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Anticipatory and Responsive Tactics for Corporate Takeover Defences: General Practice in China and Malaysia

Kai Liu*

ABSTRACT

A corporate takeover defence usually takes place in an unfriendly business context, which has dual impacts on corporate governance. Positively, it may provide an impetus for the management to strive hard to improve business efficiency and resilience. Negatively, it may divert the management's focus and affect the smooth running of business operation and the shareholders are therefore exposed to unnecessary risks. Under the negative impact, defensive tactics become particularly important to protect the interests of involved parties from takeovers, and they may assist corporate regulatory bodies to maintain the healthy market competition order. As the developing countries, both China and Malaysia just began utilizing defensive tactics against corporate takeovers in the recent three decades. Nevertheless, the application is very selective due to respective internal reasons. Through analyzing various anticipatory and responsive takeover defences and exploring related practical application in China and Malaysia, this paper recommends that both China and Malaysia should propose fair and reasonable takeover bids for target companies. In doing so, the interests between acquirors and acquirees, directors and shareholders, as well as companies and society can be well reconciled.

Key words: China, Corporate Takeover, Defensive Tactic, Malaysia

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1. INTRODUCTION

A corporate takeover is usually explained as the transfer of ownership from one company to another through share trading, and both trading partners are called an offeror and an offeree.[1] A takeover can be understood from two opposite explanations, i.e. value-maximizing and non-value-maximizing. The value-maximizing explanation considers a takeover as a transaction to increase the equity share price of an offeror, in which the wealth is transferred from an offeree to an offeror. In contrast, the non-value-maximizing explanation views a takeover as an undertaking to expand the management of an offeror, in which the wealth is transferred from an offeror to an offeree.[2] These two opposite perspectives therefore predict the positive and negative impacts on the stock price of an offeror respectively. Since an offeree is more vulnerable in a corporate takeover, defensive tactics are often used to hinder the wealth transfer from an offeree to an offeror.

Specifically speaking, an offeree undertakes a takeover defence due to four major reasons, i.e. takeover price is insufficient, takeover offer is opportunistic, motives of the offeror are improper, and financial condition of the offeror is unacceptable. Initially, the insufficient takeover price may make the target board vulnerable. The target board may opine that the takeover is welcome in other respects and may use the tactic of initial resistance to put pressure on the offeror to raise the price. Thus the target board needs to duly give shareholders all information about the financial condition and prospects of the company to prove that the takeover price is insufficient.[3] Secondly, the opportunistic offer may occur where the target company has been through a rationalization programme. The target board may argue that shareholders will obtain the rewards of improved future profits by keeping their shares, rather than relinquishing them to the offeror who is attempting to purchase the shares cheaply at a time when the expected benefits are not yet reflected in the share price. Thirdly, the offeror’s improper motives, such as asset stripping, cash plunder, break-up of business, foreign monopoly and use of the target asset as collateral for the offeror’s borrowing, may interfere with the normal operation of the target company and result in a hostile takeover.[4] Finally, the target board needs to clearly know about the financial position of the offeror since the acceptance of the takeover will constitute an investment by the target’s shareholders in the fortunes of the offeror. Furthermore, the target board also needs to pay great attention to any perceived adverse tax effects which the consideration offered may have on accepting shareholders.

Besides these major reasons from the offeror, some external factors may also drive the target board to undertake a takeover defence. For instance, since the takeover is

[1] Donald DePamphilis (2008), *Mergers, Acquisitions, and Other Restructuring Activities*, New York: Elsevier, Academic Press, ISBN 978-0-12-374012-0, p. 740.

[2] Roberta Romano (1992), *A Guide to Takeovers: Theory, Evidence, and Regulation*, Yale Journal on Regulation, Yale University, 9 Yale J. on Reg. 119.

[3] P. S. Sudarsanam (1991), *Defensive Strategies of Target Firms in UK Contested Takeovers*, Managerial Finance, Vol. 17 (6), p. 47-56.

[4] T. Jenkinson & C. Mayer, *Takeover Defence Strategies*, Economic Research Associates, Oxford, 1991, p.4.

announced to the public, various press comment may sway the target shareholders. It may directly stimulate the target board, which has no good relation with the press, to embark on a desperate defence against the takeover.[5] Moreover, the very low takeover price made by the offeror may result in the raise of target share price, which further reflects market sentiment that the offeror is serious but needs to increase its price to ensure success. This may oppositely bring pressure to the target board so as to consider a defensive measure against the takeover.

Generally, the ultimate success of a takeover is determined by the offer price. It cannot merely rely on the loyalty of shareholders even though the offeror has a strong relationship with the controlling shareholders of the target company. In order to attract target shareholders, the offeror is especially keen to highlight that the strengths of its own management is very different from that of the target company. Thus the target board needs to answer any attack on its record and performance by the offeror. Additionally, the target board should also consider what will happen if they successfully defeat the takeover. If they fail to achieve their own performance expectation as stated in defence documents, they may lose shareholders and market support. This could be extremely destructive if they have to defend another takeover bid subsequently.

2. TYPES OF CORPORATE TAKEOVER DEFENCES

In business practice corporate takeover defences are usually divided into two major categories in terms of the time difference of tender offers, i.e. anticipatory tactics and responsive tactics. The prospective target companies utilize the former to prevent latent tender offers beforehand and utilize the latter to respond to actual existing tender offers afterwards.[6] Both anticipatory and responsive tactics can effectively prevent unfriendly takeovers in various corporate restructuring activities.

Anticipatory Tactics

In the anti-takeover battles, target companies prefer to apply a range of anticipatory tactics to weaken the threat of potential takeovers. They consist of two major parts, i.e. internal defensive tactics and external defensive tactics (See Table 1). The former are the decisions and actions taken to change the internal structure or operation nature of the company. The latter are the actions taken to influence outsiders' perceptions of the company, and to provide early warning signal about potential offeror.[7]

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[5] R. Kabir, D. Cantrijn and A. Jeunink (1997), *Takeover Defences, Ownership Structure and Stock Returns: An Empirical Analysis with Dutch Data*, Strategic Management Journal, Vol. 18 (2), p. 97-109.

[6] Stephen Kenyon-Slade, *Mergers and Takeovers in the UK and USA: Law and Practice*, Oxford University Press, USA, 20th May, 2004, p. 312, para. 5.01.

[7] P. S. Sudarsanam (1991), *Defensive Strategies of Target Firms in UK Contested Takeovers*, Managerial Finance, Vol. 17 (6), p. 47-56.

Table 1 Anticipatory Tactics for Corporate Takeover Defences

No	Internal Defensive Tactics	External Defensive Tactics
1	Change ownership structure.	Make strategic defensive investment.
2	Change management structure or incentive.	Inform analysis about corporate strategy, financing policies and investment programmes.
3	Improve operational efficiency and reduce costs.	Accept social responsibility to improve social image.
4	Improve strategic focus by restructuring, divestment, demerger, etc.	Monitor the share register for unusual share purchases, force disclosure of identity of buyers.
5	Cultivate organizational constituency.	Cultivate shareholders and investors.

The anticipatory tactics in Table 1 can be generally summed up into five significant aspects, i.e. establishing early warning system, constituting protective Articles of Association, redressing corporate weakness, maintaining reasonable shareholding structure and retaining controlling power. Usually, these tactics will be effective only if they are already in place once an unfriendly tender offer emerges.

(1) Establishing Early Warning System

A good management always makes best effort to improve corporate operation and monitor market factors, such as shareholders, investors, investment institutions and potential attackers, rather than worries about merger and acquisition by another company.[8] If there is any momentum of a takeover in the market, the management will take immediate actions to gain more response time for proper defence.

Usually, an early warning system consists of two important parts, i.e. analyzing share ownership distribution of the company and monitoring share trading of the company.[9] They jointly implicate that the company shall observe its ownership status at all times. Once any of its shareholders is found to continuously increase the shareholding, the company should undertake an immediate investigation. If such a shareholder is a legal person, the investigation shall include its corporate structure, shareholding structure, production and operations management, balance sheet and employment status, etc. If such a shareholder is a natural person, the investigation shall include his family background, social position, shareholding distribution, income and liability, etc. Overall, a careful prior investigation can make a company take adequate precautions against a takeover in advance rather than respond to it in a rush.

[8] R. Ruback, '*An Overview of the Takeover Defence Economy*', in A. Auerbach, *Mergers and Acquisitions*, University of Chicago Press, Chicago, USA, 1988.

[9] Jennifer Payne, *Takeovers in English and German Law*, Hart Publishing, Oxford, England, 2002, p.98.

(2) Constituting Protective Articles of Association

In order to resist potential takeovers, companies prefer to set a number of provisions as obstacles in their Articles of Associations. The implementation of these provisions may cause direct or indirect increase of takeover costs to discourage potential acquirors.[10]

For instance, some Articles of Associations provide supermajority provisions, which particularly increase the shareholder approval requirement for a takeover. It may block a bidder from implementing a takeover even when the bidder controls the target's board of directors if the bidder's ownership remains below the specified percentage requirement.[11] It may also encourage potential bidders to directly deal with the target company's board of directors, which typically has the option to waive the provision if a majority of directors approves the merger. Similarly, some Articles of Associations also provide that the replacement of directors can only be a quarter or one third of total board members annually. As a result, the new board is made up of most original directors who still hold the majority voting powers. Even if an acquiror purchases enough target stocks, he cannot make a substantive reorganization of its board to quickly take it over.

In addition, some Articles of Associations provide that an acquiror must pay the minority shareholders of a target company at a fair price, which is usually measured with the price-earnings ratio of target stocks on the basis of both historical and industrial data of such target company.[12] It particularly ensures the equal treatment of each target shareholder in a takeover. Moreover, some Articles of Associations also provide certain additional qualifications for directors. Those who do not meet such qualifications cannot serve as directors, while those who meet such qualifications cannot enter board of directors. It brings more difficulties for an acquiror to select proper candidates to take up new posts of target directors.

(3) Redressing Corporate Weakness

If a company has a particular weakness or a particular asset which makes it attractive to a potential acquiror, it should consider taking measures to redress the position. These measures include a revaluation of certain asset; a disposal or a demerger; or a joint venture with a competitor of the potential acquiror.[13] In the meantime, the directors should always have due regard to their fiduciary duties and act in the best interests of the company.

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[10] Huang Zhongwen, Du Yu & Chen Yi'an, *Principles and Practice of Mergers and Acquisitions,* Social Sciences Academic Press, Beijing, China, December 2008, p. 335.

[11] Pure supermajority provisions would seriously limit the management's flexibility in takeover negotiations. See McWilliams.B (1990), *Managerial Share Ownership and the Stock Price Effects of Antitakeover Amendment Proposals*, Journal of Finance, 45, 1627- 40.

[12] The price-earnings ratio of a stock (also called 'P/E' ratio) is a measure of the price paid for a share relative to the annual net income or profit earned by the firm per share. It is calculated as: P/E Ratio=Market Value per Share/Annual Earnings per Share.

[13] Graham Stedman, *Takeovers*, Longman Group UK Ltd, London, the United Kingdom, 1993, p. 414, para. 18.5.3.

Due to the limitations of corporate human resource, financial strength and product competitiveness, the weakness which is addressed as the most important part of a company is possibly also the most difficult part to compete and perform. Thus, the directors cannot be complacent about the company, and they should keep a clear mind on the corporate weakness at all times.

(4) Maintaining Reasonable Shareholding Structure

A listed company shall always be cautious about its shareholding structure to prevent an acquiror from collecting shares through the securities market. Maintaining reasonable shareholding structure thereby becomes more important for a listed company to defend against various hostile attacks. Normally, the listed companies prefer to maintain four shareholding structures as follows:

(A) Self-holding Structure. In order to obtain corporate controlling power, either a corporate founder originally held absolute dominant stock rights in hand since the establishment of his company, or a corporate majority shareholder subsequently increases new shareholdings to become the largest shareholder. Although self-holding structure can effectively guard against the attack of hostile acquirors, the investment capitals of both corporate founder and majority shareholder will be excessively tied up. It is not conducive to the overall development of their company in the future. (B) Cross-holding Structure. Associated companies or companies with good relationships hold each other’s stock rights friendly. If one company is threatened by a hostile takeover, the others will immediately stretch to help. It largely increases the difficulties of hostile acquirors absorbing adequate shareholdings from the market. However, cross-holding structure needs a lot of money from the involved parties, which negatively impacts on the mobilization and utilization of their working capitals. Essentially, cross-holding structure is based on the mutual investments of the involved parties. It goes against the original intention of listed companies to raise funds by issuing shares. (C) Friend-holding Structure. Corporate founder either invited some close friends as founding shareholders to subscribe a certain number of shares since the establishment of company, or selects some suitable existing shareholders as new friends to issue a certain number of shares to them. Accordingly, listed companies not only lock numerous shares in their friends’ hands to increase the difficulties of hostile acquirors, but also utilize the voting rights of their friends to fight against hostile takeovers through the shareholder meeting. (D) Employee Stock Ownership Plan. Listed companies always issue a certain number of equity shares to all employees as their personal welfare to keep them focused on company performance and share price appreciation.[14] In view of the close relationship between interests of employees and developments of companies, loyal employees will not casually sell their shares to others, while hostile attackers have almost no opportunities to collect adequate shares from them.

The above shareholding structures have respective pros and cons in business practice. They can however alternatively prevent public listed companies from potential takeovers in effective ways.

[14] Kelly Finnell, *Ownership Transactions: ESOPs Compared to Other Strategies,* The National Center for Employee Ownership, Oakland, 7th July 2010.

(5) Retaining Controlling Power

The most operative defence against an unwelcome acquiror is to retain control of the company amongst friendly parties. This may not always be possible if the company wishes to expand, but if dilution is controlled or the directors maintain their percentage holding, then the company will be safe from acquirors.

Sometimes problems can arise on the subject of companies which are controlled by family trusts.[15] Depending on the terms of the trust, the trustees may find themselves with conflicting responsibilities and loyalties in the event of an unwelcome yet attractive offer for the company. They will naturally be sympathetic to the options of the family members, but equally they will have a duty to act in the best interests of the beneficiaries of the trusts, which may compel them to accept the offer. Trustees caught in such a position will no doubt wish to take independent professional advice to ensure that they do not commit any breach of trust. The acquiror will certainly attempt to make the most out of the situation and may raise questions about the legality or propriety of the trustees' actions. While passing control of a family company to trustees may secure certain tax benefits, it may not always make the company as safe from hostile bids as the family members may assume.

Responsive Tactics

Once the takeovers are announced to the public, the target companies will adopt a variety of tactics as shown in Table 2 to hinder the takeovers in response.[16] For instance, the pre-emption letter is used to attack bid logic and price, and advise target shareholders not to accept. The profit report is used to report or forecast improved profits for past or current year to make offer cheap. The defence document is used to praise own performance and prospects, deride bid logic and price, and form of finance and acquiror's track record. The higher future dividend is used to increase returns to shareholders, and weaken acquiror's promise of superior returns. The asset revaluation is used to revalue properties, intangibles and brands, and show bid undervalues target. The share support campaign is triggered to look for white knight, enlist own employee pension fund, and block control. The workforce is enlisted to lobby antitrust authorities or politicians to attack acquiror's plans for target. The regulatory appeal is triggered to lobby antitrust or regulatory authorities to block bid. The acquisition and divestment is triggered to buy a business to make target bigger or incompatible with acquiror, sell crown jewel, organize a management buyout, and bid cost higher and acquiror strategy thrown into disarray. The red herring is adopted to attack acquiror on peripheral matters. The customers and suppliers are enlisted to lobby antitrust authorities to repel the bid. The advertisement is used for media campaign to discredit bid.

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[15] Graham Stedman, *Takeovers*, Longman Group UK Ltd, London, UK, 1993, p. 413, para. 18.5.1.

[16] P. S. Sudarsanam (1991), *Defensive Strategies of Target Firms in UK Contested Takeovers*, Managerial Finance, Vol. 17 (6).

Table 2 Responsive Tactics for Corporate Takeover Defences

No	Defences	No	Defences
1	First Response and Pre-emption Letter	7	Workforce
2	Profit Report	8	Regulatory Appeal
3	Defence Document	9	Acquisition and Divestment
4	Promise Higher Future Dividends	10	Red Herring
5	Asset Revaluation	11	Customers or Suppliers
6	Share Support Campaign	12	Advertisement

Besides above, there are five more significant and popular defensive tactics actively responding to the announced takeovers, i.e. buying back own shares, issuing new shares, changing controlling provisions, invoking defensive laws and instituting legal proceedings. These tactics may twist the acquiring companies' takeovers to become illegal halfway and even make them further involved into litigations.

(1) Buying Back Own Shares

The target directors may use the power of company to buy back its own shares for the sake of mopping up any loose shareholdings, or to make a modest improvement in earnings per share or asset value per share, where the target share price is depressed.[17] Such an action is also called a share buy-back. The target board may use a share buy-back to return surplus cash to shareholders or to increase the marketability of the target share as consequence of its becoming known that the company itself is a potential purchase of shares.

Share buy-back is also an alternative to dividends. When a company buys in its own shares, it reduces the number of shares held by the public. The reduction of the publicly traded shares means that even if profits remain the same, the earnings per share increase. Buy-back shares when a company's share price is undervalued benefits insiders and extracts value from shareholders who sell.[18] By contrast, when a company is mainly held by insiders and institutional investors, it is harder for the company to buy back shares profitably.[19] The company can also more willingly buy back shares at a profit when the stock is liquidly traded and the company's activity is less likely to move the share price.

However, different counties have different regulations for share buy-back. For instance, Article 149 of the Chinese Company Law provides that a company may not purchase its own shares, except in the case of share cancellation for the purpose of reducing the company's capital, or in the case of merger with another company holding shares of the

[17] Michael Simkovic (2009), *The Effect of Enhanced Disclosure on Open Market Stock Repurchases*, Berkeley Business Law Journal, Vol. 6, No. 1, p. 2.

[18] Bhargava, Alok (2010), *An Econometric Analysis of Dividends and Share Repurchases by U.S. Firms*, Journal of the Royal Statistical Society A, 173, p. 631-656.

[19] Edwin Elton & Martin Gruber (1968), *The Effect of Share Repurchase on the Value of the Firm*, The Journal of Finance, Volume 23, Issue 1, p. 135-149.

company. Upon repurchase of its shares, the company shall cancel such shares within 10 days, and carry out amendment registration in accordance with the relevant national statutes or administrative regulations, and shall make a public announcement. The company may not accept its own shares as the collateral under a security arrangement. Section 67A of Malaysian Companies Act 1965 provides that a company shall not purchase its own shares unless (a) it is solvent at the date of the purchase and will not become insolvent by incurring the debts involved in the obligation to pay for the shares so purchased; (b) the purchase is made through the Stock Exchange on which the shares of the company are quoted and in accordance with the relevant rules of the Stock Exchange; and (c) the purchase is made in good faith and in the interest of the company. The company may apply its share premium account to provide the consideration for the purchase of its own shares.

These regulations may limit the numbers of shares which may be purchased and the price to be paid. Purchases at a premium may have the effect of pushing up the share price and making the company less vulnerable to an acquiror, either because the acquiror cannot afford the higher price, or because the shares were originally undervalued and the disappearance of undervalue diminishes the attractiveness of the target for the acquiror. Nevertheless, where a premium over what the market genuinely considers to be a fair value is paid for the shares, the share price is likely to fall back lower than ever when the company's reserves have been depleted by the buy-back.

(2) Issuing New Shares

Besides buying back its own shares, the target directors may arrange to issue new shares to consolidate the control of their company in the hands of a friendly party. Such an undertaking may demonstrate through four different approaches as Table 3 below:

Table 3 Approaches of New Issues of Shares

Approaches	Contents
Approach 1	A new issue for cash
Approach 2	A new issue for a non-cash consideration
Approach 3	A reverse takeover
Approach 4	A new issue underwritten by a third party who expects to acquire a controlling interest pursuant to the underwriting

As shown above, the new issue of shares by a listed company will require a white-wash, and it may require listing particulars to be prepared as well. If a new issue is for cash, the pre-emption rights of shareholders should be honored or misapplied by a special resolution. Where the company has institutional shareholders, consultation may be required with the relevant investor protection committees regarding any misapplication of shareholders' pre-emption rights. The terms of issue of any convertible securities, options or warrants should be checked to observe whether they confer any pre-emption rights or restrictions on new issues.[20] If a new issue is for a non-cash consideration, the takeover should be approved by its shareholders. A public company issuing shares for a non-cash asset will require a valuation of that asset unless the asset is shares in or all the assets of another company.

Where a bona fide offer has been communicated to the target board, or the board has reason to believe that a bona fide offer may be imminent, the issue of any further shares in the target will constitute frustrating action, and it will be prohibited unless approved by shareholders in general meeting.[21] Directors should act bona fide in good faith in the best interests of the company in issuing new shares. A new issue of shares made for improper motives is liable to be set aside by the court. Any new issue by the directors on unfair terms may attract a shareholder's petition alleging unfairly prejudicial conduct.

(3) Changing Controlling Provisions

A target company and third parties may sign contracts containing change of controlling clauses. They may provide that in the event of the target company being taken over by an acquiror, certain rights become available to the other contracting party.

The change of controlling clauses may take the form of a right for the other party to (i) terminate the relationship early; (ii) exercise an option to acquire a particularly valuable asset; or (iii) buy the target company's interest in a joint venture with the other party.[22] These clauses may either be incorporated at the insistence of the other party, or be offered by the target board to serve as a deterrent to possible acquirors. Nevertheless, the directors must have regard to their fiduciary duties to the company and act in the company's best interest, and not for some collateral purpose.

Loans may become repayable early in the event of a takeover. This may significantly increase the bid cost to the acquiror if it has to find the funds to enable the target company to meet the repayment obligations.[23] Such a cost will be further increased if they were issued at a discount with a low rate of interest but with redemption at par to compensate.

(4) Invoking Defensive Laws

For the publicly announced takeovers, the dominant defensive laws are usually Takeovers and Mergers Code and Securities Law, while the supplementary defensive laws are usually

[20] Dennis J. Block, Jonathan M. Hoff & H. Esther Cochran (1997), *Mergers and Acquisitions Symposium: Defensive Measures in Anticipation of and in Response to Unsolicited Takeover Proposals*, 51 U. Miami L. Rev. 623.
[21] Richard A. Shaw (2000), *Hostile Takeover Bids: Defensive Strategies*, The Alberta Law Review, 38 Alberta L. Rev. 111.
[22] Graham Stedman, *Takeovers*, Longman Group UK Ltd, London, UK, 1993, p. 420, para. 18.5.11.
[23] Jennifer Payne, *Takeovers in English and German Law,* Hart Publishing, Oxford, England, 2002, p.103.

Anti-Monopoly Law and Anti-Unfair Competition Law if any. Both dominant and supplementary laws play important roles in defending target companies from ongoing takeovers.[24]

Takeovers and Mergers Code and Securities Law alternatively regulate securities transaction, shareholding ratio, information disclosure, director replacement, mandatory offer, mandatory obligation as well as insider trading in terms of corporate takeovers. If acquiring companies violate such provisions, their takeovers may end in failure. For instance, Part VII and Part VIII of the Malaysian Code on Takeovers and Mergers provide for the respective obligations of an offeror and an offeree in relation to a tender offer. They cover the issues such as identity of an offeror, evidence of ability to implement a takeover offer, favorable deals, comparable takeover offers for more than one class of share capital, treatment of convertible securities, compulsory acquisition, sale and disclosure of dealings during offer period, restrictions if a takeover offer is withdrawn or lapses, information to competing offeror, frustration of an offer by the board of directors of the offeree as well as prompt registration of transfers. If any offeror or offeree fails to perform these obligations, the ongoing takeover will be considered illegal in Malaysia. Similarly, Chapter III and Chapter IV of the Securities Law of the People's Republic of China also provide for the trading of securities and acquisition of listed companies in terms of tender offers. They include the issues with respect to sustained disclosure of information, prohibited trading acts, report and announcement of takeover offers, restrictions to the withdrawal of takeover offers, permission for the balance of stock trading, approval of the acquisition of state-owned shares, etc. If any takeover fails to comply with these provisions, it will be rejected by China Securities Regulatory Commission.

Anti-Monopoly Law and Anti-Unfair Competition Law are legislated to restrain monopolistic business practices and preserve healthy market competition order. They may regulate corporate takeovers from the perspective of market control.[25] In other words, not every country has these two legislations so that they are selectively invoked as supplementary laws to resist ongoing takeovers after the consideration of Takeovers and Mergers Code and Securities Law. For instance, China promulgated Anti-Unfair Competition Law of the People's Republic of China in 1993 and Anti-Monopoly Law of the People's Republic of China in 2007. In particular, Article 10 and Article 25 of the Anti-Unfair Competition Law provide for the prohibition of trade secret infringement and related legal responsibilities correspondingly. Article 10 states that 'an operator shall not adopt any of the following means to infringe upon the trade secrets of legal owners: (1) obtaining trade secrets from legal owners by pilferage, inducement, coercion or other illegitimate means; (2) disclosing, using or allowing others to use the trade secrets of legal owners obtained by the means mentioned in the preceding item; (3) disclosing, using or allowing others to use the trade secrets that it has obtained by breaking an engagement or disregarding the requirements of legal owners to preserve the trade secrets'. Article 25 states that 'where any party infringes upon trade secrets in violation of Article 10, the relevant supervision and inspection authority shall order to stop the offense and may, according to circumstances, fine amount from more than RMB 10,000 to less than RMB 200,000'. In contrast, Chapter 4

[24] Shang Ming, *Merger Control in EU and Several Member States—Legislation & Enforcement Practice*, Law Press China, Beijing, China, 2008, p. 111.

[25] Zhan Hao, *Merger and Acquisition Practice under Antimonopoly Law*, Law Press China, Beijing, China, 2008, p. 85.

of the Anti-Monopoly Law regulates the concentration of undertakings. Especially, Article 22 in Chapter 4 provides for the circumstances under which a concentration may not be declared to the anti-monopoly authority under the State Council, i.e. '(1) one business operator who is a party to the concentration has the power to exercise more than half the voting rights of every other business operator, whether of the equity or the assets; or (2) one business operator who is not a party to the concentration has the power to exercise more than half the voting rights of every business operator concerned, whether of the equity or the assets'. When a corporate takeover occurs in China, the target company may invoke these provisions together with the above-mentioned provisions in Securities Law to conduct a comprehensive defence, while the ultimate effects are preferred accordingly.

Likewise, the Malaysian government promulgated Competition Act in 2010, of which Section 10 and Section 40 particularly provide for the abuse of a dominant position and finding of an infringement respectively. Subsection (2) of the Section 10 states that 'an abuse of a dominant position may include (a) directly or indirectly imposing unfair purchase or selling price or other unfair trading condition on any supplier or customer; (b) limiting or controlling production, market outlets or market access, technical or technological development, or investment to the prejudice of consumers; (c) refusing to supply to a particular enterprise or group or category of enterprises; (d) applying different conditions to equivalent transactions with other trading parties; (e) making the conclusion of contract subject to acceptance by other parties of supplementary conditions which by their nature or according to commercial usage have no connection with the subject matter of the contract; (f) any predatory behavior towards competitors; or (g) buying up a scarce supply of intermediate goods or resources required by a competitor, in circumstances where the enterprise in a dominant position does not have a reasonable commercial justification for buying up the intermediate goods or resources to meet its own needs.' Furthermore, Subsection (1) of the Section 40 states that 'if the Competition Commission determines that there is an infringement of a prohibition under Section 10, it (a) shall require that the infringement to be ceased immediately; (b) may specify steps which are required to be taken by the infringing enterprise, which appear to the Commission to be appropriate for bringing the infringement to an end; (c) may impose a financial penalty; or (d) may give any other direction as it deems appropriate.'

It is noteworthy that the above-mentioned Chinese and Malaysian laws provide for takeover defences from both perspectives of public tender offer and monopolistic market competition. Yet neither China nor Malaysia has a specialized law exclusively regulating defensive tactics against takeovers from the perspective of shareholder protection. Thus the defensive instruments are still inadequate for corporate adoption in both countries, while the defensive effects need to be further enhanced.

(5) Instituting Legal Proceedings

In order to resist the ongoing takeovers, target companies are frequently desperate to sue acquiring companies in court without considering any further trial outcome. It can bring a number of favorable remedies for the target companies.[26]

[26] Pang Shoulin, Qiu Ming and Lin Guang, *Corporate Merger and Acquisition Management,* Tsinghua University Press, Beijing, China, February 2008, p. 213.

Firstly, instituting legal proceedings can defer takeovers to gain more time for target companies commencing anti-takeover strategies. In the meantime it can encourage other competitors as 'white knights' to launch friendly takeovers. Secondly, instituting legal proceedings can revive the morale of target managements, and the target shareholders may calmly hold their stocks and sit on a fence. Thirdly, instituting legal proceedings may impel the acquiring companies to increase their offer prices even reluctantly so that the target companies can receive more takeover compensation. Fourthly, instituting legal proceedings may coerce the acquiring companies to give up their takeovers halfway. Owing to the lawsuits are highly time and money consuming, the acquiring companies may reconsider whether it is worthy to further their ongoing takeovers.

It is worth mentioning that there is usually a period of time from instituting legal proceedings to investigating and hearing the case. The target company may utilize such period to engage experts conducting specific review and analysis on the acquiring company's takeover conditions, credit standing and respectability, operating conditions as well as post-takeover management and improvement. This to a large extent assists the target company to carefully select effective defensive tactics in response to the ongoing takeover. Take the US as an example, once the target companies institute legal proceedings, the acquiring companies shall not further their takeovers unilaterally unless they get the official approval from the US Federal Trade Commission.

Generally speaking, both anticipatory and responsive tactics compose a structural defence mechanism to increase legal obstacles for a prospective acquiror. They need the joint approval from target shareholders, and may generate a long-term impact on the further operation of a target company. A successful defensive tactic will maximize the target shareholder value, and requires the dedication and hard work from the target board and management under intense scrutiny and great pressure.

3. CORPORATE TAKEOVER DEFENCES IN CHINA

Since 1993 when the anti-takeover campaign was kicked off in China with the groundbreaking case of Shenzhen Baoan Group Co., Ltd. (Shanghai Branch) v. Shanghai Yanzhong Industrial Co., Ltd., a range of takeover defence cases occurred in succession. They badly challenge Chinese legislations, and trigger many heated academic debates. As a consequence, some direct and indirect defensive provisions were successfully legislated into corresponding Chinese laws, and they play an important role in preventing from and responding to corporate takeovers in China.

In 2005, China amended the Company Law of the People's Republic of China. Thereinto both Article 104 and Article 122 provide for the supermajority provisions as anticipatory defences. The former states that 'a resolution adopted by the general meeting of shareholders requires affirmative votes by a majority of the votes held by shareholders attending the meeting. The resolution with regards to amendment to the articles of association, increase or decrease of registered capital, merger, division or dissolution of the company or change of the form of the company requires affirmative votes by at least two-thirds of the votes held by shareholders attending the meeting.' The latter states that 'any purchase or sale of major assets within one year or provision of a security in an amount in excess of thirty percent of the total assets by a listed company shall be deliberated and determined at a general meeting of shareholders and the resolution adopted by such a meeting requires affirmative votes by shareholders representing two-thirds of the voting rights.' These two Articles jointly demonstrate that if the target management and employees hold a considerable amount of stocks of their company, it is very difficult for the acquiring company to accomplish its takeover even though it has already collected all of the remaining target stocks.

Besides, both Article 46 and Article 112 of the amended Chinese Company Law provide for the replacement of board of directors. The former states that 'the term of directors shall be prescribed by articles of association, provided that each term may not exceed three years. A director may continue to serve his post if he is re-elected upon the expiration of his term. Where a new election is not yet available upon expiration of a director's term, or the number of directors on the board is less than the quorum due to the resignation of a director within his term, such director, before the new director takes his office, shall continue the performance of his duties in accordance with laws, administrative regulations and articles of association.' The latter states that 'a meeting of board of directors may not be held unless attended by more than half of the directors. A resolution adopted by board of directors requires affirmative votes by more than half of the directors.' Under these two Articles, even if an acquiring company has purchased a sufficient amount of target shares, it cannot substantially reorganize the target board to further control the company. Whereas the majority of target directors remain the original ones, and they still hold majority voting power for the company. They can decide to increase their investments to dilute the target shares held by acquiring company, or take other measures to fend off the takeover.

Furthermore, China also amended the Securities Law of the People's Republic of China in 2005. Thereinto both Article 92 and Article 93 provide for the fair price principles. The former states that 'all the terms of acquisition as stipulated in a tender offer shall apply to all the shareholders of a target company.' The latter states that 'in the event of an acquisition by tender offer, a purchaser shall, within the period for acquisition, neither sell any share of the target company, nor buy any share of the target company by any other means that hasn't been stipulated by provisions of its tender offer or that oversteps the terms as stipulated in its tender offer.' These two Articles jointly guarantee the fair treatment to all target shareholders, especially the fair price to purchase target shares held by minority shareholders.

In order to implement the information disclosure related provisions in both 'Administration of the Takeover of Listed Companies Procedures' and 'Administration of Disclosure of Information on the Change of Shareholdings in Listed Companies Procedures', China Securities Regulatory Commission released five supporting documents in 2002. They are Guidelines for Information Disclosure Content and Format of Public Offering Company No. 15—Report on Changes in Shareholding of Listed Companies, No. 16—Report on Acquisition of Listed Companies, No. 17—Report on Tender Offer, No. 18—Report on Board of Directors of Target Company, and No. 19—Application Documents for Tender Offer Exemption. These documents on one hand impose strict information disclosure obligations upon the acquiring companies, on the other hand induce target companies, by using their own management information and experts, to disclose operating capacity of acquiring companies and provide sufficient takeover information for shareholders. Overall, these five documents highlight the principle of openness and transparency for corporate takeovers, which constitute an integral takeover information disclosure system together with the above-mentioned two Chinese laws.

In addition to the above-mentioned written provisions, many defensive tactics with fictitious names were also borrowed and adopted in China. For instance, Shenzhen Development Bank instituted shark repellent[27] provisions into its Articles of Association as the anticipatory defensive tactics against potential takeovers. Sohu swallowed a poison pill[28] to get rid of the control of APTECH. Livzon Pharmaceutical Group introduced Taitai Pharmaceutical Company Limited as a white knight[29] to fend off the hostile takeover of Topsun Group. DEEJ implemented a golden parachute[30] plan to increase the takeover cost of the acquiror. Besides, some unconventional defensive tactics with distinctive Chinese characteristics had also been created and adopted in China. For instance, the employees of Huajian Group make a collective petition to resist their company acquiring Jinan Department Store. Sisha Co., Ltd. shut out the shareholders and management of Ningxiner Co., Ltd.

It is notable that in business practice these defensive tactics are just adopted as economic regulatory instruments against corporate takeovers, which are not yet legislated into any Chinese laws so far. There are four major reasons: Firstly, these defensive tactics were merely transplanted into China in recent decades. They are relatively new for Chinese companies. Secondly, Chinese securities market is immature, and the minority shareholders' rights lack protection. Thirdly, there are numerous restrictions to the securities trading in China, and corporate anti-takeover activities lack flexibility. Fourthly, the majority of Chinese listed companies are stated-owned enterprise, and their mergers and acquisitions lack external supervision. These objective factors directly challenge the legality of existing economic defensive tactics, although they are widely adopted in various anti-takeover battles. Thus, in the future legal reform China should systematically institute these defensive tactics into relevant laws or make an independent law for these defensive tactics in favour of Chinese companies against takeovers.

4. CORPORATE TAKEOVER DEFENCES IN MALAYSIA

Since the 1980s when a landmark white knight case of Kamunting Corporation Berhad v. Muti-Purpose Holdings Berhad emerged, Malaysian companies began to adopt defensive tactics with fictitious names as important anti-takeover weapons. They cautiously drew lessons from other countries, particularly from the UK, to tackle corporate raiders, which received many affirmative feedbacks from target shareholders. In the 1990s, the adoption of these tactics became more popular in Malaysia. The relevant cases even peaked during the

[27] Shark repellent is a provision written into the articles of association of a company to make the acquiror more difficult to take control of it.

[28] Poison pill is an attempt to discourage a takeover by making it more expensive to acquire a company, or by reducing the value of the acquired business.

[29] In the anti-takeover battle, the target management prefers to merge with a friendly acquiror rather than the hostile bidder to obstruct a hostile takeover from happening. This friendly acquiror is called white knight.

[30] A golden parachute refers to a provision written into an employment agreement between a company and one of its executives, which provides the executive with a number of benefits in cash or stock if the company is acquired.

Asian Financial Crisis 1997-1998 when many mismanaged companies were badly trapped into monetary difficulties and vulnerable to potential takeovers. It is noteworthy that, in order to earn sufficient time for takeover defences during the crisis, Malaysian target companies preferred to seek friendly white knights to save themselves takeovers. As a result, the white knight became one of the most familiar and commonly-used defensive tactics in Malaysia even until now.

For instance, in the case of Eon Bank Bhd v. KSU Holdings Bhd in 2000, KSU Holdings Bhd as the white knight of May Plastic Sdn Bhd performed a corporate guarantee in the sum of 40 million ringgit in favour of Eon Bank Bhd to secure the term loan facility granted to May Plastic Sdn Bhd. In the case of Kemayan Corporation Bhd v. Affin Discount Bhd in 2002, Kemayan Corporation Bhd executed a memorandum of understanding with a white knight i.e. Ismail Bin Othman and three proprietors i.e. Duta Nilai Holdings Sdn Bhd, Mohd Razip Bin Hamzah and Haider Bin Othaman to propose a debt restructuring scheme with the injection of income generating assets.

It is worth mentioning that although the white knight played a very important role during the Asian Financial Crisis 1997-1998 in protecting Malaysian companies from unfriendly takeovers, it was just an emergency remedy measure for target companies to rescue themselves from financial difficulties, whereas it has not yet been legislated into any Malaysian laws to further regulate corporate takeovers so far. As such the same stories happen to the other defensive tactics with fictitious names, which largely challenge their legitimacy in Malaysia. Thus, similar to China, it is also very necessary for Malaysian legislators to earnestly consider the feasibilities of either instituting these defensive tactics into related laws or making an independent anti-takeover law in the future.

However, the fortunate thing is that Malaysia promulgated the Malaysian Code on Takeovers and Mergers 1998 at the end of Asian Financial Crisis. It grants certain legal space to takeover defences in Malaysia. For instance, Practice Note 2.9.3 of the Code provides for exemption if rescue operation. It states that ‘a person may apply for an exemption from an obligation under mandatory offer where the objective of a transaction is to save the financial position of an offeree whose voting shares are being acquired by an urgent rescue operation’. This Note essentially safeguards the partial adoption of white knight in Malaysia, although it is under the special circumstance of mandatory offer. Furthermore, as to the obligation of offeror in relation to offer, Section 32 of the Code provides for sales and disclosure of dealings by offeror during the offer period. It states that ‘during the offer period, the offeror or any person acting in concert with the offeror shall not dispose any voting shares of the offeree, whether by way of sale, transfer or otherwise, unless the disposal of such shares is between the offeror and persons acting in concert with him’. By imposing information disclosure obligation upon the offeror, Section 32 ensures the offeree to choose and conduct a proper defensive tactic during the offer period.

In addition, as to the director’s power to engage in defensive tactics, Section 33A(5)(d) of the Malaysian Securities Commission Act 1993 imposes a duty on Securities Commission to ensure that the directors of both acquiring and target companies act in good faith when responding to, or making recommendations with respect to a takeover offer. Accordingly, the directors of target companies should ensure that the shareholders have adequate opportunities to evaluate the offer made for their shares and to consider any alternative or better one. Moreover, Section 34A of the Act also provides for the rights of minority shareholders in anti-takeover process. Particularly, Subsection (2) of the Section 34A states that 'within one month before the end of offer period, the offeror shall give any shareholder who has not accepted the takeover offer, notice in the manner prescribed under the Malaysian Code on Takeovers and Mergers of the right that are exercisable by him and, if the notice is given before the end of offer period, it shall state that the takeover offer is still open for acceptance'. This Section ensures the minority shareholders to exercise their rights to takeover defence during the offer period.

Another significant adoption of anti-takeover tactics in Malaysia is share repurchase. It can ensure the target shares are properly valued in the market to reduce the attractiveness of the company as a takeover target. In Malaysia, share repurchase is under the regulation of Section 67A of the Companies Act 1965. It allows a public company with a share capital to purchase its own shares if so authorized by its articles. Especially, Subsection (2) of the Section 67A provides the terms and conditions of share repurchase. It states that 'a company shall not purchase its own shares unless it is solvent at the date of the purchase and will not become insolvent by incurring the debts involved in the obligation to pay for the shares so purchased; or the purchase is made through the Stock Exchange on which the shares of the company are quoted and in accordance with the relevant rules of the Stock Exchange; or the purchase is made in good faith and in the interest of the company.' It to some extent grants the legitimacy of share repurchase defence for target companies in Malaysia. Once the target companies have acquired a certain number of shares, such shares are no longer available for the hostile bidders to purchase.

Although the above Malaysian laws endow the takeover defences with certain legitimacy, there are also some restrictive provisions keeping the target companies from abusing their power. For instance, Section 35 of the Malaysian Code on Takeovers and Mergers 1998 prohibits frustration of offers by the target board, including by means of issues of shares, issues or granting of options over unissued shares, and sales or disposals of assets of the target company of a material amount. Accordingly, the target board shall not take any action that would result in the frustration of a takeover bid, either during the course of an offer or even before the date of an offer. If a bona fide offer is imminent, the target board shall not conduct any takeover defence to protect management at the expense of their shareholders. Thus, it is very important for the Malaysian laws to properly balance the duty of directors to pursue transactions in the interests of company and the right of shareholders to frustrate the takeover bid. As such the Securities Commission of Malaysia published a public consultation paper in March 2010 to propose the fair and reasonable takeover offer in favour of the shareholders making an informed decision. It is expected that in the future there will be more applicable rules legislated for the takeover bid to protect the shareholders' rights and maximize the shareholders' interests in the takeover battle.

5. **CONCLUSION**

Under the negative impact of corporate takeovers, both Chinese and Malaysian companies have taken a variety of anticipatory and responsive defensive tactics. It is however noteworthy that their existing laws do not confer any legitimacy on corporate anti-takeover right. There is even no clear definition for it in their academic circles so far. Accordingly, it is suggested that both Chinese and Malaysian legislators should consider the following issues as references:

Firstly, the target shareholders should dominate the ultimate anti-takeover right. It is known to all that shareholders are the investors and owners of the company, and they have undoubtful rights to vote for any major issue in corporate governance through the shareholder meeting. Secondly, the target board should also be granted appropriate anti-takeover right. As the corporate management agency and business executive body, board of directors not only has the right to propose a proper defensive tactic in face of a takeover, but also has the right to implement a responsive resolution approved by shareholders in advance. Thirdly, the target board should not abuse its power for a takeover defence. In the anti-takeover process, directors always sit in a dilemma to balance the interests between individuals and company. It is very important for the board of directors to cautiously exercise its anti-takeover right in accordance with the authorization of shareholder meeting in favor of the interests of all involved parties. Fourthly, the practice of corporate anti-takeover right should subject to specific conditions and procedures. For instance, (a) the acquiring company should make a tender offer to the target company; (b) the target board should send a written report to shareholders in terms of the tender offer; (c) the target board should issue a notice to convene an extraordinary general meeting; (d) the meeting should make a resolution on whether accept or reject the takeover; (e) the resolution should only be passed through more than two-thirds of the shareholders who attended the meeting; (f) and the resolution should be recorded into the meeting minutes. Fifthly, the legislative bodies should improve existing laws to regulate corporate anti-takeover right. It requires the laws to enhance the decision-making power of shareholders—particularly the minority shareholders, strengthen the fiduciary duty of directors, improve the incentive for corporate management, and build up the system for shareholder litigation.

Generally speaking, although the adoptions of defensive tactics are different between China and Malaysia, they follow some basic guiding principles in common, i.e. the legitimacy of defence procedures, disclosure of sufficient information, equal treatment of shareholders, restriction of management conducting takeover defences, maximization of shareholders' value, etc. These principles are usually considered as the universal measurement criteria to propose fair and reasonable takeover bids for target companies so that the interests between acquiror and acquiree, directors and shareholders, as well as company and society can be well reconciled in the takeover process.

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The SmartBalances Approach toward Strategic Sustainability

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ABSTRACT

This paper proposes a complementary approach to comprehensive development programs, dubbed the SmartBalances Approach, for a sophisticated urban system that aims at creating, enhancing, and sustaining values for its changing population profiles, economic activities, social diversity, and ecological compatibility in an optimally balanced way. The primary reason for this approach is to enable policymakers in major cities across developing countries around the globe to reap full benefits from their infrastructural investments, built environments, special economic zones, and industrial clusters through maximum utilization by their residents, workforce, businesses, and planners subject to their attitudes, behavior, culture, and decisions without sacrificing short-term performance and long-term sustainability. The approach suggests three practical procedures, each with three corresponding deployable activities.

Key Words: urban development, public-policy decisions and administration, value creation, growth enhancement, balanced sustainability, competitive strategy, change-management framework

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Introduction

What is meant by the term "sustainable growth" could be controversial from different perspectives. In this paper, its contextual definition refers to "a set of an urban system's capabilities to replicate, accelerate, leverage, enhance, renew, its values from all available resources while balancing natural and man-made environments in the most efficient (cheapest and speediest), effective (maximum growth and minimum risk), and effortless (maximum flexibility and minimum intervention) manner." If adopted, this definition and its concrete description can be addressed through the following composite goals, complementary approaches, practical procedures, and deployable activities.

Sustainable-growth Goals

This paper based its treatise on general discussions with city planners and administrators in China to probe their policy requirements and implementation approaches, which culminated in the following four strategic interests and objectives:

1) Planning/managing/governing/reforming public policies to cope with asymmetric *demographical patterns* (e.g., aging concentration and middle-class distribution) and deal with uneven *population flows* (e.g., rural migration and brain-drains) within a city and across regional urban hubs for a **demographically sustainable growth**;
2) Accelerating/revitalizing *businesses* in high strategic-impact industries (e.g., high-tech-good production and high-touch-service provision) and attracting/retaining *capital* for high strategic-value investments (e.g., upstream product/process designs and downstream marketing/logistics) for an **economically sustainable growth**;
3) Empowering productive/skillful/talented *human resources* (with value-added capability and service-mindedness), enriching knowledge-based *communities* (with intelligence and intellectual maturity), and encouraging creative/ innovative *cultural exchanges* (with emotional and moral maturity) for a **socially sustainable growth**; and
4) Developing/improving/enhancing *built environments* (e.g., structural complexes and infrastructural systems) with advanced technologies for the city's livability and conserving/diversifying/enlarging *natural environments* (e.g., land reserves and water resources) with know-how for the city's longevity for an **ecologically sustainable growth**.

The SmartBalances Approach

Following the multidimensional goals outlined above, most city planners and administrators would be keen to know what kind of strategies on which they should focus their resources, efforts, and time in order to maximize their city infrastructural utilization performance and impacts on its demographic, economic, social, and ecological sustainable growth. They could resort to strategic development approaches practiced by successful city managers in various countries or recommended by some influential consulting firms. This section proposes an alternative strategy called **SmartBalances** to city planners by generally comparing it with conventional ones.

Conventional approaches to development in any area usually make certain assumptions about the natures and behavior of their input variables that are identified, specified, and included in their analytical models and decisional frameworks. Needless to say, for instance, a simple economic approach determines short-run local equilibrium price levels of some homogeneous goods or services from the rationally competitive market's or the centrally planned exchange's interactions between quantity demanded by utility-maximizing consumers and quantity supplied by profit-maximizing producers. In a more sophisticated system driven by urbanization, digitization, and globalization, however, such simplified assumptions as equilibrium, homogeneity, interactions, utility maximization, and profit maximization do not adequately represent the true conditions exposed to and empirical circumstances experienced by its participants, i.e., consumers, producers, intermediaries, policy-makers, societies, and environs. Yet, various economic decisions have been rationalized by observed/expected equilibrium prices or optimized based upon planned/targeted quantities that carry with them several value indicators and implications. Whether or not those rational or optimal decisions are considered *smart* decisions still depends on the objectives (visions), operations (missions), outputs (results), and outcomes (impacts) of the development within and beyond a dynamic setting.

The SmartBalances approach recognizes that although market prices (i.e., monetary values of resources, inputs, processes, outputs, or logistics) are necessary for minimizing transactions cost and time, they are not a sufficient condition on which a more sophisticated system that comprises such unique items as customized goods, tailored services, engineered asset classes, and intellectual properties would base, since demanders and suppliers of those items not only maximize their utility and profitability but also aim to incessantly expand their utility frontiers (by having more of better or newer items) and to perpetually sustain profitability growth (by raising returns and curbing risks while providing those items). Moreover, this SmartBalances approach comprises dimensions other than those within an economic framework by incorporating demographical, social, and ecological components into its key managerial functions, including situational assessment, empirical/analytical experiment, performance measurement, and strategic management. The reason why this approach deserves its "SmartBalances" label is not because of its pragmatic attempts to stabilize, harness, or restore balances among conflicting dimensions, but because of its witty efforts to embrace unpredictable flows and rides turbulent waves in the most anticipatory (first-mover) or responsive (second-mover) manner. A functional comparison between the conventional approaches and the SmartBalances one is outlined below in *Table 1*.

Table 1
Conventional Approaches vs. The SmartBalances Approach

Key Function	Conventional Approaches	The SmartBalances Approach
Situational Assessment • Exchangeable Items • Market Structures • Human Behavior	Main underlying assumptions include: • Classifiable industrial commodities or financial assets • Freely competitive markets with minimal interventions • Rational decision-making with return-risk tradeoffs	In addition to the conventional assumptions, • Customizable product/services or intellectual assets • Strategically adaptive market spaces with optimal interventions • Socio-ecological friendliness with flexibility-stability tradeoffs
Empirical Experiment • Exchanged Measures • Market-clearing Prices • Benchmarked Values	Main variables and parameters include: • Homogeneous quantity or heterogeneous quality • Demand-supply interactions or contractual agreements • Standardized currency with credible stabilizing mechanisms	In parallel with the conventional parameters, • Emotional exclusivity or multiple applicability (versatility) • Transparent dynamic adjustments or contingent negotiations • Digitized value mediums with predictably adaptive platforms
Performance Measurement • Efficiency • Effectiveness • Competitiveness	Key performance indicators (KPIs) include: • Maximum productivity/liquidity with minimum waste/loss • Maximum profitability/return with minimum severity/hazard • Maximum advantage/leverage with minimum barrier/shortfall	In complement to the conventional KPIs, • Maximum value enhancement from optimal operational agility • Maximum positive impacts from optimal managerial adaptability • Maximum competitive harmony from optimal strategic alignment
Strategic Management • Agility • Adaptability • Sustainability	Key success factors (KSFs) include: • Maximum speed/accuracy with minimum friction/error • Maximum growth/progress amid systematic disturbances • Maximum resiliency/renewability amid systemic crises	In alignment with the conventional KSFs, • Maximum managerial flexibility from optimal resource deployment • Maximum decisional latitude from optimal creative disequilibrium • Maximum strategic alignment from optimal innovative disruption

Towards the sustainable growth of a sophisticated urban system, its **comprehensive capabilities** to create smart values, enhance smart progresses, and sustain smart balances stem from 1) the *inner drives* of its members' diverging creativeness (e.g., customized styles), innovativeness (e.g., exclusive designs), or inventiveness (e.g., versatile products), 2) the *outer impetuses* of converging global trends in technological progressiveness (e.g., digital flexibility), societal consciousness (e.g., tolerance latitude), and environmental awareness (e.g., ecological alignment), and 3) the dynamic balances between the inner drives and the outer impetuses.

For a smart city to explore, experiment, and exploit its capabilities, it could implement the SmartBalances approach using the following practical procedures and their corresponding deployable activities:

1) Creating smart values incrementally from internal exchanges;
2) Enhancing smart growth continually by competitive adaptability; and
3) Sustaining smart balances perpetually through innovative disruptions.

1. Creating Smart Values from Internal Exchanges

One of the necessary conditions for value-creation in a closed economic system is multiplicative internal exchanges (turnovers) just like the multiplier's effects in the Keynesian welfare economy and the money-supply aggregation from a monetary base controlled by a central bank. The higher the turnovers of the same item being exchanged, the larger the size of a system until it incrementally reaches its diminishing limit, in which case it is non-sustainable. To sustain this turnover process, however, the SmartBalances approach goes beyond a basic multiplier mechanism by specifying desirable targets in which all turnovers along the value chain within the system are *strategically designed* (to match demanders with suppliers among the value clusters), *connectively reciprocated* (to maintain turnover momentum from value connections), and *flexibly accelerated* (to raise turnover velocity and drive value changes).

1.1. Designing Value Clusters

In order to strategically match the demand-and-supply components so that their value-creation from internal exchanges would become sustainable independently without any external intervention, we need to ensure that turnovers from the demand side is driven by collective spirits (beyond financial incentives) of individual *participations* by getting involved and being inclusive and *contributions* by sharing non-financial wealth while the supply side is derived from an optimal co-existence between built environments (i.e., static and dynamic urban infrastructure) and natural environments (i.e., adaptive cultural and ecological systems). Any imbalance that appears within or between those demand and supply sides would create opportunities for any participant involved to close the gaps by adjusting the minimum criteria governing the participant's attitudes, behavior, culture, and decisions.

To manage imbalances within the demand side, certain value clusters could be strategically designed by identifying distinct types of resources that can be dynamically contributed by distinct groups of overlapping participants. The main resource categories that can be contributed by individuals or institutions to create value within the internal-exchange system include 1) money, 2) efforts, 3) time, and 4) knowledge:

- **Money** (capital) can be contributed towards consuming, saving, funding, investing, hedging, and speculating;
- **Efforts** (labor) can be contributed towards production, provision, distribution, management, and governance;
- **Time** (commitment) can be contributed towards learning, producing, sharing, entertaining, and conserving; and
- **Knowledge** (technology) can be contributed to affect the economy, socio-cultural demography, and environment.

The proposed design of value clusters comprises four groups of overlapping participants, each with distinctive value-creating roles, namely 1) passive residents, 2) active workforce, 3) private businesses, and 4) public planners:

- **Passive Residents** representing growing communities that saved to accumulate their wealth, consumed to enjoy their quality of life, and invested to provide their funds to market and public activities could create value by exchanging what they have more (e.g., time or money) with what they have less (e.g., efforts or knowledge);
- **Active Workforce** is a growing group of learning and productive residents who have developed their talents and enhanced skills, worked to earn their income and share know-how, paid taxes to share their wealth, who could create value by exchanging their excesses (e.g., efforts or knowledge) with their shortfalls (e.g., time or money);
- **Private Businesses** are those associations, corporations, and institutions that have organized to productively employ others' resources and competitively deploy their results who could create value beyond what they do for stakeholders by exchanging their surpluses (e.g., money or knowledge) with their deficits (e.g., time or efforts).

- **Public Planners** comprising all levels of law-makers, policy-makers, governmental departments, administrative agencies, and state-owned enterprises who are charged with public mandates to protect lives and properties of all residents and businesses, preserve social orders and environmental conditions, and promote economic productivity, competitiveness, and growth could create value by exchanging their currently overarching powers to control and manipulate existing resources (money, efforts, time, and knowledge) with new capabilities (e.g., smart values, smart progresses, and smart balances) to enhance resource-deployability of different participants.

When the potential ability to contribute four types of generic resources are combined with the voluntary willingness of the four value clusters to partake in the reciprocal exchanges, their matrix reveals several possibilities for the demand-side system to create values incrementally as shown in in *Table 2* below.

Table 2
Resource Contributions vs. Value-cluster Participations

Value Cluster / **Resource**	Passive Residents	Active Workforce	Private Businesses	Public Planners
Money or Capital	Saved	Earned	Borrowed	Collected
Efforts or Labor	Dependent	Independent	Intensive	Extensive
Time or Commitment	Non-committal	Contractual	Committal	Indefinite
Knowledge or Technology	Standardized	Specialized	Innovative	Conventional

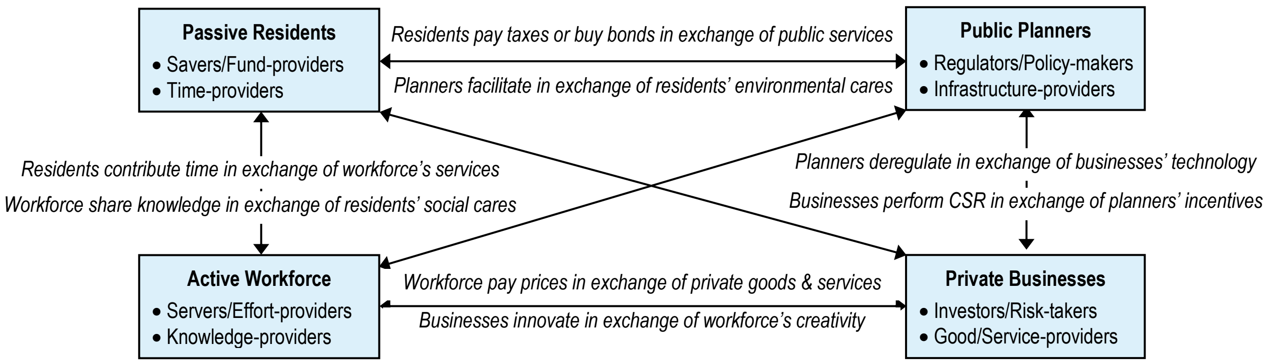
Since each value cluster could uniquely contribute its four types of resource toward the rest, opportunities for internal exchanges exist to create values beyond monetary prices determined in the marketplace. For instance, the passive-resident cluster could directly exchange its excess time availability (e.g., to assist in quality-assurance or monitoring-governance activities) with either excess specialized know-how from the active-workforce cluster or excess innovative technology from the private-business cluster that has less time to spend on its non-economic activities. In today's reality, MOOCs' (massive open online courses) higher-educational accessibility, *Uber*'s on-demand city transport services, and *Airbnb*'s cross-border residential swaps are good examples of direct value-creating exchanges made possible by social-networking technology. Bundling it with the strategically designed value clusters would allow the multiplier effects to work without a confinement of the conventional markets.

To make such non-market internal exchanges possible, the public-planner cluster that aims to collect taxes must compare the incremental values generated from those direct transactions with the costs of budgetary expenditure to create equivalent values. Money collected from direct-exchange transaction taxes must be "measured" but "exempted" to provide adequate incentives for values to be sustainably created beyond the law of diminishing return. Another way to see the merits of this value-cluster internal exchange is that it effectively raises the return on efforts, time, or knowledge vis-à-vis the return on money (e.g., from lending or renting capital resources).

1.2. Reciprocating Value Connectivity

Once the non-monetary exchanges among different value clusters are allowed, their value-chain connectivity would be possible and could be established. The following diagram (*Figure 1*) shows six two-way connections between a pair of value clusters.

Figure 1. Value Chain Connectivity



Conventionally, the passive-resident cluster also pays prices to the private-business cluster to obtain its goods and services just like what the active-workforce cluster does. With more time to spend, the residents could reciprocate the businesses' *corporate social responsibility* (CSR) programs by assisting them in their *corporate environmental responsibility* (CER) programs along with other ecologically related programs initiated by the public planners. For example, an eco-tourism with appropriate incentives (e.g., breakeven-priced hotel accommodations) in exchange of multiday tree-planting and social-gathering activities can be seasonally promoted in the city's annual calendars.

For junior learners (i.e., members of the passive-resident cluster) who are still in their school years for academic or vocational training, the private-business cluster can contribute by allowing them to obtain practical exposures to enhance their professional or entrepreneurial experiences whereas the public-planner cluster can enrich their social and environmental awareness through the city's formal educational system in addition to developing their livelihood skills and productive talents.

In essence, the management of value-chain connectivity is a process of exploring, experimenting, and exploiting all possible channels of internal exchange that would keep value turnovers going without losing their multiplier effects. In other words, any value leakage from the conventional value chain shall be absorbed and then recycled by all the value clusters back into the system. Once again, their non-market values must be measured although untaxed.

1.3. Accelerating Value Changes

The third phase of smart-value creation through strategically designed and connected value clusters is to accelerate a change in value from the internal-exchange process discussed above. This would require selective interventions by the public-planner cluster to *optimize the infrastructural utilization* based on the internal upgrading of its current authority to control and manipulate resources towards its new capabilities to enhance values and manage their impacts. The city's infrastructural utilization can optimized by changing the weights (importance or priority) applied to different public-policy measures and practices subject to set the minimum criteria on *attitudes, behavior, culture, and decisions* (ABCD) that are specified for each value cluster being strategically designed and connectively reciprocated. *Table 3* demonstrates how such an optimization framework can be preliminarily formulated although its actual implementation processes have yet to be further defined and refined.

The optimized infrastructural utilization would affect the co-existence between the built and natural environments. For example, the city's optimally reprioritized land-use policy subject to its value-clusters' ABCD would lead to a new balance between all three types of infrastructural projects and its existing natural ecosystem. However, suboptimal land utilization that fails to meet the minimum ABCD threshold would decelerate value changes rather than accelerate them.

Table 3. Infrastructural-utilization Optimization Subject to the ABCD Criteria for Value Clusters

Project / Criteria	Social Infrastructure (SI)	Logistical Infrastructure (LI)	Ecological Infrastructure (EI)
Attitudes	• Economic value should help promote demographical, social, ecological values.	• Economic, demographical, social, ecological flows should complement one another.	• Built environment and natural ecosystem should co-exist to reinforce one another.
Behavior	• Each value cluster initiates its internal exchange with others across SI projects.	• Each value cluster utilizes LI networks to routinely perform its quadruple activities.	• Each value cluster organizes activities (e.g., smart tourism) to balance SI & LI with EI.
Culture	• All value clusters agree to collect and disclose their internal-exchange data.	• All value clusters agree to implement the best practice on how to utilize LI networks.	• All value clusters agree to re-allocate their resources from SI and LI to EI projects.
Decisions	• Value-adding exchanges in SI are kept; value-reducing ones are dropped.	• Well-behaved LI practices are incentivized; misbehaved ones are restrained or retrained.	• Effective EI activities are further promoted; ineffective ones are gradually withdrawn.

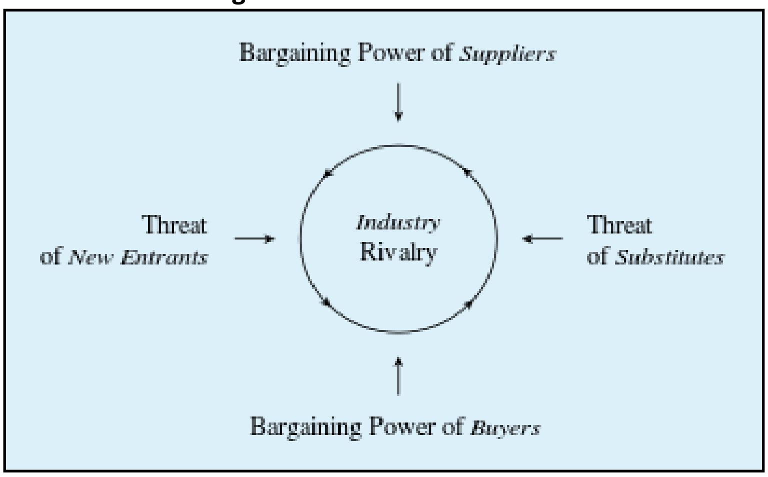
2. Enhancing Smart Growth by Competitive Adaptability

Following the value-creating clusters, value-connecting reciprocity, and value-changing acceleration in the first procedure of the SmartBalances approach, its second one calls for a smart way to continually enhance value growth. Conventionally, an annual change in the value of macroeconomic outputs is measured by an inflation-adjusted GDP-growth measure that is driven by private consumption, private investment, public spending, and net export. For a smart urban system, however, its value-growth enhancement is driven by a city's unique capabilities to *manage competitive conditions* based on its agile managerial flexibility, *promote external adaptability* through its decisional latitude, and *exploit creative disequilibria* to better deal or cope with frequent systemic disturbances.

2.1. Managing Competitive Conditions

Michael E. Porter (1980) describes how a firm's future strategic choices can lead to its unique competitive advantages based on its current position amid five forces: 1) strengths and weaknesses vis-à-vis its direct competitors within the same industry, 2) bargaining power over its upstream suppliers, 3) bargaining power over its downstream customers, 4) opportunities and threats from new challengers, and 5) opportunities and threats from substitute products or services (*Figure 2*). The resultant generic competitive strategies include price-based advantage from economies of scale, quality-based advantage from economies of scope, and segment-based advantage from commanding underserved markets. Nevertheless, such a competitive-strategy model assumes that the firm reacts to the industrial structures that are stably dynamic (less frequent changes) and market conditions that are relatively predictable (few sudden changes). When either the industrial structures or the market conditions are neither stable nor predictable, the firm's optimal strategic positions would never be sustainable.

Figure 2. Porter's Five Forces



An ideal way to make a city competitive is to change the conditions underlying any one of those five external forces in the city's favor so that its strategic position on the value chain remains dynamically advantageous at all times. For an existing city with rigid structures or restrictive conditions, the induced changes would be either very costly or strategically ineffectual. For a newly built city, however, some crucial conditions can be managed to influence such external forces thereby changing its strategic position to achieve it competitive advantages. The role of the public-planner cluster would then be highly important in this competitive-condition management exercise as it could selectively change the bargaining powers of some upstream or downstream participants as well as manipulate the participants' entry or exit barriers through legal and regulatory modifications (i.e., deregulation and reregulation).

2.2. Promoting External Adaptability

The *Reform and Opening-up Policy* of China that was first implemented in 1978 is one of the good examples of how a developing country is prepared to embrace dynamic forces from both domestic and international sources and learn how to adapt towards them accordingly (strategically and competitively). Unlike the ideal way to manage the competitive conditions in favor of the city mentioned above, the way to promote adaptability such as managerial and decisional latitudes to deal or cope with external changes seems to be a more practical approach. If proactively managing competitive conditions were akin to the "first-mover advantage," concurrently promoting external adaptability should have been considered as the "co-mover advantage" rather than being treated as the "second-mover advantage" in which generic competitive strategies are reactive towards the five external forces prescribed by Porter.

The key for an urban system to become externally adaptive is to know how to deal with frequent disequilibria so that all of its value clusters are able to either exploit any external imbalance as it occurs to enhance its value growth or avoid committing any strategic error that could potentially slow the growth down. Sensitivity, scenario, simulation, and stress-testing analyses are among the proven strategic exercises that the public-planner cluster should regularly perform, just like what all aviators and pilots are required to train in the simulators before flying their real airplanes.

2.3. Exploiting Creative Disequilibria

In spite of the differences in their approaches, both managing competitive conditions and promoting external adaptability are not mutually exclusive; they could be combined for a purpose to smartly enhance value growth for an urban setting. The tasks of managing competitive conditions should fall upon the public-planner cluster while those of promoting external adaptability should be assumed by the private-business cluster, with the passive-resident and active-workforce clusters being the ones whose ABCD would be altered along with structural changes and external shifts.

A disequilibrium that happens in the urban system should be more welcome than rejected as there always exist opportunities for improvement and growth from a current status quo. Fear of losses or frustration about risks could be lessened when all plans to manage competitive conditions, promote external adaptability, and encourage ABCD changes have been clearly laid out into which all participants could contribute their creativity, and all courses of actions have been monitored and charged to those who are accountable. For example, a demographical influx undoubtedly results in different scenarios of disequilibrium. While a given infrastructural project is expected to handle, say, double the population density on the city's current level, the challenges lie in how each disequilibrium scenario could be exploited in such a way that the infrastructural utilization is still optimized and the incremental value derived from new migrants outweighs its costs and risks. This exercise necessitates constant data analyses performed on the interactions between predicted scenarios and creative strategies to exploit any ensuing opportunity or mitigating any emerging threat with the highest standards of strategic governance, managerial transparency, and decisional accountability.

3. **Sustaining Smart Balances through Innovative Disruptions**

The third practical procedure of the SmartBalances approach deals with how a city could sustain the smart growth derived from the smart values to be created within its infrastructural projects. Referred to *Table 1* above, the key function of strategic management for an urban system to achieve its agility, adaptability, and sustainability as the outcomes requires a measurement of success, i.e., the *key success factors* (KSFs), in both the conventional and SmartBalances approaches. In the conventional approaches, while the agility factor that is measured by a maximum speed of value changes with minimum friction is under the domain of the first procedure and the adaptability factor that is measured by a maximum progress of value growth amid systematic disturbances is instrumental in the second procedure, the sustainability factor that is measured by a maximum resiliency of the urban system to restore the balances among all of its four parameters (demographic, economic, social, and ecological) falls under this third procedure. Despite their merits towards any general urban system, they still seem to be inadequate to address specific issues (e.g., non-monetary internal exchanges, competitive external adaptability, and innovative strategic disruptions) of the more comprehensively sophisticated one.

The SmartBalances approach enhances upon the conventional ones by extending the KSFs by recognizing that 1) the maximum value-change cannot be accelerated without a corresponding maximum operational flexibility based on resource-deployment optimization, 2) the maximum value-growth cannot be enhanced without a corresponding maximum managerial/decisional latitudes based on creative-disequilibrium optimization, and 3) the maximum value-balance cannot be sustained without a corresponding maximum strategic alignments based on innovative-disruption optimization. Hence, in order for the city to fully utilize this SmartBalances approach, it needs to *develop resiliency and renewability* amid systemic crises and then learn how to *master strategic alignment* so that it could *innovatively harness crises and fabricate disruptions* that may unexpectedly arise.

3.1. Developing Resiliency and Renewability

A mundane way of economic development focuses on productivity, profitability, growth, and stability along its developmental process with less attention towards its impacts on the society and the environment as they have been treated as externalities. When those foci are expanded to include social and environmental issues, questions have arisen as to how the performance of a social and an environmental setting is measured in a similar fashion to that of an economic setting. The measures of *social resiliency* and of *environmental renewability* are proposed to quantify their values resulting from the impacts of those economic-performance measures. The arguments are that since positive economic performance often leads to negative social performance (e.g., income disparities, wealth inequalities, and illegal activities) as well as negative environment performance (e.g.., resource depletion and industrial pollution), social resiliency that represents the capability of a community to withstand and counteract the economic impacts and environmental renewability that represents the capability of an ecosystem to rejuvenate at a faster rate than its decay rate are more appropriate than measuring their upside performance.

An urban system can develop its social resiliency and environmental renewability along with its economic prosperity by engaging the passive-resident and active-workforce value clusters into the overall value chains that take into account the socially and environmentally exchanged transactions. As mentioned under the first practical procedure, resources contributed by those two value clusters would be measured, recognized, retained, and ploughed back into the urban system in a more transparent and accountable way while they are being reciprocated or incentivized by the private-business and the public-planner value clusters. With adequate data observed and collected on social and environmental activities, the measurement of social resiliency and environmental renewability can be analyzed and derived with ease. Without the SmartBalances approach and the strategic design of value clusters, it would be more difficult to measure, let alone develop, social and environmental capabilities that are essential to the sustainability of the whole city.

3.2. Mastering Strategic Alignments

In 1980, Waterman, Peters, and Phillips jointly developed their *7-S Framework* for building an organization's effectiveness around dynamic alignments among resources and processes to reinforce its strategic impacts on its future performance. Such a generic change-management framework could be applied to any urban system for its sustainability. It involves six elements, i.e., strategy, structure, system, style, staff, and skill to achieve a set of shared values (the seventh element) that cuts across all of them. The definitions of 7-S elements are shown in *Table 4*.

Table 4. Definitions of the 7-S Elements

1) **Strategy for Sustainability**	The plans to create, grow, and sustain quadruple urban values in demographic, economic, social, and ecological areas amid frequent systematic disturbances or occasional systemic crises.
2) **Structure for Efficiency**	The designs of the urban system to fairly and efficiently allocate resources among its value clusters in order to grow with public confidence and be managed by best governance practices.
3) **System for Efficacy**	The interrelated activities and contingencies that effectively and effortlessly integrate innovative and prudential tasks to optimize resource utilization with creative and ethical people to drive sustainable growth.
4) **Style of Leadership**	The decision-making approaches of urban-leadership best practice to be adopted so as to incentivize value clusters, deal with expected disturbances creatively, and cope with unexpected crises innovatively.
5) **Staff Engagement**	The sharing attitudes, transparent behavior, accountability-based culture, and entrepreneurial decisions of all urban members to create and enhance values for growth while sustaining their ethically prudential impacts.
6) **Skill on Technology**	The competency, dexterity, and talents of each and every value-cluster member to utilize/employ and mobilize/deploy relevant technologies to innovate value-adding capabilities while being vigilant toward risks.
7) **Shared Value**	The core urban values being transformed into best practices that encompass all value clusters' attitudes, behavior, culture, and decisions that would lead the urban system to its sustainable growth.

Those 7-S elements can further be grouped into 1) the task-oriented hard elements as the city's infrastructure consisting of strategy, structure, and system and 2) the people-oriented soft elements as the city's ultrastructure comprising style, staff, and skill. The shared value is what both groups and their interactions are aligning among themselves to achieve. In relation to the SmartBalances approach, the hard-element infrastructure is comparable to its infrastructural projects, the soft-element ultrastructure is mapped upon its value clusters' ABCD minimum criteria, and the shared value are earmarked by the four parameters' sustainable growth targets.

Table 5. Mastering Strategic Alignments within a Dynamic Urban System

Infrastructure / **Ultrastructure**		Task-oriented Hard Elements		
		Strategy for Sustainability	Structure for Efficiency	System for Efficacy
People-oriented Soft Elements	Style of Leadership	Adoption of a growth-driven (smart) strategy by leaders whose style is to direct and steer urban innovations to leverage productive internal strengths while exploiting untapped external opportunities.	Design of a flexible decisional (smart) structure for a leadership style that promotes sustainable interactions among value clusters, built- and natural environs to achieve dynamic balances.	Utilization of a self-correcting (smart) system for leaders to encourage free and fair competition that favors urban discipline and transparency over rigid regulation and intrusive supervision.
	Staff Engagement	Employment of expert personnel who are engaged in designing, developing, and delivering products or services that not only add and accelerate values but also are easily deployable by all value clusters.	Specialization of each value cluster that encourages its members to share their know-how about the unique features and constructs of urban innovations in terms of costs, returns, and risks.	Creation of non-monetary (smart) incentive system to induce value clusters to perform their utmost in designing and disclosing their urban innovations to derive values and drive growth.
	Skill on Technology	Deployment of proprietary (smart) skills so that all value clusters can utilize such technologies as product/service designs, marketing communications, and supply-chain/customer-relation management to enhance values and withstand crises.	Funding for a self-enhancing (smart) structure by the city that invests in strategic-research programs toward urban innovations along with relevant skills that are commercially viable and conducive to growth.	Formation of a smart exchange system that promotes fair and active trading of sound value-creating activities and their urban intelligence among all value clusters to ensure a healthy competition and a robust systemic stability.

Adapting the 7-S Framework to achieve such a shared value requires an alignment among the four factors that are identifiable with one or more hard and soft elements. When the people-oriented ultrastructure are constrained, the task-oriented infrastructure can be optimized, and vice versa. For instance, the city could focus on structure and skill in order to boost latitude in the public-planning cluster, on system and style to increase fairness in the private-business cluster, on strategy and staff to bolster competition in the passive-resident and active-workforce clusters, and on style and staff to enhance transparency throughout the whole urban system.

3.3. Harnessing Crises vs. Fabricating Disruptions

The last deployable activity under this SmartBalances approach involves the way in which an urban system could either 1) harness any unexpected crisis whenever it occurs or 2) fabricate systemic disruptions before any crisis arises. To be prepared to harness the crises on the one hand, a city takes a reactive mode to analyze multiple patterns of past disruptive situations and utilizes a responsive method to adjust its future actions when engaging actual disruptions. To be equipped to fabricate the crises on the other hand, the city employs a proactive mode of assessing the likelihoods of future disruptions and deploys an anticipatory method to align its current strategies to engage different outcomes of fabricated disruptions. By practicing both crisis-handling modes, the city could be more alert to embrace both types of systemic disruptions that may arise in the least expected moment.

The difference between those two modes is underscored in five contexts, namely 1) the nature of crisis situations, 2) the structure of urban markets, 3) the approach of regulatory interventions, 4) the arrangement of urban institutions, and 5) the adaptability of urban members' ABCD, as shown in *Table 6* below.

Table 6. Harnessing Crises Innovatively vs. Fabricating Innovative Disruptions

Context \ Strategy	Harnessing Crises Innovatively	Fabricating Innovative Disruptions
Crisis Situational Nature	Unexpected but with observable past patterns to benchmark on	Fabricated from plausible stress-test simulation scenarios
Urban Market Structure	Low entry-exit barriers to compete within and across markets	Lower transactional and operational frictions relative to others
Regulatory Intervention	Automatic interventions to restore normalcy after disruptions	Strategic interventions designed to fit expected abnormalities
Institutional Arrangement	Fragmented but coordinated to freely pursue agreed targets	Clustered and empowered to jointly achieve focused targets
ABCD Adaptability	Less predictable due to low transparency and accountability	Predictable due to better incentive and governance systems

To innovatively harness crises with smart experiences, the city should draw from vast empirical data of other cities in China or foreign countries that had gone through tough times, and then design innovative actions that could respond best to actual crises as though they really happened to the city. Sometimes, such innovative reactions are proven to yield better sustainable growth under certain disruptive situations. This crisis-harnessing mode is akin to buying a contingent claim (e.g., option) that allows its holder to either exercise the locked-in action when the future situation turns out to be favorable or abandon that locked-in action when the future situation becomes unfavorable.

To innovatively fabricate disruptions with a smart foresight, the city could perform "stress-test" simulations that generate crisis scenarios and then experiment on them using innovative strategies to detect the best-fit ones in containing systemic losses while still maintaining its sustainable-growth path. This crisis-fabricating mode is similar to the preemptive-strike strategy to exploit the elements of surprise and seize the first-mover advantage, or to the money-market hedging to lock-in future outcomes by discounting future foreign obligations at foreign interest rates, converting them at today's exchange rates, and then compounding them at domestic interest rates.

Considering their strengths and weaknesses, each mode carries different aspects of pros and cons. On their positive side, the crisis-harnessing mode has data-availability and action-adjustment as its advantages whereas the crisis-fabricating mode has quantitative-analytic and strategic-alignment as its advantages. On their negative side, the time-lagging and flexibility-lacking disadvantages belong to the crisis-harnessing mode while the erroneous-assumption and costly-commitment disadvantages can be attributed to the crisis-fabricating mode.

Conclusion

This paper started by stating the general strategic interests of city planners and administrators to pursue and achieve their city's sustainable growth in four areas (demographic, economic, social, and ecological), which are used as the main contextual parameters, and proposing that the appropriate definition of sustainable growth in the city's context should be its comprehensive capabilities to replicate, accelerate, leverage, enhance, and renew all of its available resources (money, efforts, time, and knowledge) in such a way that they lead to an efficient utilization of its infrastructural projects, an effective value creation and growth enhancement within the city, and an effortless sustainability to balance values among those four parameters. Based on such a pretext, the realistic multi-faceted goals for the city to establish in order to determine its proper strategies and courses of actions should be in terms of optimizing its short-term infrastructural utilization and balancing its long-term sustainable growth.

The paper further proposed the *SmartBalances* approach as a complementary strategic-planning-and-implementation framework to the conventional ones, which includes three practical procedures and nine deployable activities. Although the scope and parameters of this proposed framework have been well-defined, its detailed initiatives have yet to be continually discussed and debated in order to crystalize the agreeable operational plans and deliverable programs.

After scrutinizing those three practical procedures, one could notice that the city's capability to create values from internal exchanges (the first procedure) can be adopted and implemented by the city as it is able to design those value clusters that can generate, reciprocate, and accelerate values in its own right. However, the additional capabilities to enhance value-growth in a competitively adaptable manner (the second procedure) and to sustain value-balances in an innovatively disruptive fashion (the third procedure) would require some knowledge-based assistance and technological expertise from the city's personnel who could provide state-of-the-art analyses and forward-looking recommendations to the city through their joint research endeavors. One can expect that the results of such collaborative efforts would allow not only the city to strive efficiently and thrive effectively but also for other growing urban systems around China and the Asia-Pacific region to similarly practice, if not better.

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A Generalized VARMA-DCC/ADCC Framework and its Application in the Black-Litterman Model - illustrated with a China Portfolio

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Abstract

The existing literature on Black-Litterman portfolio optimization model does not offer adequate guidance on how to generate investors' views in an objective manner. This paper establishes a generalized VARMA-DCC/ADCC framework that can be utilized to model multivariate financial time series in general, and produce objective views to the Black-Litterman model in particular. To test the VARMA-DCC/ADCC preconditioned Black-Litterman model's practical utility, it is applied to a ten-asset China portfolio. For the VARMA-DCC/ADCC fit, the portfolio's volatility is found persistent over time, while insensitive to the most recent shocks and the signs of the individual asset returns, which provides useful insight on portfolio performance forecast. For the Black-Litterman portfolio optimization, with a properly chosen view confidence parameter, the VARMA-DCC/ADCC preconditioned Black-Litterman model offers clear advantage on portfolio optimization over normal mean-variance optimized and market portfolios. Because the VARMA-DCC/ADCC framework improves the objectiveness of the inputs to the Black-Litterman model, its usage in the Black-Litterman model provides an automated portfolio optimization alternative approach to the classic Black-Litterman method.

JEL Classification: C32, C53, G11

Keywords: portfolio optimization, Black-Litterman, VARMA, DCC, ADCC

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A Generalized VARMA-DCC/ADCC Framework and its Application in the Black-Litterman Model - illustrated with a China Portfolio

1. Introduction

Black and Litterman (1990, 1992) establish the Black-Litterman (BL) methodology to mitigate the input-sensitive nature of the mean-variance portfolio optimization approach (Best and Grauer, 1991) by incorporating the investors' views on the future states. The original BL model assumes that, on the portfolio level, the assets are normally distributed (He and Litterman, 1999), and the investors' views are linear. Since both assumptions are not realistic in real life, the practicality of the model is thus limited. Subsequent works have extended the original model to cover a wider range of assets: Mucci (2006a, 2006b) improves upon the original model to include non-normal distribution with a copula-opinion pooling (COP) technique, and Mucci (2008) introduces an Entropy Pooling (EP) approach to incorporate non-linear views.

Despite the great research efforts, the mainstream literature primarily seeks to improve the mathematical soundness of the original BL model and extend its utilities to more generic distributions and non-linear securities, but does not provide practical guidance on how to improve the "objectiveness" of the investors' views, as most of the views on asset returns and associated portfolio weight allocations are generated just to demonstrate the usefulness of the model. Therefore, it is necessary to develop an analytical framework in order to generate objective views in order to make the BL model more practical.

In dealing with univariate financial time series, it is not uncommon to use the Auto-Regressive Moving Average (ARMA) method to model the conditional mean returns of an asset. Also, the ARMA model is typically used in conjunction with a variety of Auto-Regressive Conditional Heteroskedasticity (ARCH) and Generalized

ARCH (GARCH) methods to estimate conditional variances in case the residuals from the ARMA fitting are time-varying. As one of the key applications for financial time series is portfolio optimization, it is logical to extend the univariate ARMA-ARCH/GARCH models to cover multivariate time series.

One option is linking the Vector ARMA (VARMA) model with a multivariate ARCH/GARCH specification, and applying it to model a portfolio, essentially a multivariate time series. A particular class of multivariate ARCH models of our interest is the Dynamic Conditional Correlation (DCC), and especially the DCC(1,1) specification (Engle and Sheppard, 2001; Engle, 2002; Chong and Miffre, 2009), which is effective in analyzing time-varying conditional correlations and covariance cross asset classes. Furthermore, the Asymmetric DCC (ADCC) model (Cappiello, Engle and Sheppard, 2003, 2006) augments the DCC model to accommodate conditional covariance asymmetries and structural break induced conditional correlation increase.

Therefore, this paper seeks to accomplish two tasks. First, it combines the VARMA and DCC/ADCC models in order to provide a generalized multivariate VARMA-DCC/ADCC framework, which can be further utilized to model multivariate finance time series. Second, it applies the VARMA-DCC/ADCC framework to generate views to improve the input objectiveness in the BL model, making the process more practice-friendly. Because of the increased objectiveness in the views, the advantage of the proposed method is that it provides a highly automated alternative to the BL portfolio optimization process.

To demonstrate the proposed VARMA-DCC/ADCC framework and its application in the BL model, I construct a China portfolio that consists ten assets, covering all exchange tradable securities other than options, including equities, bonds, commodities and futures. The reason for a China portfolio is that, the country's equity market is highly speculative, and as such, it has not been functioning as a long-term wealth preservation and generation tool for the value-driven investors. Despite that China already has active bond, commodity and financial futures markets, these useful investment vehicles and risk-management tools have not been utilized to a large extent by the investors. From a quantitative finance perspective, one of the key reasons is that, the institutional investors (and their research arms) have not formed adequate and proven strategies that utilize available instruments in a "quantitative" manner, to effectively hedge the volatilities of the primary equity market. Thus, one practical motivation of this paper is to start the efforts of providing meaningful academic guidance to the Chinese practitioners.

The dataset of the China portfolio consists ten series of 304 daily returns, ranging from September 7, 2013 to December 9, 2014, including 297 in-sample observations that are used to establish the model's baseline, and 7 out-of-sample observations that test its practicality. I fit a VARMA(1,0) specification on the dataset to estimate the asset mean returns, and a DCC(1,1)/ADCC(1,1) specification to estimate the conditional covariance, basically the views for the BL model.

In the subsequent BL stage, portfolio optimization is conducted with three different view confidence levels. The view confidence parameter functions as a portfolio weight scalar, and it improves the portfolio performance (in terms of reduced portfolio variance) with increasing value to a certain point. For the purpose of this paper, a view confidence parameter of 0.01 gives the best overall performance among the three choices. With a properly chosen view confidence parameter, the VARMA-DCC/ADCC preconditioned Black-Litterman portfolios offers clear performance advantage over the regular mean-variance optimized and market portfolios.

The rest of the paper is organized as follows. Section 2 provides the literature review and the theoretical framework of the BL model. Section 3 introduces the China portfolio and the dataset. Section 4 establishes the VARMA-DCC/ADCC framework. Section 5 presents the VARMA-DCC/ADCC preconditioned Black-Litterman portfolio optimization procedure in detail. Section 6 discusses the performance of the proposed approach and compares it to that of a regular mean-variance portfolio and a market portfolio. Section 7 concludes the paper.

2. Literature Review and Theoretical Framework

Black and Litterman (1990, 1992) establish the Black-Litterman methodology to mitigate the input-sensitive nature of the mean-variance portfolio optimization approach (Best and Grauer, 1991). It seeks to optimize an equilibrium portfolio by incorporating the investor's views on the expected mean-return vector, as well as the conditional variances of such views. The BL model's general formula is given as (He and Litterman, 1999, Equation 8):

$$E[R] = \left[(\tau\Sigma)^{-1} + P^T\Omega^{-1}P\right]^{-1}\left[(\tau\Sigma)^{-1}\Pi + P^T\Omega^{-1}Q\right] \quad (1)$$

Where:

1. $E[R]$ is the posterior combined return vector, it is a $N \times 1$ column vector, where N is the number of assets in the portfolio.
2. Π is the (prior) implied return or risk premium, and is a $N \times 1$ vector.
3. Σ is the (prior) unconditional covariance matrix ($N \times N$) for the realized (historical) returns.
4. τ is the confidence level of the prior.
5. Q is the view vector ($K \times 1, K \le N$) on expected return vector.
6. P is the weight matrix ($K \times N, K \le N$) representing the investor's view.
7. Ω is conditional covariance matrix ($K \times K, K \le N$) of errors in the views.

In a general sense, the investor's views consist the expected return vector Q, the "pick" matrix P, and the conditional variance matrix Ω in Equation (1). Their relations in the original BL framework (He and Litterman, 1999; Idzorek, 2005) are modeled as normal and expressed as:

$$
\begin{aligned}
&P\mu \sim N(Q,\Omega)\\
&\mu \sim N(\Pi,\tau\Sigma)\\
&\Pi = \delta\Sigma w_{equ}
\end{aligned} \tag{2}
$$

Where μ is the expected mean-return vector, δ is the risk aversion coefficient, and w_{equ} is the equilibrium (market) weight vector of the portfolio.

Deriving the view related variables (Q, P, Ω) is somewhat tricky. In the original BL approach, the investors would just generate rather subjective views on the mean return vectors, either absolutely or relatively. The mainstream literature does not provide adequate practical guidance on how to generate more objective views. For example, in order to apply the BL model to cover a wider range of securities (such as non-linear derivatives), Mucci (2006a, 2006b) extends the original model to include non-normal distributions with a COP technique, and Mucci (2008) introduces an EP approach to incorporate non-linear views. However, both COP and EP methods still use the subjective perspectives of the investors as the mean return vectors (Q) and pick matrices (P). Beach and Orlov (2007) are among the first to utilize the Exponential GARCH-in-Mean (EGARCH-M) to derive expected returns and standard deviations as views (inputs) to the BL model, however they treat the multi-asset returns as a collection of univariate time series, thus ignore their cross-asset interactions. Palomba (2010) applies the Flexible Dynamic Conditional Correlations (FDCC) by Billio et al. (2006), a generalized extension of the Dynamic Conditional Correlations (DCC) by Engle (2002), to estimate multivariate daily returns and conditional covariance of the investor's views on a rolling basis. However, Palomba (2010) does not provide practical steps on how to derive the daily return forecasts either, other than presenting a general equation (Equation 22).

It is well accepted to use the ARMA-GARCH approach to model the conditional returns and variances (in the residuals) of a univariate financial time series, particularly in the context of maximum likelihood (ML) estimations of model fittings (for example, Ling and Li, 1997, 1998; Ling and McAleer, 2003a), and it is only logical to extend the univariate ARMA-GARCH models to cover multivariate time series. Ling and McAleer (2003b) provide an asymptotic and VARMA-ARCH framework to link VARMA-produced conditional residuals to a multivariate ARCH model. In their approach, the VARMA part is used primarily for two purposes: that it estimates the conditional means of the constituents of a multivariate time series with their interactions built-in, and it produces conditional residuals that can be further analyzed for conditional covariance and correlations by a variety of multivariate ARCH/GARCH models.

For a multivariate time series, such as a portfolio with multiple asset classes, the Dynamic Conditional Correlation (DCC) model, and especially the DCC(1,1) specification (Engle and Sheppard, 2001; Engle, 2002; Chong and Miffre, 2009), essentially a multivariate GARCH(1,1) extension, are effective in analyzing the time-varying conditional correlations and covariance cross asset classes. However, the DCC model does not accommodate asymmetries among conditional covariance for equity returns and conditional correlation for equity and bond returns, neither does it respond well to structural break induced conditional correlation increase (Cappiello et al., 2003, 2006). To deal with such asymmetries, Cappiello et al. (2003, 2006) introduce an Asymmetric DCC (ADCC) model, from which Billio and Caporin

(2006) derive a generalized version, the Asymmetric Generalized DCC (AGDCC).

This paper links the DCC model by Engle (2002) and the ADCC model by Cappiello et al. (2003, 2006) to the VARMA-ARCH approach by Ling and McAleer (2003b) in order to provide a generalized VARMA-DCC/ADCC framework, which offers an alternative for multivariate finance time series modeling. Furthermore, the paper applies the VARMA-DCC/ADCC framework to generate objective mean-return vectors (Q) and conditional covariance matrices (Ω) of the residuals in the views, in order to extend the multivariate BL models by Beach and Orlov (2006) and Palomba (2010). Thus, the paper offers a completely objective approach to the BL model, and provides a highly automated alternative to portfolio optimization.

3. The China Portfolio and the Dataset

I construct a ten-asset portfolio consisting all available exchange-tradable asset classes in China[1]: equity (3 assets), bond (3 assets), commodity (1 asset), equity futures (1 asset), bond futures (1 asset) and commodity futures (1 asset), including:

1. CSI, or CSI300 index, an index maintained by the Shanghai Stock Exchange (SHSE) that comprises 300 high market-cap and high liquidity A-share stocks, listed on both SHSE and Shenzhen Stock Exchange (SZSE), which, collectively, represents some 60% of the exchanges' total combined market cap. Although it is a benchmark index and not tradable, it is easy to identify exchange traded funds (ETFs) that track its movement. Thus, for convenience and without economical consequence, I include the CSI300 as a representative of large cap equity assets.
2. SME, or Small and Medium Exchange index, maintained by the SZSE. As its

[1] Although spot gold options and an index ETF based options have started trading in January and February of 2015, they are in their infancy and not mature instruments to be used in a portfolio that expects stable performance.

name suggests, it comprises small and medium market cap equities traded on that exchange, and I use it to represent mid cap equity assets.

3. CHI, or ChiNext 100 index, also maintained by the SZSE. It tracks “micro” cap equities or issuers with low revenues/profits and short existence. I use it to represent small cap equity assets.
4. GBI, or Government Bond Index on SHSE, a benchmark and tracking tool for the central government treasury bonds. It is not a tradable security by itself, but again a portfolio can be easily constructed to simulate its movement, thus I use it to represent government bond assets.
5. CBI, or Corporate Bond Index on SHSE, a benchmark and tracking tool for the state-owned entity debt issues. I use it to represent the public sector bond assets.
6. EBI, or Enterprise Bond Index on SHSE, a benchmark and tracking tool for the non-state-owned entity debt issues. I use it to represent the private sector bond assets.
7. AUS, or spot gold, which tracks the real time trading of the spot gold on the Shanghai Gold Exchange (SHGE). It is tradable and I use it to represent commodity, particularly because gold itself is a general-purpose investment vehicle, and has low correlations with the equity indices.
8. IFU, or the CSI300 futures. It tracks the movement of the CSI300 index, and is traded on the China Financial Futures Exchange (CFFEX). The reason I include the CSI300 futures in addition to the CSI300 index is that, in China, only futures (financial and commodity) can be used as hedging and speculation financial instruments, thus they can be short, while all other asset

classes (equity, bond, commodity, etc.) can only be long[2]. Thus, I include the CSI300 futures in the portfolio as a hedging device against the negative movement of the equity market.

9. TFU, or the 5-year treasury bond futures, also traded on the CFFEX platform. The trading of the treasure bond futures was only "re-started" in September 2013, thus it is still a relative new financial instrument. Like the CSI300 futures, it can be also be short, thus I include it as a hedging device against the bond market negative movement.
10. AUF, or the gold futures, traded on the Shanghai Futures Exchange (SHFE). As gold futures can be short, it provides a hedging tool against the negative movement of the commodity market, and hence I include it in the portfolio.

The portfolio is restricted as below:

1. The positions of non-futures assets (equities, bonds, commodities) are restricted to be either zero or long. This is not by choice, but an exchange restriction.
2. The positions of futures assets, namely the CSI300 futures (IFU), the treasury bond futures (TFU) and the gold futures (AUF), can be either long or short. Thus, the futures are used not only as long investment vehicles, but also as hedging devices against the negative movements of the equity, bond and commodity markets.

I collect all raw data of the ten assets from Thomson Reuters Datastream and WIND, ranging from September 6, 2013 (on which day the treasury bond futures started trading) to November 30, 2014 (in-sample). The daily return series starts on

[2] The spot gold options and the index ETF based options can also be short, but again they are not mature instruments to be used in a portfolio that expects stable performance.

September 7, 2013 to November 30, 2014 (in-sample).

To illustrate the practical utility of the proposed VARMA-DCC/ADCC preconditioned Black-Litterman portfolio optimization method, I also capture out-of-sample observations during the period of December 1 to December 9, 2014, with seven trading days, for the purposes of validating the model fits and running out-of-sample rolling forecast.

4. The VARMA-DCC and VARMA-ADCC Framework

I test the VARMA model on the ten-asset daily return series over the in-sample period (ten sets of 297 in-sample observations, from Sep 7, 2013 to Nov 30, 2014), identify that a VARMA(1,0) specification fits the data with statistical significance, and use the residuals as the input to the next-stage multivariate GARCH analysis. The VARMA(1,0) spec is given as:

$$Q_t = Q_0 + \Phi_1 Q_{t-1} + \mathrm{E}_t \tag{3}$$

Where Q_t is the portfolio mean return vector (the unusual choice of letter Q is to keep symbol consistency with the Black-Litterman equation), E_t is the residual vector, and Φ_1 is the coefficient matrix for AR lag 1.

The VARMA model provides one of the inputs to the Black-Litterman portfolio optimization proposed by this paper: the one-period forecast on the expected mean return vector, illustrated by the following:

$$\begin{aligned} \hat{Q}_{t+1} &= Q_{0,t} + \Phi_{1,t} Q_t \\ \hat{\mathrm{E}}_{t+1} &= \hat{Q}_{t+1} - Q_{t+1} \end{aligned} \tag{4}$$

Where $\hat{Q}_{t+1}$ is the one-period forecast on the return mean vector, while $\hat{\mathrm{E}}_{t+1}$ is the error of the forecast over the observed return mean vector (out-of-sample observations).

I use Equation (4) as an one-period forward estimation with a *recursive* (as opposed to *rolling*) fitting approach, with seven out-of-sample observations (ten sets of daily returns in first seven trading days in December, 2014,). Essentially, after each new out-of-sample observation is recorded, I refit Equation (3) so that all available information is included for the benefits of portfolio optimization. I then repeat Equation (4) to produce the seven $\hat{Q}_{t+1}$'s to be used as the view return vectors in the Black-Litterman model.

After the VARMA stage, I follow Chong and Miffre (2009) and apply a DCC(1,1) specification (Engle and Sheppard, 2001; Engle, 2002) to estimate the time-varying conditional correlations in the VARMA residual vector E_t, another input to the Black-Litterman model. The DCC(1,1) specification that deals with time-varying N-dimensional correlation matrix at time *t* is given as:

$$\begin{aligned}
&\mathrm{E}_t \mid \Psi_{t-1} \sim N(0, \Omega_t = \mathrm{H}_t \mathrm{P}_t \mathrm{H}_t) \\
&\mathrm{H}_t^2 = \mathrm{H}_0^2 + \mathrm{K}\mathrm{E}_{t-1}\mathrm{E}_{t-1}^T + \Lambda \mathrm{H}_{t-1}^2 \\
&\mathrm{P}_t = O_t^* O_t O_t^* \\
&\Xi_t = \mathrm{H}_t^{-1}\mathrm{E}_t \\
&O_t = (1-a-b)\overline{O} + a\Xi_{t-1}\Xi_{t-1}^T + bO_{t-1} \\
&a + b < 1
\end{aligned} \qquad (5)$$

Where:

1. E_t is the residual vector from the VARMA(1,0) stage.
2. Ω_t is the conditional covariance matrix of E_t; it is one input to the Black-Litterman model.
3. P_t is the conditional correlation matrix of E_t.
4. H_t is the normalization matrix for P_t.
5. K and Λ are diagonal coefficient matrices for H_t.
6. Ξ_t is the standardized residue vector of E_t.
7. O_t and O_t^* are estimator matrices for P_t.
8. $\overline{O}$ is the unconditional correlation matrix of E_t.

The matrix definitions are given as follow in a more visually straightforward format, just to illustrate their general structures:

$$\Omega_t = H_t P_t H_t = \begin{bmatrix} \sigma^2_{11,t} & \rho_{1i,t}\sigma_{1,t}\sigma_{i,t} & \rho_{1N,t}\sigma_{1,t}\sigma_{N,t} \\ \rho_{i1,t}\sigma_{i,t}\sigma_{1,t} & \sigma^2_{ii,t} & \rho_{iN,t}\sigma_{i,t}\sigma_{N,t} \\ \rho_{N1,t}\sigma_{N,t}\sigma_{1,t} & \rho_{Ni,t}\sigma_{N,t}\sigma_{i,t} & \sigma^2_{NN} \end{bmatrix} \quad (5a)$$

$$H_t = \begin{bmatrix} \sigma_{11,t} & 0 & 0 \\ 0 & \sigma_{ii,t} & 0 \\ 0 & 0 & \sigma_{NN,t} \end{bmatrix} \quad (5b)$$

$$P_t = O^*_t O_t O^*_t = \begin{bmatrix} 1 & \rho_{1i,t} & \rho_{1N,t} \\ \rho_{i1,t} & 1 & \rho_{iN,t} \\ \rho_{N1,t} & \rho_{Ni,t} & 1 \end{bmatrix} \quad (5c)$$

$$O_t = \begin{bmatrix} q_{11,t} & q_{1i,t} & q_{1N,t} \\ q_{i1,t} & q_{ii,t} & q_{iN,t} \\ q_{N1,t} & q_{Ni,t} & q_{NN,t} \end{bmatrix} \quad (5d)$$

$$O^*_t = \begin{bmatrix} \sqrt{q_{11,t}} & 0 & 0 \\ 0 & \sqrt{q_{ii,t}} & 0 \\ 0 & 0 & \sqrt{q_{NN,t}} \end{bmatrix} \quad (5e)$$

The DCC model provides another key input to the Black-Litterman portfolio optimization: the conditional covariance matrix, Ω_t, of the VARMA stage residual vector E_t. Again, I use an one-period forward *recursive* technique to refit Equation (5) with the seven residual vectors (E_t) in the VARMA stage in order to produce seven Ω_t's that embed all available information up to time period *t*.

In order to accommodate asymmetries among conditional covariance and structural breaks induced conditional correlation increase, I adopt the ADCC approach with a ADCC(1,1) specification given as below:

$$
\begin{aligned}
&\mathrm{E}_t \mid \Psi_{t-1} \sim N(0, \Omega_t = \mathrm{H}_t \mathrm{P}_t \mathrm{H}_t) \\
&\mathrm{H}_t^2 = \mathrm{H}_0^2 + \mathrm{K}\mathrm{E}_{t-1}\mathrm{E}_{t-1}^T + \Lambda \mathrm{H}_{t-1}^2 \\
&\mathrm{P}_t = O_t^* O_t O_t^* \\
&\Xi_t = \mathrm{H}_t^{-1}\mathrm{E}_t \\
&\mathrm{N}_t = I\left[\xi_{i,t} < 0\right] \circ \Xi_t \\
&O_t = (1 - a - b)\overline{O} - g\overline{\mathrm{N}} + a\Xi_{t-1}\Xi_{t-1}^T + bO_{t-1} + g\mathrm{N}_{t-1}\mathrm{N}_{t-1}^T \\
&a + b + g < 1
\end{aligned} \tag{6}
$$

Where N_t augments the asymmetric effect of the negative elements $\xi_{i,t}\left(<0\right)$ in Ξ_t; the matrix operator "$\circ$" is the Hadamard product of two identically sized matrices/vectors, computed simply by element-wise multiplication; all other parameters are defined the same way as in Equation (5). The Equation (6) can be viewed as the matrix variation of EGARCH (though no logarithmic operations) in that coefficient *a* captures the residual's magnitude effect, and *g* its sign impact.

Similarly, I use an one-period forward *recursive* technique to refit Equation (6) with the VARMA residual vectors (E_t's) to produce Ω_t's for the BL process.

5. The Black-Litterman Model with VARMA-DCC/ADCC Preconditioning

In the framework proposed by this paper, I rewrite Equation (1) to emphasize its time series nature in a recursive manner, with parameters derived from the VARMA-DCC/ADCC steps:

$$
\overline{\mu}_{t+1} = \left[\left(\tau\Sigma_t\right)^{-1} + \hat{P}_{t+1}^T \Omega_t^{-1} \hat{P}_{t+1}\right]^{-1}\left[\left(\tau\Sigma_t\right)^{-1}\Pi_t + \hat{P}_{t+1}^T \Omega_t^{-1} \hat{Q}_{t+1}\right] \tag{7}
$$

where:

1. $\overline{\mu}_{t+1}$ is the expected return vector of the posterior at time *t* for the next time period *t+1*.
2. Σ_t is the unconditional covariance matrix ($N \times N$) for the realized (historical) returns, the first Σ_t is derived from the in-sample observations, and the subsequent ones are obtained by adding one additional out-of-sample observation to each of the seven iterations.
3. Π_t represents the $N \times 1$ implied return (or risk premium) vector at time t, the first Π_t is derived by Equation (2) with the equilibrium portfolio weight w_{equ},

and subsequent ones are derived recursively by Equation (2) with the optimized portfolio weight $w_{opt,t}$ from the previous iteration. Π_t is not a forecasted value, but derived from the historic information at time *t*.

4. Ω_t is the conditional variance matrix of the VARMA residuals obtained in the DCC/ADCC stage, it is of $N \times N$ dimensions for the reason that VARMA analysis is done on all assets in the portfolio. The first Ω_t is obtained by Equation (5) or (6) with the in-sample observations, and the subsequent ones are obtained recursively with out-of-sample observations, also by Equation (5) or (6). Ω_t is not forecasted, but derived from the information available at *t*.
5. $\hat{Q}_{t+1}$ is the 1-period forward estimated view (on return) vector ($N \times 1$), obtained in the VARMA stage. That $\hat{Q}_{t+1}$ is a full $N \times 1$ vector (instead of a subset $k \times 1$ vector where $k \leq N$) also arises from that VARMA analysis is conducted on all assets in the portfolio. The first $\hat{Q}_{t+1}$ is forecasted from the in-sample observations by Equation (4), while the subsequent ones are forecasted recursively with out-of-sample observations, also by Equation (4).
6. $\hat{P}_{t+1}$ is the 1-period forward estimated weight matrix represents the investor's views and companion of $\hat{Q}_{t+1}$, thus it is a $N \times N$ matrix. Since the $\hat{Q}_{t+1}$'s are all "absolute," the $\hat{P}_{t+1}$'s are essentially identity matrices.

In addition, in order to include the posterior covariance, Equation (7) is further written as:

$$
\begin{aligned}
\overline{\mathrm{M}}_{t+1}^{-1} &= \left[\left(\tau\Sigma_t\right)^{-1} + \hat{P}_{t+1}^{T}\Omega_t^{-1}\hat{P}_{t+1} \right]^{-1} \\
\overline{\mu}_{t+1} &= \overline{\mathrm{M}}_{t+1}^{-1} \left[\left(\tau\Sigma_t\right)^{-1} \Pi_t + \hat{P}_{t+1}^{T}\Omega_t^{-1}\hat{Q}_{t+1} \right] \\
\overline{\Sigma}_{t+1} &= \Sigma_t + \overline{\mathrm{M}}_{t+1}^{-1}
\end{aligned}
\tag{8}
$$

Where

1. $\overline{\mathrm{M}}_{t+1}^{-1}$ is the Black-Litterman adjustment to the covariance matrix at time *t* for the next time period *t+1*.
2. $\overline{\Sigma}_{t+1}$ is the covariance matrix of the posterior at time *t* for the next time period *t+1*.

In practice, the first task even before the VARMA fitting, is to obtain the in-sample unconditional (historic) covariance matrix, then the seven out-of-sample unconditional covariance matrices. These matrices are the Σ_t variable in the Black-Litterman Equations (7) and (8), where the first matrix is derived from the in-sample observations, and the rest seven matrices are obtained recursively with out-of-sample observations.

The starting point of the BL process is estimating the equilibrium portfolio weight with the so-called reverse portfolio optimization. While a market-weight portfolio makes sense in general, it does not factor in the particular trading patterns in China, that its equity market contributes to more than 75% of the total market capitalization (in terms of overall exchange trading), while its bond market does less than 0.5%. Therefore, a market weight portfolio consisting China only securities would have been extremely overweight with equities, extremely underweight with bonds, and with commodity and futures taking up the rest. Another particularity in the Chinese financial market is that, only futures can be traded short[3], while other asset classes can only be long.

On the sample portfolio level, among the equity assets, the CSI would have contributed a 65% weight, with the SME and CHI taking about 7% and 5%, respectively. For the bond assets (GBI, CBI and EBI), none contributes more than 0.5% weight, with the CBI being the highest at 0.3%. For the commodities, the AUS is roughly 1% of the total weight. For the futures, the IFU contributes around 20%, while the TFU and AUF each comes in with roughly 2%[4]. Thus, I construct the initial portfolio as long only, with the weights as w_{equ} = (CSI, SME, CHI, GBI, CBI, EBI, AUS, IFU, TFU, AUF) = (60%, 7%, 5%, 1%, 1%, 1%, 1%, 20%, 2%, 2%). Basically I assign a 1% weight to all bond assets in the expense of the CSI, which is still by far

[3] Again we do not consider the immature options.

[4] In China's futures trading, the notional value is actually a lot higher, particularly for the IFU (CSI300 index futures). However, it is common that futures trading is leveraged, and in China the leverage ratio is about 10:1 in practice (ranging from 8:1 for IFU to 50:1 to TFU). The trading value is calculated as the notional value (reported by the exchanges) divided by the most common leverage ratio (10:1 for the purpose of this paper). On the other hand, the returns are calculated with the assumption that the positions are fully collateralized for simplicity and without economical consequence.

the largest component of the portfolio. Throughout the BL process, the weights of none-futures assets shall never go negative.

For the out-of-sample observations, the implied return (Π_t) in Equations (7) and (8) is given as:

$$\Pi_t = \delta \Sigma_t w_{opt,t}$$
$$\delta = \frac{\mu_{equ} - \mu_{risk-free}}{\sigma^2_{equ}} \qquad (9)$$

Where $w_{opt,t}$ is the optimized portfolio weight at time t, with the first one ($t=1$) being equal to the equilibrium weight w_{equ}, δ is the risk aversion parameter, μ_{equ} and σ^2_{equ} are the realized return and covariance of the equilibrium portfolio, respectively, calculated by using the average returns of the ten assets (with the 297 in-sample observations). The risk-free rate, μ_{equ}, is set at 5% (annualized), which is basically the average annualized rate of the 3-month SHIBOR[5]. The Equation (9) yields 3.81 for δ, which is higher than the 2.00 to 2.65 value that is typically used in literature[6], reflecting a higher requirement on reward to risk in China's securities market.

While applying the Black-Litterman model of Equations (7) and (8), I use an easy-to-follow mean-variance optimization approach, with the following practical constraints:

1. The positions of all non-futures securities (CSI, SME, CHI, GBI, CBI, EBI, AUS) can only be either zero (no position) or long.
2. For the equity assets (CSI, SME, CHI), although they represent the largest component in the equilibrium portfolio, in order to avoid over-concentration, I

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[5] SHIBOR stands for Shanghai Inter-Bank Overnight Rate, which is the golden standard of China's inter-bank overnight rate.

[6] For example, Drobetz (2001) and Idzorek (2005) use 2.25 for the Dow Jones Industrial Average (DJIA), and Idzorek (2005) uses 2.62 for a market capitalization portfolio. Beach and Orlov (2006) set δ at 2.65, although for a world portfolio for the period of January 1998 to December 2004 the calculated value is 2.01.

limit the weight of each individual asset to 50% (of the total portfolio). In addition, the total weight of all three equity assets is limited to 50%.

3. For the bond and commodity assets (GBI, CBI, EBI, and AUS), I limit the weight of each individual asset to 30%, and impose an overall asset class weight limit at 30%.
4. For the futures assets (IFU, TFU and AUF), I restrict the range of each individual asset as between -30% and +30%, as short positions are allowed for futures. In addition, the range of the overall asset class weight range is also set as between -30% and +30%.

The above optimization method and restrictions are analytically expressed as the below constrained quadratic programming problem:

$$\max\left(\overline{\mu}_t w_{opt,t}^T - \frac{\delta}{2} w_{opt,t}^T \overline{\Sigma}_t w_{opt,t}\right)$$

$$\begin{aligned}
&\text{subject to :}\\
&\sum_i^{10} w_i = 1;\\
&(i{=}CSI, SME, CHI, GBI, CBI, EBI, AUS, IFU, TFU, AUF)\\
&0 \le w_{CSI}, w_{SME}, w_{CHI} \le 0.5\\
&w_{CSI} + w_{SME} + w_{CHI} \le 0.5\\
&0 \le w_{GBI}, w_{CBI}, w_{EBI}, w_{AUS} \le 0.3\\
&w_{GBI} + w_{CBI} + w_{EBI} \le 0.3\\
&-0.30 \le w_{IFU}, w_{TFU}, w_{AUF} \le 0.30\\
&-0.30 \le w_{IFU} + w_{TFU} + w_{AUF} \le 0.3
\end{aligned} \tag{10}$$

Where $\overline{\mu}_t$ and $\overline{\Sigma}_t$ are given by the Black-Litterman Equation (8).

The quadratic programming of Equation (10) is conducted once within each iteration of the Black-Litterman model of Equation (8), which itself runs recursively, with the view confidence parameter τ being set at 0.001, 0.01 and 0.10.

Finally, the portfolio level performance of the models is given as follow:

$$\mu_{P,t} = \mu_t w_{opt,t}^T$$
$$\sigma_{P,t}^2 = w_{opt,t}^T \Sigma_t w_{opt,t} \tag{11}$$
$$\sigma_{P,t} = \sqrt{\sigma_{P,t}^2}$$

Where $\mu_{P,t}$, $\sigma_{P,t}^2$ and $\sigma_{P,t}$ are the realized (not estimated or forecasted) portfolio return, variance and standard deviation at time *t*, μ_t is the realized and observed return vector at time *t*, Σ_t is the unconditional covariance matrix for the realized returns (same Σ_t as in the Black-Litterman Equations 7 and 8).

6. The Empirical Results and Comparisons

I capture all intermediate results in Tables 1 to 12. In Table 13, I summarize the portfolio results of the Black-Litterman optimization with both VARMA-DCC and VARMA-ADCC preconditioning.

Table 1 summarizes the results of the recursive DCC and ADCC fits for the out-of-sample observations. For the DCC(1,1) specification, for each of the seven out-of-sample periods, coefficient *a* is neither statistically significant (*p*-value >> 0.05) nor numerically meaningful, while coefficient *b* is statistically significant (*p*-value << 0.01) and numerically substantial. According to Equation (5), this suggests that, on the portfolio level, shocks to conditional correlations (and thus conditional covariance) take a long time to dissipate (*b*), but at the same time it does not reacts intensely to recent market movements, or the residuals in the estimates (*a*). Essentially, for assets across all classes, the aggregated volatility is "sticky." For the ADCC(1,1) specification, similar to the DCC(1,1), coefficient *a* is not statistically significant, while coefficient *b* is in 6 cases (out of 7). In addition, coefficient *g*, the measure of the conditional correlation's dependency on the signs of the individual returns, is not statistically significant. According to Equation (6), this suggests that, on the portfolio level, the volatility is insensitive to the movement directions of the individual assets. The implication of these results is that, in the subsequent BL portfolio optimization stage, the DCC(1,1) and ADCC(1,1) may not provide sufficiently different results.

Tables 2 and 3 outline two benchmark portfolios, against which the optimization performance of the proposed method is measured. Table 2 gives the summary of the market (or equilibrium) portfolio, for which the portfolio weight stays unchanged (w_{equ}) over the out-of-sample period. The mean return vector (μ_t) is observed (i.e., not estimated or forecasted) at time t and comprises the individual asset returns in that time period. The market portfolio is regarded as the non-optimized benchmark portfolio. Table 3 captures the mean-variance portfolio. Basically, for each out-of-sample period t, the mean return ($\bar{\mu}_t$) and covariance are calculated (again, not estimated or forecasted) based on the historic returns at that time, which are then used as inputs to the mean-variance portfolio optimization of Equation (10), of which the outcome is the optimized portfolio weight $w_{opt,t}$. The process is repeated seven times in a recursive manner for the entire out-of-sample observations. The mean-variance portfolio is used as the optimized benchmark portfolio.

Tables 4 and 5 list the detailed results of the mean-variance portfolio optimization method of Equations (10) and (11), inside the framework of the VARMA(1,0)-DCC(1,1)/ADCC(1,1) preconditioned BL model of Equation (8), with the view confidence parameter τ being set at 0.001. Table 6 captures the portfolio returns and standard deviations of Tables 4 and 5, and compares them to that of the market and the mean-variance portfolios. Table 6 shows that, over the entire out-of-sample period, the VARMA/DCC-preconditioned and the VARMA/ADCC-preconditioned Black-Litterman portfolios perform almost identically in terms of portfolio mean returns and standard deviations, although they have small yet noticeable differences in portfolio weights (Tables 4 and 5). This result is consistent with that, in the ADCC(1,1) Equation (6), the conditional correlation is not significantly related to the signs of the assets returns for the 10-asset portfolio, within the given timeframe. Comparing to the market and mean-variance portfolios, they do not have observable advantage on the portfolio returns ($\mu_{P,t}$). Actually five out of seven times their mean returns are lower than that of the market portfolio, and four times lower than that of the mean-variance portfolio. On the other hand, it is clear that the standard deviations ($\sigma_{P,t}$) of the BL portfolios are reduced over either benchmark portfolio: they are 0.11% to 0.13% lower than that of the market portfolio, and 0.02% to 0.04% the mean-variance portfolio. This indicates that, for the given risk aversion parameter (δ) at 3.81 and the view confidence parameter (τ) at 0.001, the mean-variance portfolio optimization of Equation (10) tilts towards lower volatility as opposed to higher returns.

Similarly, results and comparisons with τ at 0.01 are captured in Tables 7, 8 and 9. Again, Table 9 confirms that both VARMA/DCC and VARMA/ADCC Black-Litterman portfolios perform almost identically despite small yet noticeable differences in portfolio weights (Tables 7 and 8). Comparing Tables 7/8 with Tables 4/5, there is a pattern that concentration towards several assets (e.g., CSI) becomes more obvious from the lower τ value of 0.001 to the higher value of 0.01, suggesting that view confidence level indeed scales portfolio weights to a certain degree, which supports the mainstream Black-Litterman literature (e.g., He and Litterman, 1999). Comparing Tables 9 and 6, there is no obvious change on the performance of the portfolio returns and variances, other than that both (DCC/ADCC) returns of the first out-of-sample period turn positive. This result indicates that, with the constraints of Equation (10), increasing the τ value from 0.001 to 0.01 is not sufficient to scale the portfolio return performance. Comparing to the market and mean-variance portfolios, again, the BL-optimized portfolios do not have obvious advantage on the mean returns ($\mu_{P,t}$). However, it is still clear that the standard deviations ($\sigma_{P,t}$) of the latter portfolios are improved with margins up to 0.12% over the market portfolio, and 0.11% over the mean-variance portfolio.

Tables 10, 11 and 12 gives the detailed results and comparisons τ being set at 0.10. As expected, the VARMA/DCC and VARMA/ADCC BL methods offer almost identical performance on the portfolio level, but with differences in portfolio weights (Tables 10 and 11). Comparing Tables 10/11 with Tables 7/8, it can be observed that it is more likely for certain assets to reach constraint limits (e.g., 50% for CSI) by increasing τ from 0.01 to 0.10. This is consistent with the previous results that, when τ is raised from 0.001 to 0.01, concentration towards a particular group of assets intensifies, and again supports that view confidence parameter provides portfolio weight scaling. Comparing Tables 12 and 9, it seems that the portfolio returns actually deteriorate in most cases (other than for the first time period, which is small in absolute value from 0.02%/0.03% to 0.88%) and become more uniformly distributed with τ being increased 0.01 to 0.10. In addition, the portfolio variances become higher as well, resulting in a more volatile scenario. This result indicates that, the τ value may need to be calibrated to achieve an overall portfolio level optimization, with methods such as tracking-error targeting[7]. Comparing to the market and mean-variance portfolios, again, the BL-optimized portfolios do not

[7] See Idzorek (2005), Note 9. The view confidence level calibration is beyond the scope of this paper, but will be addressed in a subsequent study.

improve the mean returns ($\mu_{P,t}$) at all, and they do not offer improved standard deviations ($\sigma_{P,t}$) either (other than for certain time periods, such as *t=3* and *4*, which is caused by particularities of the weight allocations). Thus, for the three τ values, it can be argued that τ being equal to 0.01 achieves the overall best portfolio level performance.

Finally, Table 13 provides the comparisons of overall portfolio level returns and standard deviations of the VARMA-DCC/ADCC preconditioned BL portfolios with three different τ values (0.001, 0.01, 0.10), and against that of the market and mean-variance portfolios, in a straightforward and concise way. Table 13 highlights the key findings for the 10-asset portfolio over the given out-of-sample observations: that the VARMA/DCC and VARMA/ADCC frameworks do not provide different results in the BL optimization; that with the risk aversion factor (δ) set at 3.81, the mean-variance portfolio optimization, running concurrently with the BL models, tilts towards variance reduction as opposed to mean return maximization; that for the BL models, the view confidence parameter τ functions as a portfolio weight scalar, and it improves the portfolio performance with increasing value to a certain point; that when τ is properly chosen, the Black-Litterman portfolios offer clear advantages over the mean-variance and the market portfolios in terms of portfolio variance.

6. Conclusions

This paper establishes a VARMA-DCC/ADCC framework, and applies the framework to come up with subjective views as inputs to the Black-Litterman portfolio optimization model, and demonstrates its usefullness with a China portfolio that consists 10 assets, including equities, bonds, commodities and futures.

The VARMA fitting is conducted on 297 in-sample daily return series ranging from September 7, 2013 to November 30, 2014 to establish the baseline fit, and then on seven out-of-sample daily returns from December 1 to 9, 2014 in a recursive fashion in order to produce subjective mean return views as inputs to the Black-Litterman model. For all in-sample and out-of-sample observations, a VARMA(1,0) fit is identified.

The DCC(1,1) and ADCC(1,1) specifications are then applied to the residuals from the VARMA stage to come up with the conditional covariance, also inputs to the Black-Litterman model. Similar to the VARMA, the DCC/ADCC are conducted first on the in-sample daily returns, then the out-of-sample daily returns recursively. For both DCC and ADCC models, portfolio volatility is found persistent over time, while it is insensitive to the most recent shocks. In addition, portfolio volatility is not significantly related to the signs of the individual asset returns in the ADCC model, making the portfolio level results of DCC and ADCC practically indistinguishable for the ten-assets portfolio over the given time period in the Black-Litterman model.

In the Black-Litterman stage, with the risk aversion parameter calculated and set at 3.81, portfolio optimization is conducted with three different view confidence levels at 0.001, 0.01 and 0.10. It is found that the view confidence parameter functions as a portfolio weight scalar, and it improves the portfolio performance (in terms of reduced portfolio variance) with increasing value to a certain point. For the purpose of this paper, a 0.01 value gives the best overall performance among the three choices. With a properly chosen view confidence parameter, the VARMA-DCC/ADCC preconditioned Black-Litterman model offers clear advantage on portfolio optimization over the normal mean-variance optimized and market portfolios in terms of portfolio variance.

The VARMA-DCC/ADCC framework and its usage in the Black-Litterman model proposed by this paper provide an alternative approach to the classic Black-Litterman method. Since all the view parameters, including estimated mean return vectors, conditional covariance matrices and pick matrices, are generated during the VARMA and DCC/ADCC preconditioning stage in an objective fashion, the model improves the objectiveness of inputs. The application of the VARMA-DCC/ADCC preconditioned Black-Litterman model on a ten-asset China portfolio validates its improved performance. In conclusion, the model offers a practical choice for automated portfolio balancing and optimization.

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Table 1 – Summary of the DCC/ADCC Model

This Table summarizes the results of the recursive DCC (Equation 5) and ADCC (Equation 6) fits for the seven out-of-sample observations. For both the DCC(1,1) and ADCC(1,1) specification, *a* is not statistically significant, indicating that the conditional correlations and covariance (volatility) are not sensitive to the most recent shocks, while *b* is statistically significant (except at *t =4*), indicating the volatility is persistent in time. In addition, for the ADCC(1,1) specification, *g* is not statistically significant, indicating that the volatility is not sensitive to the signs of the individual assets.

	DCC				ADCC					
t	*a*		*b*		*a*		*b*		*g*	
	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value	Estimate	*p*-value
1	0.0013	0.7596	0.8404	0.0000	0.0000	1.0000	0.7828	0.0000	0.0063	0.6108
2	0.0013	0.7591	0.8436	0.0000	0.0000	1.0000	0.7817	0.0004	0.0063	0.6483
3	0.0015	0.7245	0.8414	0.0000	0.0000	1.0000	0.7782	0.1260	0.0047	0.8201
4	0.0019	0.6307	0.8370	0.0000	0.0000	1.0000	0.7767	0.0239	0.0052	0.7587
5	0.0025	0.5149	0.8389	0.0000	0.0009	0.8852	0.8086	0.0000	0.0042	0.7315
6	0.0020	0.3916	0.8420	0.0000	0.0004	0.7818	0.8053	0.0000	0.0039	0.7110
7	0.0022	0.3057	0.8481	0.0000	0.0004	0.8245	0.8073	0.0000	0.0044	0.6698

Table 2 – Summary of the Market (Equilibrium) Portfolio

This Table summarizes the market portfolio, which is used as the baseline benchmark for portfolio optimization. The portfolio weights (w_{equ}) do not change over time. The asset returns (μ_t) are the out-of-samples observations. The $\mu_{P,t}$ is realized (i.e., not estimated or forecasted) return, the $\sigma^2_{P,t}$ is realized portfolio conditional variance, and the $\sigma_{P,t}$ is realized portfolio standard deviation, all calculated by Equation (12).

Market (Equilibrium) Portfolio							
w_{equ}	1	2	3	4	5	6	7
CSI	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000
SME	0.0700	0.0700	0.0700	0.0700	0.0700	0.0700	0.0700
CHI	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500
GBI	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
CBI	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
EBI	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
AUS	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
IFU	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
TFU	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200
AUF	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200
μ_t	1	2	3	4	5	6	7
CSI	0.0039	0.0363	0.0148	0.0451	0.0066	0.0401	-0.0459
SME	-0.0059	0.0108	0.0147	0.0200	-0.0200	0.0028	-0.0402
CHI	-0.0119	0.0084	0.0246	0.0108	-0.0249	-0.0094	-0.0407
GBI	0.0001	-0.0001	0.0001	0.0000	0.0000	0.0005	0.0003
CBI	0.0005	0.0002	0.0001	-0.0004	-0.0008	-0.0006	-0.0029
EBI	0.0001	0.0004	-0.0003	-0.0006	-0.0013	-0.0010	-0.0036
AUS	-0.0284	0.0415	-0.0038	0.0013	0.0042	-0.0084	0.0142
IFU	-0.0060	0.0441	0.0203	0.0645	-0.0040	0.0443	-0.0570
TFU	-0.0003	-0.0025	-0.0070	-0.0065	-0.0040	-0.0008	0.0016
AUF	-0.0288	0.0468	-0.0035	0.0048	-0.0015	-0.0090	0.0160
Portfolio	1	2	3	4	5	6	7
$\mu_{P,t}$	-0.0007	0.0331	0.0150	0.0418	0.0004	0.0324	-0.0434
$\sigma^2_{P,t}$	0.00008622	0.00008594	0.00008919	0.00008958	0.00009491	0.00009459	0.00009757
$\sigma_{P,t}$	0.0093	0.0093	0.0094	0.0095	0.0097	0.0097	0.0099

Table 3 – Summary of the Mean-Variance Portfolio

This Table summarizes the mean-variance portfolio, which is used as the optimized benchmark for t. The portfolio weights ($w_{opt,t}$) are the results of a mean-variance optimization process, but without the aid of the Black-Litterman model. The expected asset returns ($\overline{\mu}_t$) are the conditional means of the out-of-sample periods. The realized portfolio returns ($\mu_{P,t}$), the realized portfolio variances ($\sigma^2_{P,t}$), and the realized portfolio standard deviations ($\sigma_{P,t}$) are calculated by Equation (12).

Mean-Variance Optimized Portfolio (no Black Litterman)							
$w_{opt,t}$	1	2	3	4	5	6	7
CSI	0.3406	0.4460	0.4029	0.5000	0.5000	0.5000	0.5000
SME	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CHI	0.1594	0.0540	0.0971	0.0000	0.0000	0.0000	0.0000
GBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CBI	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
EBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IFU	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
TFU	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
AUF	-0.3000	-0.3000	-0.3000	-0.3000	-0.3000	-0.3000	-0.3000
$\overline{\mu}_t$	1	2	3	4	5	6	7
CSI	0.0006	0.0007	0.0008	0.0009	0.0009	0.0011	0.0009
SME	0.0003	0.0004	0.0004	0.0005	0.0004	0.0004	0.0003
CHI	0.0006	0.0007	0.0007	0.0008	0.0007	0.0007	0.0005
GBI	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
CBI	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
EBI	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
AUS	-0.0006	-0.0005	-0.0005	-0.0005	-0.0004	-0.0005	-0.0004
IFU	0.0006	0.0007	0.0008	0.0010	0.0010	0.0011	0.0009
TFU	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001
AUF	-0.0006	-0.0004	-0.0004	-0.0004	-0.0004	-0.0005	-0.0004
Portfolio	1	2	3	4	5	6	7
$\mu_{P,t}$	0.0064	0.0154	0.0141	0.0390	0.0015	0.0357	-0.0454
$\sigma^2_{P,t}$	0.00006883	0.00006913	0.00006871	0.00007222	0.00007682	0.00007656	0.00008029
$\sigma_{P,t}$	0.0083	0.0083	0.0083	0.0085	0.0088	0.0087	0.0090

Table 4 – Summary of the VARMA-DCC Portfolio with $\tau = 0.001$

This Table summarizes the VARMA(1,0)-DCC(1,1) preconditioned Black-Litterman model with the view confidence level τ being set at 0.001. The portfolio weights ($w_{opt,t}$) are the results of a mean-variance optimization process within the VARMA/DCC preconditioned Black-Litterman model. The expected asset returns ($\overline{\mu}_t$) are the results of the Black-Litterman model. The realized portfolio returns ($\mu_{P,t}$), the realized portfolio variances ($\sigma^2_{P,t}$), and the realized portfolio standard deviations ($\sigma_{P,t}$) are calculated by Equation (12).

DCC Preconditioned Black-Litterman Model (τ = 0.001)							
$w_{opt,t}$	1	2	3	4	5	6	7
CSI	0.4095	0.4132	0.4080	0.4099	0.4207	0.4200	0.4440
SME	0.0668	0.0759	0.0920	0.0901	0.0793	0.0738	0.0560
CHI	0.0237	0.0109	0.0000	0.0000	0.0000	0.0000	0.0000
GBI	0.2000	0.0375	0.3000	0.3000	0.3000	0.3000	0.3000
CBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBI	0.0000	0.1966	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0068	0.0531	0.0270	0.0202	0.0000	0.0004
IFU	0.3000	0.3000	0.2884	0.2876	0.2979	0.3000	0.3000
TFU	-0.0320	-0.0617	-0.0914	-0.0869	-0.0768	-0.0823	-0.0748
AUF	0.0320	0.0208	-0.0501	-0.0277	-0.0413	-0.0115	-0.0256
$\overline{\mu}_t$	1	2	3	4	5	6	7
CSI	0.0004	0.0003	0.0003	0.0003	0.0004	0.0003	0.0004
SME	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
CHI	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
GBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IFU	0.0004	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004
TFU	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AUF	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Portfolio	1	2	3	4	5	6	7
$\mu_{P,t}$	-0.0017	0.0306	0.0139	0.0393	0.0004	0.0307	-0.0401
$\sigma^2_{P,t}$	0.00006585	0.00006589	0.00006576	0.00006606	0.00007263	0.00007216	0.00007637
$\sigma_{P,t}$	0.0081	0.0081	0.0081	0.0081	0.0085	0.0085	0.0087

Table 5 – Summary of the VARMA-ADCC Portfolio with $\tau = 0.001$

This Table summarizes the VARMA(1,0)-ADCC(1,1) preconditioned Black-Litterman model with the view confidence level τ being set at 0.001. The portfolio weights ($w_{opt,t}$) are the results of a mean-variance optimization process within the VARMA/ADCC preconditioned Black-Litterman model. The expected asset returns ($\overline{\mu}_t$) are the results of the Black-Litterman model. The realized portfolio returns ($\mu_{P,t}$), the realized portfolio variances ($\sigma^2_{P,t}$), and the realized portfolio standard deviations ($\sigma_{P,t}$) are calculated by Equation (12).

ADCC Preconditioned Black-Litterman Model (τ = 0.001)							
$w_{opt,t}$	1	2	3	4	5	6	7
CSI	0.4098	0.4138	0.4083	0.4102	0.4213	0.4207	0.4446
SME	0.0664	0.0749	0.0917	0.0898	0.0787	0.0731	0.0554
CHI	0.0237	0.0113	0.0000	0.0000	0.0000	0.0000	0.0000
GBI	0.2000	0.0395	0.3000	0.3000	0.3000	0.3000	0.3000
CBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBI	0.0000	0.1947	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0077	0.0553	0.0304	0.0256	0.0000	0.0000
IFU	0.3000	0.3000	0.2885	0.2876	0.2977	0.3000	0.3000
TFU	-0.0319	-0.0616	-0.0914	-0.0868	-0.0766	-0.0819	-0.0747
AUF	0.0319	0.0196	-0.0524	-0.0312	-0.0467	-0.0119	-0.0253
$\overline{\mu}_t$	1	2	3	4	5	6	7
CSI	0.0004	0.0003	0.0003	0.0003	0.0004	0.0003	0.0004
SME	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
CHI	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
GBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IFU	0.0004	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004
TFU	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AUF	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Portfolio	1	2	3	4	5	6	7
$\mu_{P,t}$	-0.0017	0.0306	0.0139	0.0393	0.0005	0.0307	-0.0401
$\sigma^2_{P,t}$	0.00006585	0.00006589	0.00006577	0.00006606	0.00007257	0.00007215	0.00007639
$\sigma_{P,t}$	0.0081	0.0081	0.0081	0.0081	0.0085	0.0085	0.0087

Table 6 – Portfolio Level Comparisons with $\tau = 0.001$

This Table compares the realized portfolio return and standard deviation of the VARMA(1,0)-DCC(1,1)/ADCC(1,1) preconditioned Black-Litterman portfolios against that of the mean-variance and the market portfolios. The view confidence level τ being set at 0.001. M-V stands for Mean-Variance.

t	Portfolio Mean and Standard Deviation Comparisons (τ = 0.001)							
	Portfolio Returns ($\mu_{P,t}$)				Portfolio Standard Deviation ($\sigma_{P,t}$)			
	DCC	ADCC	M-V	Market	DCC	ADCC	M-V	Market
1	-0.0017	-0.0017	0.0064	-0.0007	0.0081	0.0081	0.0083	0.0093
2	0.0306	0.0306	0.0154	0.0331	0.0081	0.0081	0.0083	0.0093
3	0.0139	0.0139	0.0141	0.0150	0.0081	0.0081	0.0083	0.0094
4	0.0393	0.0393	0.0390	0.0418	0.0081	0.0081	0.0085	0.0095
5	0.0004	0.0005	0.0015	0.0004	0.0085	0.0085	0.0088	0.0097
6	0.0307	0.0307	0.0357	0.0324	0.0085	0.0085	0.0087	0.0097
7	-0.0401	-0.0401	-0.0454	-0.0434	0.0087	0.0087	0.0090	0.0099

Table 7 – Summary of the VARMA-DCC Portfolio with $\tau = 0.01$

This Table summarizes the VARMA(1,0)/DCC(1,1) preconditioned Black-Litterman model with the view confidence level τ being set at 0.01. The portfolio weights ($w_{opt,t}$) are the results of a mean-variance optimization process within the VARMA/DCC preconditioned Black-Litterman model. The expected asset returns ($\overline{\mu}_t$) are the results of the Black-Litterman model. The realized portfolio returns ($\mu_{P,t}$), the realized portfolio variances ($\sigma^2_{P,t}$), and the realized portfolio standard deviations ($\sigma_{P,t}$) are calculated by Equation (12).

DCC Preconditioned Black-Litterman Model (τ = 0.01)							
$w_{opt,t}$	1	2	3	4	5	6	7
CSI	0.4628	0.5000	0.4729	0.4931	0.5000	0.4670	0.5000
SME	0.0372	0.0000	0.0271	0.0069	0.0000	0.0000	0.0000
CHI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GBI	0.3000	0.0000	0.3000	0.3000	0.3000	0.3000	0.3000
CBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBI	0.0000	0.3000	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0278	0.0535	0.0000	0.0000	0.0000	0.0000
IFU	0.3000	0.3000	0.1991	0.1967	0.2909	0.3000	0.3000
TFU	-0.0879	-0.0671	0.2474	0.2620	0.2091	0.1176	0.2000
AUF	-0.0121	-0.0607	-0.3000	-0.2587	-0.3000	-0.1846	-0.3000
$\overline{\mu}_t$	1	2	3	4	5	6	7
CSI	0.0004	0.0004	0.0003	0.0003	0.0004	0.0003	0.0004
SME	0.0004	0.0003	0.0003	0.0002	0.0003	0.0002	0.0003
CHI	0.0003	0.0002	0.0002	0.0002	0.0001	0.0002	0.0001
GBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0000	-0.0001	-0.0001	-0.0001	0.0000	-0.0001
IFU	0.0004	0.0005	0.0003	0.0003	0.0003	0.0004	0.0004
TFU	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AUF	0.0000	0.0000	-0.0001	-0.0001	-0.0001	0.0000	-0.0001
Portfolio	1	2	3	4	5	6	7
$\mu_{P,t}$	0.0002	0.0300	0.0106	0.0321	0.0017	0.0337	-0.0444
$\sigma^2_{P,t}$	0.00006643	0.00006707	0.00005382	0.00005449	0.00007496	0.00006843	0.00008019
$\sigma_{P,t}$	0.0082	0.0082	0.0073	0.0074	0.0087	0.0083	0.0090

Table 8 – Summary of the VARMA-ADCC Portfolio with $\tau = 0.01$

This Table summarizes the VARMA(1,0)-ADCC(1,1) preconditioned Black-Litterman model with the view confidence level τ being set at 0.01. The portfolio weights ($w_{opt,t}$) are the results of a mean-variance optimization process within the VARMA/ADCC preconditioned Black-Litterman model. The expected asset returns ($\overline{\mu}_t$) are the results of the Black-Litterman model. The realized portfolio returns ($\mu_{P,t}$), the realized portfolio variances ($\sigma^2_{P,t}$), and the realized portfolio standard deviations ($\sigma_{P,t}$) are calculated by Equation (12).

ADCC Preconditioned Black-Litterman Model (τ = 0.01)							
$w_{opt,t}$	1	2	3	4	5	6	7
CSI	0.4654	0.5000	0.4699	0.4903	0.5000	0.4663	0.5000
SME	0.0346	0.0000	0.0301	0.0097	0.0000	0.0000	0.0000
CHI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GBI	0.3000	0.0000	0.3000	0.3000	0.3000	0.3000	0.3000
CBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBI	0.0000	0.3000	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0362	0.0515	0.0000	0.0000	0.0000	0.0000
IFU	0.3000	0.3000	0.1999	0.1968	0.2871	0.3000	0.3000
TFU	-0.0869	-0.0651	0.2486	0.2651	0.2129	0.1178	0.2000
AUF	-0.0131	-0.0712	-0.3000	-0.2619	-0.3000	-0.1841	-0.3000
$\overline{\mu}_t$	1	2	3	4	5	6	7
CSI	0.0004	0.0004	0.0003	0.0003	0.0004	0.0003	0.0004
SME	0.0004	0.0003	0.0003	0.0002	0.0003	0.0002	0.0003
CHI	0.0003	0.0002	0.0002	0.0002	0.0001	0.0002	0.0001
GBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0000	-0.0001	-0.0001	-0.0001	0.0000	-0.0001
IFU	0.0004	0.0005	0.0003	0.0003	0.0003	0.0004	0.0004
TFU	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AUF	0.0000	0.0000	-0.0001	-0.0001	-0.0001	0.0000	-0.0001
Portfolio	1	2	3	4	5	6	7
$\mu_{P,t}$	0.0003	0.0298	0.0106	0.0320	0.0017	0.0337	-0.0444
$\sigma^2_{P,t}$	0.00006647	0.00006702	0.00005392	0.00005453	0.00007427	0.00006831	0.00008019
$\sigma_{P,t}$	0.0082	0.0082	0.0073	0.0074	0.0086	0.0083	0.0090

Table 9 – Portfolio Level Comparisons with $\tau = 0.01$

This Table compares the realized portfolio return and standard deviation of the VARMA(1,0)-DCC(1,1)/ADCC(1,1) preconditioned Black-Litterman portfolios against that of the mean-variance and the market portfolios. The view confidence level τ being set at 0.01. M-V stands for Mean-Variance.

t	Portfolio Mean and Standard Deviation Comparisons ($\tau = 0.01$)							
	Portfolio Returns ($\mu_{P,t}$)				Portfolio Standard Deviation ($\sigma_{P,t}$)			
	DCC	ADCC	M-V	Market	DCC	ADCC	M-V	Market
1	0.0002	0.0003	0.0064	-0.0007	0.0082	0.0082	0.0083	0.0093
2	0.0300	0.0298	0.0154	0.0331	0.0082	0.0082	0.0083	0.0093
3	0.0106	0.0106	0.0141	0.0150	0.0073	0.0073	0.0083	0.0094
4	0.0321	0.0320	0.0390	0.0418	0.0074	0.0074	0.0085	0.0095
5	0.0017	0.0017	0.0015	0.0004	0.0087	0.0086	0.0088	0.0097
6	0.0337	0.0337	0.0357	0.0324	0.0083	0.0083	0.0087	0.0097
7	-0.0444	-0.0444	-0.0454	-0.0434	0.0090	0.0090	0.0090	0.0099

Table 10 – Summary of the VARMA/DCC Portfolio with $\tau = 0.10$

This Table summarizes the VARMA(1,0)/DCC(1,1) preconditioned Black-Litterman model with the view confidence level τ being set at 0.10. The portfolio weights ($w_{opt,t}$) are the results of a mean-variance optimization process within the VARMA/DCC preconditioned Black-Litterman model. The expected asset returns ($\overline{\mu}_t$) are the results of the Black-Litterman model. The realized portfolio returns ($\mu_{P,t}$), the realized portfolio variances ($\sigma^2_{P,t}$), and the realized portfolio standard deviations ($\sigma_{P,t}$) are calculated by Equation (12).

DCC Preconditioned Black-Litterman Model (τ = 0.10)							
$w_{opt,t}$	1	2	3	4	5	6	7
CSI	0.5000	0.5000	0.1013	0.3567	0.5000	0.4000	0.5000
SME	0.0000	0.0000	0.3987	0.1433	0.0000	0.0000	0.0000
CHI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GBI	0.3000	0.0000	0.3000	0.3000	0.3000	0.3000	0.3000
CBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBI	0.0000	0.3000	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IFU	0.3000	0.3000	0.2000	0.2000	0.3000	0.3000	0.3000
TFU	0.2000	0.2000	0.3000	0.3000	0.2000	-0.3000	0.2000
AUF	-0.3000	-0.3000	-0.3000	-0.3000	-0.3000	0.3000	-0.3000
$\overline{\mu}_t$	1	2	3	4	5	6	7
CSI	0.0011	0.0008	0.0003	0.0004	0.0012	0.0003	0.0009
SME	0.0009	0.0005	0.0004	0.0004	0.0008	0.0001	0.0002
CHI	0.0004	0.0001	-0.0001	0.0002	-0.0003	-0.0001	-0.0008
GBI	0.0001	0.0000	0.0001	0.0001	0.0002	0.0000	0.0001
CBI	0.0000	0.0001	0.0000	0.0000	0.0000	-0.0001	0.0000
EBI	0.0001	0.0001	0.0000	0.0000	0.0000	-0.0001	0.0000
AUS	-0.0003	-0.0001	-0.0007	-0.0002	-0.0006	0.0000	-0.0004
IFU	0.0009	0.0015	-0.0003	0.0002	0.0007	0.0007	0.0009
TFU	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0001	-0.0001
AUF	-0.0001	-0.0001	-0.0009	-0.0001	-0.0007	0.0002	-0.0004
Portfolio	1	2	3	4	5	6	7
$\mu_{P,t}$	0.0088	0.0169	0.0104	0.0284	0.0017	0.0270	-0.0444
$\sigma^2_{P,t}$	0.00007112	0.00007133	0.00005826	0.00005410	0.00007663	0.00007328	0.00008019
$\sigma_{P,t}$	0.0084	0.0084	0.0076	0.0074	0.0088	0.0086	0.0090

Table 11 – Summary of the VARMA-ADCC Portfolio with $\tau = 0.10$

This Table summarizes the VARMA(1,0)-ADCC(1,1) preconditioned Black-Litterman model with the view confidence level τ being set at 0.10. The portfolio weights ($w_{opt,t}$) are the results of a mean-variance optimization process within the VARMA/ADCC preconditioned Black-Litterman model. The expected asset returns ($\overline{\mu}_t$) are the results of the Black-Litterman model. The realized portfolio returns ($\mu_{P,t}$), the realized portfolio variances ($\sigma^2_{P,t}$), and the realized portfolio standard deviations ($\sigma_{P,t}$) are calculated by Equation (12).

ADCC Preconditioned Black-Litterman Model (τ = 0.10)							
$w_{opt,t}$	1	2	3	4	5	6	7
CSI	0.5000	0.5000	0.0783	0.3356	0.5000	0.4000	0.5000
SME	0.0000	0.0000	0.4217	0.1644	0.0000	0.0000	0.0000
CHI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GBI	0.3000	0.0000	0.3000	0.3000	0.3000	0.3000	0.3000
CBI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBI	0.0000	0.3000	0.0000	0.0000	0.0000	0.0000	0.0000
AUS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IFU	0.3000	0.3000	0.2000	0.2000	0.3000	0.3000	0.3000
TFU	0.2000	0.2000	0.3000	0.3000	0.2000	-0.3000	0.2000
AUF	-0.3000	-0.3000	-0.3000	-0.3000	-0.3000	0.3000	-0.3000
$\overline{\mu}_t$	1	2	3	4	5	6	7
CSI	0.0011	0.0008	0.0003	0.0004	0.0012	0.0003	0.0009
SME	0.0009	0.0005	0.0004	0.0004	0.0008	0.0001	0.0002
CHI	0.0003	0.0001	-0.0001	0.0002	-0.0003	-0.0001	-0.0008
GBI	0.0001	0.0000	0.0001	0.0001	0.0002	0.0000	0.0001
CBI	0.0000	0.0001	0.0000	0.0000	0.0000	-0.0001	0.0000
EBI	0.0001	0.0001	0.0000	0.0000	0.0000	-0.0001	0.0000
AUS	-0.0003	-0.0001	-0.0007	-0.0002	-0.0006	0.0000	-0.0004
IFU	0.0009	0.0015	-0.0002	0.0002	0.0007	0.0007	0.0009
TFU	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0001	-0.0001
AUF	-0.0001	-0.0001	-0.0009	-0.0001	-0.0007	0.0002	-0.0004
Portfolio	1	2	3	4	5	6	7
$\mu_{P,t}$	0.0088	0.0169	0.0104	0.0279	0.0017	0.0270	-0.0444
$\sigma^2_{P,t}$	0.00007112	0.00007133	0.00005919	0.00005404	0.00007663	0.00007328	0.00008019
$\sigma_{P,t}$	0.0084	0.0084	0.0077	0.0074	0.0088	0.0086	0.0090

Table 12 – Portfolio Level Comparisons with $\tau = 0.10$

This Table compares the realized portfolio return and standard deviation of the VARMA(1,0)-DCC(1,1)/ADCC(1,1) preconditioned Black-Litterman portfolios against that of the mean-variance and the market portfolios. The view confidence level τ being set at 0.10. M-V stands for Mean-Variance.

	Portfolio Mean and Standard Deviation Comparisons (τ = 0.10)							
t	Portfolio Returns ($\mu_{P,t}$)				Portfolio Standard Deviation ($\sigma_{P,t}$)			
	DCC	ADCC	M-V	Market	DCC	ADCC	M-V	Market
1	0.0088	0.0088	0.0064	-0.0007	0.0084	0.0084	0.0083	0.0093
2	0.0169	0.0169	0.0154	0.0331	0.0084	0.0084	0.0083	0.0093
3	0.0104	0.0104	0.0141	0.0150	0.0076	0.0077	0.0083	0.0094
4	0.0284	0.0279	0.0390	0.0418	0.0074	0.0074	0.0085	0.0095
5	0.0017	0.0017	0.0015	0.0004	0.0088	0.0088	0.0088	0.0097
6	0.0270	0.0270	0.0357	0.0324	0.0086	0.0086	0.0087	0.0097
7	-0.0444	-0.0444	-0.0454	-0.0434	0.0090	0.0090	0.0090	0.0099

Table 13 – Portfolio Level Comparisons

This Table compares the realized portfolio return and standard deviation of the VARMA(1,0)-DCC(1,1)/ADCC(1,1) preconditioned Black-Litterman portfolios against that of the mean-variance and the market portfolios, including all view confidence levels ($\tau = 0.001, 0.01, 0.10$). M-V stands for Mean-Variance.

Portfolio Return Comparisons ($\mu_{P,t}$)

t	DCC			ADCC			M-V	Market
	τ = 0.001	τ = 0.01	τ = 0.10	τ = 0.001	τ = 0.01	τ = 0.10		
1	-0.0017	0.0002	0.0088	-0.0017	0.0003	0.0088	0.0064	-0.0007
2	0.0306	0.0300	0.0169	0.0306	0.0298	0.0169	0.0154	0.0331
3	0.0139	0.0106	0.0104	0.0139	0.0106	0.0104	0.0141	0.0150
4	0.0393	0.0321	0.0284	0.0393	0.0320	0.0279	0.0390	0.0418
5	0.0004	0.0017	0.0017	0.0005	0.0017	0.0017	0.0015	0.0004
6	0.0307	0.0337	0.0270	0.0307	0.0337	0.0270	0.0357	0.0324
7	-0.0401	-0.0444	-0.0444	-0.0401	-0.0444	-0.0444	-0.0454	-0.0434

Portfolio Standard Deviation Comparisons ($\sigma_{P,t}$)

t	DCC			ADCC			M-V	Market
	τ = 0.001	τ = 0.01	τ = 0.10	τ = 0.001	τ = 0.01	τ = 0.10		
1	0.0081	0.0082	0.0084	0.0081	0.0082	0.0084	0.0083	0.0093
2	0.0081	0.0082	0.0084	0.0081	0.0082	0.0084	0.0083	0.0093
3	0.0081	0.0073	0.0076	0.0081	0.0073	0.0077	0.0083	0.0094
4	0.0081	0.0074	0.0074	0.0081	0.0074	0.0074	0.0085	0.0095
5	0.0085	0.0087	0.0088	0.0085	0.0086	0.0088	0.0088	0.0097
6	0.0085	0.0083	0.0086	0.0085	0.0083	0.0086	0.0087	0.0097
7	0.0087	0.0090	0.0090	0.0087	0.0090	0.0090	0.0090	0.0099