selected based on the provincial level in accordance with the other indicators. Meanwhile, we rely on the degree of concern in the same type of research to choose the index, including related 11indexes,such as the macroeconomic situation, characteristics of the industrial structure, health development level and the level of education. According to the correlation analysis, we screen out the 7 most related indexes characterized which include the following: (rgp) per capita GDP, reflecting macroeconomic conditions; (egr) the economic growth rate;(cpi) the currency inflation rate;(ind)

GDP, representing the regional industrial structure;(ser) GDP, representing the value of service industry output; (med), representing the number of beds in medical institutions to proxy for regional public health status;(edu), representing the number of students enrolled in universities per 100,000 persons to indicate the regional education level; β_1,β_2,$\beta_3$and β_4 are the vectors of regression coefficients; and $\varepsilon_{i,t}$ is the error term.

The data used to construct the variables are from 2003 to 2011 and include all 30 provincial regions across China (except for Tibet). There are nine data sampling points along the time dimension, and each cross-section has 30 elements, which yields a total sample volume of 270. To obtain a smooth data chart and mitigate the impact of heteroscedasticity, we take the natural logarithms of per capita GDP(rgp), the number of beds in medical institutions (med) and the number of students enrolled in universities per 100,000 persons (edu). Definitions for the variables discussed above and summary statistics are presented in Table4.

Table 4. Summary statistics and description of the variables

Variables	Definition	Average Value	Standard Difference	Maximum	Minimum	Observation Value
E1	Integrated environmental indicator	0.583	0.107	0.808	0.324	270
E2	Sub-environmental indicator-state	0.643	0.155	0.997	0.253	270
E3	Sub-environmental indicator—impact	0.566	0.166	0.866	0.103	270
E4	Sub-environmental-response	0.540	0.163	0.930	0.108	270
C	The urbanization rate**	0.460	0.125	0.893	0.220	270
rgp	Per capita GDP	0.648	0.642	2.122	−0.998	270
egr	The GDP growth rate	12.87	2.178	23.80	5.400	270
cpi	Currency inflation rate	3.109	2.263	10.09	−2.346	270
ind	Industrial output value/GDP	0.474	0.078	0.664	0.218	270
ser	Service sector output/GDP	0.389	0.077	0.761	0.274	270
med	Number of beds in medical institutions*	11.57	0.731	12.94	9.622	270
edu	The number of people per 100,000 students in Colleges and Universities *	7.521	0.452	8.839	6.614	270

Note: * indicates variables in natural logarithms; and ** urbanization rate = urban population/total population. The data is from "China Statistical Yearbook(2003–2011)".

3.2. Empirical Results

Based on the model specified above and taking correlation among the variables into consideration, we conduct a regression analysis in a stepwise fashion, adding additional control variables gradually (see Table 5 for specific results). In addition to the urbanization rate and the control variables, we also account for the delayed effects of environmental change, which indicates that the state of the environment in the previous period would have a substantial impact on its state in the current period. Therefore, in the regression analysis, we include the lagged values of the environmental variables in the regression as explanatory variables. In Table 5, we list the results of six different regression equations. Equation (1) reflects the results when only the relationship between environmental quality and the urbanization rate are considered; Equation (2) introduces the squared term of urbanization to determine whether there is a U-shaped relationship between environmental quality and the urbanization rate; Equations (2), (3) and (6) control for macroeconomic factors, industrial structure factors, social factors and educational factors. Based on the results, we arrive at the following conclusions:

(1) At the 1% confidence level, the comprehensive environmental index in the previous period has a substantial impact, indicating that the rate of environmental change is constant and that the state of the environmental in the previous period has a significant impact on environmental

change in the current period. Regarding regression coefficients, after controlling for related factors, the coefficient is between 58% and 62%, which indicates that 60% of the state of the environment in the previous period would persist into the current period.

(2) The urbanization rate and the comprehensive environmental index exhibit a clear inverse U-shaped relationship. According to the results of Equations (1) and (2), the urbanization rate *C* and the comprehensive environmental index are positively related and have a negative relationship with the environmental index (the significance level is often 1% or better), which indicates that this quadratic relationship is statistically significant. Moreover, according to the results of Equations (3)–(6), after controlling for all possible factors influencing environmental change, including macroeconomic factors, industrial structure factors, social factors and educational factors, the urbanization rate and the comprehensive environmental indices continue to clearly exhibit a quadratic relationship, which indicates that the finding of an inverse U-shaped relationship is robust.

(3) The level of economic development and the economic development strategy have substantial, but opposite effects on the regional environment. According to the results, the rate of economic growth and the cpi have negative relationships with environmental quality, and environmental quality has a positive relationship with GDP per capita. This indicates that, as the economy develops, environmental quality will improve, whereas an extensive mode of economic growth will have a negative impact on environmental quality. Underdeveloped provinces frequently initiate energy-wasting, high-pollution projects to pursue a high rate of GDP growth, which tend to rapidly deteriorate the state of the environment.

(4) Improvements in public health have a clear, positive impact on environmental quality. The results of Equation (5) presented in Table 5 show that the number of beds in medical institutions and the comprehensive environmental indices have a positive relationship at the 1% level. As the number of beds in medical institutions is regarded as a proxy for the level of public health in a region, this result suggests that developing the regional public health industry improves the regional environment. In addition, the results of Equation (5) do not permit a clear inference regarding the coefficient of education.

Moreover, we should note that, although the results of the empirical analysis for the urbanization rate and *E1* are presented, we also conducted regression analyses of the relationships between the urbanization rate and the three other environmental indices (*E2*, *E3* and *E4*) to consider the potential differences across indices. The results of these robustness checks support the finding of an inverse U-shaped relationship between the urbanization rate and environmental change.

Table 5. Urbanization, economic development and comprehensive environmental index

	The Dependent Variable is the Comprehensive Environmental Index (*E1*)					
	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 6
$E(-1)$	0.766285***	0.675209***	0.623015***	0.581094***	0.569507***	0.577029***
	(16.56079)	(13.98954)	(12.03095)	(10.60322)	(10.27357)	(10.43163)
C	0.110660***	1.162854***	0.628664**	0.590912**	0.525618*	0.673482**
	(1.865738)	(5.626873)	(2.348484)	(2.171141)	(1.866496)	(2.235822)
C^2		−0.966342***	−0.640027***	−0.588442***	−0.516369**	−0.659994***
		(−5.380880)	(−3.074182)	(−2.727634)	(−2.312709)	(−2.711629)
rgp			0.036235***	0.032809***		0.039890**
			(3.214149)	(2.875333)		(2.443021)
egr			−0.002330*	−0.002449*	−0.002354*	−0.002369*
			(−1.745297)	(−1.822420)	(−1.765896)	(−1.752127)
CPI			−0.002264**	−0.002340**	−0.002111**	−0.002479**
			(−2.348404)	(−2.315604)	(−2.249827)	(−2.381170)
ind				0.177236**	0.172490**	0.175416**
				(2.141423)	(2.329468)	(2.109488)
ser				0.018086		0.019493
				(0.176644)		(0.190201)
med					0.079720***	
					(3.145562)	
edu						−0.019239
						(−0.625385)
Cons.	0.097163**	−0.116440**	0.098516	0.040971	−0.831378***	0.161311
	(3.687128)	(−2.419174)	(1.283554)	(0.403481)	(−3.590973)	(0.734228)
Obs.	240	240	240	240	240	240
Provinces	30	30	30	30	30	30
F-statistic	73.29610	73.87312	63.49567	61.40237	64.51919	59.89887
D-W stat.	2.205026	2.228669	2.240162	2.177569	2.141307	2.178759
Adjusted R^2	0.903636	0.907038	0.901498	0.903391	0.905372	0.903518

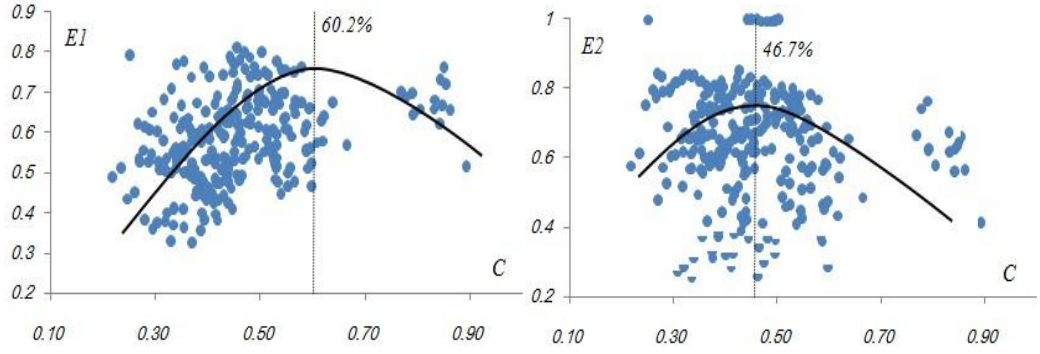
Note: In parentheses is the T Statistics; ***Show the 1% confidence level significantly; ** Show the 5% confidence level significantly; * Show the 10% confidence level significantly.

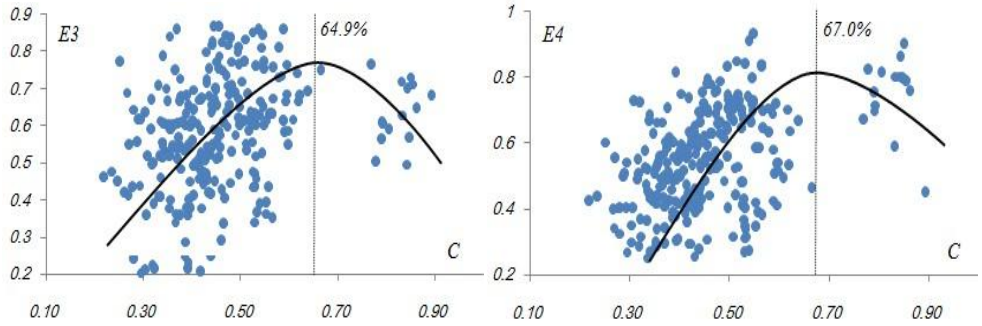
3.3. Further Discussion on the Relationship between Urbanization and the Environment: Determining the Inflexion Point and Elasticity Coefficient

The empirical analysis above confirms that there is an inverted-U-shaped relationship between the urbanization rate and environmental change from a qualitative perspective. In what follows, we will analyze the relationship between urbanization and environmental change from a quantitative perspective. There are questions in this respect that must be resolved: first, the elasticity coefficient of the impact of the urbanization rate on environmental quality; second, the location of the inflexion point, from the perspective of the urbanization rate, in the inverse U-shaped relationship between the urbanization rate and environmental change. To consider possible differences across different environmental indices, we will focus our analysis on the comprehensive environmental indices and the three sub-indices. The results are presented in Table 6, which also presents the regression results for models with and without lagged environmental variables, among which, Models 8, 10, 12 and 14 employ lagged environmental variables. From the perspective of model optimization, models with lagged environmental variables are obviously more tenable. Therefore, we employ a ternary regression model to analyze the relative effects when discussing the elasticity coefficient and determining the inflexion point of the inverted-U-shaped relationship.

With respect to the inflection point, it can be identified using the regression coefficients from Equations (8), (10), (12) and (14) in Table 6. First, according to the quadratic relationship between comprehensive environmental index *E1* and the urbanization rate, the inflexion point of the inverted-U shape is at a 60.2% urbanization rate; second, according to the quadratic relationship between sub-item environmental index *E2* and the urbanization rate, the inflexion point of the inverted-U shape is at a 46.7% urbanization rate; third, according to the quadratic relationship between sub-item environmental index *E3* and the urbanization rate, the inflexion point of the inverted-U shape is at a 64.9% urbanization rate; fourth, according to the quadratic relationship between sub-item environmental index *E4* and the urbanization rate, the inflexion point of the inverted-U shape is at a 67.0% urbanization rate. We illustrate the conclusion above in Figure 2 using scatter plots.

Figure 2.The inflexion point of the urbanization rate in the inverted-U-shaped relationship.





After confirming the location of the inflexion point, we can now conduct further analysis to determine the elasticity coefficient between environmental change and the urbanization rate. Using the quadratic relationship between comprehensive environmental index E1 and urbanization rate C, we can determine the corresponding equation, as follows, according to Equation:

$$[\ E_1 = -0.116 + 0.675E_1(-1) + 1.163C - 0.966C^2\ ] \quad (4)$$

Taking the first-order derivative of C, we obtain:

$$[\ \frac{\partial E_1}{\partial C} = 1.163 - 1.932C\ ] \quad (5)$$

From the simple calculation of the elasticity coefficient using Equation (3), we can conclude the following: the elasticity coefficient between E1 and the urbanization rate decreases gradually before reaching the inflexion point at 60.2%. The comprehensive index would increase by 39% if the urbanization rate were to increase by 1%; after passing the inflexion point at 60.2%, the elasticity coefficient between the urbanization rate and comprehensive environmental index E1 is negative and gradually increasing. The comprehensive index would decrease by 29% if the urbanization rate were to increase by 1%.

Table 6. Urbanization and environmental index of "inverted U"

	The Dependent Variable(*E1*)		The Dependent Variable(*E2*)		The Dependent Variable(*E3*)		The Dependent Variable(*E4*)	
	Equation 7	Equation 8	Equation 9	Equation 10	Equation 11	Equation 12	Equation 13	Equation 14
C	2.113065***	1.162854***	1.086534***	0.499421**	2.620592***	1.610145***	2.373726***	2.235423***
	(10.50599)	(5.626873)	(5.451241)	(2.247635)	(8.816426)	(4.602620)	(6.908686)	(5.899553)
C^2	−1.552077***	−0.966342***	−0.864116***	−0.534542**	−1.891616***	−1.240111***	−1.584727***	−1.668867***
	(−8.149981)	(−5.380880)	(−4.190281)	(−2.380394)	(−6.923183)	(−4.064560)	(−4.930872)	(−5.058342)
$E(-1)$		0.675209***		0.410385***		0.607842***		0.438431***
		(13.98954)		(6.981203)		(11.10901)		(7.585782)
Cons.	−0.036200	−0.116440**	0.340005***	0.279086***	-0.209727***	−0.230356***	−0.191761***	−0.338437***
	(−0.696662)	(−2.419174)	(6.984679)	(4.728398)	(−2.692481)	(−2.689489)	(−2.130021)	(−3.516374)
Obs.	270	240	270	240	270	240	270	240
Provinces	30	30	30	30	30	30	30	30
F-statistic	43.41956	73.87312	80.31190	497.6562	70.30698	93.74622	28.46965	33.49984
D-W stat.	1.140397	2.228669	1.314666	2.138094	1.161652	2.046739	1.377395	2.249693
AdjustedR^2	0.830177	0.907038	0.901381	0.985185	0.888729	0.925473	0.759941	0.813134

Note: In parentheses is the T Statistics; ***Show the 1% confidence level significantly; ** Show the 5% confidence level significantly; * Show the 10% confidence level significantly.

Using the same measures and procedures as above, according to Equations (10), (12) and (14), we can calculate the elasticity coefficients of *E2*, *E3* and *E4*. The results are presented in Table 7. According to Table 7, comprehensive index *E2* would increase by 13% if the urbanization were to increase by 1% before reaching the inflexion point at 46.7%; thereafter, comprehensive index *E2* would decrease by 21% if the urbanization rate were to increase by 1%. Second, comprehensive index *E3* would increase by 72% if the urbanization rate were to increase by 1% before reaching the turning point at 64.9%; thereafter, comprehensive index *E3* would decrease by 28% if the urbanization rate increased by 1%. Third, comprehensive index *E4* would increase by 1.03% if the urbanization rate increased by 1% before reaching the turning point at 67%; thereafter, *E4* would decrease by approximately 33% if the urbanization rate were to increase by 1%.

Table 7. Analysis of the comprehensive environmental index and the elasticities of the environmental indices

Environmental Index	First-order Derivative Equation	Inflection Point Location	Mean Elasticity before Inflexion Point	Mean Elasticity after Inflexion Point
E1	$\frac{\partial E_1}{\partial C} = 1.163 - 1.932C$	0.602	0.39	−0.29
E2	$\frac{\partial E_2}{\partial C} = 0.499 - 1.069C$	0.467	0.13	−0.21
E3	$\frac{\partial E_3}{\partial C} = 1.610 - 2.480C$	0.649	0.72	−0.28
E4	$\frac{\partial E_4}{\partial C} = 2.235 - 3.338C$	0.670	1.03	−0.33

Given the agreement between the results discussed above and experience, the state of the environment is substantially affected by the pressures of rapid urbanization. Moreover, as urbanization increases, local governments have introduced a series of policies to address environmental problems. Consider Hebei Province; in 2003, its urbanization rate was 33.52%, and its PM10 was 0.175 mg/m^3, which was the best result in the country. In 2007, its urbanization rate increased to 40.26%, and its exhaust volume reached 4803.6 billion m^3 from 15,758m^3, which made it the most polluted area in the country. With the consistent increase in the urbanization rate, sewage volume reached 1,471,840,000 tons in 2009 from 1,183,057,000 tons in 2005. The urbanization rate increased 45.60%, and the environment faced an even more substantial impact, which is in keeping with model projections. The number of days in which air quality was below Level 2 reached a maximum of 141 in 2003 in Beijing, which accounted for 39% of the total, and there were many hazy days. A plan to cope with hazy days was launched in 2007. In 2008, the share of hazy days fell to 25%, and the effect of this change is obvious. During this period, the urbanization rate rose by 5%. The environmental impact and its lagged terms conform to the model's predictions.

4. The Environmental Impact of Urbanization over the Next Decade: Forecast and Assessment

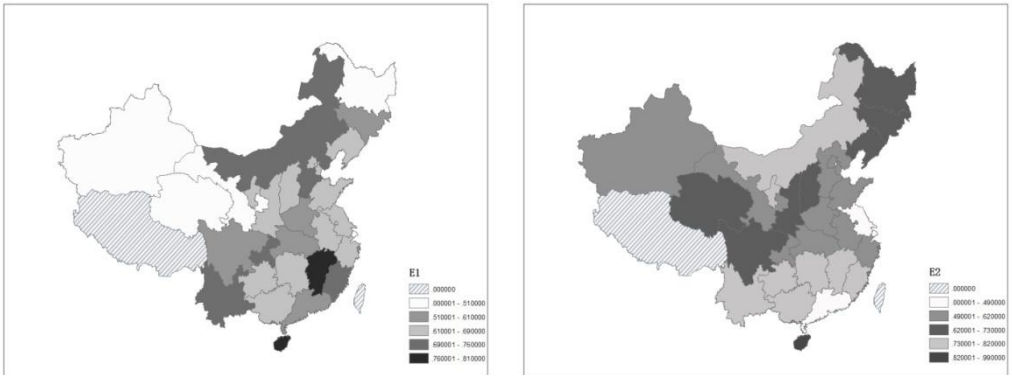
This paper analyzes the environmental state, impact and response in China's 30 administrative regions using the environment assessment methodology presented in Section2 above. According to the forecast values presented above, the relationship between the state of the environment and urbanization is reflected in a 46.7% urbanization rate. Based on data from the 30 provinces, the

urbanization rate in 2008 was 46.23%, which approached the inflexion point in the relationship between the urbanization rate and the state of the environment.

Employing 2011 as the assessment year, the state of the environment in Hainan province is better than that in other regions according to the results in Figure 3, followed by that of Inner Mongolia and the southern regions; the environment in Shanghai, Jiangsu and Guangdong is in relatively poor condition. Regarding environmental impact results, Jiangxi, Yunnan and Fujian are relatively less affected than other regions of the country; the impact in the east is lower than in the west, and Gansu suffers from the largest impact among the regions considered. Regarding environmental response, the northern areas have responded more forcefully than those in the south; the eastern regions perform better than those in the west. Chongqing, Mongolia and Tianjin have higher levels of environmental response than other regions; the environmental response in Gansu is relatively weak, but not significantly weaker. With respect to the comprehensive environmental index assessment, the coastal areas exhibit higher values than the inland regions; environmental conditions in Hainan and Jiangxi are the best of the regions considered, and the state of the environment in Gansu is relatively poor.

According to the assessment above, the inflection point in the effect of the urbanization rate on the environment, *i.e.*, the point at which it becomes positive, appears at an urbanization rate of 0.602. According to the current level of urbanization level, the state of the environment and urbanization in Beijing, Tianjin and Shanghai are enjoying rapid, but stable improvement; regarding the area around the inflexion point in the relationship between changes in urbanization and environmental impacts, Guangdong, Liaoning, Zhejiang, Jiangsu and Fujian are close to shifting from a positive relationship to a negative one. Therefore, care should be exercised to ensure sustainable urbanization while preserving the environment. Conflicts between the two objectives should be managed to maintain the environment as urbanization continues. The state of the environment in eight provinces, including Mongolia, Chongqing and Shandong, has a positive relationship with urbanization, such that further urbanization would improve the environment. The state of the environment in seven provinces, including Qinghai, Jiangxi and Sichuan, shows a positive relationship with urbanization, although those relationships are both low and stable. The level of urbanization in Gansu, Yunnan and Guizhou is very low, which has little effect on the environment; thus, it would be advisable to increase the rate of urbanization to generate environmental benefits in those provinces. The projections are depicted in Figure 4:

Figure 3.Depiction of the comprehensive environment index and sub-item environment indices for the 30 administrative regions of China.



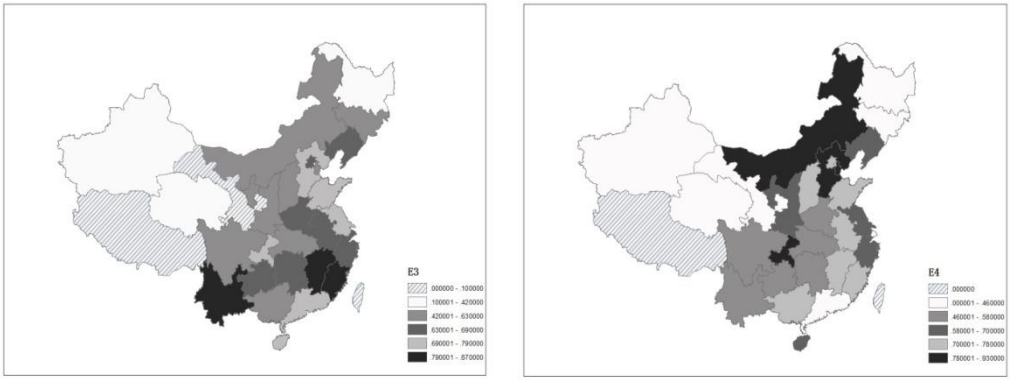
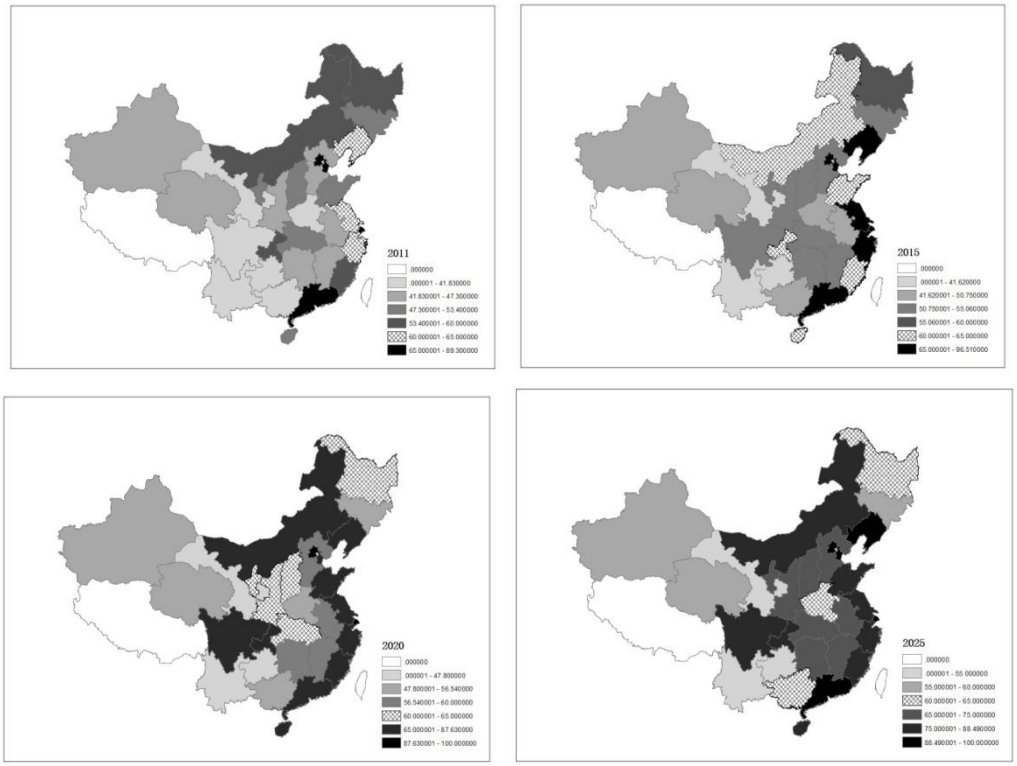


Figure 4.Depiction of the urbanization rates in the 30 administrative regions: 2011—2025.



As of the analysis above demonstrates that the urbanization process in coastal regions may place additional pressure on the environment. The urban population is projected to increase by 8% annually during the years 2011 to 2015. The national average is expected to increase to 54.5% by 2015. Regions, including Mongolia, Chongqing, Fujian and Shandong, would begin to feel the negative impacts of urbanization as the inflection point is reached. The government should attach greater importance to mutually beneficial changes in the two goals of urbanization and environmental protection to realize sustainable urban and environmental development. By the year 2020, the urbanization rates of 12 cities around the country will be in a positive relationship with the state of the environment. The urbanization rates of multiple regions, including Hubei, Shaanxi, Shanxi, Heilongjiang, Ningxia and Sichuan, would reach levels

between 60% and 65%, entering developmental levels at which urbanization has positive consequences for the state of the environment. By 2025, only six cities will have urbanization rates that exhibit a positive relationship with the state of the environment. The urbanization rates of Guangxi, Heilongjiang and Henan will reach levels between 60% and 65%, entering the region in which the urbanization rate has positive effects on the state of the environment. We should attempt to balance the relationship between the two to maintain stable development.

5. Conclusions

Based on the PSR model, this paper establishes environmental quality indices for the 30 administrative regions of China from 2003 to 2011 and studies the relationships among urbanization, economic development and environmental change by empirically analyzing panel data. The results indicate that the urbanization rate and rate of change in regional environmental quality exhibit an inverted-U-shaped relationship. This relationship remains robust after controlling for various other factors with the potential to influence environmental change. Further analysis reveals that the inflexion point in the inverted-U-shaped relationship between the comprehensive environmental index E1 and urbanization rate is located at an urbanization rate of 60.2%. The inflexion point in the inverted-U-shaped relationship between the urbanization rate and the sub-item environment indices E2, E3 and E4 appears at an urbanization rate of 46.7%, 64.9% and 67.0%, respectively.

Regarding the relationship between economic development and environmental change, our empiricalanalysis reveals that the mode and level of economic development have different, but significant impacts on the regional environment. Specifically, as the economy develops, the environment will improve. However, an extensive development pattern would have a significantly negative effect on the environment. This conclusion provides an important policy insight for many industrial or developing countries: during the process of industrialization and urbanization, a more intensive mode of economic development must be pursued to realize the dual goals of economic development and environmental improvement.

Generally, on the one hand, this paper provides further support for the EKC assumption proposed by Grossman and Krueger (1991; on the other hand, it represents an extension. The analysis in Grossman and Krueger (1991) is based on a GDP index and international data, whereas this paper is based on the urbanization rate and regional environmental data. Therefore, the analysis in this paper indicates that the inverted-U-shaped relationship between environmental quality and economic growth remains tenable for developed and developing countries; it is suitable to address changes in environmental quality, not only at the country level, but also at the regional level. Therefore, it is widely applicable.

In addition, the assessments in this paper have substantial implications for the environmental issue in question. According to the empirical conclusions of this paper, the relationship between the state of the environment and the urbanization rate in the 30 administrative regions appeared to exhibit an inflexion point in 2008. As urbanization accelerates, environmental quality declines; by the year 2024, the environment impact will clearly increase with consistent growth in the urbanization rate; by the year 2027, the environmental response will lag behind the urbanization rate. Overall, comprehensive environmental quality will decline as urbanization accelerates, and then, the former will stabilize at a relatively high level, at which point increases in the urbanization rate also increase environmental quality.

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IMI International Monetary Review

The Monetary Root of Financialization*

By LUO YU*

Marxism has a strong influence on Western left-wing economists' understanding of financialization, in that they regard financialization as the consequence of the transformation of capitalism. Neoclassical economics and finance scholars tend to think of financialization (financial development) as not exclusively occurring within the economic system of capitalism but as existing throughout an entire human history filled with numerous financial innovations. The unprecedented change of the monetary system ascribed to the collapse of the Bretton Woods System, among all historical and systemic changes, is the strongest underlying impetus to financialization. Financialization is the unintended consequence of a change in the monetary system from commodity money to credit money. Taking a more in-depth point of view, financialization is philosophically a means for human beings to cope with the advent of a risk society, reflecting the advance of instrumental rationality, and hence is the embodiment of late modernity.

Keywords: Financialization; Monetary Root; Risk Society; Instrumental Rationality

1. Introduction

Finance's pervasive role in the economy and society over the last four decades is often referred to as the process of 'financialization' (Arrighi 1994; Epstein 2005; Palley 2008;Van der Zwan 2014). However, interpretations of the definition, origin, and nature of financialization vary among scholars, who can roughly be divided into two ideologically opposing parties. Lapavitsas (2011) states that the concept of financialization has emerged from within Marxist political economy in an effort to relate a boom in finance to poorly performing production, but there is no general agreement on what it means, and other areas of the economic and sociological literature have also become involved in this issue. The so-called "heterodox economists" have commonly used this terminology to describe the current development of capitalism. For example, left-wing economists, influenced by Marxism and post-Keynesian economics, frequently use the term to depict capitalism as it enters a new stage. A classical broader definition of financialization is 'the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies' (Epstein2005,3), while from more narrow perspectives, financialization is defined as 'a pattern of accumulation in which profits accrue primarily through financial channels rather than through trade and commodity production' (Krippner2005, 174), 'the engagement of non-financial businesses in financial markets' (Stockhammer 2004, 721), or 'the shift in gravity of economic activity from production (and even from much of the growing service sector) to finance' (Foster 2007, 8). In general, left-wing scholars emphasise the negative effects of financialization. They criticize the process behind it and the policy framework that accelerates it, and they propose 'de-financialization.' By contrast, mainstream economics and finance scholars

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hold positive or at least neutral attitudes towards financialization, regarding it as a phenomenon or a consequence of financial innovation and financial development. Although mainstream scholars do not use the term ‘financialization’ often, they use alternative terminologies that express a similar meaning. From a macro perspective, both Goldsmith’s (1969)theory on the evolution of financial structures and MacKinnon’s (1973) and Shaw’s (1973) theories on financial deepening can be considered to represent a branch of the origin of financialization. It has been stated that an essential function of finance is to enhance liquidity for less liquid assets: once liquidity is increased, assets can be allocated more efficiently, thus creating economic value(Levine1997). In his bestseller Capitalism in the 21st Century, Piketty (2014) also mentioned the effect of financialization on enlarging the income gap. From a micro perspective, financialization is defined as the securitization of commodities or assets with the help of financial innovation. Tang and Xiong (2012) reveal that commodity prices behave similarly to typical financial assets and that the futures prices of different commodities have become increasingly correlated since the early 2000s in the US, which they identify as the start of the financialization of commodities markets. The financialization of commodities implies that market pricing does not mainly rely on supply and demand, but on series of financial factors. The securitisation of assets is also known as a typical pattern of financialization. The nature of securitisation is to transform less liquid assets into more liquid assets (Chen et al.2013).

Despite differences in interpreting the term ‘financialization,’ all opinions stand on three stylized facts: (1) financialization enhances the relative importance of the financial sector vis-à-vis real sectors, which means that the socio-economic and political influence of the financial sector has increased since the 1970s; (2) non-financial enterprises become increasingly involved in financial activities, which leads to greater income transfer from non-financial sectors to the financial sector; and (3) financialization exacerbates the inequality of income distribution, i.e., the labour share of national income shrinks and income gaps between executives and employees grow (Lin andTomaskovic-Devey2013). Numerous studies have attributed financialization to neoliberalism, deregulation, capital monopoly, the increasing scale of institutional investors, shareholder value orientation movements, among other things. After the 2008global financial crisis, left-wing scholars argued that financialization reflected an inherent defect in contemporary capitalist institutions; hence, they see de-financialization as a must to cope with a series of socio-economic problems. However, mainstream economists have unshakeable faith in fundamental economic theory, which claims that financial innovation and financial development are needed and should be encouraged. Meanwhile, economists must rethink the role that finance plays in benefiting society, and financial rent-seeking should be more prudently regulated (Zingales 2015). The aim of finance is to build a ‘good society’ (Shiller2013).

Ideology imposes its conspicuous role in the existing study. In the author’s opinion, financialization is not a unique feature of capitalism, nor should it be tagged good or bad. Neoliberalism plays an important role indeed; however, the fundamental causes behind the prevalence of financialization lie in the great changes in finance itself. Some studies have more or less deviated from the intrinsic logic of finance when discussing financialization in an attempt to understand financialization from peripheral factors. They prefer a grand narrative to explain the origin and nature of financialization, rather than micro mechanisms. There is value in seeking the monetary root of financialization to better clarify the related controversies and to reconcile the understanding of heterodox and mainstream economists on the origin of financialization. The well-known post-war international economic order, the Bretton Woods System, lasted for less than thirty years, from its establishment in 1944 to its collapse in 1971, but it still had a far-reaching impact. The current global monetary system was formed after the

end of the Bretton Woods System, but the influence that the end of the Bretton Woods System imposes on monetary and financial development is sometimes undervalued. Ordinary people may take for granted that credit money, e.g., legal tender notes, is a product with a long history, while in fact, pure credit money is a modern creation ascribed to the collapse of the Bretton Woods System.

This paper attempts to reveal the connection between the collapse of the Bretton Woods System and the advent of the financialization era. We believe that the unprecedented change in the monetary system, among all historical and systemic changes, is the strongest underlying impetus behind financialization. Financialization is the unintended consequence of changes in the monetary system, for which the collapse of the Bretton Woods System serves as a watershed. From a more in-depth point of view, financialization is philosophically a natural choice made by human beings to cope with the advent of a risk society; it reflects the advance of instrumental rationality and hence is the embodiment of late modernity.

The remainder of this paper is organized as follows: First I provide a literature review on the origin of financialization. The following section describes the relationship between the collapse of the Bretton Woods System and the advent of the financialization era, in which we try to identify the monetary root of financialization. Next, I further discuss the nature of financialization against the theoretical background of a risk society and late modernity. The last section concludes the paper.

2. A literature review on the origin of financialization

Neo-Marxism economics

Radical political economics

Radical political economists are the earliest scholars to systematically address the concept of 'financialization.' They commonly follow Karl Marx's analysis of capitalism, Hilferding's (2006)analysis of finance capital, and the thinking of Paul Baran and Paul Sweezy (1966)on monopoly capital to explain the changes in capitalism over the last four decades. They often characterise these changes as three mutually reinforcing trends: 'neoliberalism', 'globalisation', and 'financialization.' Financialization is now increasingly seen as the dominant force in this triad (Foster 2007), resulting in 'financial hegemony' (Duméniland Lévy 2011). Financialization, according to Foster (2007), is 'the shift in gravity of economic activity from production (and even from much of the growing service sector) to finance'. It is believed that the emergence of financialization correlated with the stagnation of the capitalist economies after the 1970s.The stagnation stemmed from the slowdown of the capital accumulation process and an inability to absorb the enormous surplus generated within production. This in turn reflected the continual shortage of profitable real investment outlets due to a growing degree of monopoly in the economy (Magdoff and Foster 2014).The only potential source of economic stimulus was the expansion of financial sectors, which, according to Baran and Sweezy (1966),could serve to stimulate the economy by partially soaking up surplus capital. Magdoff and Sweezy (1983) argue that financial explosion under conditions of economic slowdown was the main factor counteracting stagnation. When the capitalist economy fell into stagnation, the excessive expansion of capital and rise of the elite rentier class offered a way to absorb economic surplus. The owner of capital regarded financial investment as a method of capital preservation and appreciation, creating increasing demand for financial products and innovation. Economic surplus was absorbed through financial speculation, which provides another channel for the usage of capital aside from putting it into production.

Although the capitalist economy has changed as a result of financialization, Foster (2007) did not regard it as an entirely new stage of capitalism. Instead, he coined the term

'monopoly-finance capital' to epitomise capitalism's tendency towards capital accumulation and financial expansion, in which financialization has become a permanent structural necessity of the stagnation-prone economy. He explained that 'monopoly-finance capital' is a new hybrid phase of the monopoly stage of capitalism that is the consequence of financialization. In the era of monopoly-finance capital, real accumulation becomes subordinated to fictitious capital, and speculative assets expand at the expense of real investment; capital is trapped in a seemingly endless cycle of stagnation and financial explosion.

The social structure of accumulation theory

The social structure of accumulation theory, a French left-wing school that originated in 1980s, refers to financialization as a natural consequence of developed capitalist economies' entrance into the stage of neoliberalism (e.g. Gordon 1978; Gordon, Edwards, and Reich 1982). According to the social structure of accumulation theory, every society has an accumulation structure within which production is organised, and profits are generated and distributed in a particular institutional form. Hence, the social structure of accumulation can be interpreted as a coherent, long-lasting institutional structure that promotes profit-making and forms a framework for capital accumulation. Each social structure of accumulation functions effectively at promoting profit-making for a period of time, but at some point, it ceases to do so. This brings crisis, and eventually a new social structure of accumulation replaces the previous one (Kotz 2008).

The social structure of accumulation theory offers an analysis of the periodic changes in the capitalist institutional structure (Kotz, McDonough, and Reich 1994; McDonough, Reich, Kotz 2010).It asserts that the social structure of the accumulation of capitalism has changed periodically since it emerged, and thus neoliberalism is the latest institutional form of capitalism. The social structure of accumulation under neoliberalism represents a sharp break from the previous structure. Kotz (2008) summarises its main features as(1) the removal of barriers to free the movement of goods, services, and especially capital, throughout the global economy;(2) the deregulation of economic activity; (3) privatisation; (4) capital fully dominating labour; and so forth. Under the institutional framework of neoliberalism, financial deregulation unleashes the financial sector, promoting development of the financialization process. As financial sectors play a crucial role in capital accumulation and profit-making, financialization accordingly becomes a characteristic tendency. Therefore, the social structure of accumulation theory holds that financialization has a close relation to the transition of the accumulation structure to neoliberalism. It appears that the beginning of neoliberalism set the stage for financialization. However, some scholars of this theory admit that financialization also has deeper roots that are unrelated to neoliberalism (Kotz 2008).

Regulation School

The Regulation School originated in France in the 1970s and focuses on analysing the long-term transformation of capitalist economies. A core concept of the Regulation School is that a special regime of accumulation needs an accompanying mode of regulation – a set of institutions and policies – to make economic and social reproduction feasible. The regulationists suggest that capitalism has undergone different accumulation regimes in a system to maintain balance between social reproduction and consumption. Each regime refers to a particular pattern that regulates the process of accumulation (Boyer and Sailard 2001).The Regulation School considers financialization to be the successor of the Fordist regime of accumulation, which declined in the 1970s (Aglietta 1979), and they argue that a new regulation regime is now being formed. The regulationists have several proposed terminologies to describe the new regulation regime, such as 'finance-led growth regime' or 'financialized growth regime' (Boyer2000),

'financial wealth-induced growth regime'(Aglietta 2000), and 'financialized regime of accumulation' (Aglietta and Breton 2001).

As to the origin of financialization, Boyer (2000) postulated that the financialized growth regime was the latest candidate for replacing Fordism. The new regime began to develop in response to declining productivity in the late 1960s, when the relationship was severed between rising wages and demand for industrial production. The new regime combined flexible labour markets with the expansion of credit, and the hierarchy among institutional forms drastically shifted: the financial regime plays the central role formerly attributed to the wage-labour nexus under Fordism.

In addition to offering an explanation for the shift from Fordism to the financialized growth regime of accumulation in developed capitalist economies, the Regulation School also analysed the path towards the financialization of developing economies in an integrated framework. Developing economies have experienced a shift from different forms of 'peripheral Fordism' to forms of financialization locally specific to their economies (Becker et al. 2010).

World system theory

The world system theory initiated by Immanuel Wallerstein is applied to the study of financialization by Marxist sociologist Giovanni Arrighi. Arrighi (1994) situates the manifestation of financialization in the long history following the emergence of capitalism. He believes that financialization is not a phenomenon that solely appears in a particular historical period but that it is a component of accumulative changes occurring periodically and repeatedly throughout the history of capitalism. Each accumulation regime is endangered due to excessive accumulation and consumption, which reduces the profit from trade and production. Hence, the embodiment of crisis that occurs in any accumulation regime is the declining profitability of production and the occurrence of financialization. Financialization occurs during a period of hegemonic transition, when capitalist elites respond to increased international competition by shifting their investments from trade and production to finance. Arrighi asserts that the final quarter of the twentieth century represented the height of American hegemony.

Many other scholars influenced by world system theory have also contributed to the study of financialization. They postulated a series of important theories, such as Amin's (1994) 'dependency theory,' Panitch and Gindin's (2004) 'global capitalism and American empire' theory, and Harvey's (2003) 'new imperialism' theory, to focus on the origin and systematic long-term impact of financialization. Some studies echo the idea of Arrighi that financialization is not new but, from a historical point of view, one of the theories of crisis (Tomé 2011).

Post-Keynesian economics

Financialization is a prime research subject in post-Keynesian economics. Post-Keynesian economists use the term 'financialization' to depict the change of relations between the real economy and the financial sector. In addition to Gerald Epstein's broad definition of financialization as 'the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies' (Epstein 2005, 3), Stockhammer (2004), Palley(2008), Skott and Ryoo(2008), Van Treeck (2009) and Hein (2013) also provide various analytically precise definitions for financialization. For example, Stockhammer (2004, 721) explains financialization as 'the engagement of non-financial businesses in financial markets.' Other terminologies are simultaneously used to express the sometimes different meaning of financialization, e.g., 'finance-led economies'(Van Treeck2008), 'finance-dominated regime' (Stockhammer2008), 'neoliberalism' (Duménil and Lévy2001; Crotty2003), 'shareholder value orientation'(Froud et al. 2000), and 'transformation of corporate governance'(Lazonick and O'Sullivan 2000). Indeed, the lack of an integrated definition reflects to some extent the incompatibility between various understandings

offinancialization. Different economists study financialization based on partial stylised facts, from either the macro perspective or the micro perspective, and focusing on income distribution or on economic accumulation. Thus, the interpretations of financialization vary even in post-Keynesian economics.

Post-Keynesian economics has ideological similarities to other left-wing schools. It began to elucidate financialization when it highlighted capital and income distribution. Starting from the concept of a 'rentier'(Crotty1990;Epstein2005;Pollin2007), especially moneylenders, post-Keynesian economists believe that the elite rentier class gains benefits from the financial investment of production profits, therefore sharing some points with Neo-Marxists. They also share concepts in common with the Regulation School. In the understanding of the regimes of economic accumulation, post-Keynesians believe that capitalism, after the decline of the Fordist accumulation regime, entered a 'finance-dominated regime,' while regulationists prefer the term 'finance-led growth regime.' Despite certain differences, they have the same belief in the importance of finance in the new institutional system of economic growth (Stockhammer2008; Evans 2009). Post-Keynesian economics has a close connection to Michal Kalecki's theory, as post-Keynesian scholars often apply a post-Kaleckian distribution and growth model when analysing the channels through which financialization influences the real economy(Hein2013).There are connections between post-Keynesian economics and Hyman Minsky's theory. The two are often considered to be the origin of both theories on financialization, however, distinctions still exist. Minsky (1982) notes that financial innovation may become an accelerator of economic growth; however, he is also concerned that financial innovation could impede economic development by increasing risks. Post-Keynesians study the allocation of gains or losses due to financial disturbances among different groups in the economy.

Post-Keynesian economics believes that financialization interplays with the economic accumulation regime. Duménil and Lévy(2001) find that the growth rate of real capital accumulation depends on that of retained profits – profit after interest and dividend payments – which has diminished in recent decades. Crotty (2003) states that non-financial corporations have increased financial investments in response to high interest rates and the low rates of profit associated with real investments. Stockhammer(2004) holds that financialization is a phenomenon involved in the slowdown of real capital accumulation in advanced capitalist economies since the 1970s. Orhangazi's(2008) investigation reveals the negative relationships between real and financial investment, which implies a crowding-out effect of financial investment. Accordingly, the average growth rate of advanced capitalist economies since the start of the financialization process has been lower than in the period between post-WWII and the 1970s.

Some studies emphasised the impact of micro-level changes on financialization. One of the most important changes is so-called 'shareholder value orientation' in cooperate governance. A shift in management behaviour has occurred from a 'retain and reinvest' strategy to a 'downsize and distribute' strategy. Rather than striving for the management-labour balance of the Fordist era, firms in the financialized era are transiting toa management-shareholder balance. Management strategies have changed to focus more on the maximisation of shareholder value and less on long-term growth(Lazonick and O'Sullivan 2000).The shift is correlated with the stagnation of real investment and a sharp increase of financial investment returns, e.g., interest payments, dividend payments and stock buybacks, in recent years.

Post-Keynesian economics naturally links financialization to deregulation and the neoliberal policies instituted since the 1970s (e.g. Epstein2005; DuménilandLévy 2011). The deregulation of financial markets increases the frequency of capital flows, income inequality and

indebtedness for households and firms. As a consequence, volatile financial asset prices and excessive indebtedness can lead to an increase in risks and repeatedly cause financial crises. This, in turn, promotes broader demand for finance to manage risks in the economy.

Financial development theory

Although the terminology of 'financialization' is not widely used in mainstream neoclassical economics, it appears in the literature in regard to financial development theory, which was established based on neoclassical economics, in similar expressions such as 'financial deepening' and the evolution of 'financial structure.' The core argument of this theory focuses on the need to unleash the control of government over finance, fulfil the transition to a stage of 'financial liberalisation' where the market plays a dominant role in financial resource distribution, and realise 'financial deepening.'

The financial development theory and financialization theory appear to differ only in terminology, but they actually differ in their understanding of the role finance plays in economic development and, to deeper extent, in ideology. Financial development theory holds that financial development can, most of time, enhance economic growth and that, accordingly, deregulation of the financial sector is worthwhile. Nevertheless, many financialization theorists hold a negative position on financialization as well as on related concepts such as neoliberalism. From the author's point of view, financialization theory mainly focuses on developed capitalist economies, while financial development theory mainly focusses on less developed economies. When the degree of financial development for a country reaches a higher stage, there is perhaps no significant difference in the meaning of the two terms.

The analytical method on financial structure proposed by Goldsmith(1969) and theories on financial development by Gurley and Shaw (1960, 1967), Mckinnon(1973), and Shaw(1973) can be considered to be the origin of neoclassical financialization theory. Gurley, Shaw, and Mckinnon highlight money and capital in their studies, as monetisation was the central topic of that time. Goldsmith, however, focusses on the entire financial sector and notes that financial development refers to changes in financial structure – more financial tools, improved financial services and functions, and a more advanced structure – that feature financialization. He also specifically develops a series of financial development indicators, of which 'financial interrelations ratio' is one of the important indicators used in the present study of financialization. According to Levine (1997), the core function of finance is to inject liquidity into less liquid assets: once liquidity is added, assets can be allocated more efficiently, thus creating economic value. In Capitalism in 21st Century, Piketty (2014) examines the rate of capital accumulation in relation to economic growth and traces the causal relationship between financialization and wealth and income inequality in Europe and the US since the 18th century.

Mainstream economics has believed in the efficiency of the financial market for quite some time. Alan Greenspan once said, 'Financial innovation will slow as we approach a world in which financial markets are complete in the sense that all financial risks can be efficiently transferred to those most willing to bear them' (Greenspan 2003).After the 2008 global financial crisis, mainstream economists gained an unshakeable faith in the fundamental economic theory that financial innovation and financial development are needed and should be encouraged, but economists must rethink the role of finance. Zingales (2015)notes that academics' views of the benefits of finance vastly exceed societal perceptions. Finance can easily degenerate into a rent-seeking activity without proper rules. Hence, immoderate financialization currently reflects insufficient regulation over finance. We should promote good finance and minimise the bad. As noted earlier, the aim of finance is to build a 'good society' (Shiller 2013).

Financialization in financial markets

'Financialization' in financial markets, from a micro perspective, refers to the financialization of commodities and assets. The financialization of assets often entails securitisation. With the development of financial innovation led by the Wall Street, the expected future cash flow of special assets is converted into current financial securities. The fundamental aim of financialization is to convert assets with low liquidity into highly liquid assets to benefit financial market trading (Chen et al. 2013).

The term 'financialization' has frequently appeared in literature concerning the commodity market in recent years. The main point is to discuss how futures contracts can be operated as securities (e.g.Cheng and Xiong 2013).Empirical studies find that commodity futures have become a popular asset class for portfolio investors, similar to stocks and bonds, in recent years. As a consequence, the price of an individual commodity is no longer simply determined by its supply and demand. Instead, commodity prices are also determined by a whole set of financial factors, such as the aggregate risk appetite for financial assets and the investment behaviour of diversified commodity index investors (Tang and Xiong 2012). In the process of financialization, commodities, once excluded from financial assets, can enjoy the same importance as common securities in a portfolio. Financialization blurs the boundary between commodities and underlying financial assets and establishes correlation between them. Capital is free to move between the commodity futures market and other security markets. Financialized commodities share the properties of financial assets. Differences across various commodities have also faded, as capital is free to flow between different markets, strengthening the correlation of prices. All of these traits distinguish financialized from unfinancialized assets.

Derivatives are considered to play a central role in financialization in the financial market. Wigan(2009) states that the advent of limited liability and absentee ownership spurred risk management through derivatives. The use of derivatives disengages the direct ties between ownership and a particular asset and accordingly excludes the possibility of a conceptual link between property and stewardship. Instead, ownership proceeds on the basis of financialization. Such analysis in fact provides an entirely finance-based explanation for the ascent of financialization.

Financialization beyond the economics discipline

The discussion of financialization issues is no longer restricted to economics but is related to broader disciplines including economic geography, sociology, political science and even humanities. Economic geographers investigate the impact of financializationon the spatial development of capitalism (Leyshon and Thrift 2007);some argue that the financialization of capitalism is compromised by the 'anaemic geographies' that structure and animate it (Christophers 2012).Among sociologists, Dore (2002) introduces stock market capitalism as a consequence of financialization, while Krippner (2011) investigates the political origins of financialization in the United States. The concept of financialization came under public scrutiny in the 1990s thanks to the political scholar Kevin Phillips and his books Boiling Point (1993) and Arrogant Capital (1996). He distinguishes the real economy from finance, asserting that the latter rules over the former. Humanists have also noticed the advent and impact of financialization: Martin (2002), a humanist, uses the concept of financialization to depict the encroachment of finance into the realms of everyday life. Pryke and Du Gay (2007)discuss the cultural aspects of finance in contemporary capitalism. Langley (2008) highlights the far-reaching psychological consequences of financialization as individuals must develop new forms of financial self-discipline.

Comments on different theories

All of the definitions of financialization or explanations of its origin noted above are based on stylised facts in developed capitalist economies over the last four decades, reflecting more or

less partial interpretation of the term. Since the 1970s, the United States and the United Kingdom, so-called 'Anglo-Saxon model' counties, have implemented neoliberalist policies to deregulate the market and revitalise an economy undergoing a slowdown. As an unintended consequence, the finance sector has drastically expanded and has taken a dominant role in the economy, even becoming a self-sustaining system. However, things may be quite different in developing countries and in other developed countries, such as those in Continental Europe, as the Anglo-Saxon model is a market-dominant economic system, while systems may be bank-dominant or may have less developed financial markets.

Ideology has heavily influenced the above study. Left-wing economists often negatively link financialization to financial crisis, economic decline, and a parasitic rentier economy. More orthodox economists regard financial development/financialization as a generally neutral or positive influence. In the author's opinion, financializationis not a unique feature of capitalism, let alone tagging it as good or bad. It is more meaningful to seek the underlying impetus behind financialization, among all of its historical and systemic origins, rather than becoming entrapped in ideological debates.

3. The collapse of the Bretton Woods System and the advent of the financialization era

Characteristics of monetary systems

Any monetary system entails 'dual anchors': one anchor is the form of money and the other is the social institution within which it circulates (Wicksell1898; Simmel 2004). An effective monetary system must overcome the adversities that impede its functioning: (1) counterfeit money in circulation; (2) concerns about a loss of value when holding money; and (3) money not being accepted by third parties. The 'dualanchors' of a monetary system mean that the viability of the monetary regimes relies on either the physical form of money or the social institution to eliminate these three worries. Differences in monetary systems lie in their usage of the dual anchors (Dembinski2009).

Monetary history reveals that the public is inclined to put its trust in the physical form of money when the social institution is weak, while when the social institution becomes strong, and the monetary system becomes complex, trust in the physical form of money is gradually replaced by trust in the social institution (Davies and Bank 2002). In the era using commodity money, e.g. metal coins, the genuineness and quality of the monetary material were the main concern. In the credit money era, money circulates in a dematerialised form as symbolic information under legal and technological support. As a result, concerns about material quality and counterfeit money from the past have been gradually transformed into worries about financial fraud and other illegal bank account invasion, along with the fear of shrinking purchasing power. The public's confidence in money solely relies on the government: the government must ensure the technical security of the money exchange process; meanwhile, it should also maintain a stable value for money through monetary policies. The public's trust depends on whether monetary policy can effectively protect the purchasing power of money from macroeconomic fluctuations and inflation. However, governments often have unreliable credibility. Political intervention may destroy price stability. Thus, we can observe that various countries are struggling to find an external anchor to consolidate the sole anchor left (the social system) in order to maintain price stability. Creations such as inflation targeting and central bank independence have emerged accordingly.

When social institutions become the sole source of faith in monetary systems, they become more sophisticated. Money loses its intrinsic value. The two core functions of money – payment means and value storage – also change over time. For the means of payment, in addition to notes and cash, payment becomes a process of transferring the information symbol. Money symbols

flow from a virtual account to another account. The development of information and communications technology has greatly influenced money. With the economies of scale brought by information technology, transaction costs have been greatly reduced. A growing number of transactions must rely on a third party that is capable of processing payments, meanwhile charging a transactional fee; the third party also helps to maintain liquidity during the settlement process, since transactions become more efficient. The status of financial intermediation is strengthened in the face of an increasing need for financial services. This provides an opportunity for the ascent of money and finance (Ferguson2008).

As for value storage, money is being gradually replaced by various types of financial assets. When money and financial assets exist in symbolic form, with the help of information technology, any temporary, idle money can easily be transformed into financial assets, thus creating interest income, which of course also bears the corresponding risks. Due to the efficiency and convenience of the transformation, it is inefficient to count physical money as a means of value storage. Currently, idle cash of any kind can be converted into financial assets with the help of financial institutions. The value storage function of money has been replaced by a more specialised field, namely 'financial investment' or 'wealth management,' which has greatly stimulated the demand for financial services. Financial innovation promotes asset liquidity, and some assets play the role of 'quasi money.' This has led to the emergence of a series of highly liquid financial assets, which are not considered to be money but still function as money. In fact, the boundary between 'quasimoney' and money has become very blurred.

The collapse of the Bretton Woods System and its historical significance

From the usage of commodity currencies in ancient times to the 1970s when credit money prevailed, money was never detached from the anchor of its material form throughout most of the world. The gold standard system (or the gold exchange standard) is a typical 'dual anchor' monetary system. During the 1920s-1930s, the gold standard system collapsed due to the economic crisis, but at the end of World War II, the Bretton Woods System revived nostalgia for the metallic monetary system, and a legal commitment was made to the interchangeability between gold and the US dollar as well as other currencies. The dollar was actually the last currency fixed on gold standard, and in turn, the dollar was attached toall other currencies. The Bretton Woods System collapsed in the 1970s. When the United States abolished the gold 'anchor,' the world also irreversibly cut off its connection. After the collapse of the Bretton Woods System, money was detached from the real value 'anchor' as commodity currency. Human beings entered the pure credit money era at that point. It can be asserted that until the 1970s, money in the Western world has never really been detached to become a commodity currency. Ultimately, as representatives of the social institution, governments control the issuance of legal tender, which has no intrinsic value and solely relies on the credibility of the government to circulate. The 'dual anchors' of the monetary system, for the first time, became a 'sole anchor.'

Credit money has no intrinsic value and therefore cannot be mutually exchanged with any metal currency; it mainly exists in the form of deposits in bank accounts. With monopolistic issuance rights and no longer being subject to moderate metal, governments have supreme power over money. The immoderate issuance of paper money by governments with low self-discipline has frequently caused inflation. Inflation has become a common phenomenon since the 1970s and the tendency appears to be irreversible. Figure 1 shows the long-term tendency of inflation for six representative countries in the twentieth century and the early twenty-first century. Regardless of whether in developed or developing countries, regardless of whether the country implemented inflation targeting as the monetary policy regime, inflation gained significantly increasing momentum after the 1970s. The hoarding of money is irrational in light of persistent

inflation. The increasing demand for wealth preservation and appreciation stimulates financial investment and financial services. It provides the breeding ground for financialization.

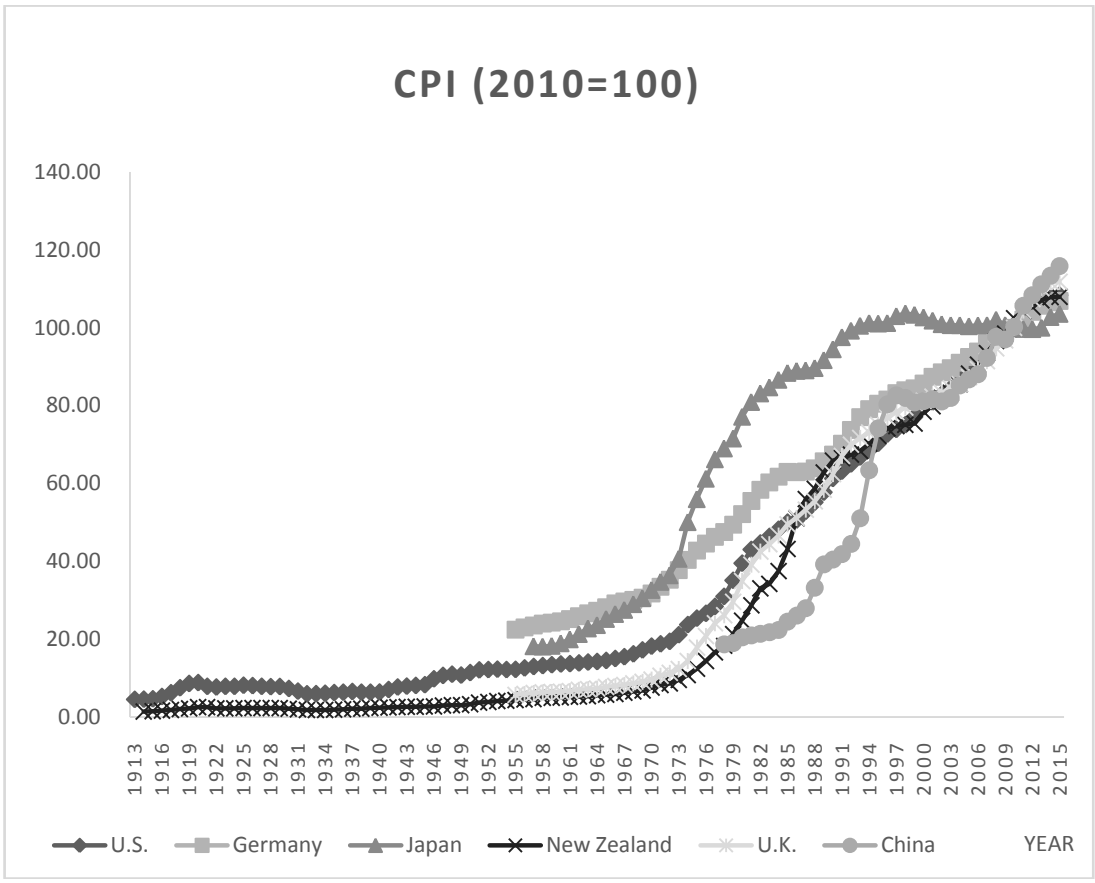

Figure 1.Long-term inflation among representative countries.

Data source: OECD dataset.

Note: CPI data are all index numbers with a fixed base period, 2010=100.

After the advent of the pure credit money era, the general acceptability of money became subject to the power of the nation that issued it. Only a very small amount of money is used for international payment and reserve. The currency exchange rate fluctuates frequently, and speculation is prevalent in foreign exchange markets. Worldwide commodity flows and currency flows look like a game. Dollars given by developed countries to purchase commodities in developing countries are returned to the developed countries in the form of financial investment, e.g. treasury bonds or stocks. These dollars then quickly disappear in the circulation of the financial system and are used to generate cheaper credit, which has induced the rapid development of various forms of securitisation and asset price bubbles. All of these phenomena are identified as characteristics of financialization.

To summarise, many changes have taken place since the 1970s in the world economy. These are directly or indirectly connected to the transition from the commodity money system that had been implemented for nearly two thousand years to a pure credit money system. Despite other

influential factors in the origin of financialization, the grand transition of monetary systems is the most fundamental driver.

4. Financialization, Risk Society and Late Modernity

Taking a more in-depth point of view, financialization is philosophically a natural choice because it allows human beings to cope with the advent of a risk society; this reflects the advance of instrumental rationality and hence is the embodiment of late modernity. Although this type of analysis is slightly beyond the disciplines of economics and finance, it is conducive to the understanding of financialization against the backdrop of the historical changes of human society.

Risk refers to potential loss, disaster or other unpredictable uncertainties. With the acceleration of technological change, the emergence of new forms of risk causes more uncertainties for individuals, whose futures are far less determined than the futures of those in traditional societies. In modern society, the impact of the uncertainty of nature on human life has been significantly reduced. However, a growing number of manufactured or artificial risks have emerged. Some of the major risks in modern society – global nuclear threat, environmental pollution and economic crisis – are the consequences of modernisation. Based on this observation, the German sociologist Ulrich Beck proposed the concept of 'risk society.' Beck defines the risk society as 'a systematic way of dealing with hazards and insecurities induced and introduced by modernization itself' (Beck 1992, 21). The risk society is one of the social features of modernity, and 'modernity' is a philosophical and sociological concept referring to a common understanding of the innovative mode of production, social structure and cultural spirit after the birth of capitalism, particularly to the social conditions, processes, and discourses consequent to the Age of Enlightenment. Giddens (1991) called the modernity of contemporary society 'late modernity', considering it to be a developed, radicalised, 'late' modernity in order to distinguish it from post modernity.1 Late modernity highlights the more severe and more pervasive consequences of modernity, but does not acknowledge that global societies, mainly capitalist economies, have entered into a new era that is completely distinct from the past.

The advanced development of instrumental rationality and its irrational consequences provide a clue to understanding the boom of financialization from the philosophical level. Instrumental rationality is one of the human capacities for reasoning. It focusses on the most efficient or cost-effective means to achieve a specific end, but not on the value of that end itself. The counterparty of instrumental rationality is valuerationality. Max Weber prompted the identification of these as generic motives for rational behaviour. Weber (1978, 2-5) argued that instrumental rationality – choosing means as instruments for coping with conditions to achieve temporary ends – motivates instrumentally rational action and that value rationality – choosing permanent ends that are valuable in themselves – motivates value-rational action.

Within risk society, the establishment of risk prevention mechanisms is the consequence of the development of instrumental rationality. People continually create new techniques, rules and bureaucracy as they try to manage the uncertainties of the world. Financial instruments are a typical embodiment of instrumental rationality. Risk management is one of the core functions of finance, which relies on effective financial instruments. Some important financial innovations, aiming to spread risk, thrive in a highly uncertain society where demand for risk management is larger than it is in a less risky environment.

[1] Late modernity is the characterisation of contemporary highly developed societies as thecontinuation of modernityrather than as part of succeeding era known as postmodernity.

As technology advances, more people are facing manufactured risks rather than natural risk. Inflation becomes a common phenomenon; ordinary people are forced to become involved in the process of financialization, in which financial risks are inevitable; financial risks become highly contagious worldwide and increase with the intensification of globalisation. Individual responsibility alongside risk-taking and calculative assessment in financial management are emphasised through the specific narratives and discourses set by elites (Martin 2002, 34). To cope with these risks, elites believe that more sophisticated financial instruments and innovation are needed. This leads to an endless loop: addressing risk requires financialization, but financialization itself brings new risk. With the advance of financialization, complex financial activities are created, which may result in the endless expansion of instrumental rationality. The outcome may well be irrational and reflected by frequent financial crises.

5. Conclusion

This paper explores the existing theories of financialization. We find that Marxism has a strong influence on the understanding of financialization among Western left-wing economists in that they regard financialization as the consequence of the transformation of capitalism. The latter investment in Marx's classical capital circulation formula, the 'investment-profit-investment' cycle, changes from real investment into financial investment, thus beginning a new accumulation regime. The financialized accumulation regime implies the loss of the productivity advantages of capitalism. Neoclassical economics and finance tend to think that financialization (financial development) does not exist exclusively within the economic system of capitalism but that it was present throughout an entire human history filled with numerous financial innovations. Finance is supposed to benefit society, although sometimes it does not do so.

The author argues that financialization is the unintended consequence of the development of instrumental rationality in the risk society. The collapse of the Bretton Woods System and the drastic changes in the monetary system aggravated risks in a society, and financialization is the means to cope with this. Financialization is not the exclusive property of contemporary capitalism. Capitalism itself has probably not stepped into a new institutional system that is distinctive from the past hundreds of years. The world is entering a new phase, in which the consequences of financialization will be more severe and prevalent than ever before.

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IMI News

- On January 8, the First China Venture Capital Forum was held in Yifu Hall of Renmin University of China (RUC), co-sponsored by Beijing Venture and Innovation Association and Science and Technology Communication Center of China Association for Science and Technology. The theme of the forum is "the prospect and development of venture capital in the new situation". Experts and scholars of different fields, heads from the research institutes of venture capital and private equity funds, insurance companies, investment banks, venture capital companies participated in the meeting.
- On January 11, the research team of *RMB Internationalization Report* including Prof. Tu Yonghong, deputy director of IMI, Prof. Dai Wensheng, Prof. Di Dongsheng, etc. visited CNIC Corporation Limited. Sun Lujun, director of CNIC, Wang Jiansheng, general manager of Asset Management Department, and Duan Dapeng, general manager of Risk Control Department received them and discussed related issues in depth with the RMB internationalization team.
- On January 12, Macro-Finance Salon (No.48) was held in Renmin University of China. Zhou Yinggang, professor of the School of Economics and deputy dean of the Wang Yanan Institute for Studies in Economics of Xiamen University, delivered a keynote speech on "why is RMB more and more important—based on a network analysis approach". The meeting was presided over by Prof. Tu Yonghong, deputy director of IMI.
- On January 13, Macro-Finance Salon (No.49) was held at IMI. The salon invited Mr. Wang Jian, research fellow of IMI, senior analyst of banking from Guotai Junan Securities, to deliver keynote speeches on the outlook in 2017 on the allocation of bank's assets and liabilities. The salon was chaired by Qu Qiang, assistant director of IMI.
- On January 15, Roundtable on Money and Finance·Winter 2016 and the Plenary Meeting of IMI was held at Renmin University. The Conference was presided over by Cao Tong, IMI co-director, CEO of XFinTech and former vice president of China Import and Export Bank. The meeting was attended by members of IMI Advisory Board, Academic Committee and Research Team including Ma Delun, chairman of Banking Accounting Society of China and Former Deputy Governor of PBoC, Guan Qingyou, vice president of Minsheng Securities, Chen Weidong, director of International Finance Institute of the Bank of China, Ding Jianping, director of Research Center for Modern Finance of Shanghai University of Finance and Economics, Ding Zhijie, assistant president of University of International Business and Economics, etc.
- On February 25，IMI held the Macro-Finance Salon（No. 50）at RUC. Mr. Yu Pingkang, IMI senior research fellow and chief economist of Changjiang Pension Insurance Co., Ltd., delivered a keynote speech on warning of anti-globalization. Chen Binkai, associate dean of school of economics, Central University of Finance and Economics, participated in the meeting. Gang Jianhua, associate professor of RUC, chaired the meeting.
- On March 1, the IMI-Hande Fintech Salon (No. 2) was held in Culture Square, Renmin University of China. The salon was co-organized by IMI and Shenzhen Qianhaihande Internet Finance Institute. Mr. Wu Yuanwen, CEO of the JingTum Tech, Deputy Secretary-General and Director of the Exchange Committee of Zhongguancun Big Data Industry Alliance, was invited to deliver a keynote speech on digitalization of asset. The

salon was chaired by Su Zhi, professor of the School of Statistics and Mathematics and the associate dean, Internet Economy Institute of the Central University of Finance and Economics.

- On March 2, the IMI-Hande Fintech Salon (No. 3) was held in Renmin University of China. Ms. Ji Feifei, manager and co-founder of Tai Cloud Corp., delivered a speech on the dialectical unity of autonomy and sharing in block chain technology.
- On March 3, IMI-Hende Fintech Salon (No. 4) was successfully held in Cultural Square of Renmin University of China. Yang Tao, doctor of economics and assistant director of the Institute of Finance at CASS, gave a speech entitled "Fintech is Leading the Revolution of Payment System".
- On March 6, IMI-Hande Fintech Salon (No. 5) was successfully held at the Cultural Building of Renmin University of China. The salon invited Mr. Yi Huanhuan as guest speaker. Mr. Yi is the board director of the Estock, board member of the Key Bridge, and the secretary general of the IFC1000. Mr. Yi delivered a keynote speech on Intelligent Finance and Value Network.
- On March 8, IMI-Hande Fintech Salon (No. 6) was held in Renmin University. This salon invited two guests, Zou Jun, CTO of Hainayun and doctor of service contract research, and Zhang Haining, chief construction executive of Chinese Research Center in VMware and Master of Computer Science from Simon Fraser University. Both delivered keynotes speeches on the status quo and development of block chain technology and hyperledger.
- On March 8, IMI-Hande Fintech Salon (No. 7) was held in Renmin University of China. Duan Xinxing, vice president of OKCoin gave the keynote speech entitled "The Design of Digital Currencies and the PBOC's Strategy".
- On March 14, Macro-Finance Salon (No. 51) was held in Renmin University of China. George Jabbour, the guest speaker, is the professor of Finance in the School of Business at George Washington University. He is also a visiting professor at Franklin College (Switzerland), Dongseo University (South Korea), and Sorbonne University (France). The salon was presided over by Prof. Qian Zongxin, the associate professor of the School of Finance at Renmin University. Prof. Zhao Xijun, Associate Dean of the School of Finance, gave his comments on the speech.
- On March 15, the IMI-Hande Fintech Salon (No. 8) was held in Room 801, Mingde Building of Renmin University. Mr. Liu Sheng, chief architect of the Union Mobile Financial Technology Co., Ltd., was invited to deliver a keynote speech on Block Chain Changes Banking Industry.
- On March 16, IMI-Hande Fintech Salon (No.9) was held at Renmin University. The salon invited Mr. Cai Kailong, the founder of the Touchstone Asset Management Company and the co-founder of the IFC1000, to deliver a keynote speech on "block chain vs. artificial intelligence, who will lead the future financial technology".
- On March 17, Macro-Finance Salon (No. 52), was held in Room 605, Cultural Square of Renmin University. Particularly, this salon invited Luo Yu, researcher fellow of IMI, assistant professor of school of finance at RUC to be the guest speaker. He delivered a keynote speech on "Research on Deleveraging Experience in Major Developed Countries". This salon was presided over by Qu Qiang, the assistant director of IMI.
- On March 19, the Tao Xiang International Finance Lectures (No. 8) was held at RUC. Mr. Fan Xiwen, the Chief Risk Officer (CRO) of China-LAC Cooperation Fund, made a keynote speech on "Mechanism of and Lessons from the 2008 U.S. Financial Crisis". The lecture was chaired by Wang Fang, senior research fellow of IMI and associate professor from the School of Finance of RUC.

- On March 23, the Launch of *Start Sailing - Chinese Insurance Industry Taking the International Stage* and Inauguration of the Academy of Internet Finance (Beijing Office) was held in Culture Square of RenminUniversity, co-organized by IMI and the Academy of Internet Finance of Zhejiang University. The event was presided over by Dr. Song Ke, deputy director of IMI.
- On March 25, Roundtable on Money and Finance•2017 Spring was held in Renmin University of China. The theme of this roundtable is Inclusive Finance and Credit System. Keynote speakers include Wang Zhongmin, vice chairman of the National Council for Social Security Fund; Chen Long, chief strategy officer of Ant Financial Services Group; Wang Jun, professor at CEIBS and former chief financial expert of the World Bank Finance and Marketing Bureau. Other attendees include Wei Benhua, former deputy administrator-in-bureau of SAFE; Hu Xuehao, deputy director-general of the Finance Department of the Ministry of Finance; Chen Weidong, director of the International Finance Institute of the BoC; Guo Jianwei, president of the PBoC Urumqi Branch; and other experts scholars from the financial regulatory authorities and academia. The conference was presided over by Ben Shenglin, IMI executive director and founding dean of Academy of Internet Finance at Zhejiang University.
- On March 25, the External Review Meeting of *RMB Internationalization Report 2017* was successfully held at Renmin University of China. Participants include Chen Yulu, deputy governor of PBoC, Wei Benhua, former deputy administrator-in-bureau of SAFE, Zhang Xiaopu, deputy director-general, Macroeconomic Administration, Office of the Central Leading Group for Financial and Economic Affairs, Guo Song, director-general of Capital Account Management Department of SAFE, Sun Lujun, director of CNIC Corporation Limited, E Zhihuan, chief economist of Bank of China (Hong Kong), Tu Yonghong, deputy director of IMI, and the members of the research team.
- On March 26, Tao Xiang International Finance Lectures (No. 9) was held at Renmin University of China. Dr. Fan Xiwen, Chief Risk Officer of China-Latin America Cooperative Fund, delivered a speech on "Credit Risk Management: Innovation and Application of CDS". The lecture is chaired by Prof. Tu Yonghong, deputy director of IMI.
- On March 29, Mr. Wang Min, vice chairman of the Security Association of China, together with his colleagues, visited the School of Finance of Renmin University, and discussed the cooperation between the Association and the School. Attendees of the meeting include Chen Chuang, Li Yalin and the other two department heads from the Security Association; Tu Yonghong, IMI deputy director; He Qing, IMI senior research fellow, deputy director of the Monetary and Finance Department of the school of Finance; Zhu Shuangshuang, deputy director of IMI Publicity Department; and Jiang Nan, IMI research fellow.

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