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Procyclical herding of institutional investors in stock markets and financial stability

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Abstract

This thesis is devoted to identifying the procyclical herding of institutional investors in stock markets as an endogenous market destabilizer. The procyclical herding is a collective representation of the behavior of certain institutional investors that can create "mutually reinforcing interactions with price movements." First, this thesis identifies the theoretical rationale of procyclical herding with regard to price movements in the existing asset pricing framework. Second, the thesis explores psychological and institutional mechanisms embedded in current stock markets which rationally lead institutional investors to procyclical herding. They range from investors' expectation formation process on future price movements to institutional investors' balance sheet structures to current popular trading practices and capital movements. Third, the thesis measures and compares procyclicality in stock investments across major institutional groups (investment funds, banks, insurance companies & pension funds - ICPFs) and four countries (U.S, France, Korea, Japan). The regression results show that investment funds and banks are procyclical investors in most countries, whereas ICPFs are counter-cyclical investors. The U.S stock markets appear the most skewed toward procyclical institutional investors, whereas Japanese markets seem skewed toward counter-cyclical investors. The distinctive behavioral features of two economies would have generated contrasting trajectories of price evolutions in the two countries since the late 1990s. Fourth, the measurement is extended to the "mutually reinforcing interactions between investment behavior and price movements" for Korean stock markets using the Vector Autoregressive (VAR) model. The results confirm that foreign investors potentially cause significant "mutually reinforcing interactions" with the Korean stock market return, while Korean domestic institutional investors more or less absorb the shocks provoked by foreign investors. Lastly, the emergence of procyclical institutional investors has undesirable implications such as financial instability and low economic growth. Consequently, we should develop and incorporate macro-prudential policies beyond the banking sector for preventing procyclical herding in a broad range of the financial system. We have the objective to reorient stock markets toward sustainable finance providers, which is an urgent call for responding to threats of climate change.

Title: Procyclical herding of institutional investors in stock markets and financial stability

Keywords: Procyclical herding, Institutional investors, Stock investments, Mutually reinforcing interactions, Financial stability

Abstract

Cette thèse vise à identifier le comportement grégaire procyclique des investisseurs institutionnels sur les marchés boursiers entendue comme un déstabilisateur endogène des marchés. Ce comportement grégaire est une représentation collective des comportements des certains investisseurs institutionnels pouvant créer "des effets se renforçant mutuellement avec les mouvements des prix." Premièrement, cette thèse identifie la logique théorique du comportement grégaire procyclique en fonction des évolutions des prix dans le cadre des théories d'évaluations des actifs financiers existantes. Deuxièmement, cette thèse explore des mécanismes psychologiques et institutionnels inhérents aux marchés boursiers actuels, conduisant de manière rationnelle les investisseurs institutionnels à un comportement grégaire procyclique. Il s'agit du processus de formation des anticipations des investisseurs sur les mouvements des prix futures, des structures de bilan des investisseurs institutionnels, des opérations boursières courantes et des mouvements des capitaux. Troisièmement, cette thèse mesure et compare la procyclicité des investissements sur les marchés boursiers au sein des différentes catégories d'investisseurs (fonds d'investissement, banques, companies d'assurances & fonds de pension - ICPF) et dans quatre pays (États-Unis, France, Corée, Japon). Les résultats de la régression montrent que les fonds d'investissement et les banques sont des investisseurs procycliques dans la plupart des pays, tandis que les ICPF sont des investisseurs contra-cycliques. C'est sur les marchés boursiers américains que les investisseurs institutionnels semblent les plus procycliques, alors que le comportement des investisseurs institutionnels apparait comme contra-cyclique sur les marchés boursiers japonais. Ces différences de comportements ont induit des trajectoires des prix diverses dans deux pays depuis la fin des années 1990. Quatrièmement, la mesure de procyclicalité est étendue aux "interactions se renforçant mutuellement entre le comportement d'investissement et les mouvements des prix" pour les marchés boursiers coréens grâce à un modèle du Vecteur Autoregressif (VAR). Les résultats confirment que les investisseurs étrangers peuvent être soumis à d'importantes interactions se renforçant mutuellement avec le rendement du marché sur les marchés boursiers coréens. En revanche, les investisseurs institutionnels domestiques coréens absorbent plus ou moins les chocs provoqués par les investisseurs étrangers. Enfin, l'emergence des investisseurs institutionnels procycliques a des conséquences indésirables comme l'instabilité financière et la baisse de la croissance économique. Par conséquent, il est nécessaire de développer et mettre en place des politiques macro-prudentielles au-delà du secteur bancaire pour réduire les comportements grégaires procycliques au sein du système financier. L'objectif serait de favoriser la prise en compte par les marchés boursiers d'objectifs de

développement durable. Cela est d'autant plus important qu'il y a une urgence liée aux menaces du changement climatique.

Titre: Comportement grégaire procyclique des investisseurs institutionnels sur les marchés boursiers et stabilité financière

Mots clés: Comportement procyclique, Investisseurs institutionnels, Placement boursier, Interactions auto-renforçantes, Stabilité financière

To my grandma in heaven,

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INTRODUCTION

(Background)

The financial system is procyclical by nature. It has financial variables to tend to oscillate around a trend during the economic cycle. In downswing phases, which are triggered by negative shocks of the real economy side or a market event, the financial market encounters sudden liquidity dry-ups, surges in short-term money market interest rates, tightened credit conditions, collective pessimism for the future price movements, panic and fear, and asset fire-sales by institutional investors for *flight to quality* or *flight to liquidity*. The market downswings sometimes develop into market crises by procyclical operations of financial variables themselves. Asset prices fall drastically on a massive scale far below assets' true values. In upswing phases, markets have excessive liquidity following low-interest rates, relaxed credit conditions and forbearance lending policies, collective market optimism, and investors' *search for yields*. Prices surge beyond the true values up to the level of so-called bubbles in a dramatic but enduring way. These are recurrent phenomena in the capitalist market system.

This thesis focuses on procyclicality in the investment behavior of institutional investors as an endogenous market destabilizer. While previous discussions on procyclicality are primarily devoted to procyclicality in banks' credit supplies in relation to real economic cycles, a growing number of studies focus on procyclicality in investors' investment behavior since the global financial crisis from a financial stability perspective. Institutional investors' procyclical investments (buying stocks when prices rise and selling them when prices fall) sometimes cause the "mutually reinforcing interactions" with prices and other financial variables, primarily when the procyclical investment behaviors are collectively represented (*procyclical herding*). The dynamics often occur regardless of the real economy side but hamper the financial system and real economy. They work as a cross-sectional risk transmission channel propagating risks to the whole financial system, especially during market stress times, and also contribute to amplified fluctuations in financial and economic time series. In fact, the business cycles amplified by endogenously reinforced market forces are a typical pattern of finance-led capitalism or financialization of the economy that emerged in developed countries in the early 1980s (Guttmann, 2014).

The procyclical herding of institutional investors may have been particularly problematic in developed stock markets since the late 1990s. During two decades from the late 1990s up to the present, the global economy has completed the transition into an era of the market economy. Several market crises, structural market changes, and specific macro-economic circumstances have prompted a huge transformation in investment culture. The stock markets have grown beyond real economic activities (107%, market capitalization of GDP in OECD countries, 2018). The markets got an important presence of institutional investors (51%, domestic financial institutions' holdings in the U.S listed companies, 2019). Notably, rapid demographic aging contributed to the extension of insurance companies, pension funds, and the asset management industry through asset management delegations. Such institutional investors became the major shareholders of companies who can directly impact companies' decision-making under the shareholder value maximization system, the normative ideal of corporate governance over the world. Technical and informational innovations introduced algorithmic or high-frequency trading that accounts for 70-80% of daily stock trading volumes in major stock markets currently. Under the prolonged low economic growth, low-interest rates, and growing uncertainties, cost-effective investing tools such as passive funds and ETFs gained popularity, but in the meantime, some investors are encouraged to seek short-term high returns. Markets got fragmented into various platforms and financial product markets that are, nevertheless, closely interconnected. Capitals moving freely across borders transmit regional risks to global markets or vice versa. The massive global capital movements often influence emerging stock markets like "a big fish in a small pond." After several crises, political authorities introduced the regulation and accounting system that link asset valuation or impairment loss to market prices. This led to institutional investors more connected and sensitive to short-term market changes.

Procyclical herding of institutional investors takes place in a psychological, institutional and social context. Contemporary stock markets have strong mechanisms that rationally lead investors to the procyclical investment orientation. Institutional investors may be incentivized to exhibit procyclical herding so easily and intensively that rational arbitragers could not correct their impacts on prices, or the rational arbitragers may even reform into procyclical investors. Institutional investors are sophisticated investors with superior abilities to find out fundamental values, but undoubtedly they are more situated at the heart of developed capitalist markets. In an individual context, the procyclical herding may be a fruit of rational judgments under certain institutional and social constraints rather than just poor investment decisions due to irrationality or behavioral errors. However, in aggregate, the procyclical herding can have undesirable impacts on financial stability and the real economy, reflecting the *market failure* or the *fallacy of composition*.

(Objective and question)

This thesis aims to identify the procyclical herding of institutional investors in stock markets. The first objective is to identify the concept and nature of procyclical herding in relation to price movements. Procyclical investment behavior is an investment decision responding to price movements under the environment surrounding institutional investors. However, when it comes to procyclical herding, the collective behavior becomes influential in future price formation. While the concerns were initially raised by central banks and international legislators from a financial stability view (Bank of England, 2014; IMF, 2014, etc.), the procyclical herding can be interpreted as a price formation mechanism itself. It is essentially associated with the idea of the *self-referential hypothesis* and *finance of conventions* (Orléan, 2004, 2005, 2007, 2011).

The second objective is to identify the rationality of procyclical herding of institutional investors in the current financial system. The current financial system embeds various procyclical mechanisms that rationally lead institutional investors to have a procyclical orientation. Above all, we need to raise the question of how investors form their expectations for future price movements in stock markets. The expectation is the root of all actions, but it is regarded as exogenous in most theories. According to the rational bubble theory (Blanchard and Watson, 1982), as long as investors anticipate that a price will go on a trend (momentum) for a while, it will be *a priori* a lucrative strategy for investors to earn short-term capital gains by buying the rising stocks and reselling them at a higher price, which ultimately generates the bubbles. Here we are curious why stock market investors easily adopt the bubble-generating anticipation that the current price trend will continue for a while (*self-reinforcing expectation*).

Procyclical herding of institutional investors may be notably associated with institutional vulnerabilities inherent in institutions' specific asset and liability design. Which elements of the balance sheet structure determine the procyclical investment propensity? Who are procyclical investors by nature, and who are inherent counter-cyclical investors? Some studies report evidence that public pension funds, which are regarded as long-term counter-cyclical institutional investors, behaved procyclically during the global financial crisis (Papaioannou et al., 2014, etc.). Under what conditions are their ability and willingness for the long-term counter-cyclical investments eroded?

Institutional investors may be mechanically led to procyclical herding through current popular trading practices. Passive investing and passive investment tools such as benchmark indices and ETFs are

likely to embed procyclical mechanisms that induce investors to blindly choose stocks with rising market capitalization and liquidity without considering the fundamental values. In addition, several recent Flash Crash episodes demonstrate how high-frequency trading and algorithmic trading interact with one another in the face of drastic falls in prices, generating short-term price overshooting.

We have a particular focus on foreign investors in emerging stock markets as one of the main institutional investors. Numerous studies prove that foreign investors are procyclical or momentum investors in emerging stock markets (Kim and Wei, 1999; Kaminsky et al., 2000; Richards, 2004, etc.). Only a few studies give explanations on why they have a procyclical orientation in the emerging markets. This thesis tries to fill the gap by giving institutional interpretations on foreign investors, i.e., institutional characteristics of the main foreign investors, their investment purposes, and tools leading them to procyclical investors in emerging markets.

The third objective is to measure procyclicality in investment behavior across institutional investor groups and countries from a financial stability perspective. Only a few studies conduct quantitative measurement of the procyclicality in investment behavior, most of which mainly focus on a single sector, i.e., mutual funds or pension funds. There is no study analyzing different institutional investors and countries simultaneously using consistent regression models. Do institutional investor sectors' investment patterns conform to the theoretical assumptions based on institutional characteristics? Can we say that such investment patterns by institutional sectors are a generalized nature over countries? The measurement can be extended to the concept of procyclicality, "mutually reinforcing interactions between investment behavior and price movements." The Vector Autoregressive (VAR) models provide an ideal framework for capturing endogenous dynamic relations between variables. The VAR analysis is applied to Korean stock markets, where high-frequency (monthly and daily) trading data are available, and especially focuses on the market dynamics caused by foreign investors in Korean stock markets. Do foreign investors destabilize Korean stock markets by causing mutually reinforcing interactions with prices? If they are influential in the future price formation, how do domestic institutional investors respond to foreign investors' behavior? Do domestic institutional investors herd to foreign investors, pushing prices to rise or fall further, or do they absorb the price shocks provoked by foreign investors by trading on the other side of foreign investors?

The last objective is associated with the undesirable consequences of institutional investors' procyclical herding on stock markets and the real economy. The emergence of institutional investors with short-term procyclical orientation as the major stock traders and shareholders can destabilize

stock markets, amplifying market cycles and increasing short-term price volatilities, and undermine economic growth, distorting corporates' investment decisions and hampering efficient capital allocations. This may lead to the legitimacy of macro-prudential policies beyond the banking sector for preventing procyclical herding in a broad range of the financial system. Going forward, we need to discuss the fundamental role of stock markets as sustainable finance providers in the real economy.

(Contribution)

This thesis contributes to previous studies in two different fields by linking macroeconomic concerns raised by political authorities to asset pricing or investment theories. The theories of asset pricing or investment strategies provide theoretical backgrounds in understanding dynamic relations between investment behavior and prices. In the meantime, consideration of macroeconomic effects of the collective procyclical behavior fills the deficiencies of previous studies in finance that primarily focus on the profitability of momentum strategies and neglect the financial stability issue. Moreover, this thesis demonstrates the rationality of procyclical herding as a rational investment decision of institutional investors under institutional constraints in the contemporary developed stock markets. Therefore, it is distinguished from the Noise Trader Approach or herd behavior theory of behavioral finance that attributes investors' correlated behaviors to their irrationality or behavioral errors. Finally, this thesis adds to a growing body of research that investor heterogeneity is crucial in understanding financial market dynamics and maintaining financial stability. The institutional sector- and country-heterogeneity models are a novel aspect of this thesis because other studies analyzing only a single sector cannot address the role of trading counterparties of procyclical institutional investors. Markets need long-term, counter-cyclical investors to offset drastic price movements driven by short-term procyclical investors' one-directional investments. If a market is skewed toward procyclical investors, it is vulnerable to amplified price fluctuations and increased price volatilities.

(Plan and structure)

This thesis is structured as follows: Chapter I constitutes the conceptual framework of procyclicality in investment behavior. It defines procyclicality in investment behavior and describes a typical pattern of procyclical behavior over the recurrent market boom and bust cycles (I.1). Procyclical behavior is essentially a result of each investor's investment decisions and closely related to momentum strategies. Therefore, it can be interpreted with existing asset pricing theories in relation to price movements from a micro-perspective. The procyclical investment behavior is theoretically rooted in the self-referential hypothesis and finance of conventions (I.2).

Chapter II presents psychological and institutional mechanisms that potentially encourage the procyclical herding of institutional investors. It covers an extensive examination of procyclical mechanisms that are embedded in the current stock markets but cannot be quantitatively identified. Section 1 analyses how investors form expectations for future price movements in stock markets. This section especially concentrates on why investors form a self-reinforcing expectation that the current price trend will continue for a while, contributing to reinforcing the current price trend. Even though individual investors have heterogeneous personal beliefs on the future price movement, such heterogeneities are merged into the collective self-reinforcing expectation, which is self-fulfilled (II.1). Section 2 identifies the institutional background of procyclical herding of major institutional investor sectors; investment funds, banks, insurance companies & pension funds (ICPFs). Institutional investors' procyclical herding is notably associated with how much they are exposed to market-related liquidity and leverage risks in their balance sheets. Institutions actively involving in market-related activities are more likely to expand asset investments during price uptrends and engage in asset fire-sales during market turbulence. From this perspective, investment funds and banks intrinsically have procyclical orientations arising from the liquidity risk in balance sheets. ICPFs with long-term liabilities are intrinsically counter-cyclical. However, ICPFs is eventually led to short-term procyclical investments under the prevailed underfunding risk driven by long-lasting low-interest rates and the market valuation system. Complex investment chains around ICPFs through asset management delegations additionally decline the long-term and counter-cyclical nature of ICPFs' investment strategies (II.2). Section 3 addresses procyclical mechanisms in popular trading practices of current stock markets; passive investing, ETFs, high-frequency trading, and algorithmic trading. The tools materializing passive investment strategies involve procyclical mechanisms. It is through methodologies constructing market indices tracked by passive investors or the specific designs of ETFs. High-frequency traders may be a new source of market instabilities. This section focuses on the institutional characteristics of high-frequency traders that make them act as endogenous market-makers in normal times but turn into an aggressive market destabilizer in the face of drastic price drops in stress times. The event study of the recent Flash Crash shows how high-frequency and general trading algorithms interact with one another, respond to drastic falls in market prices, and cause price overshooting (II.3). Section 4 finds the answers to why foreign investors have a procyclical orientation in emerging stock markets through an institutional approach. It decomposes the major foreign investor base and analyzes their investments in emerging markets. Even long-term institutional investors like ICPFs are encouraged to engage in emerging markets via mutual funds for liquidity purposes (II.4).

Chapter III measures procyclicality in investment behavior by three institutional investor sectors (investment funds, banks, ICPFs) and four counties (U.S, France, South Korea, Japan) over 1996 - 2018. Section 1 introduces various methodologies of measuring procyclicality in investment behavior (or momentum strategies) developed in the existing literature (III.1). Section 2 describes data and stylized facts. The quarterly national flow of funds statistics is used for the cross-country comparison analysis as they are published on a consistent standard and capture pure trading volumes, excluding market valuations (III.2). Section 3 builds country- and institutional sector-heterogeneity regression model (baseline model) that regress net buys in stocks by institutional sectors on the lagged market returns with controlling macroeconomic and institutional factors (III.3). Section 4 builds the asymmetric regression model based on the baseline model to examine any changes in investment behavior depending on market conditions (III.4). Section 5 concludes. Institutional investors' investment behaviors are heterogeneous across institutional groups and countries, and asymmetric depending on the market conditions. Notwithstanding, investment funds are procyclical investors in most countries (U.S, France and Korea), particularly in boom periods, whereas ICPFs are counter-cyclical investors (Korea, Japan, and France). Banks are mostly procyclical investors (Korea, U.S and France). These results are in accord with the theoretical assumptions. Interestingly, the U.S stock markets are the most skewed toward procyclical institutional investors, whereas Japanese markets are skewed toward counter-cyclical investors. The distinctive behavioral features of the two economies would have generated contrasting trajectories of price evolutions since the late 1990s (III.5).

Chapter IV measures "the mutually reinforcing interactions" between investment behavior and market returns by a VAR analysis. The VAR analysis includes four institutional sectors (investment funds, banks, ICPFs and foreign investors) of Korean stock markets from January 1997 to June 2019, where high-frequency (monthly and daily) stock trading volume data are available. The mutually reinforcing effects must satisfy two conditions: first, increased market returns raise stock purchases (first-round effect). Second, increases in stock purchases also stimulate the market returns to rise again (feedback effect). Besides, this chapter attempts to analyze dynamic interactions among institutional investor sectors from a behavioral perspective. Given the considerable influence of foreign investors in the Korean stock markets, it allows us to examine foreign investors' behavior responding to changes in domestic market returns and behavior of domestic institutional sectors responding to foreign investors' behavior. Section 1 analyzes the mutually reinforcing interactions at a medium-term investment horizon using monthly trading volume data, contributing to explaining procyclicality amplifying medium-term market cycles (IV.1). Section 2 proposes an analysis at a short-term investment horizon using daily data, which may be linked to procyclicality causing increased short-term price volatilities

(IV.2). From the results, we have convincing evidence that foreign investors have the potential to provoke mutually reinforcing interactions with domestic market returns at the medium-term and short-term horizons. ICPFs are counter-cyclical, but their stabilizing role appears limited in magnitude relative to the significant destabilizing effects of foreign investors in the Korean market. All the domestic institutional sectors tend to trade on the opposite side of foreign investors as trading counterparties, at both short-term and medium-term investment horizons. This may imply that domestic Korean institutional investors more or less contribute to absorbing the shocks from foreign investors and thus tempering market instabilities provoked by foreign investors (IV.3).

Chapter V explores the implications of institutional investors' procyclical herding on stock markets and the real economy. Section 1 describes short-termism in finance, wherein even long-term investors and individuals are obsessed with short-term quantitative performance (V.1). Section 2 analyzes how short-term procyclical investors can lead to the short-termism of corporate governance with a particular focus on microeconomic relations of institutional investors with investee corporates under the shareholder value-oriented system. Procyclical institutional investors can impact corporate governance directly by ownership engagements as the major shareholders. Some procyclical institutional investors have no incentives for the ownership engagements, whereas some, like hedge funds and PEFs, are so-called "activist shareholders" seeking short-term quantitative profits only. Thus, corporates are forced to make decisions skewed for cash dividends, stock buy-backs, immediate quantitative restructuring, or real investments realizing short-term profits at the expense of long-term productive investments. Even the supposedly long-term institutional investors do not have responsibilities as corporate owners for promoting sustainable growth and maintaining a trust relationship with corporates in reality (V.2). Section 3 explains the macroeconomic implications of procyclical herding for financial stability and the real economy. At a macroeconomic level, procyclical herding creates amplified market cycles going with recurrent booms and busts and increases short-term price volatilities. The amplified market cycles influence the real economy, resulting in intense business cycles through the wealth effect and collateral effect (V.3). Section 4 raises questions about financial instability and regulatory interventions. It rationalizes the legitimacy of policy interventions for financial stability and investigates the existing regulatory frameworks potentially addressing institutional investors' procyclicality. Then, it proposes possible macro-prudential policy options for preventing procyclical investments by institutional investors (V.4). Section 5 raises initiatives for long-term finance that can support the transition toward a low-carbon economy, a critical and urgent goal of the current capitalist system (V.5).

CHAPTER I

Conceptual framework on procyclical herding

This chapter constitutes the conceptual framework of procyclical behavior in stock investments. The procyclicality of the financial system in relation to the real economy is a theoretical concept that has a long history. However, since the global financial crisis, a growing number of studies have focused on procyclicality in investors' investment behavior that destabilizes markets from a financial stability perspective. While policy authorities initially raised the concerns in terms of financial stability, procyclical behavior is essentially a result of investors' investment decisions with regard to price movements and closely related to momentum strategies conceptually. Therefore, the procyclical investment behavior can be interpreted in the existing asset pricing framework. It may serve as an asset pricing mechanism itself, especially when the procyclicality is collectively represented among investors.

The remainder is structured as follows. Section 1 starts with describing the classic concept of procyclicality of the financial system in relation to the real economy and then defines procyclicality in investment behavior in relation to price movements. Section 2 explores the theoretical rationale of procyclical herding in the existing asset pricing theories.

I.1. Procyclicality from a macro-perspective

I.1.1. Classical concept of procyclicality

The financial system is excessively procyclical, unnecessarily amplifying swings in the real economy (Borio et al., 2001). Financial Stability Forum (2009) defines procyclicality as "the mutually reinforcing interactions between the financial and the real sectors of the economy, amplifying business cycle fluctuations and exacerbating financial instability." While the global financial crisis of 2008-2009 kindled the discussions on it, procyclicality is a theoretical concept that has a long history itself, tracing back at least to Fisher (1933). Fisher's "debt-deflation" is in line with procyclicality in that it emphasizes a feedback loop of a self-feeding spiral of debt liquidations, forced asset fire-sales

for debt repayments, a fall in asset prices, and cutbacks that may easily throw the economy into depression. The theory focuses on procyclical credit supply and deflation as a dominant driver leading to downward economic deviations from equilibrium.

While Fisher underlines a propagation mechanism of negative shocks caused by declines in credit supply and deflation, the financial instability hypothesis of Minsky (1992) focuses more on the behavior of heavily indebted borrowers in explaining reinforced economic cycles. Minsky demonstrates the process of how the business cycle is amplified on both upswings and downswings by a procyclical credit cycle of expansions and contractions. Over the periods of prolonged prosperity, economic agents with euphoric optimism take on excessive debts. The debt-financing spending induces the economy to excessively over-expand, and financial fragility is built with growing debt servicing charges of indebted agents in the upswing economy. At a point when the upswing economy exhausts itself with a slowdown of income growth, falling corporate profits, etc. or witnesses a trigger event near its cyclical peak (the *Minsky moment*), general market mood changes from euphoria to fear, credit supplies are sharply squeezed, forcing highly indebted agents in a panic to sell assets at discounted prices and cut back spending. The capitalist economy tends to follow a growth path with such recurrent amplified cycles.

Some literature explains the procyclical credit cycle with the information asymmetry problem between borrowers and lenders, or inappropriate estimation practices for risks. According to the "financial accelerator" of Bernanke and Gertler (1996), during economic downturns, borrowers, even with profitable projects, face difficulties in finding credits with decreases in collateral values against which they can borrow in the presence of the information asymmetry. However, during economic upturns, they can easily access credits with increases in collateral values. Borio et al. (2001) focus on market participants' inappropriate responses to changes in risk over time, which serves as an additional procyclicality source in credit supplies. Due to difficulties in measuring risks, market participants tend to under-estimate default risks on loans in an economic boom and over-estimate in a recession.

Meanwhile, Shiller sheds light on social and psychological dynamics to explain how bubbles are accumulated in speculative asset prices and come to an end. He proves excess stock market volatility that cannot be justified by the present value efficient market models, which implies "fads" or "bubbles" in asset prices (Shiller, 1990). In his books, *Irrational Exuberance* (2000/2015) and *Animal Spirits* (2009), he demonstrates structural, cultural and psychological precipitating factors of U.S asset

market bubbles underlying speculative market behavior from the early 1980s up to present. He argues that changes inside and outside markets experienced during recent three decades, such as demographic aging, the expansion of pension funds, respect for the private property amid declines in labor unions and communal social movements, new media as a vehicle of spreading ideas, information and technology revolutions, fed speculative investors and market bubbles. Markets are driven by how irrational investors subject to sentiments respond to fundamental information, which makes markets change dramatically.

I.1.2. Procyclicality in investment behavior of institutional investors in stock markets

While previous discussions are primarily devoted to procyclicality in banks' credit supplies in relation to real economic cycles, a growing number of studies focus on procyclicality in institutional investors' investment behavior from a financial stability perspective since the global financial crisis. It is often addressed in the context of cross-sectional risk transmission channels propagating risks to the whole financial system, especially in times of market distress. Procyclical behavior of institutional investors during market stress causes negative price dynamics and increases short-term price volatilities in stock markets, whereby losses are spread to other parts of the financial system through complicate interconnectedness among institutions, balance sheets loss contagion, funding markets, and collateral channels (Allen and Carletti, 2008; Adrian and Shin, 2008; Brunnermeier and Pedersen, 2009; IMF, 2014, etc.).

The procyclical investment behavior of institutional investors also contributes to amplified cycles in financial and economic time-series. Although there are parallels, stock market booms and busts are exhibited in an asymmetric way in usual. Explaining stock market busts often require taking into account different factors than explaining bubbles. In an upswing phase, the market experiences a dramatic upward price movement, which may be triggered by economic productivity shocks, but are more often reinforced by investors' procyclical rush for the rising stocks based on exaggerated optimistic expectations for the productivity potential, like U.S dot.com bubbles of the late 1990s and the early 2000s. The procyclical behavior seeking a high return in the upward stock price momentum takes place in a dramatic but enduring way, accompanied by excessive liquidity preceded by long-lasting low-interest rates and accommodative monetary policy. Financial deregulations and market innovations allowing easy access to the financial system also progressively support the expansions of investors' risky asset holdings such as stocks, non-investment grade or subordinated debt securities, etc. The rapid upward trend ends with a sharp fall in prices triggered by a small market event,

concerns for fundamental values or changes in market sentiment. Even without the market trigger event, it is when the trending up movement becomes weak for investors to exit from the stocks to avoid decreases in profits. When the market gets into a downward phase, investors start to sell stocks to avoid further losses. This causes negative price dynamics and market turbulence. Collective pessimism for the future price movements and fear in a crowd is spread over the market, and the market liquidity starts to evaporate with surges in short-term money market interest rates. The market stress sometimes develops into a market crisis by procyclical operations of the financial system itself. As prices fall sharply, market participants swiftly shift from stock to government bond markets for *flight to quality* or *flight to liquidity*. The asset fire-sales by institutional investors in stock markets occur mechanically through automatic activations of internal risk management tools like stop-loss orders or portfolio insurance strategy algorithms facing drastic falls in stock prices. Stock investors trading on margins face margin calls on a massive scale, and their stocks are automatically sold to meet the required margin level. This is precisely what happened in the worldwide stock market turbulence during March and April of 2020 after the outbreak of the COVID-19 pandemic and other U.S stock market crashes of 1987, 2000, 2008, and 2011, etc. The market may revert to the fundamental value level but possibly in the long-run after producing excessive price variations.

Consequently, since the global financial crisis, political authorities and academy literature have defined procyclicality in investment behavior in stock markets, taking account of relations with price movements from a financial stability view. The European Commission defines a pattern as procyclical if it "unnecessarily amplifies swings in underlying economic cycles or contributes to excessive market movements."[1] Bec and Gollier (2009) consider a variable to be procyclical, if it "tends to increase when the overall level of the economy also rises, or the global financial market cycle is on the upswing." Bank of England (2014) gives a more precise definition of procyclicality: Procyclicality in the short-term as "a tendency to invest in a way that exacerbates market movements and contributes to asset price volatility," and in the medium-term as "a tendency to invest in line with asset price and economic cycles."

In this thesis, the definition of procyclicality in investment behavior is based on the existing definitions. Procyclical investment is defined as "buying stocks when prices rise and sell them when prices fall," increasing short-term price volatilities and medium-term market fluctuations. Furthermore, procyclical investment behaviors are often collectively represented by institutional

[1] Solvency II: Frequently Asked Questions (FAQs) – European Commission Internal Market and Services Directorate General (Abstracted from Boon et al., 2014).

investors. In this thesis, we call the collective procyclical representation as *procyclical herding*. When investors collectively engage in the procyclical investment behavior, they may impact the price movements. The procyclical herding can create the "mutually reinforcing interactions between investment behavior and price movements," a positive feedback loop between investors and prices. Therefore, the procyclical herding can be defined as a collective investment behavior causing mutually reinforcing interactions with prices.

I.2. Theoretical rationale of procyclical herding in relation to price movements

Though central banks and international organizations initially raised the concerns from a financial stability point of view, the procyclical investment behavior in the capital market does not essentially look different from the investment strategies in practice that call for "buying past winners and selling past losers." There are a variety of such strategies, including time-series momentum strategies[2], trend-chasing, stop-loss trading or portfolio insurance strategies, etc. The procyclical investment behavior is an investment decision responding to price movements under certain circumstances from an individual point of view. But when it is represented collectively, it can influence prices. Therefore, we may understand the rationale and nature of procyclical herding in relation to price movements in the existing asset pricing framework. The theories are devoted to giving micro-level explanations for the rationality (profitability) of momentum strategies and the origin of price momentum. The Noise Trader approach and the positive feedback theory of the behavioral finance may be useful to understanding the procyclical herding. Nevertheless, more fundamentally, the *self-referential finance* and *finance of conventions*, the French economic approach, may provide the ideal theoretical framework to interpret the procyclical herding. In the approach, procyclical herding can be interpreted as an asset pricing mechanism itself.

I.2.1. Procyclical herding and the Efficient Market Hypothesis

Under the Efficient Market Hypothesis (hereafter, EMH) (Fama, 1965, 1970), the market price of a stock is essentially consistent with its fundamental value, which is a net present value of future earnings from the stock. Rational investors expect the fundamental value rationally using all available

[2] The time-series momentum strategy entails buying stocks with recent history of good performance (past winners) and selling stocks with bad performance (past losers) (Jegadeesh and Titman, 1993; Bikhchandani and Sharma, 2001), whereas contrarian strategy proposes a trading strategy buying poorly performing stocks and selling better performing stocks (De Bondt and Thaler, 1985).

information. Even if the price deviates from its fundamental value, it is immediately corrected by arbitrages of rational investors to exploit price differences, and thus stock prices are supposed to follow a random walk process around at their fundamental values. Rational investors can gain profits through value-investing strategies that buy undervalued stocks and sell them when their prices go close to the fundamental values. The rational investors thereby stabilize the markets. From this view, procyclical or momentum investment strategies are irrational. The irrational procyclical behavior cannot be rewarded by excess returns because rational investors eliminate the opportunities of riskless excess returns through arbitrages. If irrational procyclical investors get excess returns than corresponding risks, it is only because they are lucky. In general, they are likely to continue to face a loss and eventually disappear in the efficient market.

Nevertheless, subsequent empirical studies uncovered anomalous phenomena, "momentum in stock prices" and "abnormal excess returns," which are difficult to reconcile with the EMH. Momentum strategies generate significant positive returns over 3- to 12- month holding periods (Jegadeesh and Titman, 1993).[3] Past price movements are helpful for investors to forecast future price movements and make investment decisions. The empirical finding challenged the EMH and Capital Asset Pricing Model (CAPM). Proponents of the EMH have explored the origin of prices' deviation from the fundamental values and the profitability of momentum strategies. They regard the abnormal excess returns as compensation for hidden systematic risks not explained by the CAPM.[4] Therefore, from the view of the EMH and related asset pricing models, procyclical or momentum investment strategies are irrational or risk-taking behavior. Only risk-taking procyclical behavior is rewarded by excess returns in compensation for bearing the risks.

I.2.2. Procyclical herding under the Noise Trader Approach, positive feedback theory, and behavioral finance

When George Soros (1987/2003), a successful speculator over the past decades, describes his investment strategy, he claims he bets not on fundamental values but future crowd behavior. In the

[3] On the contrary, De Bont and Thaler (1985) show that contrarian investment strategies earn abnormal positive returns over past 3- to 5- year holding periods due to the price mean-reverting. It is generally acknowledged that momentum strategy achieves significant positive returns in the medium term (3- to 12- months) and contrarian strategy is profitable in the short- (1 week or 1 month) and long-term (3- to 5- years).

[4] The three-factor model of Fama and French (1996) and four-factor model of Carhart (1997) attempts to find risk factors to explain the abnormal excess returns. Berk, Green and Naik (1998) suggest that the momentum effect can be caused by the natural temporary persistence of the systematic risks of each firm which will be represented by a tendency in the stock returns.

conglomerate booms in the 1960s and REITs booms in the 1970s, he saw a number of poorly informed investors excited about the outperformance of conglomerates. Soros says, “The truly informed investment strategy, in this case, was not to sell short in expectation of the future collapse of the conglomerate market boom but instead to buy in anticipation of further buying by uninformed investors” (Soros, 1987/2003).

The behavioral finance’s explanations of the price momentum and speculative momentum investors are essentially in line with Soros’s insight. Motivated by Tversky and Kahneman’s (1974) psychological research, they revise the perfect rationality hypothesis of the EMH focused on the fundamental value and introduce irrational investors in the markets. In other words, markets have rational investors but also irrational investors. The Noise Trader Approach calls these irrational investors “noise traders” with a cognitive bias whose trading is anchored at noise signals or sentiments, not fundamental values. They make investment decisions without the use of fundamentals, exhibit poor market timing, follow trends, and tend to over-or under-react to good and bad news (Ramiah et al., 2015). The noise traders can make prices away from the fundamental values, especially when rational investors’ arbitrages are limited due to risk aversions or certain institutional constraints.

The positive feedback theory (De Long et al., 1989) calls the irrational investors “positive feedback traders” who form extrapolative expectations and trade on past price movements, buying when prices rise and sell when prices fall. In the presence of positive feedback traders, rational speculators bet on the short-run future direction of the market if they expect prices to move away from fundamentals. Rational speculators ride the price momentum rather than bet against the trend because they expect prices not to return to fundamental in the near future. Then, positive feedback traders, in turn, react to these price movements. That is to say, when rational speculators buy expecting a future price increase, and so raise prices, positive feedback traders react to today’s price rise by buying and so raising future prices even further. As a result, prices move further away from fundamentals even when rational speculators are present. Rational investors speculate on the behavior of other positive feedback investors in anticipation of price increases by them and activate the positive feedback strategies of other investors. The price increases initiated by rational speculators accelerate due to following positive feedback investors. When the price increases stop, rational speculators collapse the prices to the fundamental values through disinvestments or short sales. This theory tells that rational speculators destabilize stock prices in the presence of positive feedback traders rather than stabilize them. The rational speculators are rational in that they make a profit by riding price momentum

reinforced by positive feedback investors. This is precisely the same story as Soros' investment strategy.

The imperfect rationality hypothesis of the behavioral finance is incorporated with the form that individuals are subject to behavioral errors based on heuristics and cognitive biases. The heuristics and cognitive biases in individual investors' psychology lead to investors' under- or over-reaction to past returns or fundamental information, which causes prices' deviations from the fundamental values and increased price volatilities. For example, investors with asymmetric risk preference depending on past investment performances can make the price much more volatile than underlying dividends. Based on the prospect theory, investors who have experienced subsequent losses in their stock investments are more risk-averse (loss-aversion) and thus reluctant to invest in stocks, but investors who have subsequent prior gains are less risk-averse and thus extend stock investments more willingly (Barbeis et al., 1998). The conservatism bias makes investors under-react to new information and slowly incorporate the information into the prices, which produces a price momentum (Barberis et al., 1998). Under uncertainty, individuals have a strong tendency for herding a larger group, based on social norms of conformity or a belief that a large group cannot be wrong. It is in line with Keynes' insight, "Worldly wisdom teaches that it is better to fail conventionally than to succeed unconventionally" (Keynes, 1936). In usual, the herding arises in a procyclical manner (Bikhchandani and Sharma, 2001).[5] As long as prices are on a trend driven by irrational investors, investors can gain short-term momentum profits without taking risks by riding on the trend. But the mispricing is eventually corrected as rational investors bet against the mispricing at the cyclical peak or information is gradually incorporated into prices by irrational investors with a cognitive bias. Thereby the stock prices revert to the fundamental values in the long-run. Hirshleifer (2001) says, "The purely rational paradigm will be subsumed by a broader psychological paradigm that includes full rationality as a significant special case."

Under the behavioral finance, investors engaging in procyclical herding are irrational investors such as noise traders and positive feedback investors. The irrational investors' procyclical herding arises based on individual cognitive biases. But the approaches show, in the presence of sufficient numbers of irrational procyclical investors that can impact prices, even rational investors can reform into

[5] Numerous studies explain herding in terms of the information asymmetry rather than cognitive bias. According to the information cascades model (Bikhchandani et al., 1992), investors who decide on investments early are likely to have superior private information. Thus, the actions of previous investors reveal their information and other investors having inferior private information try to mimic the same actions. From this view, herding is a rational strategy for uninformed investors as a process of discovering the fundamental values of stocks.

procyclical investors. They are still rational investors exploiting short-term price movements. In the positive feedback theory, investors' expectations play a crucial role in creating positive feedback effects between investors and prices. Investors make investment decisions in anticipation of other investors' behavior or price trends, not fundamental values. Rational investors anticipate future price movements based on other positive feedback investors' behavior, and positive feedback investors trade on the price trend under the extrapolative expectation that the recent past price trend will continue in the near future. The expectations interplaying with other investors and price trends are self-fulfilling.

The behavioral finance proves (temporary) price deviations from fundamentals through a bottom-up approach, employing individualistic assumptions. Therefore, it is limited to explain procyclical herding as a collective behavior and its interactions with market prices in aggregate. In the behavioral finance theories, the presence of irrational investors with a cognitive bias is necessary for proving price deviations and the market inefficiency. Only individuals' simultaneous cognitive biases in the same direction could serve to a collective irrational behavior (collective irrationality). However, it is difficult to justify the majority of investors commit the same cognitive errors. Investors' behavior and the market in aggregate may be an entity, not a sum of individuals.

I.2.3. Procyclical herding under the *self-referential hypothesis* and *finance of conventions*

The self-referential hypothesis and finance of conventions (Orléan, 2004, 2005, 2007, 2011) are a heterodox French school approach that inherits the works of Keynes. They attempt to demonstrate the "generalized mispricing" in stock markets driven by investors' stock evaluation process and investment behavior. When investors make an investment decision, they are more concerned with other investors' majority opinion than the fundamental values because the majority opinion influences the future price movements. This view is also reflected in the Noise Trader Approach and positive feedback theory where rational investors are concerned about the behavior of irrational investors, i.e., noise traders or positive feedback investors, and bet on the price movements driven by irrational investors, even if they know the fundamental values and their investments are wrong from the fundamentalist view. The investment strategies in anticipate of others' behavior or major opinion on price movements can maximize investors' profits, at least in the short-term.

Investors engage in the self-referential process to know others' expectations and behaviors. The stock markets are a social place where investors interact with one another to know a major opinion, i.e.,

what other investors think. Everyone tries to know what others expect the major opinion to be. What is important in the markets is now to know the major market opinion, not the stock's fundamental value. It is analogous to the Keynesian beauty contest metaphor[6]. Winners in the beauty contest (stock market) are those who anticipate well what the other participants (the major market opinion) choose, not those who know the beauty of faces (the fundamental value). Betting on stocks that they think the majority investors will later decide should be a more profitable strategy than discovering undervalued stocks. The probable result is that investment behavior becomes extremely volatile because the fundamental values are ignored and that investors understanding mass psychology can gain more profits.

However, investors tend to coordinate around the market convention. The market convention is a stabilized result of investors' self-referential interactions. It is a general agreement on uncertainties that unfold while the market evolves. Investors consider it as a collective belief and try to follow it as a reference norm. The market convention works as the reference point to which investors' attention may drown when they have to anticipate others' beliefs, as does a focal point in the game theory of Schelling (1960) and related experiments of "salience" (Mehta et al., 1994).[7] Here, the market convention is a price trend itself that reflects the majority investors' support. It is more prominent, especially when investors have experienced a strong price trend for an extended period. The price trend is a reference point on which investors expect future price movements.[8] Through the price trend, the stock market accesses an autonomous social life and forces everyone to position themselves in relation to it (Orléan, 2004). As such, the price trend replaces investors' personal beliefs on corporates' fundamental values. From the conventionalist view, noise traders and positive feedback investors are also strategically rational like rational speculators.

As a result, under the approach, procyclical herding is a strategically rational investment strategy and the product of a general decision-making process to make profits in stock markets. Investors herd the majority investors following the price trend, which is a way to proceed the future price movements

[6] Keynes described rational investors' behavior in the stock market using an analogue of a beauty contest announced in a London newspaper. Participants of the beauty contest were asked to pick a set of the most beautiful six faces from 100 photos of women. Participants who pick a top ranked beautiful face were granted a prize. "It is not a case of choosing those (faces) that, to the best of one's judgement, are really the prettiest, nor even those that average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practice the fourth, fifth and higher degrees." (Keynes, 1936)

[7] In the experiment of Mehta et al. (1994), players choose the strategy corresponding with the focal point in the expectation that others will recognize it and do the same. This shows that players draw on the shared concepts of salience to identify 'focal points' on which they can coordinate.

[8] For the more explanations in detail, see Chapter II

and gain profits (or avoid further losses). Although the conventionalists do not explicitly use the term "procyclicality," their description of stock market investors adhering to the self-referential process and the price trend as the market convention essentially coincide with the concept of procyclical herding described by political authorities in section 1. They show prices can continue to deviate from the fundamental values without the assumption of irrational investors. Even if all investors know the fundamental values and some personally believe the fundamental estimation is right, they willingly engage in the collective market belief adhering to the price movements, whereby heterogeneous individuals are transformed into a collective procyclical representation.

Under the self-referential hypothesis and finance of conventions, procyclical herding of investors can be interpreted as a pricing mechanism in stock markets that generate generalized mispricing, increased price volatilities, and amplified market cycles. Investors' interactions in a decision-making process can create the "mutually reinforcing effects between investment behavior and prices", which is the concept of procyclical herding. This nature of procyclical herding originates from the specialty of the stock market as a market of a financial asset with liquidity. In the stock markets, investors can buy stocks and resell them at a higher price in the future. Rises in stock prices increase the wealth of the stockholders. Contrary to commodities whose values are usually objectively determined by their "utility," stock values are determined by the majority investors' preference (Orléan, 2011). A rise in a stock price rather promotes new demand than discourages it because the rising price proposes investors high future profitability of their stock investment and increased wealth, whereby the price rise attracts more investors to the stock. The added demand boosts the price up again, and the additional rise in the price encourages new demand. As long as the major investors believe that the trend will continue for a while, even if they know the market price has bubbles, the optimal strategy will be to get high profits by participating actively in prompting the bubbles. The upward price trend (market convention) persists until investors observe repeated incoherent facts (inferior returns to the expectation) so that they are forced to give up the convention and correct their strategy. On the other hand, in a downswing phase, prices often go down far below the fundamental values. But the price depreciation or under-valued stocks often fail to promote demand of the stocks and rather undermines potential buyers because the price depreciation signifies a decrease in investors' wealth. The endogenous positive feedback loop between investors and prices can eventually lead to speculative bubbles followed by a dramatic collapse, which constitutes self-realizing price evolutions in stock markets. This is distinguished from the commodity markets, where prices play an automatic stabilizing role by changing the supply and demand of goods.

I.3. Summary

For summarizing, procyclicality in investment behavior is defined as "buying stocks when prices rise and selling them when prices fall," leading to increased short-term price volatilities and medium-term market fluctuations. Especially, we focus on institutional investors collectively representing procyclical investment behavior (*procyclical herding*) because the procyclical herding may impact the future price movements and create mutually reinforcing interactions with price movements. From this perspective, the procyclical herding can be defined as a "collective investment behavior causing mutually reinforcing interactions with prices."

From an individual point of view, the procyclical investment behavior is essentially an investment decision responding to price movements under certain circumstances, which, in turn, can impact future price formation. Therefore, we can identify the rationale and nature of procyclical herding in relation to price movements in the existing asset pricing framework. Under the EMH and related studies, procyclical herding is irrational or risk-taking behavior. The irrational behaviors are supposed to face losses continuously and disappear in the markets. Only risk-taking procyclical behavior can be rewarded by abnormal excess returns. Nevertheless, the EMH appears to give limited explanations to the rationale of procyclical herding and thereby price deviations. Under the behavioral approach, including the Noise Trader approach and positive feedback theory, investors engaging in procyclical herding are irrational investors such as noise traders and positive feedback investors. The irrational investors' procyclical herding arises based on individual cognitive biases. In the presence of sufficient numbers of irrational procyclical investors that can impact prices, even rational investors can reform into procyclical investors. However, in the behavioral finance, procyclial herding's rationale relies on the restrictive assumption that individuals have the same cognitive bias simultaneously (collective irrationality).

Under the self-referential hypothesis and finance of conventions, procyclical herding is a rational investment strategy and the product of a general decision-making process for making profits in stock markets. Stock market investors engage in a self-referential process to know the majority market opinion determining the future price movements. Investors in the self-referential process for investment decisions ultimately coordinate around the market convention, which is typically the price trend that they have experienced, not fundamental values. As a result, investors herd the majority investors following the price trend because it is a way to proceed the future price movements and gain profits (or avoid further losses).

The theoretical rationale of procyclical herding that this thesis discusses is rooted in the self-referential hypothesis and finance of conventions. Investors' rational investment strategy with regard to price movements presumed by this approach essentially coincides with the concept of procyclical herding described by political authorities. Investors' attachment to others' behaviors or expectations in a decision-making process and their collective coordination around the price trend produce a generalized mispricing in stock markets, continuously disassociating prices from fundamental values, causing increased price volatilities and amplified market boom and bust cycles. The investors' collective positioning with regard to price movements is in line with the "mutually reinforcing interactions between investment behavior and prices," the concept of procyclical herding defined above.

Tab.I-1 Comparison of interpretations of procyclical herding

	EMH	Behavioral finance	Self-referential hypothesis, Finance of conventions
Stock pricing	The price is consistent with the fundamental value by investors' rational expectations and rational arbitragers' arbitraging activities.	Stocks can be temporarily mispriced by investors' imperfect rationality but eventually adjusted toward the fundamental values in the long run, as new information is gradually incorporated into the prices, or rational investors bet against the trend at the cyclical peak.	There is a generalized mispricing in stock markets under uncertainty. Prices are determined by the major opinion that may be false.
Causes of price momentum	The price momentum is regarded as a reflection of hidden risks.	Irrational investors with cognitive biases	Investors' self-referential interactions and coordination around the market convention (the price trend). As a result, they herd the majority investors following the price trend.
Persistency of the price momentum	Prices revert to the fundamental value quickly with rational investors' arbitrages.	The price momentum persists temporarily. The mispricing is gradually corrected in the long run (overshooting and correction)	The price momentum persists until investors observe repeated incoherent facts for the current price trend (decreased profits than the expectation, etc.) and correct their strategy.
Interpretation of procyclical behavior/momentum strategy	Procyclical herding is irrational or risk-taking behavior. Irrational procyclical investors will continue to face a loss and eventually disappear in the efficient market. Only risk-taking procyclical behavior can be rewarded by excess returns corresponding to the risks	Irrational investors engage in procyclical herding. Even rational investors reform into procyclical investors so as to exploit excess returns without taking extra risks over some time.	Procyclical herding is a rational investment strategy and the product of a general decision-making process for making profits in stock markets. Procyclical herding of investors can be interpreted as a generalized mispricing mechanism in stock markets.

Source: author's compilation

CHAPTER II

Psychological and institutional forces of procyclical herding

Investors are psychologically biased, socially embedded and institutionally situated in stock markets. The stock market environment influences investors' preferences, decisions, and actions. The stock market environment is also affected by investors' actions. Individuals do not just interact with their environment, which includes other individuals, groups of individuals, and the collectivity, but their interactions have consequences for their decisions. It applies to not just non-professional individual investors but also professional institutional investors. Undoubtedly the latter is thought to be more situated at the heart of developed market capitalism, despite their superior abilities to find economic fundamentals.

This chapter takes an extensive examination of psychological and institutional mechanisms existing in the contemporary capitalist stock markets that potentially encourage institutional investors' procyclical herding. A plurality of psychological and institutional factors, none of which is captured by traditional asset pricing models, conspires with investors' behavior in the market. It is not easy to isolate the effects of one factor from those of others and to quantitatively identify them. In this context, this chapter may have similarities with the "Noise Trader Approach," which focuses on market structures that limit arbitraging activities of rational arbitragers by bringing up transaction costs, imperfect substitutes of a security, fear of future loss under uncertainty or specific micro-structure of stock markets, etc. However, while the "Noise Trader Approach" regards the correlated behavior, i.e., procyclical herding, as an irrational representation of irrational or ignorant investors (noise traders) who are subject to sentiment, this chapter notes that investors can exhibit such behavior on a rational basis, led by mechanisms inside stock markets.

The remainder of this chapter is structured as follows: Section 1 deals with how investors form their expectations in stock markets. The expectation is the root of all action. Section 2, 3, and 4 investigate various institutional mechanisms embedded in the contemporary stock markets that are likely to cause institutional investors' procyclical herding. Section 2 explores procyclical herding resulting from balance sheet dynamics and institutional characteristics of institutional investors. Section 3 addresses market innovations in trading practices during recent decades that encourage procyclical herding of

institutional investors. In the final section, we have a special focus on foreign investors, as one of institutional investor groups that supposedly have procyclical investment orientation and cause price instabilities in emerging markets.

II.1. How do investors form their expectations? : Individual rationalities and a collective representation

Behind every market boom and bust episode, there is a collective expectation that the current upward or downward price momentum will continue, at least in the near future. The collective expectation of the future price movement is dependent on the current price trend and reinforces the current price trend. As long as investors anticipate that the prices will continue to go up for a while, regardless of whether it is just a long-term adjustment process toward the equilibrium or a continuous mispriced movement, it would be the best option for investors to ride the upward price momentum by buying the stock that has seen rises in the price and to sell it at a higher price. While many asset pricing or bubbles theories provide explanations of asset price deviation from the fundamental, investors' expectation about future price movement is taken as exogenous. How do investors form their expectations in the stock market? Why do investors tend to believe that the current price uptrend or downtrend will continue for a while? Why are investors prone to a self-reinforcing expectation that reinforces the current price trend? This section addresses the related issues: How investors form their expectations at an individual level, how the individual expectations are merged into a collective expectation and mass-psychological dynamics, and why the collective expectation easily takes the form of the self-reinforcing expectation that reinforces the current price trend and causes market booms and busts.

II.1.1. Expectation formation at an individual level: The rational expectation, extrapolative expectation and reflexivity theory

The rational expectation theory introduced by Muth (1961) and popularized by the Lucas critique (1976) is a good starting point for discussing expectation formation. Muth (1961) formulates the hypothesis of how agents form their expectations as follows:

"Expectations, since they are informed predictions of future events, are essentially the same as the predictions of the relevant economic theory. ··· The hypothesis can be rephrased a little more precisely

as follows: that expectations of firms (or, more generally, the subjective probability distribution of outcomes) tend to be distributed, for the same information set, about the prediction of the theory (or the "objective" probability distributions of outcomes)." (Muth, 1961, p.316)

He assumes that all individuals are perfectly rational in *using economic theories* to form their expectations. The rational expectation is a model-consistent expectation, as "it models the agents as if they know the model" (Muth, 2011). Therefore, the association of the rational expectation with the EMH and the fundamental value postulates that the fundamental value reflecting all available information is the best forecast of the future asset return. The price is destined to move toward the fundamental value because investors with rational expectations based on the EMH and fundamental value theory expect that the future price will be equivalent to the fundamental value. In this context, individuals' expectations in the rational expectation theory are exogenously formed in the market, independent of other investors' behavior, current price trend, or others' expectations.

However, when there are uncertainties or asymmetric information relating to estimation of the fundamental value, the expectation formation, in reality, is consisted of various components that are interwoven, those of which could be a past price movement, valuations of other stocks with similar properties, or valuations of other investors as well as the fundamental information. Empirical studies on how investors form expectations in practice are scarce. Notwithstanding the rational expectation revolution in macroeconomics, a paradigm replacing the rational expectation with the extrapolative or adaptive expectation has been gradually emerging again. Results of experiments and surveys seem to support the idea that investors tend to hold the extrapolative or adaptive expectation weighing past experience more than new information when they anticipate the future. In psychological research, the adaptive expectation is proved psychologically more attractive and plausible. Adaptive expectations are consistent with the anchoring and adjustment-type processes are often found in the information-processing models (Tversky and Kahneman, 1974). For example, subjects of a psychological experiment tend to extrapolate past time series, which lead them to chase trends (Andreassen and Kraus, 1990). Buyers tend to hold an ongoing expectation of performance adjusted based on the currently available information (Winer, 1985). Shiller (1990) shows, in his survey subject to individual and institutional investors of the U.S IPO market, that half of the respondents appear to be referring to past price changes for an information source. He adds that the U.S stock market investors do not believe that the market will surely go back down in a couple of years if it goes up dramatically (Shiller, 2000/2015). Chow (2011) provides a statistical reason and strong econometric evidence supporting the adaptive expectation hypothesis in economics. Greenwood and Shleifer (2013) find

that six measures of investors' expectations for future stock market returns are highly positively correlated with past stock returns.

The findings of psychological biases in the human mind when making decisions provide theoretical backgrounds for investors holding the extrapolative or adaptive expectation anchored to past price trends at an individual level (Tversky and Kahneman, 1974; Barberis, Shleifer and Vishny, 1998). For example, they show that people's estimations in experiments are anchored to the initial values, even if the initial values are randomly given (*Anchoring*). This suggests that investors' expectations for future stock returns can often be anchored to high returns that they have recently observed. The anchoring and adjustment heuristics dynamics can explain the exponential smoothing in the adaptive expectations (Bell, 2009). Conservatism in the human mind leads investors to over-weigh prior belief and under-weigh new information to forecast the future price (*Conservatism bias*). Besides, people tend to be more influenced by salience and recency, the more frequent and recent instances such as rising or dropping stock prices that investors experience and hear from media every day (*Availability or Representativeness bias*). Even though investors face new information, they often fail to interpret the information accurately because of the biases. Once a strong price momentum is formed in the market, investors easily get to believe that the current tendency will continue at least in a short period, hesitating to consider or failing to interpret the new information accurately in their expectations, particularly for the near future, which is contrary to what the rational expectation theory proposes. When individuals' valuations and expectations are psychologically anchored to past increases in prices they have observed, they are likely to ride the increasing price momentum by buying stocks in the expectation of further price increases in the future. Nevertheless, the premise that investors as individual human beings are psychologically biased can be significant to the market as a whole, only when many individuals have psychological biases in their thoughts.

More essentially, the expectation in social science reflects a perception of subjects or facts by individuals that are easily influenced by the world where they live. Let me recall the reflexive expectation of George Soros (1987/2013). The successful speculator is the pioneer that suggests the idea of reflexive interplay among investors' expectations, underlying stock price trends and future price movements. He believes that the price formation is reflexive and predominantly influenced by a positive feedback loop between investors' expectations and prices. Here is Soros's view about investors' perception of reality and its central role in making future stock price movements.

"The underlying stock price trend influences the participants' perceptions through the cognitive function; the resulting change in perception affects the situation through the participation function. In the case of the stock market, the primary impact is on stock prices. The change in stock prices may, in turn, affect both the participants' bias and the underlying trend." (Soros, 2003, p.53)

He considers the expectations to be led by investors' biased perceptions of an underlying trend, not economic fundamentals. The actions based on the expectation impact fundamentals and prices in turn, which then influences investors' perceptions. This process is reinforcing, serving to continuous price deviation from the fundamental values and a boom/bust sequence. Typically, a self-reinforcing process undergoes orderly corrections in the early stages, and if it survives them, the bias tends to be reinforced and is less easily shaken. When the process is advanced, corrections become scarcer and the danger of a climactic reversal greater (Soros, 1987/2003). Eventually, when the price trend cannot sustain prevailing expectations, a correction sets in. Disappointed expectations and thereby faltering stock prices weaken the underlying trend. The reflexive theory poses challenges to the EMH based on the rational expectation and, in the meantime, is distinct from the adaptive expectation theory in a sense that self-reinforcing expectations are a key driver of positive feedback between prices and investment behaviors.[9]

According to all the arguments mentioned so far, it is the individual irrationality or limited rationality that leads investors to the self-reinforcing expectation formation. Individual biased perceptions of reality generate the expectations further accelerating the existing trends on which investors' procyclical herding occurs. However, the arguments relying on individual irrationalities cannot explain how individual irrationalities turn into a collective irrational representation. Individual irrationalities may cancel each other out when individual expectations are aggregated into a market's collective expectation. Or only simultaneous cognitive biases of individuals in the same direction could serve to a collective irrational expectation. It is in line with what Muth (1961) recognizes as follows;

"Allowing for cross-sectional differences in expectations is a simple matter, because their aggregate affect is negligible as long as the deviation from the rational forecast for an individual firm is not strongly correlated with those of the others. Modifications are necessary only if the correlation of the errors is large and depends systematically on other explanatory variable" (Muth, 2003, p.321)

[9] The expectation theories rooted in this idea are called "a positive expectation feedback theory"

II.1.2. Individual rationalities merged into a collective irrational expectation: Self-referential hypothesis, market convention, and self-reinforcing expectation

(*The self-referential process to form price expectation at an individual level*)

Consequently, we need to refer to the self-referential hypothesis of Orléan (2004, 2005, 2007, 2009, 2011) that offers a general hypothesis on how investors behave to generate expectations for the future stock prices. This hypothesis does not require individuals' particular cognitive biases to explain the self-reinforcing expectation formation in the stock market. Even without the assumption of cognitive irrationality, investors can easily expect that the current price trend will continue for a while, where procyclical herding occurs and the current price trend accelerates further. Let us look into the self-referential hypothesis.

For an individualistic approach, individuals' expectation formation for the future stock prices is essentially a matter of what *an investor thinks* the valuation of stocks is anchored. In other words, the process of individual expectation formation depends on her conception of the reference point to which the market price is valued. If *an investor thinks* that the market price is a reflection of the fundamental value, as the rational expectation theory and EMH presume, they will seek the models and new information crucial for predicting the fundamental values. Individuals will try to rationally establish the expectation system in mind consistent with the models that the orthodox asset pricing theories propose, using all available information for the best forecast. The reference point of her expectation is the future fundamental value which is exogenously determined outside the market, independent of other investors' behaviors. She is indifferent to others' behaviors, especially those who do not have information. After all, her subjective beliefs converge to objective model-consistent expectations. By contrast, if *an investor thinks* that the market price is a visible reflection of the majority investors' beliefs, their expectations will be anchored to the majority's belief that will determine the future price movement.[10] Therefore, identifying the majority preference is crucial for anticipating the future market movement and gaining profits. Facing the new information, they do not concern about what it means in terms of the fundamental value but how others will interpret and respond to it. This leads investors to be self-referential to anticipate others' behaviors. To what personal beliefs of individuals about stock valuations are dominantly anchored depends on historical and cultural contexts of a market at a given time where investors are situated.

[10] This results from the intrinsic characteristics of stocks as a liquid asset that can be resold in the future, as distinct from an ordinary good. Therefore, increases in stock prices by increasing demands by other investors give rise to increases in wealth of stockholders whereby investors can no longer be indifferent to others' actions in stock markets. Refer to Chapter 2-3 of <L'empire de la valeur> (Orléan, 2011).

Nevertheless, Orléan notes that individuals, in reality, are more apt to the latter case. It stems partially from difficulties and subjectivities in calculating the fundamental values, but more importantly, from difficulties in remaining indifferent to opportunities of short-term capital gains during an upward period or evasion of further losses during a downward period. In particular, investors with an investment horizon designed to pursue short-term optimization will be more likely to concern others' behaviors for gaining short-term price momentum profits. Consequently, even investors anchoring the fundamental value personally have to participate in the self-referential process to anticipate interacting investors' higher-order beliefs, especially when they see lasting gaps between prices and fundamental values.

(*From the self-referential process to the attachment to the market convention which serves to the emergence of a collective expectation reinforcing the current price trend*)

Then, how do self-referential interactions of investors lead them to self-reinforcing expectations? Let us recall the "market convention", a general agreement under radical uncertainty that unfolds while the market evolves. Investors consider it as a collective belief and try to follow it as a reference norm. When the market convention exists, investors no longer seek to anticipate each other's behaviors to anticipate future prices. Instead, they try to mimic just the market convention because the majority's behaviors are expected to simply draw on the market convention. As long as the market convention is stably placed as a collective belief that the majority supports, conformity to the market convention is regarded as a winning strategy for anticipating others' behavior and making profits from the market movement that will be determined by the majority's behaviors. Here, the market convention is the price trend itself that investors have been experiencing because the price is considered to reflect the majority investors' support and help them anticipate others' beliefs. Orléan (2011) writes about this as follows:

"We must leave the static framework of a pure coordination game and consider its dynamic counterpart. In the event that a coordination game is repeated in exactly the same fashion, a choice perceived as having salience at instant t will be perceived to have even greater salience at t+1. This force of precedence is what allows salience to acquire a power of its own, for the group preserves the recollection of its ability to achieve unanimity. A particular trace of salience, having been stored in collective memory, is reactivated when the group is confronted with a coordination problem that it recognizes to be similar. In this way there emerges what I call conventional belief, or more simply, conventions." (Orléan, 2011, p.219)

Historical precedents play a crucial role in the determination of the market convention. The price trend at the time *t-1* is likely to be a superior expectation of investors at *t* for the future price movement because the trend itself is the market convention representing the majority's collective belief. This market convention persists until investors observe repeated incoherent facts so that they are obliged to give up the belief and correct their strategy. As a result, individual investors form their expectations according to the price trend they have been experiencing or experienced in the past because it is the market convention that will determine other investors' behavior and, thus, the future price movement. An upward (downward) price trend drives them to bullish (bearish) expectations for the future price movement. The bullish expectation ultimately induces procyclical herding of investors and reinforces, in turn, the price momentum again, as long as the collective belief persists in the market. Interestingly, this hypothesis can be compatible with the fundamentalist approach. It allows individualistic fundamentalism to adhere to the estimation of the fundamental value. Even though certain investors personally believe the value justified in light of the real economy, they form expectations and act according to the collective belief (market convention, i.e., the recent price trend), not to a personal belief, because they expect others to have the same high-order expectations in the face of the strong price trend. Thus, the personal fundamentalist beliefs are only poorly transmitted to the marketplace, or sometimes not at all (Orléan, 2007).

The specialties of the self-referential hypothesis and finance of conventions in terms of expectation formation are found in two points: First, the self-reinforcing expectation can be formed based on individuals' rationality, contrary to the behavioral approach. Even though they may be aware that a stock is under-or over-valued, they continue to sell or buy it because what counts for them to make profits in the market is not what they believe to be the "right value" for the asset, but what they expect from others' behaviors. Accordingly, it is strategically rational for investors to have the self-reinforcing expectation following the price trend they experienced or experienced in the past.[11] There can be no doubt that procyclical herding occurs based on irrationality, but it can also occur based on perfect rationality. Secondly, this approach explains a relationship between heterogeneous individual expectations and their collective representation by relating individuals' behaviors to a collective belief or market convention. It demonstrates how heterogeneous individualistic expectations can be transformed into a collective expectation reinforcing the price trend, especially when there is a sustained or recurrent strong price trend in the market. The origin of the collective belief lies in shared

[11] This rationality is a broader meaning of rationality than the fundamentalist rationality in which investors' rational expectations for the future price movement are anchored to the fundamental value model in order to maximize profits.

historical and cultural points of reference that define the group's identity. The past brings investors legitimacies that restrict strictly the freedom of individuals, whatever their personal beliefs may be. The price movements are experienced by individuals as a force that is beyond their power to control and everyone is obliged to be positioned with regard to the price movement. With a disconnection between the personal belief and the collective belief allowed, individuals' beliefs are eventually merged into a collective belief through a self-referential process and adhering to the market convention that all groups will believe, where the collective representation emerges and is reinforced. We must be aware that it is not necessarily certain irrational human motives, e.g., the constraint of conformity, the propensities of herding, emulsion, or other-directedness that explain assimilation or adaption to others' behavior. Similarly, the self-referential hypothesis and market convention approach is also distinguished from the 'Noise Trader Approach' that requires the presence of a large number of irrational noise traders and limited arbitrages of rational arbitragers. In the former approach, all investors act rationally based on the *expectation for others' behavior* that others are all reacting to the presence of such positive feedback investors. As such, the self-referential behavior by rational investors serves to magnify collective blindness (Orléan, 2005).

II.1.3. Stock market mass-psychology as an entity

Kindleberger (1978/2015) and Shiller (2000/2015), in their masterpieces, describe mass-psychological dynamics that are recurrently observed in stock market history. Mass-psychology is a collective emotion or irrationality as an entity. It is not the sum of individual irrationalities or emotions rather influences individual irrationalities or emotions. Euphoria, mania, fear, and panic in a crowd are rapidly spread over the market through social interactions and increase investors' emotional arousal under pervasive uncertainty. This emotional contagion process ultimately generates synchronization of investors' trading behavior. During periods of dramatic price uptrends, there is a generalized feeling of profound optimism or euphoria in the whole economy, not just for the anticipation of future asset prices but also for anticipation of prosperity in the real economy. The market has a solid belief that this uptrend will continue, rather than a belief in the long-term price reversion. Repeated individual experiences provide strong emotional motivation for joining the collective blindness. Feelings of overconfidence of those who have ever experienced large profits from prior uptrends or sharp pain of regret of those who have not engaged in the profits that others have enjoyed fuel the decision of buying stocks in the price uptrends (Shiller, 2000/2015). The optimistic expectations become a self-fulfilling prophecy because investors buy more stocks for capital gains, which realize further price rises. The euphoria and excessive optimism accompanied by lax monetary policies and deregulations

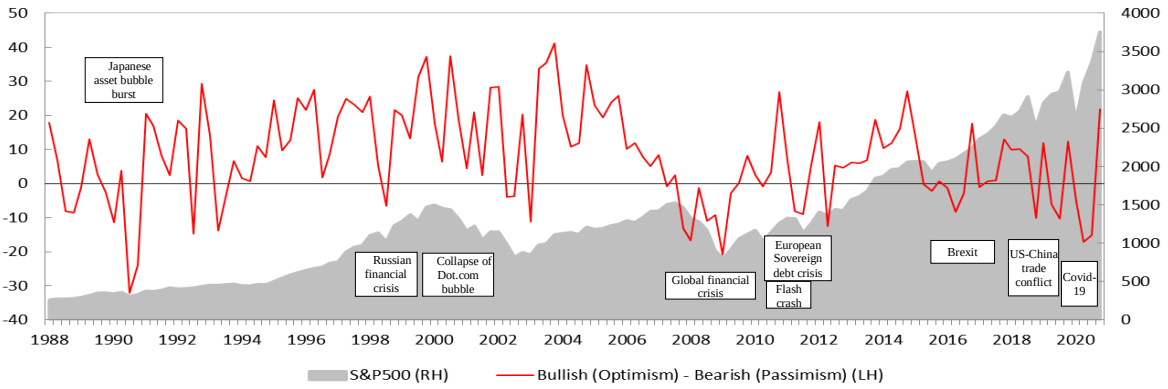
drive the economy to “speculation,” “mania,” or “irrational exuberance” in search of short-term profits. On the contrary, decreases in stock prices make investors discouraged. When the prices continuously decrease, the markets have collective pessimism that prices are not likely to rise for a while, leading investors to realize that they should sell their stocks before seeing further declines in the prices. Sometimes this realization occurs gradually, but sometimes suddenly, escalating the market pessimism into a panic (Kindleberger, 1978/2015). Investors swift from illiquid assets to liquid assets, to avoid further losses from drastic price declines of illiquid assets or secure liquid assets for a precautionary purpose. Panic feeds on itself until declines of prices are interrupted by contrarian investors tempting to buy illiquid assets at low prices or interventions of political authorities convincing investors to provide liquidity in need.

Fig.II-1 shows historical data of the U.S stock market investor sentiment survey conducted by AAII[12]. The survey measures the percentage of individual investors who are bullish, bearish, and neutral on the market short-term (next six months). Bullish (Bearish) indicates the percentage of investors surveyed that had a bullish (bearish) outlook on the market. The red line in Fig.II-1 represents (bullish – bearish) where positive numbers mean investors hold more optimistic expectations. The U.S stock market appears more prone to optimistic than pessimistic expectations as optimistic expectations are dominant for most periods of three decades. In particular, investors exhibit strong optimistic expectations over 1994-2007 for the stock price movement in the next six months. Over the period, the market was supported by the strong bullish market convention with only a few exceptions, even when the market entered a three-year downturn right after the collapse of dot.com bubbles. The persistent optimism even in the downturn may suggest that the market expectations depend on what investors have discovered and learned from the previous path. The U.S stock markets had experienced the sudden stock market crash of 1987 without lasting consequences and following long-lasting impressive returns, rather than expectations for mean-reversion after a dramatic rise in prices. According to Orléan (2005), since the 1987 market crash, it became apparent that sporadic crashes can occur without necessarily leading to a major macroeconomic crisis. Investors have subsequently modified their expectations of market opinion after a crash. This new model had a major influence during the crisis of 1997. A large number of investors kept calm and decided not to withdraw their funds. On the other hand, pessimism for the future stock prices appears temporarily only with specific events negatively influencing the market, such as the Japanese asset bubble burst, dot.com bubble crash, global financial crisis, and recent Covid-19 pandemic. While the pattern of long-lasting optimism and abrupt but temporary pessimism in the U.S markets appear to have changed since 2015,

[12] American Association of Individual Investors

the market is still experiencing a sharp upward trend. This may be explained by other factors such as quantitative easing and Taper Tantrum by the central bank, which leaves for future research.

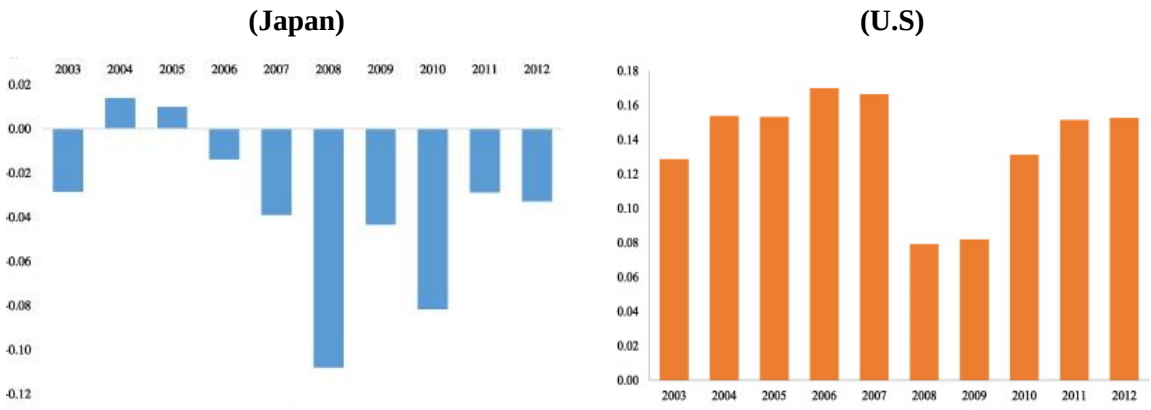
Fig.II-1 U.S stock market investor sentiments (expectations)[1) 2)]



Notes: 1) Bullish (Bearish) indicates the percentage of investors surveyed that had a bullish (bearish) outlook on the market. An investor that is bullish (bearish) will primarily think that the market will head higher (lower) in the next six months. The positive (bullish – bearish) represents that investors hold more optimistic expectations. 2) Backward moving average of the last four weeks applied.
Source: U.S AAII Sentiment Survey, Author's calculation

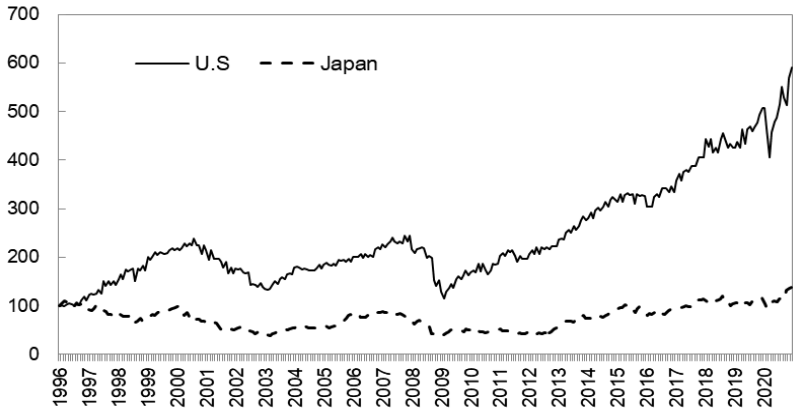
The market sentiment can vary according to historical and social contexts because information relating to the stock values is not interpreted in the same way by investors. This generates heterogeneous investors' investment behavior and price evolutions in different countries. Look at the stock market sentiment measures of Japan and the U.S over 2003-2012 (Fig.II-2). The sentiment measures are constructed by interpreting sentiments attached to news stories of market and firms using Thomson Reuters News Analytics machine learning (Khuu et al., 2016). A positive (negative) measure means positive (negative) market sentiment. The sentiment measures show contrasting market sentiments across the two countries. The Japanese market exhibits pervasive negative sentiment over most of the period, partly reflecting Japanese melancholia during long-lasting "lost decades" after asset bubble bursting. It is opposed to the predominant positive market sentiment of the U.S market, even in the financial crisis of 2007-2008, which is also largely confirmed in Fig.II-1. The Japanese prevailed pessimism after the bubble bursting is associated with the increased risk aversion of investors after the traumatic stock market crash, the long-lasting deleveraging process of banks, low GDP growth rates, and high preference for cash holding of households. But it is also associated with societal pessimism caused by structural factors of rapid demographic aging and a lack of national goal after the accomplishment of industrialization in the years of post-war (Shiller, 1996; van Houwelingen, 2016; Altman, 2019). It is contrary to the U.S markets that had experienced 'New economy' convention based on technology innovations during the same period. Fig.II-3 displays stock price evolutions of Japan and the U.S. The contrasting stock price paths in the two countries may suggest a strong relationship between expectation and price evolution.

Fig.II-2 Comparison of stock market sentiments[1)]



Notes: 1) It indicates a yearly market sentiment measure for the TOPIX (Japan) and the NYSE (U.S), respectively. This measure is constructed by interpreting sentiments attached to news stories of market and firms using Thomson Reuters News Analytics using machine learning. A positive (negative) measure means positive (negative) market sentiment.
Source: Khuu et al. (2016)

Fig.II-3 Comparison of stock price evolutions between the U.S and Japan[1)]



Note: 1) For comparison, stock price indices are computed to equal 100 at the reference year (Jan. 1996).
Source: Author's calculation

II.1.4. Summary

The dynamics of collective expectation formation in stock markets can be better explained by the self-referential hypothesis and the market convention theory, rather than individualistic approaches such as the rational expectation theory or the extrapolative expectation based on cognitive bias in the human mind. Investors' individual expectations are more likely to be anchored to the majority's belief that

will determine the future price movement rather than the estimation of the fundamental value. Identifying the majority preference is crucial for anticipating the future market movement and gaining profits. This leads investors to be self-referential to anticipate others' behaviors. But when the market convention is stably placed as a collective belief that the majority supports, they try to mimic just the market convention as a reference norm instead of being self-referential to others' behaviors. Here, the market convention is the price trend that investors have been experiencing because the price trend is considered to reflect the majority's support. An upward (a downward) price trend can drive them to bullish (bearish) expectations for the future price movement rather than the mean-reverting expectation. This is a robust framework because it shows how individual heterogeneous expectations are merged into a collective self-reinforcing expectation. The collective self-reinforcing expectation is formed based on individuals' perfect rationality and also compatible with heterogeneous personal expectations. Meanwhile, stock markets are prone to a mass-psychology, a collective emotion or irrationality, as an entity. It is not the sum of individual irrationalities or emotions rather influences individual irrationalities or emotions. Euphoria, mania, fear, and panic in a crowd are rapidly spread over the market through social interactions and increase investors' emotional arousal under pervasive uncertainty. The market sentiment can vary according to historical and social contexts because information relating to the stock values is not interpreted in the same way by investors. This can generate heterogeneous investors' investment behavior and price evolutions across different countries.

II.2. Institutional background of institutional investors' procyclical herding

The balance sheet structure of institutional investor groups is crucial for understanding how institutional investors make investment decisions. Notably, the institutional investors' procyclical herd behavior is associated with two institutional vulnerabilities inherent in the asset and liability design: Liquidity risk and leverage risk. Institutions structurally exposed to liquidity risk and excessive leverage are more likely to behave procyclically during boom and bust times. Moreover, recent external surrounding and industry practices - macroeconomic environment of prolonged low-interest rates and regulatory constraints, asset management delegations, etc. - poses challenges to even long-term institutional investors that are relatively free from the liquidity and leverage risks. In this context, this section analyzes institutional backgrounds arising from balance sheet structures that encourage institutional investors' procyclical herding. The institutional analysis includes three major institutional investor groups that account for important activities in stock markets: Investment funds, banks, and

ICPFs (insurance companies & pension funds). This section also focuses on complex investment chains centered on ICPFs through asset management delegations that decline the long-term and counter-cyclical nature of ICPFs' investment strategies additionally.

II.2.1. Balance sheet dynamics and institutional characteristics of institutional investor groups

(Investment funds)

- *Overview*

Investment funds are collective investment vehicles, pooling money from retail or other institutional investors and investing in a variety of assets. They include open- and closed-end mutual funds, Money Market Funds (MMFs), Private Equity Funds (PEFs), hedge funds, and Exchange-Trade Funds (ETFs), etc., of which open-end mutual funds[13], hedge funds, and ETFs are major stock market participants.[14]

Fig.II-4 presents a stylized balance sheet structure of typical equity and mixed mutual funds, hedge funds, and ETFs, respectively. The primary funding source of investment funds is fund shares or units issued to investors. For most investment funds, leverage funding through borrowing is prohibited or very limited depending on national regulations, except for hedge funds that typically depend on high leverage. Hedge funds raise funds through short-term borrowing from prime brokers, derivatives, or short-sales as well as equity capital. Considerable parts of those external borrowing are off-balance sheet items. The Assets under Management (AuM) of investment funds encompass a wide range of asset classes from short-term money market assets to bonds, stocks, and real estate properties, depending on funds' business models. Equity and mixed mutual funds invest mainly in stocks and debt securities in secondary markets.[15] [16] Other assets, including cash and deposits, are relatively negligible. Hedge funds have various assets, but there is great heterogeneity in hedge funds' asset

[13] The open-end investment funds are typically referred to as 'mutual funds' in the U.S, 'UCITS' in the EU, 'investment trusts (Toushin)' in Japan and 'beneficiary certificates' in Korea.

[14] Open-end mutual funds, PEFs, hedge funds and ETFs account for 63%, 9% , 5% and 6% of total investment funds of the world in 2013, respectively (IMF, 2015). The lion's share of the open-end mutual funds (46 trillion dollars in 2018) is equity and mixed funds that stand at 25.7 trillion dollars (56% of total open-end mutual funds). Most of the investment funds are managed by asset managers located in the U.S and Europe (IIFA).

[15] For the U.S open-end mutual funds, debt securities and stocks account for 33% and 58% of total assets, respectively, at the end of 2018. Cash and deposits account for only 0.7% of total assets. Their funding is usually fully from fund shares or units issued

[16] There are two dominant types of investment funds; corporate type (the U.S mutual fund model) and contractual type (German, U.K, Japanese, and Korean models). While investors of the corporate type funds are shareholders of fund shares, investors of the contractual type funds are beneficiaries of fund units or unitholders. Fund shares of the corporate type are an equity capital, but fund units of the contractual type are a liability. Thus, investors of the corporate and contractual investment funds have different legal rights but economically the same position for the fund.

compositions depending on business models. The assets of ETFs consist of constituent stocks of the benchmark index tracked by each ETF.[17]

Fig.II-4 Stylized balance sheet structure of investment funds

(Mutual funds - equity or mixed)

Assets	Liabilities/Equities
Cash and Deposits	Investment fund shares (units) issued
Debt securities	
Stocks	
Investment fund shares	
Others	

(Hedge funds)[1)]

Assets	Liabilities/Equities
Cash and deposits	Short-term borrowing from prime-brokers
Margins	
Debt securities	Equity capital and others
Stocks	
Derivatives and others	
(Off-balance sheet) Derivatives, short positions, etc.	

(ETFs)

Assets	Liabilities/Equities
Stocks (Constituents of the benchmark index)	ETF units issued

Note: 1) There is a great heterogeneity in hedge funds' balance sheet structure depending on business models
Source: Author's compilation

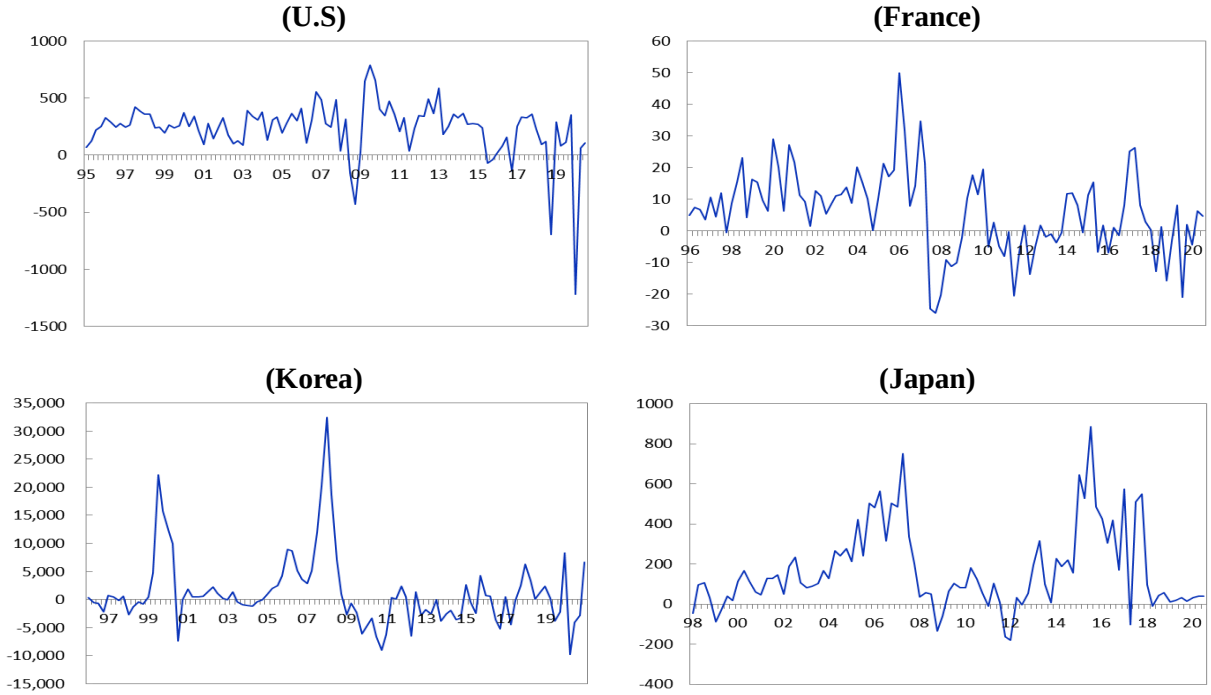
- *Open-end mutual funds: Liquidity mismatch*

Institutions are under two-dimensional liquidity pressure; funding liquidity and market liquidity. Funding liquidity is financial institutions' scarcity of capital. It is organizational liquidity that constraints the investment behavior of each institutional investor. Market liquidity is more related to asset side liquidity constraining the value of marketable securities that institutions hold. At first glance, the balance sheet structure of mutual funds is apparently resilient with respect to liquidity risk, as they fund from equity capital and have limited or no external borrowing. However, open-end mutual funds that are a dominant type of mutual funds in most countries are generally under high funding liquidity pressure because fund investors can exercise daily redemption rights with low costs. Even though the funds have long-term contractual maturities of five years or more, investors can redeem their shares or units easily and immediately and receive pro-rata portions of the current value of the fund's net assets in cash. In usual, redemptions of mutual fund investors are not independent of the market condition. Flows in mutual funds (injection or redemption of shares/units) have a procyclical tendency themselves. Fig.II-5 describes net inflows in mutual funds of four countries over two decades. Net inflows in mutual funds have a procyclical pattern. The mutual funds have positive net inflows in normal times, while they confront massive withdrawals of fund shares/units in stress times. It is

[17] Institutional characteristics of ETFs will be explained in more detailed in section 3 of this chapter.

observed in four countries that mutual fund investors redeemed their shares/units in stress times, including the financial crisis of 2008-2009, European sovereign debt crisis of 2011-2012, Brexit referendum of 2016, and Covid-19 crisis of 2020.

Fig.II-5 Net inflows in open-ended mutual funds[1) 2)]



Notes: 1) Billion in national currency 2) Net inflows in equity mutual funds for the U.S, Korea and Japan. For France, net inflows in all type of mutual funds. Source: OECD, U.S Fed, Bank of Japan, Korean Financial Investment Association

Mutual funds are also bound to market liquidity. Market liquidity generally refers to the convertibility of an asset into cash without a big loss.[18] Market liquidity is usually captured by "price movement" resulting from an asset trade at a given time (market depth). If a sell trade of an asset causes a large price drop, the market is considered illiquid because investors have to take a significant loss to sell their assets. In general, market liquidity has a fragile feature. Assets with high market liquidity in normal times easily turn into assets with low market liquidity when the market enters into turbulence. The illusion of market liquidity is more pronounced in risky asset markets such as stocks or corporate bond markets than government bond markets. Orléan (2011) notes, "*(market) liquidity has the aspect of a collective belief. It rests on the confidence that the financial community places in it*." Investors' confidence in stocks or corporate bonds is fragile relative to confidence in government bonds that the government guarantees. Consequently, market liquidity of marketable securities, especially stocks that equity mutual funds primarily hold on their balance sheets, tends to be drained more quickly than any

[18] Its original concept can be traced back to Keynes (1936), "*One asset is more liquid than another if it is more certainly realizable at short notice without loss.*"

other type of securities when the market goes under stress. Liquid stocks in normal market condition turn into illiquid stocks in stress times due to growing concerns about credit risk.

Procyclical injections and redemptions of fund investors drive asset managers to procyclical investment behavior in both normal and stress times. Money inflows to open-end mutual funds in normal times push mutual funds to purchase more stocks, accelerating a rising price momentum further. But in stress times, asset managers in the face of fund investors' massive redemptions from underperforming mutual funds are forced to sell their stocks at discounted prices caused by a sudden drain of stock market liquidity. Unit- or shareholders may overestimate the liquidity of their fund's assets without considering costs or difficulties related to disposing of the assets or rebalancing portfolios in turbulent times (FSB, 2017). Overestimating market liquidity of assets held by funds, sometimes they make greater redemptions than would be the case if investors had directly invested in stocks. Some open-end mutual funds even generate incentives for a "first-mover advantage" that incentivizes fund investors to exit from the funds ahead of others (IMF, 2015). Massive asset sales by asset managers to meet redemptions during stress times can produce negative price dynamics with the potential to result in additional redemptions and asset sales, which may ultimately contribute to stress contagions across asset classes as funds sell a range of illiquid assets.

Open-end mutual funds with funding redeemable at any time with low costs and marketable securities holdings are likely to be sensitive to short-term market changes and have short-term investment horizons. Procyclical changes in funding constraints and asset values give them intense pressure for short-term performance and make it difficult for them to have a long-term investment perspective over multicycles of markets.

There is a number of evidence supporting that mutual funds (or investment funds) are procyclical or momentum investors. Chevalier and Ellison (1997) confirm that injections and redemptions of U.S mutual fund investors are procyclical. They inject more resources into a fund when it performs well. Grinblatt et al. (1995) show that 77 percent of mutual funds are momentum investors in the bull markets, buying past winners, but most did not systematically sell past losers. Timmer (2016) also shows that German investment funds destabilize the market by responding in a procyclical manner to price changes. As procyclicality in investment funds' investments is present in both upward and downward periods, asset managers increase market volatilities and distort asset prices (Guerrieri and Kondor, 2012).

- *Hedge funds and some PEFs: High dependence on leverage*

Hedge funds and some PEFs have a different dimension of profit-risk profiles. Contrary to open-end mutual funds, hedge funds and PEFs have redemption restrictions such as closed-end with a long-term finite life, lock-up periods, or requirement of 90 days advance notice, etc. These restrictions mitigate potential fund runs and funding liquidity risk, allowing asset managers to have more discretion and pursue profitable strategies by investing in illiquid assets with a secured long-term investment horizon. Consequently, hedge funds and PEFs do not hold liquid assets for urgent liquidity needs, as shown in Fig.II-4. Instead, they invest in even more illiquid assets than stocks that cannot be converted into cash without a large price discount during stress times.

Typically, they make use of high leverage to boost investment returns. The investments incorporating high leverage to maximize returns generate a probability distribution of risk profiles with a fat left-tail (negative skewness, high kurtosis). Such fat left-tailed risk profiles can facilitate maximizing the expected investment returns during normal times. It is uncertain whether or not high leverage induces hedge funds to behave in a procyclical way in normal times, given their diverse business models. Evidently, hedge funds are the most sophisticated investors, probably closer to rational arbitragers trading against mispricing. One of their most popular stock strategies is the *long/short stock*, as 23.3% of hedge funds follow the strategies in 2006 (Lipper, 2007). It is a sort of a contrarian strategy, buying undervalued stocks and selling overvalued stocks, which may correct mispricing. Nevertheless, the empirical finding of Brunnermeier and Nagel (2004) argues that hedge funds invested procyclically during the U.S technology bubble, riding the technology bubble, not attacking it.

It is in stress times when high leveraged hedge funds are more likely to behave procyclically. The investment strategies generating the fat left-tailed distribution of investment returns make the high-leverage hedge funds and PEFs vulnerable to the distressed situation, creating extreme losses during turbulence, albeit with rare probabilities. In fact, hedge funds' strategies entailing high leverage recorded large losses in 2008, while some strategies trading against market movements gained positive profits (Rigot, 2010). The pursuit of the same strategies by hedge funds leads to increases in cross-correlations of losses among hedge funds during stress times, which drives a loss contagion and amplifies systemic risk. There are two channels through which the high leverage destabilizes the financial system in stress times. First, increased solvency risk of hedge funds can be directly transmitted to funding counterparties such as investment banks or other financial institutions (counterparty channel). The second channel is negative price dynamics caused by asset fire-sales (asset price channel). Leveraged funds are forced to behave procyclically when they have to reduce

exposures in order to obtain liquidity and deleverage during market downturns, affecting other market participants through declining asset prices and increased margin calls (FSB, 2017).

The procyclicality of hedge funds and some PEFs in stress times results from the high level of leverage that is obtained by short-term market funding. While they have a variety of leverage means, by far the vast majority of leverage is obtained by short-term collateralized borrowing provided by prime-brokers in the repo markets because only a few large hedge funds can directly issue long-term debt or manage to obtain medium-term bank loans or guaranteed credit lines (*The Economist*, 2007, 2011). Changes in margins or haircuts applied to collateralized borrowing according to market changes directly impact hedge funds' funding conditions. In this context, the leverage issue that leads hedge funds to procyclical behavior, especially during stress times, can essentially translate into a liquidity issue. Tab.II-1 summarizes institutional characteristics of investment funds with regards to liquidity and leverage risk.

Tab.II-1 Institutional characteristics of investment funds with regard to liquidity and leverage risk[1)]

	Redemption	Trading practice	Liquidity of fund assets	Leverage through borrowing	Leverage through derivatives	Type of behavior
Open-end mutual funds	Easy redemption from a fund	End of day	High-Low	Possible with cap, but not common	Possible with cap, but rarely used	Procyclical
Closed-end mutual funds	Not redeemable from a fund	N.A (primary), Intraday (secondary)	High-Low	Possible with cap, but not common	Possible with cap, but rarely used	-
MMF	Easy redemption from a fund	End of day	High	Possible with cap, but not common	Possible with cap, but rarely used	Procyclical (in money markets)
PEF	Closed-end with long-term finite life	N.A	Low	Some yes, no cap	N.A	Procyclical (high leveraged funds, in stress times)
Hedge fund	Quarterly, Redemption restrictions	lock-up periods, 90 days advance notice	Low	High, no cap	High, no cap	Procyclical (high leveraged funds, in stress times)

Source: IMF (2015), author's estimates

- *Current regulatory framework for investment funds*

We experienced some market disruptions resulting from structural weakness in the design of certain investment funds in history. A hedge fund, Long-Term Capital Management (LTCM), collapsed in 1998 due to its arbitraging strategy accompanying high leverage and distressed the financial system through complex interconnectedness with other institutions and markets. Structural vulnerabilities in MMFs that were subject to easy redemptions and supposed to maintain stable net asset values (SNAV)

were a source of market fragilities during the global financial crisis, though they do not have stock market exposures. Despite rare evidence of financial crises triggered by non-money market investment funds, FSB and IMF have recently been aware of their structural fragilities, as the development of the sector and their increasing security holdings suggest that risk may have increased in recent years (FSB, 2017; IMF, 2015).

Risk management tools to mitigate liquidity and leverage risk of investment funds have been developed by policy authorities and asset managers (Tab.II-2). Given diversities of investment funds and market circumstances across countries, international legislators take a principal-based approach by proposing policy recommendations on risk management to policy authorities instead of consistent quantitative requirements. A wide range of policy measures currently exist at a national level, but these measures vary considerably across fund types and countries. Most national regulators require investment funds to set up a defined redemption policy and risk management procedures. Beyond general principles, countries also impose mandatory regulatory requirements such as restrictions on the type of assets in which funds can invest, limits on investment in illiquid assets, asset concentration, and a leverage cap.[19] Some countries require a minimum amount of liquidity buffers[20]. These regulatory requirements primarily apply to open-end schemes, while closed-ended funds are subject to much less stringent requirements (IOSCO, 2015). In addition to national requirements, risk management is more reinforced by measures specified in the prospectus of individual funds, e.g., swing pricing[21], anti-dilution levies[22], gates[23], side pockets[24], redemption in kind[25], suspension of

[19] Most countries including U.S, U.K, most EU countries (France, Germany, Spain, Netherlands, Luxemburg, Ireland), Canada, Japan, Hong Kong, Singapore, Turkey, India, South Africa have national requirements of limits on illiquid assets, asset concentration and leverage for all or certain types of investment funds (IOSCO survey results, 2015)

[20] France, Germany (real estate funds), China (open-end funds) and Singapore require investment funds to hold liquid buffers (IOSCO survey results, 2015).

[21] Swing pricing is a mechanism that subscribing and redeeming share- or unitholders bear costs of transactions processed on assets by adjusting a fund' NAV.

[22] When a fund has requests of sizable subscriptions or redemptions of minor investors, purchases or sales of underlying assets to accommodate the requests incur trading costs and related expenses (transaction charges, brokerage fees, taxes and bid/offer spreads), which will be charged to other major investors in the fund. The anti-dilution levy is used to protect the majority of investors from costs of trading by a minority (https://approchesfinancieres.wordpress.com).

[23] A fund gate partially limits the abilities of investors to redeem from a fund. Unlike the suspension of redemption that suspend temporarily and completely redemptions, the gate slows the redemptions at a predetermined rate at which they have a limited impact on value and liquidity of the fund. However, when it is inappropriately designed, it could rather encourage investors' redemptions more (Bloomberg Law Report, 2011).

[24] A side pocket is a type of account created to separate illiquid and distressed assets from other liquid assets in a fund portfolio so that the drop in the NAV of illiquid assets does not affect the NAV of liquid assets in a case of a credit event. Separating illiquid and distressed assets protects the entire fund scheme from forced sales of good assets and declines in the fund value by limiting redemptions for these assets. But the side pocket should be used with a caution because when the valuation of illiquid and distressed assets is contentious, investors find it difficult to separate two NAVs, or the fund house could misuse the side pockets to protect asset managers' fees on liquid assets or hide poor performance of the fund. While it is commonly used to hedge funds, in some countries it is also permitted to use the side pockets in open-end mutual funds.

redemptions, etc. These tools may address liquidity risk by incurring redemption costs to investors that request redemptions, controlling the frequency of redemptions, resulting in orderly asset disposal in the best interest of all investors. In general, national regulators do not have the right to activate such risk management tools specified in the prospectus, except for a suspension of redemptions.[26] Consequently, the use of the optional tools is left up to asset managers' discretion in most countries.

Notwithstanding the efforts to mitigate risks from investment funds, the existing tools often face institutional impediments or may not sufficiently consider system-wide aspects of financial stability. First of all, inappropriately designed tools have the potential to amplify financial risks. The redemption gate that gives priority to early redemption requests generally encourages the first-mover advantage. The short-term borrowing to meet massive redemptions increases short-term leverage to a fund that is already in distress, which may aggravate strain and amplify interconnectedness with other institutions. Asset managers may also be less willing to activate such tools because of reputation and other impediments. More crucially, as supervisory authorities have no intervention rights to the optional risk management tools of individual funds and the tools aim to investor protection and market integrity with limited attention to financial stability, asset managers may fail to mitigate system-wide build-ups of risks. The use of the tools in the best interest of the fund investors may contribute to unintended negative outcomes to the financial system. For example, redemption gates or suspensions could cause spillover effects on other investors, funds, and ultimately widespread rush to redemptions in stress times. Collective procyclical behavior of investment funds causing asset boom and bust cycles may need to be addressed by national supervisory authorities with a system-wide perspective. But the existing supervisory tools appear insufficient in mitigating the procyclical tendency of fund flows and high reliance on leverage. Despite enhanced leverage controls, most countries do not still impose a leverage cap on hedge funds. Though European countries and ESMA[27] are allowed to impose hedge funds a cap on leverage by the AIFMD[28], the tool has not been used up to date (FSB, 2017).

[25] Redemption in kind is a payment by securities or other instruments rather than in cash. It is rarely used to mutual funds but commonly used to ETFs.

[26] Compared to other tools, the activation of a suspension of redemptions is strictly regulated by regulatory authorities in countries. It cannot be activated in normal times in most countries and in the U.S, Spain, Canada and Turkey, regulatory approval is required beforehand for the activation (IOSCO survey results, 2015).

[27] European countries and the European Securities and Markets Authority

[28] Alternative Investment Fund Managers Directive

Tab.II-2 Liquidity and leverage management policies of investment funds

	Liquidity mismatch	Leverage[4)]
Policy recommendation of FSB to policy authorities	• Consistent reporting requirements to authorities for effective monitoring and improving disclosure to investors • Liquidity risk management tools available to open-end funds to reduce first-mover advantage • Provide guidance on open-end funds' use of exceptional liquidity risk management tools in stressed conditions • System-wide stress testing that captures effects of collective selling by funds and other investors on the resilience of financial markets and the financial system	• Identification and development of consistent measures of leverage in funds • Data collection on leverage in funds and enhanced monitoring of the use of leverage not subject to leverage limits
National regulatory requirement[1)]	• Limits on illiquid asset investment[3)] • Limits on asset concentration[3)] • Liquidity buffers • Maturities restriction[3)] • Timing restrictions between subscription and redemption • Short-term borrowings to meet redemptions[3)] • Withdrawal rights • Buybacks • Valuation at bid price • Exemptions to redeem at any time, etc.	• Limits on leverage (leverage cap) [3) 5)] • Limits on derivatives use[3) 5)] • Reporting and/or disclosure on leverage
Measures in prospectus of individual funds	Swing pricing, anti-dilution levies, side pockets, gates, redemption in kind, suspension of redemption, etc. [2)]	Predetermination of the maximum leverage level, Reporting leverage amounts

Notes: 1) These regulatory requirements generally apply to open-end schemes, while closed-ended funds and hedge funds are subject to much less stringent requirements (IOSCO, 2015). 2) Generally, in most countries, these optional measures specified in the prospectus of individual funds are available for all fund types. 3) These requirements are commonly applied in most countries. 4) Excessive leverage of hedge funds is indirectly regulated by the enhanced capital requirement of banks to transactions with hedge funds and requirements for central clearing of derivatives and margin requirement for non-centrally cleared derivatives. 5) The limits on leverage are generally not applicable to hedge funds and PEFs. Source: IOSCO (2015), FSB (2017), Rigot (2010), author's compilation

(Banks)

Banks are vulnerable to liquidity risk by nature due to their fundamental role in maturity transformation. They generally fund retail demand deposits and short-term wholesale market funding, whereas their assets mainly encompass long-term loans and debt securities. Fig.II-6 shows a stylized balance sheet structure of banks. Essentially, the balance sheet structure of banks and following risk can vary across banks and countries depending on their main business models. However, since the financial crisis of 2008-2009, major banks have retrenched from market activities and have shifted their business models toward retail businesses from investment banking in response to enhanced regulatory requirements and market pressure (Fig.II-7) (IMF, 2019; ECB, 2016; BIS, 2018).[29] Hence, there is no big difference in banks' liability structures across countries as for present, but asset

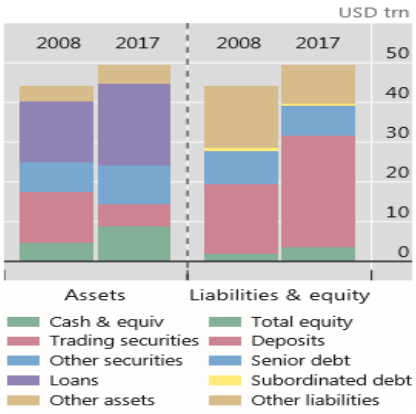
[29] In addition, the U.S banks have undergone significant consolidation as a result of the growing similarity of the functions provided by different types of financial institutions over the recent two decades. Japanese banks carried out asset deleveraging for an extended period of time after the bubble bursting.

structures differ more or less, resulting from different treatments taken by each country and their banks to cope with crises during recent decades.[30]

Fig.II-6 Stylized balance sheet structure of banks

Assets	Liabilities/Equities
Cash and deposits	Deposits
Debt securities	
Stocks	
Loans	Wholesale funding[1)]
	Equity capital and others
Others	

Fig.II-7 G-SIB[2)] balance sheet reflecting changing business models



Notes: 1) Debt securities issued, interbank borrowing, and repos are included. 2) Global Systemically Important Banks
Source: Author's compilation, BIS (2018)

Traditional banking crises resulted from run-off of retail deposits, so-called *bank runs*, as described in Diamond and Dybvig (1983). Yet recent crises are unleashed from a loss of short-term wholesale funding capacities (e.g., Northern Rock, IndyMac, etc.). Banks raise funds in the wholesale market to complement retail deposits. The wholesale funds are usually raised on a short-term rollover basis through instruments such as Certificate of Deposits (CD), Repurchase agreements (Repos), Commercial Paper (CP), or interbank borrowing. Wholesale funding gives banks active investment opportunities without being constrained by retail deposit supply, and banks can also cope with retail deposits run-off by refinancing in the wholesale funding market (Goodfriend and King, 1998). The incentive of wholesale funds providers to monitor banks imposes market discipline on banks (Calomiris, 1999). However, wholesale funding providers tend to be more sophisticated and sensitive to risks than retail depositors because they are likely to be more informed. Besides, the wholesale funding is highly incentivized to withdraw their funds even on a noisy public signal, especially when they can liquidate banks at a low cost, e.g., when banks have sufficient liquid assets and thus liquidation value of banks' assets is high (Huang and Ratnovski, 2010). In contrast, retail depositors

[30] Whilst a main funding source of the deposits-taking institutions is deposits, which are on average around 70% of total liabilities of the industry, wholesale funding accounts for 7-16% of total liabilities in the U.S, France, Korea and Japan at the end of 2018. In the asset side, while the largest fraction of assets is a loan in common, the U.S banks have a relatively large proportion of debt securities (24% of total assets) compared to other countries. Japanese banks' securities holdings that had hit 30% of their total assets before the financial crisis have been reduced up to 15% of total assets. It is also notable that French banks hold relatively large amounts of cash and deposits (38%) exceeding loans (36%). The stock holdings account for only a small fraction of banks' total assets in common.

are sluggish and insensitive to risks, though retail deposits can also be withdrawn on demand (Feldman and Schmidt, 2001). It is partly because of deposit insurance by the government and high switching costs associated with transaction services that banks offer depositors (Kim et al., 2003; Huang and Ratnovski, 2010). Therefore, retail deposits are the most stable source of long-term funding for banks. Banks bear wholesale funding risk that its providers abruptly withdraw their funds upon a hint of negative news. Indeed, in the episode of Northern Rock bank failure, wholesale funding providers exited the bank before retail depositors' bank run, at the first phase of the liquidity crisis when the short-term wholesale funding market froze (Shin, 2008).

When the rollover of short-term wholesale funding is refused in a sudden liquidity dry-up of the short-term wholesale funding market, banks must fill the funding gap by refinancing or reducing tradable assets. Facing heightened refinancing risk with increasing interest rates, banks must reduce liquid assets to meet the unexpected funding wind-up. If banks do not have sufficient liquid assets, they are forced to sell illiquid assets such as stocks, sometimes at discounted prices much below their fair values. This process can be accelerated during market stress times, especially when banks are highly exposed to secured funding or derivatives or required to mark the asset values to the market. Banks collectively face balance sheet depreciation and have to post additional collaterals to secure the funding or derivatives contracts following drops in the market values. Market-wide stocks depreciation via the mark-to-market valuation system during market stress leads to collective asset fire sales, generating positive feedback between prices and banks' investment behavior in stock markets.

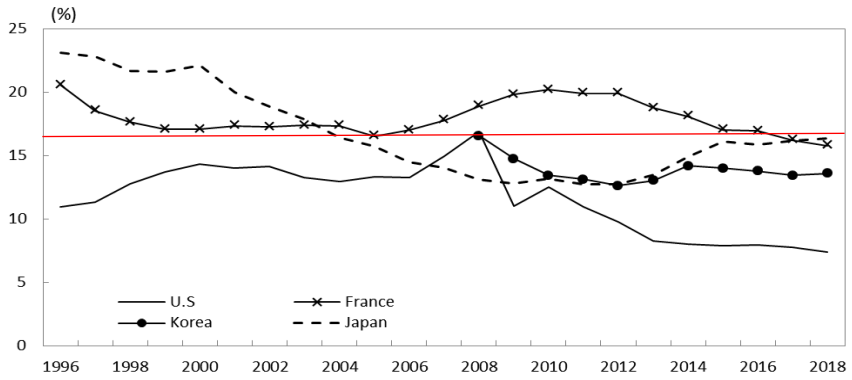
Banks' procyclical herd behavior in stress times is highly associated with how much they are resilient to liquidity risk. That is to say, how much banks' activities are involved in capital market movements. Funding liquidity in a liability side and market liquidity in an asset side of banks are determined by multi-dimensional factors, not just residual maturities but also redemption option on liabilities, a propensity of funding providers to withdraw funding, securities they hold, guarantee mechanism, and quality of assets, etc. According to BCBS[31] (2014), longer-term funding is regarded as more stable than short-term funding. From past experience on market movements and agents' behavior, short-term funding provided by retail and small business customers tend to be behaviorally more stable than wholesale funding of the same maturity provided by other counterparties such as non-financial and financial corporates, etc. For assets, unencumbered high-quality assets that can be traded, securitized, or used as collaterals for additional funding and thus can be readily converted into cash with little or

[31] Basel Committee on Banking Supervision

no loss of value are regarded as liquid assets. Banks with high reliance on short-term wholesale funding provided by non-financial and financial corporates and insufficient high-quality liquid assets are especially vulnerable to a sudden dry-up of wholesale funding markets and are likely to behave in a procyclical manner in stock markets during market stress times. Even in boom periods, wholesale funding can be a fuel of procyclical investments in stock markets. Amidst long-lasting low-interest rates in normal market conditions prompting a search for yields, the wholesale funding has backed up aggressive expansions of high-yield but illiquid assets where prices rapidly increase during boom periods in general.

Due to enhanced regulatory efforts such as the introduction of new liquidity ratios (LCR and NSFR) and a leverage ratio, banks have become resilient to liquidity and leverage risk since the global financial crisis. Fig.II-8 shows that wholesale funding of deposits-taking institutions stayed at a high level before the crisis but has been contracted since the crisis in most countries. Nevertheless, for France and Japan, the wholesale funding ratio is still as high as the historical peak of the U.S (17% of total fundraisings) that recorded at the heart of the financial crisis of 2008-2009.

Fig.II-8 Wholesale funding of deposits-taking institutions[1)]



Notes: 1) wholesale funding (%) of total fundraising including liabilities and equity capital
Source: OECD, Author's calculation

(Insurance Companies & Pension Funds - ICPFs)

- *Balance sheet structure of ICPFs as long-term investors and some evidence of procyclicality*

ICPFs[32] have a unique asset and liability structure compared to investment funds or banks. Their liabilities comprise life insurance technical reserves, annuity, and pension entitlements. Unearned

[32] For the discussions of ICPFs, we consider only life insurance companies, private and public pension funds that are supposed to have long-term liabilities and thus pursue long-term investment strategies. We exclude property and casualty

premiums and reserves for outstanding claims are also the second main components of liabilities (Fig.II-9). These are net equities of households in life insurance and pension funds. ICPFs receive money from households or their employers in the form of premiums or contributions and then use them for future payouts to households in the form of insurances, pensions, or annuities. ICPFs have limited borrowing in general. Therefore, most of their liabilities are long-term liabilities where redemptions cost high, and their payouts are contingent upon long-term plans determined by retirements, life expectancy, and contractual maturities. This leaves ICPFs almost free from liquidity and leverage risks that other institutional sectors typically bear. Consequently, the long-term and predictable liabilities structure allows ICPFs for long-term investment horizons and more autonomy in investment decisions than investment funds or banks. They invest in a variety of asset classes, ranging from cash and deposits, long-term debt securities, illiquid stocks to real estates, etc. Fig.II-9 presents a stylized balance sheet structure of ICPFs.

Fig.II-9 Stylized balance sheet structure of ICPFs

<table>
<tr><th>Assets</th><th>Liabilities/Equities</th></tr>
<tr><td>Cash and deposits</td><td>Equity capital</td></tr>
<tr><td>Debt securities</td><td rowspan="2">Net equities of households in life insurance and pension funds</td></tr>
<tr><td>Stocks</td></tr>
<tr><td>Investment fund shares</td><td>Unearned premiums and reserves for outstanding claims</td></tr>
<tr><td>Others</td><td>Others</td></tr>
</table>

Source: Author’s compilation

The investment strategies of ICPFs taking into account the stable nature of long-term liabilities give ICPFs significant systemic importance in security markets and the real economy. They are stable liquidity suppliers in stock markets but also a potential market stabilizer. Given the long-term investment horizon, ICPFs can ride out short-term market movements with risk-bearing capabilities and rather profit from forward-looking and counter-cyclical strategies over the long-term. They can take advantage of the mean-reverting process of stock prices over a long-term cycle, buying stocks when prices have fallen and selling them when prices have risen. They are more inclined to have a long-term optimal asset allocation and a “buy and hold” strategy than frequent trading. They periodically rebalance their portfolios (*portfolio rebalancing*), reducing positions in stocks in strong

insurance companies that are not considered as a long-term investor, as they are often in needs of asset liquidations when natural disaster or big accidents hit.

bull markets and increasing them in bear markets to maintain a desired longer-term strategic allocation. It provides ICPFs with mechanical signals of counter-cyclical trading. In addition to the long-term and stable liability structure, some public pension funds have a financial stability responsibility to some extent as a mandate. For example, the National Pension Service of Korea is obliged to respect the explicit investment principle that their asset dispositions must not impact domestic financial markets. Thus, they are expected to behave in a less procyclical manner or even actively engage in stabilizing the markets during stress times in favor of public interest.

However, recent studies provide evidence of procyclical investment behavior of ICPFs and pose a challenge to the theoretical view. Pension funds in several countries were net stock sellers during the global financial crisis of 2008-2009, reflecting a move toward more conservative asset allocations (Papaioannou et al. 2016). Life insurance companies contributed to the downward spiral in the stock markets' fall in 2001-2003 and during the crisis of 2008-2009, when they sold stocks to bolster their balance sheets (Impavido and Tower, 2009). World Economic Forum (2011) also expresses, "These institutions feel that their counter-cyclical role in the market has begun to change as regulatory and accounting changes have forced institutions to be concerned with short-term changes in market prices."[33] Fig.II-10 compares net stock purchases by ICPFs of OECD countries during the global financial crisis and recent Covid-19 stock market crash. Insurance companies in several countries (Czech Republic, Greece, Chile, Denmark, Netherlands, Germany, Hungary, and Japan) behaved procyclically by reducing their stock holdings by around 30-2% during the crisis. Private pension funds in Czech Republic, Netherlands, Denmark, Germany, U.S, Austria represented procyclical behavior to the same extent (30-2% sales of total stock holdings) as well. Social security funds[34] appeared largely counter-cyclical, as most countries purchased stocks during the crisis, except for four countries (Switzerland, Poland, Czech Republic, France) that were net sellers (13-2% sales of their total stock holdings). The same behavioral patterns are surprisingly observed during the recent Covid-19 stock market crash in March 2020. Almost a half of insurance companies and private pension funds of countries where data are available engaged in procyclical stock investments, selling their stocks during the market crash. In contrast, social security funds of four counties where data are available behaved counter-cyclically. These show that even long-term investors are not immune to procyclical investments, especially during a crisis. However, they may also be procyclical even in normal times as

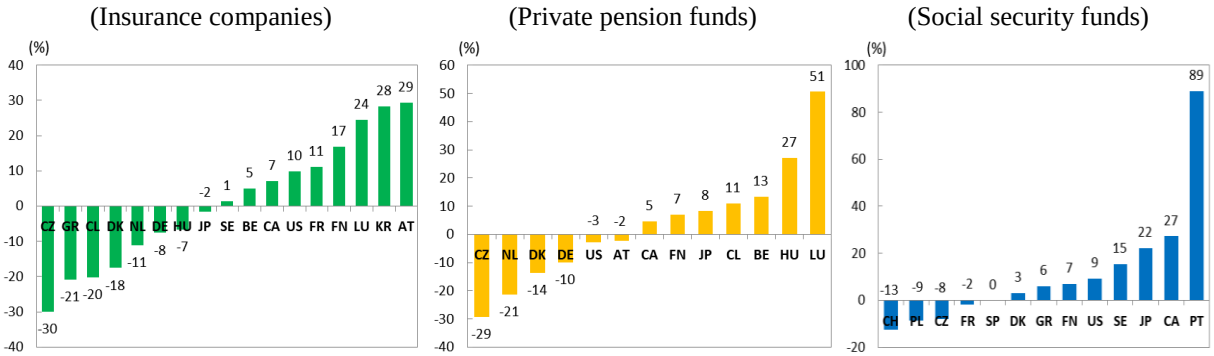
[33] In fact, the results of recent empirical studies on procyclical investments of ICPFs are divided. Contrary to the evidence on procyclicality above, there is still much evidence supporting their counter-cyclical investment tendencies (de Haan and Kakes, 2010; Timmer, 2016, etc.).

[34] Social security funds include institutions that manage social insurance services as a social security system such as public pension funds (for the U.S, federal, state and local government employee retirement funds), medical care insurance, employment insurance, etc.

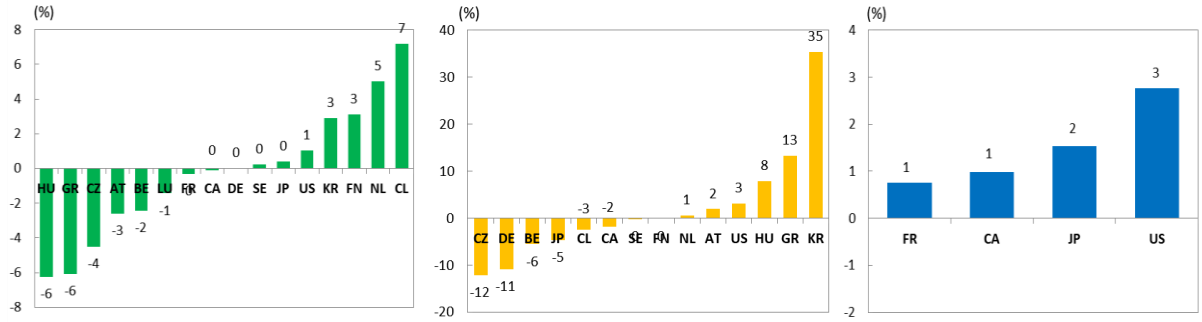
well as the crisis times, as they had been continuously net buyers prior to 2007. While it should be cautious of explanations because the persistent net purchases can be just a reflection of industry expansions in the period rather than an investment strategy, Bikker et al. (2007) prove that the asset allocation of Dutch pension funds is much more procyclical in bull markets than in bear markets. Only 13 percent of positive excess stock returns are rebalanced, while 49 percent of negative shocks result in rebalancing.

Fig.II-10 Net stock purchases by ICPFs durig market crashes

Global financial crisis – during 2008-2009[1)]



Covid-19 stock market crash – during the first quarter of 2020



AT: Austria, BE: Belgium, CA: Canada, CL: Chile, CZ: Czech Republic, DE: Germany, DK: Denmark, FN: Finland, FR: France, GR: Greece, HU: Hungary, JP: Japan, KR: Korea, LU: Luxemburg, NL: Netherlands, SE: Sweden, US: the United States

Note: 1) Net stock purchases during 2008-2009/the amount of stock holdings at the end of 2007 (%) with effects of market valuation and exchange rates excluded. 2) Net stock purchases during the first quarter of 2020/the amount of stock holdings at the end of 2019 or 2018 (%) with effects of market valuation and exchange rates excluded.
Source: OECD Flow of funds, author's estimation

- *Potential procyclicality of DB schemes under the current macroeconomic and regulatory circumstances*

It is not easy to give theoretical explanations on underlying reasons for the procyclical investment behavior of ICPFs with long-term liabilities. Though it is still theoretically debated, possible explanations may include motivations facing structural changes in the industry, regulatory constraints, and a macroeconomic environment of prolonged low-interest rates that they have gone through for recent decades. While their liabilities are long-term, ICPFs are highly linked to changes in the macroeconomic and financial market condition via the regulation and valuation system.

Market-based regulatory and accounting system introduced in many countries requires ICPFs to evaluate both assets and liabilities at fair values. They are required to calculate the present value of long-term liabilities using market-based discount rates. The discount rate is the expected return of asset investments consisting of a risk-free rate and sometimes risk premium.[35] As the discount rate is lower (higher), the present value of liabilities gets higher (lower). This market-based valuation of long-term liabilities exposes important interest rate risks to ICPFs, though they are immune to liquidity and leverage risks. To manage interest rate risks from long-term duration liabilities, most ICPFs adopt the asset-liability management (ALM) strategy, which considers the nature of liabilities when setting up investment strategies. It is typically done by matching the duration of liabilities with that of assets, e.g., allocating large fractions of capital to long-term debt securities.

Generally, the market-based valuation amplifies institutions' sensitivities to short-term market changes and impacts their investment strategies directly. For ICPFs matching the long-term duration of liabilities with that of assets, the impacts of the market-based valuation are more specific, especially in a combination of the long-lasting downward interest rate trend and existing regulatory frameworks. As shown in Fig.II-11, nominal yields on 10-year government bonds have been declining in countries since the beginning of the 1980s. Declines in interest rates affect both the assets and liabilities, expanding a negative duration mismatch between assets and liabilities. Lower interest rates increase the estimated value of liabilities via lower discount rates. In contrast, lower interest rates immediately decrease the asset value due to lower yields on large amounts of long-term debt securities they hold. While lower yields reflect higher bond prices and may imply higher returns that could increase the asset value, it is not the case of ICPFs who hold them to maturity in usual. As a

[35] The discount rates used by ICPFs vary across countries, funds, purposes (whether it is for financial reporting or determining statutory contributions), from long-term government bond rates (U.S, Japan) to corporate bond rates (U.K) to swap rates (Netherlands) to fixed rates (Germany) and "best estimates of long-term returns", etc.

result, the combination of prolonged low-interest rates, ALM strategy and market-based valuations has continuously undermined the solvency positions of ICPFs. In particular, it substantially impacts ICPFs that offer defined-benefits (DB) pension schemes and insurance products that promise fixed benefits or fixed investment returns in the future because it is ICPFs or pension sponsors (i.e., employers for occupational pensions) that bear all investment risk in the DB scheme products. They are usually subject to the minimum funding[36] or solvency requirements to protect plan assets and future payouts of pension benefits or annuities. Employers or insurers are required to increase pension contributions or capital buffers when ICPFs are underfunded or under the required solvency position. Instead, for overfunded pensions, they are allowed to exploit contribution holidays or access to plan surplus[37]. Under this structure, large swings in ICPFs' solvency positions can be caused by small changes in interest rates and asset prices rather than inherent changes in the solvency positions of DB plans. Fig.II-12 displays underfunding of the U.S private DB pension funds. They have been consistently underfunded except for the periods of late 1990s, and the underfunding has significantly expanded since the financial crisis, which is associated with declining interest rates and the introduction of the mark-to-market asset valuation. According to the OECD (2008), pension funds of 25 countries among 28 countries were reported to be underfunded in 2007.

Fig.II-11 Nominal yields on 10-year government bonds in selected countries

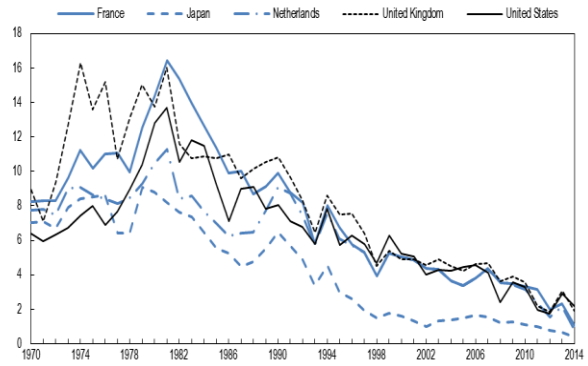
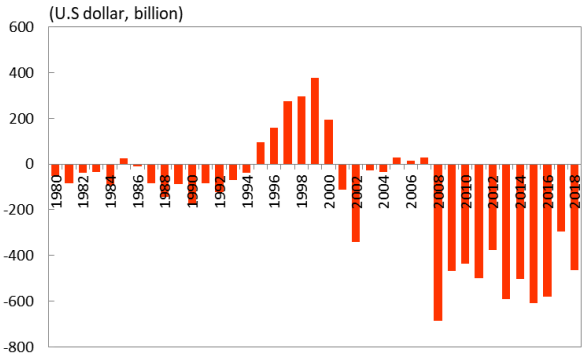


Fig.II-12 Underfunding[1)] of the U.S private DB pension funds



Notes: 1) (Total assets – total liabilities), which equals pension funds' claims on sponsor in the U.S flow of funds statistics.
Source: OECD (2015), U.S Fed, author's estimation

[36] Pension funds are required to meet the minimum funding ratio (the present value of assets / the present value of liabilities) (%) that differs depending on countries and whether it is private or public pension funds, etc.

[37] In most OECD countries, plan sponsors generally have very little access to the plan surplus. Some notable exceptions are Ireland, Netherlands, Portugal and Sweden. Ireland only requires that the extent and modality of surplus withdrawal is stipulated in the plan rules. In the Netherlands, this is complemented with legal requirements to ensure that all members have received full (indexed) benefits in the last 10 years before the surplus withdrawal. In Portugal, surplus withdrawal is allowed as long as it is deemed to be structural, that is, if it has lasted at least five years above a specific level. In the United States, return of surplus to the employer is possible, although heavily taxed. (Yermo and Severinson, 2010).

These dynamics lead to procyclicality in ICPFs' investment strategies and procyclicality in pension contributions by corporate sponsors. First of all, employers are forced to increase their contributions during economic downturns due to declines in stock prices and further declines in bond yields as a result of "flight to safety" or accommodative monetary policies. In contrast, they can exploit contribution holidays during good times when plans are more likely to be overfunded. The drain of employers' cash flow at periods of low or negative profitability can have second-order macroeconomic effects via cuts in business investments, further worsening the outlook for employers (Yermo and Severinson, 2010). Pervasive underfunding risk put forward by decreasing interest rates also influences stock investment strategies of ICPFs[38]. The asset allocation decision to stocks is a key variable to determine risk-profit profiles of ICPFs' investments, as stocks bring high returns in exchange for high volatilities. One of ICPFs' important asset management objectives is to maximize the expected returns on assets at an acceptable level of risk, e.g., measured in terms of the probability of underfunding (Bikker et al. 2007). Under heightened risk of being underfunded around the corner and continuously low bond yields even in good times, a possible strategy for ICPFs in order to meet the minimum funding requirement or solvency requirement in a short period is a search for short-term high returns or a structural shift toward "de-risking" by reducing stock holdings continuously[39]. The investments for short-term high returns can be implemented by tactical strategies (or *market timing*)[40] in the short-term, taking short bets on the relative asset returns, for example, changing asset allocation temporarily from safe assets to high return-high risk assets during boom periods, or adjusting the stock allocation in a medium-term depending on stock investment performances (increasing stock allocation after outperformance and decreasing them after underperformance). During stress times, ICPFs are likely to reduce their stock holdings to avoid further declines in the asset values. But the incentive of ICPFs to engage in procyclical investment may not be necessarily symmetrical to stock market shocks. Bikker et al. (2007) say, "Apparently, asset managers are able to convince pension funds both to replenish their funds in bear markets to profits from low asset prices and to increase the stock allocation in bull markets to take advantage of rising markets." Likewise, investment of ICPFs may be more procyclical in an upward trend than a downward trend, notwithstanding some flights to safety episodes during a crisis. Procyclical investment in good times may be accelerated if employers can benefit from premium reductions, contribution holidays, or access to plan surplus. In this context, insurers have greater incentives for taking aggressive investment strategies than pension funds

[38] In the DB pension funds, it is a pension scheme trustee that decides investment strategies of the DB plans with inputs of a sponsor (an employer), investment consultants and asset managers.

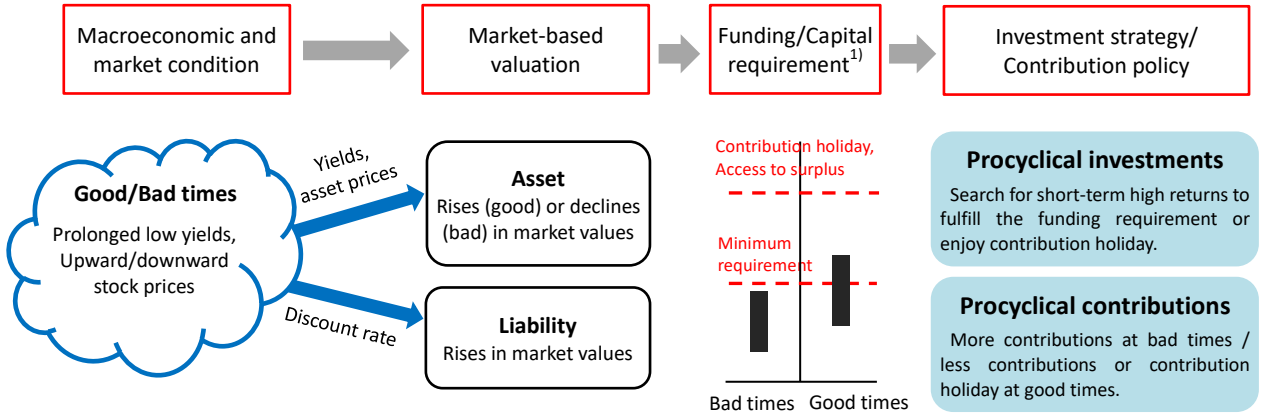
[39] The structural de-risking of U.S pension funds is partly due to the recent trend of employees decreasing joins in DB pension plans, whereby increasing proportion of existing pension plans are in decumulation phases.

[40] It refers to a temporary higher or lower weighting of stocks (or other asset classes) relative to a pension fund's strategic asset allocation motivated by short-term return expectations (Bikker et al., 2007).

because the surplus exceeding liabilities profits the insurance companies directly by allowing financing future growth, returns to shareholders, or development of reserves, etc.

OECD (2015) also raises concerns of "the search for high returns of ICPFs in order to fulfill any fixed guarantee promises they have made when interest rates were higher." Higher investments of U.K pension funds in alternative assets such as PEFs, derivatives, or structured products may be a sign of the search for higher returns (OECD, 2015). In Germany, Canada, Netherlands, and the U.S, life insurance companies with capital ratios closer to the required minimums and greater proportions of guaranteed return products allocate significantly more of their investments to higher risk-assets (IMF, 2016). Fig.II-13 summarizes the aforementioned potential mechanism that drives ICPFs to procyclical investments.

Fig.II-13 Potential mechanism of procyclical investments of ICPFs with guaranteed liablities



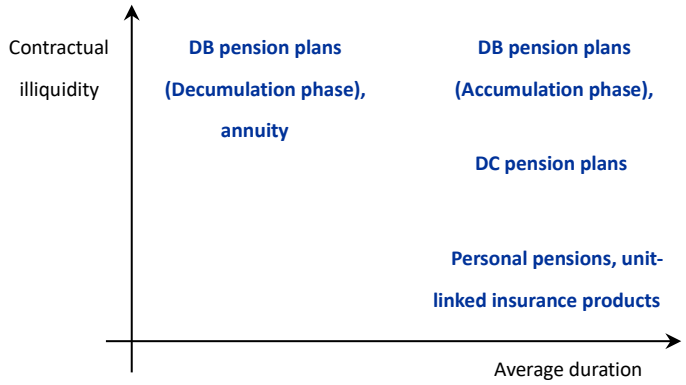
Notes: 1) According to OECD (2008), pension funds of 25 countries among 28 countries were reported to be on average underfunded in 2007. The average level of underfunding was -24%.
Source: author's compilation

- *Investment behavior of DC scheme products*

In contrast to DB plans and non-linked insurance products, defined-contribution (DC) pension plans and insurance products pay out benefits or returns that vary according to investment performance over time until the point of retirement. Therefore, it is beneficiaries and policyholders that bear all the investment risks in DC plan products. Insurance companies manage the majority of DC pension plans and annuity products. But individual policyholders can participate periodically in a degree of investment decisions related to the DC scheme products, which differentiate their liability characteristics and investment strategies from DB products. Fig.II-14 shows the "long-termness" of various ICPF products with regards to their liabilities, which is measured by underlying duration and

contractual liquidity of liabilities. Though liabilities of DC scheme pension plans and insurance products are deemed to have long durations, their contractual maturities, in reality, are less long than those of other types, as policyholders can alter the asset allocation or switch annuity providers. As such, we might expect that asset managers of DC scheme products are incentivized to seek short-term returns to maintain and attract clients. In the meantime, investment strategies of DC products chosen by beneficiaries/policyholders depend essentially on individuals' preferences, risk appetites, or capacities to judge risk. Individuals are arguably more risk-averse and less capable of understanding risk accurately than professional asset managers of ICPFs. Individuals are also likely to be more reactive to 'headlines' (Bank of England, 2014). Possible investment behavior of individuals to cope with their limited knowledge and abilities is conservative investing (e.g., disproportionately investing in fixed income securities), passive asset management (e.g., stuck with the initial investment decision they made), or following the market rather than making confident determinations (Stabile, 2002).

Fig.II-14 Long-termness of ICPF liabilities



Source: Bank of England (2014)

Lastly, ICPFs have increasingly delegated responsibilities for managing their underlying assets to external asset management companies since the early 2000s. As a result, considerable underlying assets of ICPFs are managed by asset management companies, which can alter the role of ICPFs as long-term investors in financial markets and the real economy. This issue is discussed in the following.

II.2.2. Erosion of ICPFs' long-term and counter-cyclical role amid complex asset management delegation chains

(*Asset management delegation relations centered on ICPFs*)

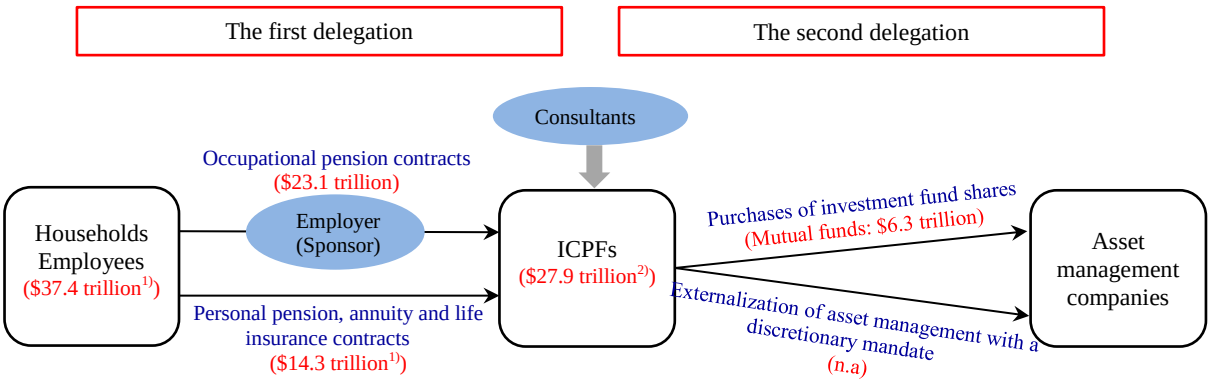
Hereinafter we focus on the particular nature of asset management delegation concerning ICPFs. Some incentive mechanisms introduced to address principal-agent problems arising from complex delegation relations may potentially decline the long-term contrarian nature of ICPFs' resources substantially.

A considerable part of ICPFs' assets is not managed by ICPFs but by external asset managers. It creates double layers of delegation relations that are overlapped with the first delegation between beneficiaries/policyholders and ICPFs (the pension plan administrator) and the second delegation between ICPFs (the pension plan administrator) and external asset managers (Rigot, 2010). The two delegation relations made by an agent contract imply a principal-agent relation. In the first relation made by occupational or personal pension/annuity/insurance contracts, beneficiaries/policyholders are principals, and ICPFs act as agents on behalf of the principals. Beneficiaries/policyholders may delegate responsibilities for investment decisions and portfolio management to ICPFs. ICPFs may also invest money in assets in accord with investment strategies given by beneficiaries/policyholders (employers for occupational DB pension plans). The beneficiaries/policyholders are households. They have claims for ICPFs' assets. ICPFs make recourse to investment consultants, which does not mean that asset management responsibilities are transferred to the consultants. The second delegation relation occurs when ICPFs use external asset managers by delegating management of a part of their portfolios to asset management companies. It is materialized via delegation contracts with the external (or subsidiary) asset management companies assigning responsibilities for making investment decisions on a discretionary mandate or purchasing investment fund shares such as mutual funds, PEFs, or hedge funds. In the second delegation relation, ICPFs (the administrator) are principals, and external asset managers are agents. The external asset managers are responsible for setting out asset allocation strategies and tactical strategies, or only tactical strategies with an asset allocation fixed by the administrator. Recently, amidst a core-satellite investment strategy becoming popular, the satellite portion of portfolios that consist of actively managed stocks or alternative investments are managed by external asset managers (Rigot, 2010). The externalization of asset management has many benefits. It helps ICPFs gain higher investment returns and diversify assets more easily. The delegation via purchasing investment fund shares enables ICPFs to exploit the economies of scale, best performing asset managers in the markets, and their capabilities to select securities.

At the end of the third quarter of 2018, pension, annuity, and life insurance contracts of U.S households (the first delegation) account for $37.4 trillion. $23.1 trillion of total contracts are occupational pension contracts in which employers intermediate the first relation between employees and ICPFs. $14.3 trillion of total contracts are personal contracts that make a direct delegation relation between two counterparties. Meanwhile, the strong growth in the second delegation has been witnessed in developed countries over recent decades. The amounts outstanding of mutual fund holdings by U.S ICPFs stand at $6.3 trillion at the end of the third quarter of 2018. Taking into account presumably considerable amounts of delegated portfolio management with discretionary mandates and investments in hedge funds and PEFs, the ICPFs would account for the lion's shares of the U.S asset management market. In Europe, 55% (€12.9 trillion) of total Assets under Management (AuM) of the asset management industry are delegated through investment funds, and 45% (€10.8 trillion) of the total AuM are delegated through portfolio management contracts with discretionary mandates at the end of 2017. ICPFs' shares in total AuM reach 53% (efama, 2019). ICPFs are currently a major institutional client for the asset management industry. Fig.II-15 describes the asset management delegation relations centered on ICPFs.

Fig.II-15 Structure of asset management delegation centered on ICPFs

(U.S ICPFs, amounts outstanding at the end of third quarter 2018)



Notes: 1) Individual Retirement Accounts (IRAs) ($9.5 trillion) are included. 2) IRAs are excluded.
Sources: OECD, U.S Fed, author's estimation

(*Asset management industry practices to address the principal-agent problem but encourage procyclical herding in the meantime*)

- *Industry practices introduced to address the principal-agent problem*

In a setting of the principal-agent theory, the delegation of investment decisions causes a conflict of interests between principals and agents, i.e., moral hazard and adverse selection. The overlapped delegation relations centered on ICPFs also share many features with the principal-agent theory. In the first delegation relation, ICPFs (agents) have superior information on asset management to beneficiaries/policyholders (principals). The latter, particularly members of DB scheme products, can neither intervene in the process of investment decisions of ICPFs nor control pension administrators' behavior. The administrator or internal asset managers of ICPFs with superior information are motivated to act in their own interests or the interest of the employer[41], not beneficiaries or policyholders. In the second delegation, notwithstanding periodical reporting by external asset managers (agents), it is difficult for ICPFs (principals) to know information on intrinsic quality of delegated portfolio management (profitability, a degree of risk-taking, investment technics, etc.) and the efforts of asset managers unobservable and not easy to communicate on. The external asset managers with informational superiority are likely to be incentivized to maximize their own interests diverged from principals (ICPFs and beneficiaries/policyholders)' interests.[42]

Consequently, the asset management industry introduces incentive mechanisms to address the principal-agent problem in two delegation relations. Like in a typical agent setting, agents are required to provide periodical reporting to principals in order to reduce information asymmetry. The compensation system for agents is designed to relate compensation to the performance of portfolios they manage, whereby the agents have incentives to work hard. In a peculiar agent setting of the asset management industry, the performance is evaluated against some benchmarks or annual relative performance targets that asset managers are supposed to achieve. The benchmarks usually include the average performance of peer asset managers or industry-wide indices.[43] The performance of asset managers is periodically evaluated based on the benchmarks, and they would get penalties when they underperform the benchmarks. Furthermore, ICPFs usually make short-term delegation contracts with

[41] The employer (the corporate) who is authorized to select the administrator of its pension fund often maintains close relationships with the administrator. Thus, the administrator may be highly encouraged to privilege the interests of the employer when he or she makes a decision (Rigot, 2010).

[42] However, the overlapped delegation relations and a specific environment surrounding ICPFs - pension fund ownership, product types, funding requirements and prevalent shortfall risks, etc. - can make the delegation relations centered on ICPFs much more complicate than a typical principal-agent relation.

[43] It is also stipulated in the U.S *Uniform Prudent Investor Act* that sets out guidelines for trustees to invest trust assets. Trustees are obliged to prove their *prudence* of the investment by some benchmarks or standardized products enabling a comparison of performances instantly (Rigot, 2010).

external asset managers. Contract renewal is conditional on the past performance of the managed portfolios. If underperformance lasts over some time, the contract will not be renewed. In a multi-period game, reputation serves as an implicit incentive for asset managers to work hard. Effectively, amidst a high degree of competition among asset managers and comparability of their performances, reputation concerns of asset managers are likely to motivate them to give the best efforts to make superior performance relative to peers.

- *Procyclical mechanisms in the complex delegation relations*

The asset management delegation affects investment strategies on delegated portfolios, whether it is intended or unintended. Especially in the delegation of ICPFs portfolios, the impact can be particularly problematic in the second delegation, where the delegated portfolios are ICPFs' assets deemed to stabilize the markets and provide the economy with long-term finance.

Beyond the principal-agent context, the second delegation via purchases of investment fund shares implies that ICPFs' portfolios with long-term investment horizons are pooled into procyclical money of other fund investors and are invested according to the aforementioned investment logic of investment funds. That is to say, ICPFs' portfolios delegated to mutual funds can be invested in a procyclical manner to profit from short-term market changes, going with procyclical fund flows (injections and redemptions of fund shares). Portfolios delegated to hedge funds can be incorporated into investments taking excessive risk in the search for high returns, backed by excessive leverage.

Back to the principal-agent setting, the agent-incentive mechanisms to address the principal-agent problem in the asset management industry can incentivize procyclical herd behavior of asset managers and short-termism of investment horizon. This impact is more pronounced in the second delegation than the first delegation. Benchmarks or relative performance targets may lead to an excessive focus on peer asset managers' investment behaviors, which ultimately cause herd behavior of asset managers. The short-term performance targets, a high degree of comparability, frequent evaluations, and short-term delegation contracts can also motivate asset managers to focus on short-term results at the expense of long-term benefits. Asset managers that cling to short-term results may be less motivated to evaluate long-term fundamental values for delegated investments and more likely to be concerned with returns from short-term price momentum or losses from short-term market volatilities. Although the delegated portfolios backed by ICPFs' long-term liabilities are deemed to have long-term investment horizons, external asset managers may not necessarily have the same long-term perspective due to the industry practices used in the asset management industry. Even in a multi-

period game where reputation works as an implicit incentive to agents, asset managers can be incentivized to pay attention to realizing short-term returns to attract new money to their funds because the reputation of an asset manager is essentially explained by a fund size or net inflows of funds that he manages. Fund investors respond to fund performance because they are searching for skilled active managers (Berk and Green, 2004). Past outperformance relative to a reference is more likely to attract new money.

Additionally, the market structure of investment consultancies may also encourage the herd behavior of asset managers. According to a survey by the National Association of Pension Funds, 50% of UK workplace pension funds use the three largest investment consultancies, and the top six consultancies account for around 70% of the schemes surveyed (Bank of England, 2014). Given that consultants' recommendations have a significant influence on investment decisions of assets managers, the concentration of investment consultancies might increase the likelihood of similar investment behavior being displayed (Jenkinson et al., 2013). The procyclical herding, pursuit of short-term returns, and excessive risk-taking by external asset managers for the delegated long-term horizon portfolios do not conform to principals' interests (beneficiaries/policyholders and ICPFs) but also have undesirable consequences on stock markets and the real economy at a macro level.

The resulting investment behavior may not be observed in the first delegation relation. The first principal-agent relation between beneficiaries/policyholders and ICPFs may not be explained as a typical principal-agent case, as the incentive mechanism of agents (ICPFs) can be significantly influenced by the second delegation relation and specific industrial factors of ICPFs such as pension fund types, fund ownership and shortfall risks in a low yield environment, etc. Rigot (2010) points out that the first delegation relation of U.S pension funds with their beneficiaries is akin to a *trust* relationship rather than a typical principal-agent relation founded on the legal ownership of the U.S pension funds. She adds that constraints on performance and risk controls imposed by pension funds in the second delegation can be determined by commitments made by beneficiaries in the first delegation contract beyond the incentive mechanism provided by the second delegation itself. The overlapped delegation relations and a specific environment surrounding ICPFs can make the delegation relations centered on ICPFs much more complicated than a typical principal-agent relation.

II.2.3. Summary: Comparison of potential institutional vulnerabilities to cause procyclical herding

Tab.II-3 compares institutional characteristics that could cause procyclical herding investment behavior by institutional investor groups. Investment funds have great heterogeneities by fund types and their risk profiles are also heterogeneous across fund types. For open-end mutual funds, they are exposed to structural liquidity mismatch between assets and liabilities. Their liabilities are unstable due to easy redemption options and procyclical injections/redemption patterns of fund investors, whereas their assets mainly consist of illiquid assets or may easily turn into illiquid assets depending on the market condition. This liquidity mismatch can lead to procyclical investment behavior of mutual funds. On the other hand, vulnerabilities of hedge funds and some PEFs stem from high leverage backing investment strategies. It is uncertain whether or not high leverage induces hedge funds to behave in a procyclical way in normal times, given their diverse investment strategies. But according to their left fat-tailed distribution of returns, hedge funds and some PEFs with high leverage are necessarily vulnerable to a distressed situation, facing extreme losses during stress times. They are forced to participate in asset fire-sales to obtain liquidity and deleverage, contributing to the propagation of crisis to the whole financial system. But, given the vast majority of leverage is obtained by short-term market borrowing provided by prime-brokers, the leverage issue that leads hedge funds to procyclical behavior during stress times can essentially translate into a liquidity issue. Notwithstanding recent regulatory efforts to mitigate risks from investment funds, they are still subject to less stringent regulation than other sectors. Most risk management tools are left to the discretion of asset managers, and existing supervisory tools do not consider sufficiently system-wide aspects of collective individual behaviors.

Banks are vulnerable to liquidity risk by nature as liquidity transformation is their fundamental role as financial intermediaries. Procyclical herding of banks in recent decades is highly associated with how much they rely on short-term wholesale funding and are resilient to liquidity risk. The wholesale market funding backs up aggressive investments in boom periods. In the meantime, banks bear the wholesale funding risk that its providers abruptly withdraw their funds in a sudden liquidity dry-up of wholesale funding markets. When the rollover of short-term wholesale funding is refused during market stress, banks must fill the funding gap by refinancing or reducing tradable assets. Owing to enhanced regulatory efforts since the global financial crisis, banks became resilient to liquidity risk with more stable liabilities and liquidity buffers.

ICPFs have a unique balance sheet structure. Their stable long-term liabilities leave ICPFs almost free from liquidity and leverage risks, instead, allow for long-term investment horizons and autonomy in investment decisions. ICPFs can ride out short-term market movements with risk-bearing capabilities and rather profit from forward-looking and counter-cyclical strategies over the long-term in stock markets. Some public pension funds even have a financial stability responsibility to some extent as an explicit mandate. Theoretically, they are supposed to be a market stabilizer and long-term finance provider. However, the stabilizing role of ICPFs is being eroded as they are highly linked to changes in the macroeconomic and financial market conditions via the market-based valuation system. In a prolonged low-yield environment, the market-based valuations and ALM strategies expose ICPFs to a negative duration mismatch between assets and liabilities and prevalent underfunding risk. These dynamics may lead to procyclicality in ICPFs' investment strategies as well as procyclicality in pension contributions of corporate sponsors. Under heightened risk of being underfunded, a possible strategy in order to meet the minimum funding requirement or solvency requirement in a short period is a search for short-term high returns or a structural shift toward de-risking by reducing stock holdings continuously. It may be particularly problematic in DB scheme products where all investment risks are borne by ICPFs and employers.

The increasing trend of portfolio management delegation from ICPFs to asset management companies also threatens the counter-cyclical nature of ICPFs' investment strategies, as the delegation disconnects assets and liabilities of ICPFs. The delegation via investment funds implies that ICPFs' portfolios delegated to mutual funds can be invested in a procyclical manner to profit from short-term market changes, going with procyclical fund flows. Portfolios delegated to hedge funds can be incorporated into investments taking excessive risk in the search for high returns, backed by excessive leverage. More crucially, some industry practices to address the principal-agent problem in the delegation relation between ICPFs and external asset managers (short-term performance targets, a high degree of performance comparability, frequent evaluations, and short-term delegation contracts, etc.) can also incentivize procyclical herding of external asset managers and short-termism of investment horizons. Although the delegated portfolios backed by long-term liabilities of ICPFs are deemed to have long-term investment horizons, asset managers may not necessarily have the same long-term investment perspective.

Tab.II-3 Institutional characteristics of institutional investor sectors

		Stability of liability	Leverage through borrowing	Main clientele	Liquidity buffers	Regulatory constraint	Delegation of investment decision	Peer pressure	Financial stability responsibility	Size[1)] in U.S stock markets
Invest-ment fund	MMF	Low	Low/ Forbidden	Retail, Institutional	High	Medium	Low	Medium	Low	0.0
	Mutual Fund	Low	Low/ Forbidden	Retail, Institutional	Medium/ Low	Medium	Medium/ Low	High	Low	11.9
	PEF	High	Medium/ High	Retail, Institutional	Low	Low	Low	High	Low	N.A
	Hedge fund	High	High	Institutional	Low	Low	Low	High	Low	N.A
Bank		Low	Medium	Retail, institutional	High	High	Medium/ Low	Medium/ Low	Low	0.1
ICPF		High	Low	Retail	Medium/ Low	High	High	Medium/ Low	Medium	6.7

Note: 1) The amounts outstanding of U.S corporate shareholdings ($ trillion) at the end of 2020.
Source: author's estimation, U.S Fed

II.3. Market innovations in trading practices during recent decades

During two decades from the late 1990s up to the present, global developed stock markets have witnessed structural market changes prompting the emergence of a new type of market participants and a huge transformation in investment culture. This section addresses procyclical mechanisms embedded in the new market participants and trading practices dominating current stock markets. First, it investigates procyclical mechanisms in investment tools such as market benchmarks and ETFs (Exchange-Trade Fund) materializing passive investing strategies. Then it explores algorithmic trading and high-frequency trading. On the fragmented trading platforms and financial product markets that, nevertheless, are closely interconnected, the new market participants and investment tools interact with stock prices, other participants, or other product markets in an unexpected way, sometimes causing price overshooting and spreading price instabilities of a market to other markets. The modern trading practices based on technical and informational innovations may explain the recent stock market crashes in the form of a "flash crash".

II.3.1. Passive investing and ETFs

The asset management industry has gone through a significant shift from active to passive investment strategies during recent decades. Active investing aims to beat the average market return by exploiting price differences or fundamental analysis. Active asset managers have discretion for securities selection and trade securities actively based on in-depth analyses on market movements or fundamental values. By contrast, passive investing is a rule-based strategy to track an index, typically buying and holding all or a part of constituent securities of a market portfolio. In the U.S, passive funds account for 41 percent of combined U.S mutual fund and ETF assets under management (AuM) as of March 2020, up from three percent in 1995 and 14 percent in 2005. Passive funds make up 48 percent of the AuM in equity funds (Kenechukwu et al., 2018). The popularity of passive investing may be simply a reflection of the theoretical belief on the EMH by which active managers cannot beat the market. But recent underperformances of actively managed funds and cost-effectiveness of passive funds have also fueled the trend for passive investments.

In principle, passive investment strategies tracking market portfolios do not necessarily imply a momentum strategy or procyclical investment[44]. Nevertheless, investment tools materializing the passive investment strategies often embed procyclical mechanisms inside. The first mechanism can be simply created through methodologies constructing market indices tracked by passive investors. The second one is related to an ETF structure that propagates positive feedback effects caused by ETF investors to constituent securities prices through a price co-movement channel. The third procyclical mechanism is associated with synthetic and exotic designs of certain index-linked products. The last two mechanisms originate essentially from the ETF-specific structure.

(*Procyclical mechanisms in methodologies constructing market indices*)

It is not surprising that benchmark indices mostly used by market practitioners are highly concentrated on few indices: S&P 500, MSCI World, Russell 2000, and country-representative indices such as FTSE 100, CAC 40, etc. These indices are tracked by index-linked products or reported as a performance benchmark in a prospectus of mutual funds. According to Standard & Poor's, $3.5 trillion is benchmarked to S&P 500 alone, including $915 billion in explicit index funds. Russell Investment estimates that there is $3.9 trillion linked to its indices (Wurgler, 2011). The index-link

[44] According to the four-factor model of Carhart (1997), the price momentum is one of factors that justify abnormal excess returns beyond the market beta, so called 'alpha'. Conceptually, the momentum strategy implies an active investment that searches for 'alpha' returns by actively buying rising stocks and selling falling stocks.

products or index performance benchmark system encourages asset managers to favor constituent stocks of an index over non-constituent stocks directly or indirectly. If both index constituents and non-constituents bring the same return, other things being equal, active asset managers benchmarked to the index are likely to prefer the index constituents to non-constituents to avoid tracking errors.

In fact, the methodologies of most indices are in favor of stocks with large market capitalization and high liquidity. Therefore, mechanical buys of constituent stocks driven by index-linked investments may implicitly lead to a momentum strategy for stock investments. For example, S&P 500 is a capitalization-weighted index. A stock can be included in the S&P 500 if a committee decides it satisfies specific requirements on pre-defined criteria, which are based mainly on market representativeness (market capitalization) and liquidity (trading volumes). Once constituents are decided, S&P 500 is calculated with a weight based on the market capitalization of each stock. Russell 2000 is an index of U.S small-cap company stocks, which is also a market-cap weighted index. Constituent stocks of the index and their weights are reexamined on the basis of their current market capitalizations every year. Likewise, MSCI World, CAC 40, and FTSE 100 are all market cap-weighted indices. Whereas market capitalization (the share price multiplied by the number of shares outstanding) and liquidity of each stock are typically main components in calculating the market-cap weighted index, fundamental information of companies such as price-to-earnings, dividend yields, etc., are rarely considered. Practitioners highlight that, given the growing popularity of passive investing, the calculation methodologies of major indices tracked by passive investing may implicitly lead passive strategies to include a momentum strategy component. That is, operating portfolios to replicate the market cap-weighted indices may imply a possibility that it steadily increases exposures to rising stocks and decreases exposures to falling stocks (*Forbes*, 2018). The reason is that they trade the index stocks mechanically based on market-capitalization weights applied to index calculation, not based on fundamental exposures to the index. If a stock is declining in prices, it becomes a smaller portion of the index, leading passive funds to decrease the stock holdings. If a stock is rising in prices for some reason, then the stock becomes a larger portion of typical market-cap weighted indices, and passive funds will blindly increase stocks over time.[45] This was the case of technology stocks during the U.S IT bubbles of the late 1990s and early 2000s when their values were inflated with their growing portion of indices. Tab.II-4 displays historical weights of S&P 500 by industrial sectors. The technology sector had a weight of 29.2% at the end of 1999 just before the IT bubble reached a peak in March 2000. After the IT bubble burst, the financial sector took the reign. By the end of 2006, by

[45] *Forbes*, "The drawback of market-capitalization weighted indexing" (Dec 26, 2018)

which the expansion of financial credits, including sub-prime mortgages, had fueled the U.S economy to boost, the financial sector's weight had ballooned up to 22.3%.

Tab.II-4 Historical sector weighting of S&P 500

Sector	1990	1992	1994	1996	1997	1998	1999	2000	2001	2002	2003	2004	2006	2007	7/15	9/19	Current
Financials	7.5	10.6	10.7	15.0	17.2	15.4	13.0	17.3	17.8	20.5	20.7	20.6	22.3	17.6	12.9	16.4	16.0
Technology	6.3	5.1	8.6	12.4	12.3	17.7	29.2	21.2	17.6	14.3	17.7	16.1	15.1	16.7	16.7	15.7	15.9
Health Care	10.4	9.9	9.2	10.4	11.3	12.3	9.3	14.4	14.4	14.9	13.3	12.7	12.0	12.0	12.9	12.5	13.7
Energy	13.4	9.7	10.0	9.2	8.4	6.3	5.6	6.6	6.3	6.0	5.8	7.2	9.8	12.9	15.3	13.6	12.8
Cons Stap	14.0	14.5	13.2	12.7	12.3	11.1	7.2	8.1	8.2	9.5	11.0	10.5	9.3	10.2	11.6	11.7	12.4
Industrials	13.6	13.3	13.0	12.7	11.7	10.1	9.9	10.6	11.3	11.5	10.9	11.8	10.8	11.5	11.2	11.2	11.0
Cons Disc	12.8	15.8	14.9	11.7	12.1	12.5	12.7	10.3	13.1	13.4	11.3	11.9	10.6	8.5	8.1	8.7	8.0
Utilities	6.2	5.6	4.8	3.7	3.3	3.0	2.2	3.8	3.1	2.9	2.8	2.9	3.6	3.6	4.1	3.5	3.6
Materials	7.2	6.9	7.1	5.8	4.5	3.1	3.0	2.3	2.6	2.8	3.0	3.1	3.0	3.3	3.9	3.7	3.3
Telecom	8.7	8.5	8.6	6.5	6.9	8.4	7.9	5.5	5.5	4.2	3.5	3.3	3.5	3.6	3.4	3.1	3.3

Source: Bespoke Investment Group

As long as the passive investment money is growing at the current pace, the new money will be mechanically allocated to the stocks that increase in values relative to the market. The market-cap weighted indexing ends up contributing to momentum investing, mechanically investing in rising stocks rather than undervalued stocks. It may be profitable but is prone to sudden sharp reversals (*Financial Times*, 2017).[46] This procyclical mechanism may be stronger for the index constituent stocks particularly with higher weights and relatively less liquidity (Shim, 2019). Some practitioners argue that the increasing popularity of passive investments tracking an index and the arguable "index bubble" inhibit active asset managers' arbitraging abilities to beat the index (Wurgler, 2011).

(*Procyclical mechanisms in ETF transaction structure*)

The other procyclical mechanisms stem from specific structures of ETFs. ETFs are one of the most popular passive investment vehicles of recent decades. While they were created in the early 1990s, ETFs' growth has been spectacular since the financial crisis. At present, ETFs account for more than 30% of total daily trading volumes on average in U.S stock markets (Ben-David et al., 2017). The basic structure of ETFs with a physical replicate of an index is shown in Fig.II-16. When an ETF sponsor issues an ETF, authorized participants (APs), who are usually market makers, deliver the basket of constituent securities that replicate the underlying ETF index to the sponsor and receive "creation units", i.e., shares in large blocks, from the sponsor.[47] The transactions between the ETF sponsor and APs take place in the primary market. Once the ETF shares are issued, ETF investors

[46] *Financial Times*, "Momentum investing bubble worries fanned by focus on market cap" (Oct 10, 2017)

[47] In Europe, the predominant practice is the exchange of an equivalent amount of cash to buy a basket of securities for the ETF creation units (Pagano et al., 2019).

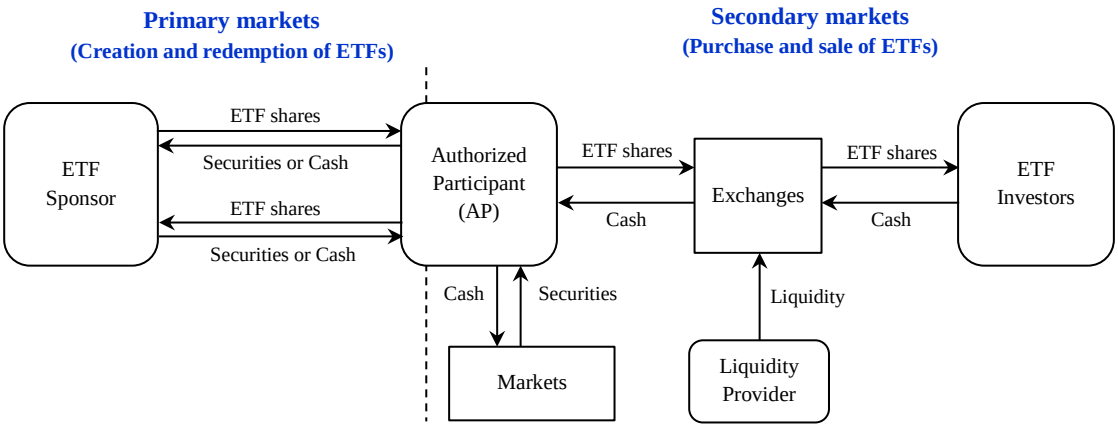
make intraday trading on exchanges in the secondary market with other investors, APs, or liquidity providers at market prices. ETF investors purchase and sell ETFs shares like stocks instead of purchasing and redeeming them from the fund directly. The shares can be redeemed by the ETF sponsor only to APs in kind (through constituent securities of the fund) rather than in cash.[48]

The net asset value (NAV) of an ETF is calculated at the end of the trading day and makes up the basis for determining its market price. The NAV is the value of assets held by a fund less liabilities. The market price is determined by the demand and supply of ETFs in the secondary market. The daily NAV and market price of an ETF may be different from each other. But in principle, the intraday differences should be eliminated by APs' arbitrages. For example, if an ETF is traded at a price beyond the NAV (at a premium), APs can sell ETF shares, buy a basket of constituent securities in the secondary market, and then create ETF units by delivering the basket of securities. Oppositely, if an ETF is traded at a price below the NAV (at a discount), APs buy ETF shares and redeem creation units in exchange for a basket of securities, then sell the securities in the secondary market again. Through the arbitrage and adjustment of ETF amounts by APs, the prices of ETFs are eventually adjusted in accord with the NAVs and APs can gain arbitrage profits. That is the reason why APs engage in the process of ETF transactions, even though they have no obligations for ETF investors, nor do they receive fees from ETF sponsors.

ETFs attract traders especially with short investment-horizons due to high liquidity, easy access, and high visibility of underlying indices. The majority of ETF investors in Europe are institutional investors, such as investment funds representing 80% of total European ETF shares. Insurance companies, banks, and pension funds also hold ETF shares, albeit with relatively low proportions relative to investment funds (Pagano et al., 2019). On the other hand, the U.S has higher participation of retail investors in ETF investments (about 50%), with the remaining held by institutional investors. Hedge funds are also one of the main institutional investors of U.S ETFs (Ramaswamy, 2011).

[48] Therefore, the ETFs share the features of both open-end and closed-end mutual funds, as the number of shares can change over time in response to investor demand like those of open-end mutual funds and shares are traded in secondary markets throughout trading day like those of closed-end mutual funds (Pagano et al., 2019). In the U.S, ETFs are not considered as mutual funds due to the limited redeemability, but classified as open-end funds or unit investment trusts (UITs) under the *Investment Company Act* of 1940, whereas in Europe, distinction is not made but ETFs can be established under the *Undertakings for Collective Investments in Transferable Securities* (UCITS) similar to those for mutual funds (Ramaswamy, 2011).

Fig.II-16 Functioning structure of ETFs with a physical replicate



Source: author's compilation

ETFs redeemed in-kind are relatively resilient to liquidity risk or first-mover advantages. The fund shares are redeemed through the basket of securities and the basket constitution does not change according to APs' redemption requests. So, forced asset fire-sales by ETFs in stress times to respond to redemption requests of APs are not likely to occur. ETF investors can dispose of their ETF holdings by selling them on exchanges like stocks. In this context, ETFs have no structural liquidity mismatch problem caused by easy redemption and redemption in cash like open-end mutual funds.[49] Instead, procyclical mechanisms in ETFs originate from the ETF-specific structure designed to accomplish fund objectives rather than liquidity transformation. When funds receive inflows, they have no choice but to invest in constituent stocks of an index based on index weights without considering fundamental values or relative values. Consequently, constituent stocks prices tend to co-move with their respective index once the stocks are included in the index (price co-movement). Investment through ETFs effectively means that investors have blindly the same strategies. Instead of selecting and investing in quality companies, ETF investors allocate more money to the largest, most popular stocks because those stocks have the largest weights in the indices. Often set up to mimic the index, ETFs have to buy more of stocks rising in prices, sending those stocks prices even higher (*Financial Times*, 2018).[50]

[49] In the case of ETFs tracking illiquid securities, the liquidity transformation from high liquidity of ETFs to low liquidity of constituent securities may be present, which can be problematic in market stress times when the market liquidity dries up. But these risks are currently limited given the current size of the illiquid ETF market segment (Pagano et al., 2019).

[50] *Financial Times*, "Passive investing is storing up troubles" (Aug 8, 2018)

Prices of constituent stocks can be affected by procyclical behavior of ETF investors through the price co-movement channel. It may be undesirable in terms of market stability and price discovery if potential procyclical behavior of the ETF investors impacts price movements of constituent stocks indirectly. ETFs' high liquidity and continuous trading tend to attract liquidity traders who take large directional short-term positions on asset classes. As described in the previous section, major institutional investors, especially investment funds, have procyclical mechanisms in their asset and liability structures that encourage them to have short-term investment horizons and correlated investment patterns. They are more likely trend-chasers riding short-term price momentum rather than active investors having recourse to long-term price mean-reverting or fundamental values. Even active fund managers may turn into short-horizon investors when benchmarked to a market index by short-term delegation contracts. Therefore, possible positive feedbacks in ETF prices generated by the short-term liquidity traders may be propagated to constituent stocks by arbitrages of APs responding to investors' demand for ETFs. That is to say, the taking of short positions on ETF shares by investors when an ETF price drops will accelerate the ETF price drops. APs buy the ETF shares at relatively low prices and redeem them in exchange for a basket of constituent stocks equivalent to the ETF shares, following the process of Fig.II-16. APs will sell the received stocks to gain profits from price differences between ETF shares and a basket of corresponding constituent stocks or flatten their inventories, which will ultimately drop the prices of constituent stocks. Oppositely, when the ETF price rise accelerates by investors' large long positions on the ETF shares, opposite directional transactions by APs will be executed to gain arbitrage profits. APs sell the ETF shares and buy a basket of constituent stocks equivalent to the ETF shares they sold, probably at a lower price than that of the ETF. Then, APs can issue the same amount of ETF shares in exchange for the basket of stocks. In this process, stock prices will rise. Ben-David et al. (2018) prove that one standard deviation increase in ETF ownership results in an increase in the standard deviation of the stock prices by 16%. The risk transmission from ETFs to constituent stocks may be more problematic in stress times when market liquidity dries up fast than in normal times. In stress times, APs may face investors' herding for ETF sales whereby ETF prices sharply drop. Consequently, this creates negative spillovers of sharp price drops and increased volatilities in stock prices. Stock prices can be more volatile, especially when the stocks are relatively illiquid or are included in a creation basket with high weights, which is not related to a fundamental reason. Price movements of constituent stocks are a result of the propagation of noise trading shocks rather than of price discovery of fundamental information about systematic risk (Pagano et al., 2019). The co-movement of the index and underlying stock prices makes it more likely that stock investors face simultaneous capital gains and losses, which may reinforce investors' synchronized investment patterns across stocks.

Institutional investors would have a procyclical orientation for stock investments by nature, even if there were no ETFs. But without ETFs, placing short-term directional bets on the index would be more or less limited because it is more expensive with transaction costs or lower liquidity of constituent securities. Therefore, ETFs may fuel institutional investors into directional trading by reducing costs. If the institutional investors have a short-term investment horizon, they are more likely to behave in a procyclical manner in ETF markets and thereby spill over undesirable effects to stock markets. ETFs issued in Europe, where the main clientele is investment funds with a short-term investment horizon, may be more vulnerable to positive feedbacks and their propagation to underlying stocks through the price co-movement channel compared to ETFs issued in the U.S, where the main clientele is retail investors.

(*Synthetic and exotic ETF products, and the Flash Crash of February 5, 2018*)

Another source of procyclicality is a synthetic and exotic ETF product structure designed to track volatility indices. There have been growing volatility products such as volatility futures, options, or Exchange-Traded Products (ETPs) by which investors can trade volatilities for hedging or speculation. Some volatility products are found vulnerable in stress times when market volatilities sharply rise, as shown in several U.S stock market crash episodes in recent history. Inverse volatility ETPs were a key factor behind the flash crash of February 5, 2018. As volatilities of stock market prices have stayed low since the global financial crisis, inverse volatility ETPs to make a bet on low or lower volatilities were enjoying growing popularity. They offer inverse performance of the VIX index, a measure of implied volatilities for the S&P 500, by shorting VIX futures. On February 5, 2018, the VIX rose temporarily during the trading time of the day by 116%. As the VIX sharply increased, prices of associated VIX futures surged, and the values of inverse volatility ETPs to take short positions in the VIX future contracts fell to near zero.[51] Issuers of ETPs must rebalance portfolios at the end of the trading day to maintain target exposure. In the last hour of that day, the inverse volatility ETP issuers had to buy VIX futures to rebalance portfolios and cover losses from short positions in VIX futures. As a result, both long and short types of volatility ETPs engaged in buying VIX futures upon the sudden jump in VIX, which pushed the VIX future prices and VIX index up again, creating a positive feedback loop. The case of leveraged inverse volatility ETPs was even worse. They use leverage to magnify the expected returns from the low VIX. For example, a 2x VIX ETP can build short positions twice as large as their assets by using leverage whereby the leveraged inverse ETP carries high profits

[51] For example, the closing value of VolocityShares Daily inverse VIX short-term ETN on that day was $4.22 per share explained a 96% plunge from its value ($108.37) on the previous trading day.

and bears heavy loss potentials instead. The perverse feedback loop created between leveraged inverse ETPs and VIX eventually impacted stock markets that day. One transmission channel worked via VIX futures dealers that hedged their exposure from selling VIX futures to ETPs by shorting S&P futures, thus putting further downward pressure on stock prices. Additionally, normal algorithmic arbitrage strategies between ETFs, futures and cash markets kept the related market dynamics tightly linked (Sushko and Turner, 2018). The flash crash episode of February 5, 2018, suggests the VIX spike on that day was caused by mechanical trading and rebalancing strategies of ETPs rather than by expectation on future volatilities.[52] While the current volume of volatility products is relatively small, the internal dynamics in the products have growing impacts on the VIX and related stock markets.

II.3.2. Price overshooting caused by interactions of algorithmic and high-frequency trading

(*Definition of algorithmic trading (AT) and high-frequency trading (HFT) and their strategies*)

Hereinafter this section focuses on more short-term price dynamics that appear in from weeks to milliseconds or microseconds, which are driven by algorithmic trading or high-frequency trading. Markets are increasingly influenced by algorithmic trading or high-frequency trading capable of handling with market movements at an ever higher frequency beyond human traders' capability to monitor and manage effectively. Algorithmic Trading (AT) is a tool for automatically generating trading decisions, submitting and managing orders according to pre-defined trading instructions without human intervention. High-Frequency Trading (HFT) is a subset of AT where trading system analyses data or signals from markets at high speed and send a large number of orders within a very short time period in response to that analysis (European Commission, 2011; Gomber et al., 2011).[53] Institutional specialties of the algorithmic HFT are well described by Securities and Exchange Commission (SEC); HFT uses extraordinarily high-speed and sophisticated computer programs for generating, routing and executing orders. It also uses co-location services, and individual data feeds offered by exchanges and others to minimize data networks and other types of latencies. It has very short time-frames of establishing and liquidating positions (SEC, 2014).

Dramatic changes in stock market structures over the world in the 1990s prompted a huge transformation in trading culture. Wide-ranging deregulation liberalized finance and increased market liquidity significantly. Technological innovations introduced electronic trading desks and advanced

[52] The VIX is composed of expected future volatility and risk premium. Sushko and Turner (2018) show that the rise in the VIX on February 5 far exceeded expected future volatility.

[53] There are academic debates on the definition of "algorithmic trading", "automated trading" and "high-frequency trading". For more details, see Vuorenmaa (2012), Market Committee (2011), etc.

trading infrastructure, while traders abandoned the traditional floor trading system. This eventually led to market fragmentation, where markets got fragmented into increasing exchanges and order matching platforms closely interconnected. Competition among the platforms became strong. All these changes created ideal conditions for the emergence and development of HFT. Currently, HFT explains 70-80% of stock trading volumes and the lion's share of order books on the major stock markets, including the U.S and Europe. This implies that it plays a non-negligible role in the stock price formation and market volatilities for the stock market concerned (Arena et al., 2018; Aubert, 2010).

Essentially, AT and HFT are technological tools rather than being trading strategies. AT and HFT are the most innovative tools for executing various trading strategies by professional investors. Their impacts on markets, therefore, may depend on the trading strategies applied. In general, strategies of HFT fall into two categories: Market-making and aggressive trading (e.g., arbitraging, directional trading, etc.). Contrary to the mostly negative coverage of media on HFT, a fairly large stream of academic research highlights its advantages in terms of price discovery and market efficiency (Brogaard et al., 2013, etc.). HF traders often serve as endogenous market-maker, providing liquidity to the market. HFT is in the best position to find arbitraging opportunities, thanks to its ability of fast data analysis and trading executions with regard to traditional traders. In this context, HFT plays a crucial role in price discovery and market efficiency by enabling large block trades without changing stock prices significantly and exploiting price anomalies between fragmented markets. For instance, APs' arbitraging activities between ETFs and underlying securities markets, as described above, are usually operated by algorithmic HFT that is pre-programmed for detecting discrepancies between ETF prices and their NAVs and then executing cross-market trading. The algorithmic HFT of APs contributes to the fast convergence of different market values between an ETF and its constituent stocks traded in different trading venues, which is crucial for the well-functioning of ETF markets.

Nevertheless, some HFT strategies are disruptive to market stability, leading to price overshooting and increased price volatilities at intraday intervals. Some strategies aim to take advantage of millisecond correlations or price momentum, which is sometimes manipulated by HFT, or make a liquidity illusion to gain favorable executions. For example, "Quote stuffing" refers to a strategy characterized by HF traders rapidly submitting a torrent of orders in an order book to manipulate bid/ask quotes, which is intended to cause prices to fall or rise subsequently (Bogoev and Karam, 2016). "Front-running" is a strategy where an HF trader steps in front of a large institutional order, pushes prices too high (low) when the institutional investor wants to buy (sell) and exploits following executions of the large order. Sometimes HF traders place limit orders and cancel them fast right before trade

executions are completed to make favorable price movement ("Order fade" or "Layering").[54] In the "momentum ignition" strategy, an HF trader causes an initial price move by a spike in volumes and instigates other traders to join the directional trading to create a short-term price momentum by which the HF trader can generate profits. Once the HF trader covers their position, the price usually reverts itself to the original level (Bogoev and Karam, 2016). Hirschey (2011), who detects empirical evidence of positive correlations between HFT and slow traders' trading, demonstrates that the positive correlations are not simply due to faster reaction to news arrivals than slow traders but may imply that HF traders predict buying and selling pressure of slow traders and then place trades in a slow traders' trading direction. Such strategies are a so-called "predatory trading," which refers to strategically placed trades that hunt their "prey," especially in need of liquidation by first trading in the same direction and then reversing the position and making a "kill" (Vuorenmaa, 2012). Numerous empirical studies prove that algorithmic HFT increases short-term and even long-term price volatilities, especially when it involves speculative trading in the same direction as other traders (Boehmer et al., 2012; Zhang, 2010, etc.).[55]

Predatory strategies of algorithmic HFT are not essentially different from what traditional slow traders did. In the aftermath of the Russian debt crisis in 1998, the fact that LTCM was highly leveraged and in liquidity distress became well-known to large traders like Goldman, Sachs & Co. The large traders started to trade in the same direction as LTCM, which drove it to the brink of bankruptcy. Brady et al. (1988) suggest that the stock market crash of 1987 was also partly due to predatory trading, commenting, "Precipitous decline began with several triggers that ignited mechanical, price-insensitive selling by a number of institutions following portfolio insurance strategies and a small number of mutual funds." Brunnermeier and Pedersen (2005), who provide the first theoretical model of predatory trading, highlight that predatory trading leads to price overshooting and amplifies large traders' liquidation cost and default risk. It ultimately enhances systemic risk, as the liquidity distress of one large trader spills-over across other traders and markets.

(*Institutional specificities of high-frequency traders*)

HFT strategies are not something new. What is new relative to the trading of traditional slow traders is the intensive reliance on the technology of information, pre-programmed algorithm, and speed

[54] According to AMF, three hedge funds that are known to use HFT in French stock markets explained 40% of orders of CAC40 in 2010 and they cancelled 97% of these orders before trading executions.

[55] The empirical evidence about the impact of HFT on short-term market volatilities is controversial. Brogaard (2012) and Hasbrouck and Saar (2011) find evidence that HFT activities lower short-term volatilities. But an important question on causality remains unclear. In other words, there is no clear answer on whether HFT activities actually lower volatilities or they participate only in low- volatility regimes (Vuorenmaa, 2012).

(Foucault, 2016). Decades ago, designated market makers such as NYSE specialists were the only ones who were able to see order books and forecast the direction of short-term price movements. But technology and competition of HF traders have replaced the protected status of certain designated groups. In addition to superior technical and informational capabilities, HF traders have their institutional specialties liable to use the capabilities to serve short-term price overshooting.

HF traders are distinguished from other institutional investors such as traditional market makers, long-term investors, or other general algorithmic traders in a broad sense regarding holding periods and trading purposes. They have an ultra-short investment horizon at intraday intervals. In a report of SEC (2014), HF traders are characterized as "professional traders acting in a proprietary capacity that engage in strategies that generate a large number of trades on a daily basis. These traders could be organized in a variety of ways, including as a proprietary trading firm, as the proprietary trading desk of a multi-service broker-dealer, or as a hedge fund". That is to say, they invest on their own account, not for clients, regardless of whether they are broker-dealers, hedge funds, investment banks, or specialized HFT firms.[56] SEC (2014) adds, "They usually end trading days in as close to flat positions as possible". That is, HF traders do not want to carry significant unhedged positions overnight and usually unwind all positions before the end of each trading day. HFT industry believes that the short intraday holding times of positions allow them better risk protection than traditional trading styles because the market risk is further decreased by their extremely fast absorption of news and by taking minimal overnight positions when important news could arrive (Vuorenmma, 2012). The view of HFT industry is well captured in the public commentary of Tradeworx (2010) on SEC Market Structure Concept Release; "HFT can't accumulate large positions, thus can't deploy large amounts of capital, have little needs for outside capital or leverage and tend to be proprietary traders. So they can't "blow up" (can't lose much capital)." Such institutional structure necessarily leads them to have the objective to generate gains on a relatively small amount of capital through intensive uses of high technologies and advanced trading infrastructure. They search for the opportunity to generate a low margin on each trade then make up the low margin with large numbers of trades by automated frequent trading in the millions for low transaction cost. It is vital for HF traders that the invested small amount of capital on their own account be turned over very quickly (Aubert, 2010). Therefore, according to some analysts in the banking sector, HFT may be a new business model of international

[56] Despite the definition by SEC (2014), broker-dealers or banks' brokerage services make use of HFT on behalf of third-parties (agency trading) that covers only the part of transactional chain relative to the execution of orders. In this case, execution strategies generally aim above all to limit implementation shortfall. For instance, to optimize executions (minimize both risks relating to execution time and orders' impact cost), they tend to fragment orders to spread the executions out over time (Aubert, 2010)

investment banks during liquidity crisis following increases in the cost of capital necessarily, because it has the capacity to generate returns on potentially small capital by means of a large number of ultra-fast trades based on technology.[57] This implies that HFT might be an alternative investment tool applicable in critical conditions where a fast reaction to intraday market changes without large capital losses is important. Ultimately, these institutional characteristics make the algorithmic HF traders extreme short-term investors who are extremely sensitive to short-term price dynamics and other traders' behavior in a range from milliseconds to minutes or hours, putting too much emphasis on statistical properties of short-term returns and neglecting fundamental valuations. This feature of algorithmic HFT is contrasting to that of long-term investors. Long-term investors carry large positions on large amounts of capital or leverage. They generally have large commissions and trading costs that far exceed the expected return of a typical HF trade. Likely, long-term investors have no interest in HFT because the margins measured in only a few basis points are too low for them to invest in HFT infrastructure.[58] Long-term investors are supposed to hold a stock for the purpose of investment over long-term horizons, exploiting third-party trading solutions (Tradeworx, 2010), whereas HF traders hold a stock for an extremely short period for the purpose of trading (Zhang, 2010).

On the institutional foundations, algorithmic HF traders are more deeply reliant on new technologies relative to traditional traders. They employ cutting-edge mathematical models and technologies for computation, data and execution processing, communication, etc. They co-locate computers in the data center where an exchange locate its data server for speedy data processing and trading executions. The firms co-locating the server can access the exchange's direct data feeds and execute trading faster by milliseconds than others. Advanced algorithms using Artificial Intelligence (AI) and machine learning collect and select signals that can help to estimate future price movements. AI and machine learning allow traders to obtain quantitative information such as non-linear order flows, trade dynamics, past stock returns, or cross-correlations among assets for a low cost. The informational capability of the high-frequency traders can extend to even qualitative information such as market sentiment from textual analyses on news, pre-news, or other influential materials. Recently, technologies allow computers to analyze discussions and opinions on social networking websites. Algorithms with powerful calculation capacities via neural networks or support vector machines, etc.,

[57] For example, Huw van Steenis and Bruce Hamilton, financial analysts of Morgan Stanley, proposed flow trading in 2009. Constrictive provisioning standards for banks could also foster the development of this type of business model in the future (Aubert, 2010).

[58] In its public commentary to SEC, Tradeworx (2010) comments, "Investment of a long-term investor in HFT technology would allow him to improve his returns from 10% (hypothetically) to 10.005%, which is a pointless and stupid exercise given than third-party solutions are available which provide most of the benefit for little or no cost."

prove their superior ability to analyze vast amounts of data and thereby forecast future price movements in different asset markets. They facilitate sophisticated statistical analyses to identify tendencies or regularities in past prices that will help predict the price movement in the upcoming time intervals. HFT, equipped with advanced technology, does fast analysis on the status of order books, aiming to fast response (low latency) to incoming large orders in a range of milliseconds or less. It makes the HF traders easier to profit from predatory trading or another aggressive trading against incoming large orders of traditional slow traders.

(*Destabilizing interactions of algorithmic and high-frequency traders facing drastic price drops and the Flash Crash of May 6, 2010*)

HF traders with an extreme short-horizon are more likely to exploit their informational and speed advantages in the way of generating price momentum or price overshooting because they typically do not trade based on fundamental analysis. Zhang (2010) offers novel empirical evidence supporting that HFTs create stronger price reactions to earning news in the contemporaneous quarter[59], which indicates a quarter-price momentum and subsequent price reversal in the following months. He suggests two possible mechanisms of the price momentum, "HFT interacts with traditional traders. It is possible that HFT front-runs large orders of institutional investors, who tend to trade in the direction of earning news, a practice driving up (down) a price following good (bad) news. It is also possible that HFT induces more momentum traders to trade in the direction of earnings news." [60] This explanation of HF traders' behavior is basically in accord with noise traders' behavior with cognitive bias and rational speculators that the theory of behavioral finance presumes. From the view of Zhang (2010), mean-reverting strategies that arbitrage over time also do not appear likely for HF traders since the short-horizon traders have no opportunities to profit from price reversals in the following months if they do not hold positions long enough. As a consequence, HF traders with extremely short-horizons are institutionally prone to exploit their superior informational speed ability to identify and take advantage of information relating to short-term price movements, especially in relations with traditional traders. It leads to producing or reinforcing short-term price volatilities in the end, which contrasts with some studies assuming that price volatility is determined by the volatility of the stock's fundamental value.

[59] One standard deviation increase of HFT strengthens the price reaction to earning news by 8.3~8.4% (Zhang, 2010)

[60] It is also possible that HFT and traditional investors' trading are independent. HFT first reacts to earning news and moves the stock price. Traditional traders trade stocks subsequently and further move the price, without adjusting for the initial price reaction introduced by HFT (Zhang, 2010).

Reversely, increased price volatilities or strong price movements are also likely to attract and promote aggressive HFTs. Endogenous market-making activities by HF traders that are supposed to reduce price volatilities can be ceased when they confront strong price movement. Generally, market-makers prefer a stable price for market-making activities, as price movement does not benefit themselves. Unlike designated market-makers at exchanges who are constrained by regulatory requirements to provide liquidity in periods of market stress, HF traders are free to engage in or desist from market-making activities. HF traders cease market-making activities and shift to aggressive strategies exploiting the price movement if the market conditions are not right for them to make profits, likely under the condition of high market uncertainty (Zhang, 2010). It could create potentially periodic illiquidity and price overshooting. But this can also apply to general algorithmic trading operated by traditional traders, in which trading executions are pre-programmed to take a certain action mechanically responding to changing markets and do not allow for the time for human intervention. The automated trading executions by pre-programmed algorithms sometimes trigger system-wide market instabilities, especially when they are similarly employed for large directional movements.

The U.S stock market Flash Crash of May 6, 2010 is a good example of how high-frequency trading, general algorithmic trading, and other traditional manual traders interact with one another in the face of drastic market movements under high market uncertainty. This episode is a case of a "confluence of events", but we only focus on the mechanical actions of trading algorithms responding to a large sell order program and thereby rapid price declines. On May 6, 2010, the market started in a nervous mood with unsettling economic news regarding the European debt crisis. By 11:00 a.m., the Dow Jones index already decreased by 60 points, and around 1:00 p.m., the VIX began to rise with broadly negative market sentiments and reached 28.6 at 2:00 p.m. while the Dow Jones Industrial Average (DJIA) was down about 1.5% and S&P down 2.9%. At 2:23 p.m., the NASDAQ began to alert abnormal price movements of many securities, and the VIX surged by 31.71% from its early morning level. Shortly, the first stock was traded against a stub quote which was 80% lower than the closing price of the previous day. At 2:32 p.m., a traditional trader, Waddell & Reed (a mutual fund complex), initiated a heavy sell program of E-mini future contracts. According to the joint report of CFTC[61] and SEC (2010) on the market event of Flash Crash, the trader chose to execute this sell program via an automated execution algorithm ("Sell Algorithm") that was programmed to feed orders into the June 2010 E-mini market to target an execution rate set to 9% of the trading volume calculated over the previous minute, but without regard to price or time. In general, when executing a sell program, a large trader utilizes a combination of manual trading entered over the course of a day and several

[61] Commodity Futures Trading Commission

automated execution algorithms that take into account price, time, and volumes. On that occasion, it usually takes more than 5 hours for the large trader to execute the same size of future contracts as those initiated by the sell program on May 6, 2010. However, the sell program without regard to price or time which was chosen on that day executed trading extremely rapidly in 20 minutes. As a result, E-mini prices, which had already been falling from around 2:32 p.m., suffered an accelerated decline of approximately 3% in just four minutes from the beginning of 2:41 p.m. to 2:44 p.m. It was driven by a combined sell pressure of HFT and other intermediaries, not just by the large sell program. HF traders and other market makers had likely been the initial absorbers of sell orders by the sell program, providing liquidity to the market at the first phase. But this led them to build up net long positions. HFT began to sell aggressively future contracts in order to reduce the temporary long positions between 2:41 p.m. and 2:44 p.m., taking liquidity from the market at this time. Furthermore, according to the report of CFTC and SEC, during the time between 2:41 p.m. and 2:45 p.m., HFT repeated buying and selling of contracts, producing a high trading volume of "hot potato", which is consistent with a typical trading pattern of HF traders, a large number of trades, but not accumulating an aggregate inventory beyond three to four thousand contracts in either direction (CFTC and SEC, 2010). The increased trading volumes caused by HFT pushed the sell program to feed sell orders into the market at an increasing rate, which generated a price decline of more than 5% during the time between 2:41 p.m. and 2:45 p.m. The prices were falling fast, but fundamental traders or opportunistic traders seemed either unable or unwilling to buy future contracts while experiencing sharp declines in prices. The E-mini market was stabilized at 2:45:28 p.m. after trading was paused for five seconds when the Chicago Mercantile Exchange (CME) Stop Logic Functionality was triggered to prevent a cascade of further price declines (CFTC and SEC, 2010). Other securities markets experienced a similar decline and recovery of prices during the time between 2:32 p.m. and 2:45 p.m. Turbulence in the E-mini future market was broadly spread to ETF and stock markets at the same time, due to opportunistic traders' cross-market arbitrages by buying E-mini contracts, but not enough to stop the prices from declining, and simultaneously selling S&P500 SPDR ETFs (SPY) and its constituent stocks of S&P500. During the time, SPY suffered a price decline of 5%. In the stock markets, Accenture shares fell down to 1 cent, while Sotheby's were traded at 99,999.99 U.S dollars.

The episode of Flash Crash on May 6, 2010, shows that the automated trading execution can trigger market turbulence, especially if the execution algorithm is programmed without considering price or time. The automated trading of a large sell order that would otherwise have been in 5 hours was executed in 20 minutes, causing rapid downside movements of prices. This sell order program also responded to a high level of trading volumes caused by HFT by increasingly feeding sell orders into

the market, accelerating erosion of market liquidity and further declines of prices. However, beyond the flawed individual algorithm as an accidental event trigger, more interestingly, we can observe specific actions of other manual traders and automated trading algorithms responding to the rapid price declines during the very short time interval. According to SEC (2010), low-frequency fundamental traders appeared unwilling to buy future contracts during rapid price downturns. Between 2:32 p.m. and 2:45 p.m., fundamental buyers sold more than 80,000 contracts net, whereas the fundamental buyers purchased 50,000 contracts net, representing 30,000 net selling contracts in the market. The size of net selling by low-frequency fundamental sellers is 15 times larger, while net buying by fundamental buyers is 10 times larger than during the same time interval of the previous three days. Haldane (2011) comments about this, "The equilibrating force of long-term investors went missing."

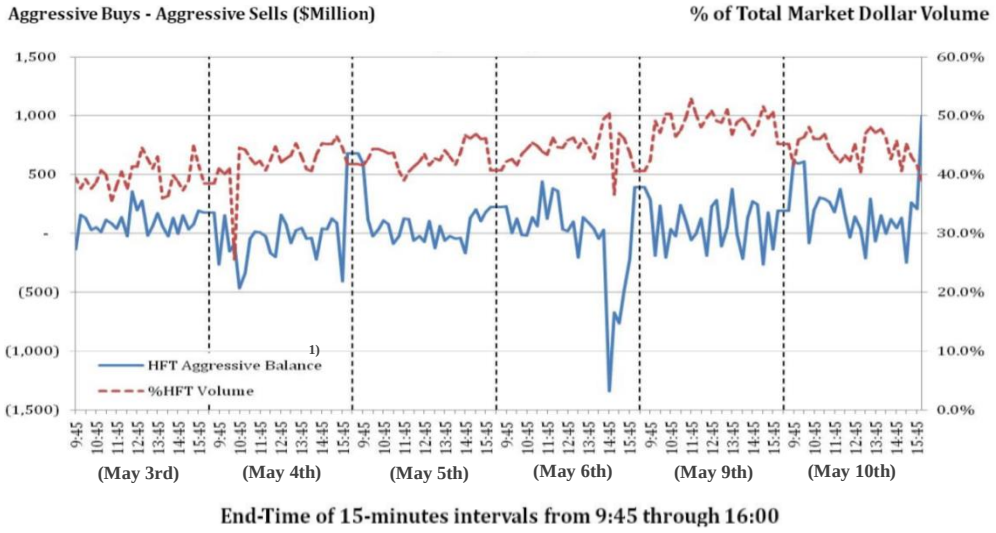
Against this backdrop, HF traders who were initially buyers of the large sell order turned into aggressive sellers because their algorithms started to sell automatically in order to reduce their temporary long positions. Then they repeated a large number of buying and selling trades between 2:41 p.m. and 2:44 p.m., which indicates a typical trading pattern of HFT. Some HFT programmed for cross-market arbitrages transferred extreme price movements of the E-mini market to stock and ETF markets, buying future contracts, which are, nonetheless, insufficient to stabilize the future market, and selling stocks and ETFs contemporaneously. Looking into HFT algorithms' behavior in stock and ETF markets, HF traders increased their aggressive selling[62] actively during the rapid price decline across broad markets. Fig.II-17 shows net aggressive buys (aggressive buys minus aggressive sells) of 17 executing broker-dealers on public quoting markets for six business days from May 3 to May 10 that SEC supposes to be primarily associated with HFT firms,[63] along with a percentage trading volume of 17 HFT of the total trading volume on the public quoting markets. A positive (negative) figure of net aggressive buys implies that HFT firms bought (sold) securities aggressively more than they sold (bought) aggressively. Notably, these 17 HFT firms increased their aggressive selling significantly during the time from 2:30 p.m. through 3:00 p.m. on May 6, while increasing their trading activity to a peak of 50.3% between 2:00 p.m. and 3:00 p.m. Tab.II-5 presents trading volumes of the 17 HFT firms by strategies and trading directions over the course of May 6. As consistent with what Fig.II-17 shows, around 2:45 p.m., the aggressive selling volume of the HFT firms was the most remarkable among four categories of trading patterns, reaching $9.3 billion. HFT algorithms engaged

[62] By definition of SEC (2014), aggressive trading means liquidity-taking buys and sells (generally taking bids and lifting offers), whereas passive trading means liquidity-providing buys and sells (generally posting bids and offers).

[63] As this group does not include all types of HFT firms, for example, the proprietary trading of multi-service broker-dealers that involve in HFT, etc., it should be cautioned to explain the trading volume of this group as overall trading volume of HFT.

more heavily in selling securities during the drastic price downturns in stock and ETF markets, which was in part driven by cross-market arbitrages that propagate E-mini market turbulence to those markets.

Fig.II-17 Aggressive order imbalance and trading volume of 17 HFT firms



Note: 1) A positive (negative) figure of net aggressive buys implies that HFT firms bought (sold) securities aggressively more than they sold (bought) aggressively. Source: CFTC and SEC (2010)

Tab.II-5 Trading volume of 17 HFT firms on public quoting markets (May 6, 2010)

($, Million)

	Aggressive[1)]			Passive[1)]			Total
	Selling	Buying	Net	Selling	Buying	Net	
1:30 p.m.	2,294	2,425	131	2,269	2,139	-130	1
1:45 p.m.	1,834	1,919	85	1,811	1,688	-123	-38
2:00 p.m.	1,834	1,871	37	1,879	1,651	-228	-191
2:15 p.m.	4,002	3,955	-47	3,739	3,517	-221	-268
2:30 p.m.	5,786	5,814	28	5,571	5,294	-277	-249
2:45 p.m.	9,302	7,959	-1,343	7,528	7,714	185	-1,158
3:00 p.m.	5,748	5,071	-677	5,575	5,480	-95	-772
3:15 p.m.	5,820	5,054	-765	5,515	5,428	-86	-852
3:30 p.m.	5,220	4,732	-488	4,823	4,984	160	-328
3:45 p.m.	4,763	4,547	-216	4,677	4,324	-353	-568
4:00 p.m.	6,173	6,561	388	7,658	7,194	-465	-76

Note: 1) By definition of SEC (2010), aggressive trading means liquidity-taking buys and sells (generally taking bids and lifting offers), whereas passive trading means liquidity-providing buys and sells (generally posting bids and offers).
Source: CFTC and SEC (2010)

Let us focus on the actions of more general trading algorithms and human traders that afternoon. CFTC and SEC (2010) report anecdotal evidence provided by firms that SEC interviewed after the Flash Crash. They included various types of financial firms who traded that afternoon, ranging from

stock and ETF market makers to asset managers and several HFT firms. Almost all firms utilized a combination of automated algorithms and human traders to make trading decisions and executions. SEC (2014) reports, “The rapid price declines starting around 2:40 p.m. in the E-mini market triggered “price-driven integrity pauses” across a number of automated algorithms. Whenever data integrity was questioned for any reason, firms temporarily paused trading in either the offending security or in a group of securities.” The rapid price moves raised data integrity concerns, and the automated trading systems paused trading in securities temporarily. But the concerns for potentially erroneous data were not the only trigger of automatic pauses. It was reported that many firms paused trading due to triggers of their internal risk or internal capacity limits, which are predefined by algorithms to calculate various indicators such as price volatility, intraday P&L, or long/short exposure to a security etc. Triggers of such internal risk or capacity limit parameters driven by sharp declines of prices and increased price volatilities paused or even halted trading activities during that afternoon. Broker-dealers that handle retail clients' orders reportedly found added heavy sell pressure on the declining markets due to triggers of retail stop-loss orders to limit potential losses. Since the broker-dealers engage in trading as a riskless principal of their retail clients, they stopped trading executions for their clients, but when the price went below a certain level, predefined stop-loss orders made them send sell orders to exchanges, which put further selling pressure to already declining markets. As sell orders initiated by retail stop-loss orders were sent to exchanges, both market orders and limit orders got executed at lower prices due to a lack of available liquidity. Some orders hit a stub quote that was automatically generated by exchanges or broker-dealer trading systems. While market liquidity was vanishing, some market orders seeking immediate selling executions at current market prices were automatically traded at the stub quote in pennies. Likewise, following the prices down, limit orders that could not be filled were resubmitted at an extremely lower price, ultimately reaching a stub quote.

As noted above, during a short time of rapid price declines caused by a large sell program without considering price or time, many trading systems automatically engaged in fire-sales or temporarily paused their trading. It is partly because HF firms had to unwind temporary net long positions at some point of time, and it is partly due to automated triggers in “price-driven integrity pauses”, “stop-loss sale algorithms”, “internal risk limits,” or “internal capacity limits” across a number of automated algorithms. Low-frequency fundamental traders that are supposedly capable of providing liquidity found sold securities as well. Even automated trading systems of the majority market makers that are supposed to accumulate large inventory positions and provide liquidity reduced their trading activities significantly and widened bid-ask spreads. The same event market participants were experiencing led

them to make similar decisions to sell securities or stop trading. The collective trading behavior of automated trading systems that may have been trading in their own way in normal conditions automatically withdrew market liquidity and put further pressure on declining prices. The additional price drops would, in turn, trigger more stop-loss sales and price-driven integrity pauses, creating an adverse feedback loop in the markets. The dynamics of intraday risk management practices of HFT and other automated trading systems contributed to short-term price overshooting and systemic risk spill-over.

Once automatic pauses are triggered, some form of human intervention is required in order for firms to reenter the marketplace. It is reported that the time needed by the various participants to reenter the market ranged from as short as a few seconds to as long as several hours (CFTC and SEC, 2010). Many firms that SEC interviewed said that they pulled back from the market because they were not confident about what they were seeing and trading under such extreme conditions (Berman, 2010).[64] Zigrand et al. (2011) argue that it eroded confidence in markets for a considerable time to come.

Algorithms should not be considered in isolations but in relation to other algorithms (Vuorenmaa, 2012). Strategies of HFT tend to be more correlated with each other than non-HFT strategies (Brogaard et al., 2013). Strategies of AT or HFT are more correlated over time than manually operated strategies (Chaboud et al., 2011). Cross-market arbitrages of HFT based on automated trading systems at high speeds may lead to worse contagion effects across markets (Finance Watch, 2012). Homogeneous algorithms, automated trading executions, and algorithmic interactions can generate a collective procyclical herding behavior, creating negative price dynamics and causing system-wide instabilities, especially in stress times, though each algorithm is designed for individual optimization or risk minimization, which is like a “tragedy of the commons”.

II.3.3. Summary

This section talks about how current popular trading practices induce procyclical investments mechanically and implicitly on highly fragmented markets. Passive investing embeds procyclical mechanisms in the methodologies used for constructing market indices and ETF-specific structures. Passive investing that replicates market cap-weighted indices blindly lead to procyclical herding, increasing holding of popular stocks with increasing market capitalization and liquidity without

[64] From a speech of SEC staff (2010), “*Market participants and the May 6 Flash Crash*”

considering corporates' fundamental values. This may inhibit arbitraging abilities of active asset managers to beat the index and contribute to the arguable "index bubble". ETFs are issued based on underlying stock baskets of a benchmark index but traded as separate securities with high liquidity and visibility in ETF markets. Such ETF characteristics are likely to attract procyclical stock investors with short investment horizons. Potential procyclical behavior of ETF investors can transmit risks to stock markets through a price co-movement channel. Moreover, synthetic and exotic designs of certain index-linked products serve as a new source of market instabilities as shown in the U.S Flash Crash of Feb 8, 2018.

Algorithmic HFT produces a new dimension of instability to markets. The objective of HF traders is to generate returns on small capital by means of large numbers of ultra-fast trades based on cutting-edge technology. This business model makes HF traders ultra-short horizon traders who are extremely sensitive to short-term price dynamics and other traders' behavior in a range from milliseconds to minutes or hours, putting too much emphasis on statistical properties of short-term returns and neglecting fundamental valuations. In normal times, they may act as endogenous market makers providing liquidity. But in the face of drastic price drops in stress times, they turn into an aggressive market destabilizer. Their unexpected interactions with drastic price movements and other trading algorithms cause price overshooting and maximize market uncertainty. The U.S Flash Crash episode of May 6, 2010 is an ultimate example. High-frequency traders who were initially shock absorbers turned into aggressive traders engaging in fire-sales to unwind temporary long positions. Other algorithmic trading system temporarily paused their trading or automatically triggered "price-driven integrity pauses" or "stop-loss sale algorithms", which accelerated liquidity drain further. Low-frequency fundamental traders that are supposedly capable of providing liquidity found sold securities as well. Even the majority market-makers reduced their trading activities significantly and widened bid-ask spreads. The automated trading systems that may have been trading in their own way in normal conditions automatically and collectively made similar decisions to sell securities or stop trading during the market turbulence, putting further pressure on declining prices.

II.4. Procyclical orientation of foreign investors in emerging stock markets

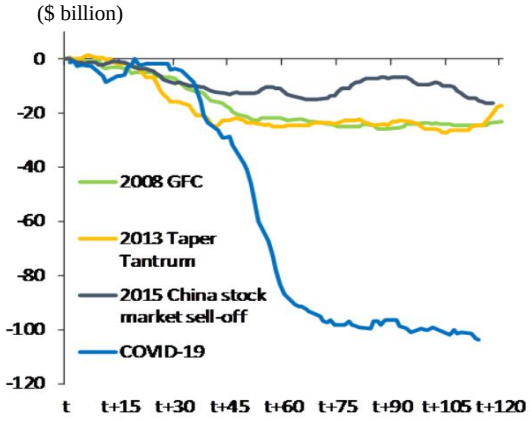
The final section has a particular focus on foreign investors in emerging stock markets. While numerous previous studies prove that foreign investors are procyclical or momentum investors in emerging stock markets, only a few studies give explanations on why they have a procyclical orientation in the emerging markets. This section finds the answers through an institutional approach, examining foreign investors' institutional characteristics, their investment purposes, and investment tools leading them to procyclical investors in emerging markets.

II.4.1. Foreign investors' procyclicality in emerging stock markets

Foreign investors are momentum investors in emerging stock markets with regard to domestic stock returns. Foreign investors buy emerging market stocks when prices rise and sell them when prices fall. It was a prominent feature, especially in the periods before and during the Asian crisis of 1997-1998 (Kim and Wei, 1999; Kaminsky et al., 2000; Richards, 2004, etc.). The global financial crisis of 2008-2009 shed light on the behavior of global capital flows again because global capital flows propagated the risk of advanced countries to emerging markets amid the crisis. But related research and regulatory focus were mainly on the short-term cross-border lending of international banks, which was the most unstable capital source, rather than stock portfolio inflows. Global capital inflows via domestic banks' short-term borrowings taking the form of non-core foreign exchange liabilities were prominently procyclical with regard to GDP or domestic financial cycles of some emerging countries, leading to amplified business cycles and distortion of monetary policy transmission channels (Song and Kim, 2009; Hahm et al., 2011, etc.). Despite relative declines in cross-border lending of international banks since the global financial crisis due to enhanced macro-prudential policies and changes in bank business models, global portfolio flows still represent procyclicality in foreign investors' investment behavior in emerging markets, especially when economic uncertainty rises. For example, in mid-2013 and at the beginning of 2014, when the U.S Fed announced the Taper Tantrum, a gradual exit from its quantitative easing program, foreign investors generated substantial sell-offs in emerging market securities (IMF, 2014). Chinese stock markets experienced a sudden stop in global capital flows during the Chinese stock market turbulence of 2015-2016. OECD (2020) reports that during the first stage of the Covid-19 crisis, around $103 billion were drawn from emerging markets between mid-January and mid-May, with stock inflows plummeting first, followed by debt flows. This sudden stop in global capital flows has been faster and more incisive than observed during the Taper

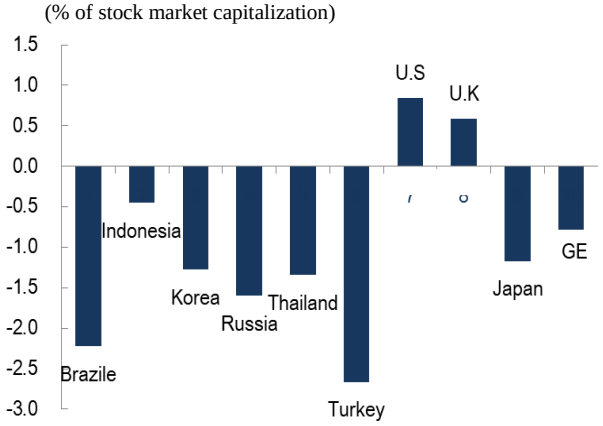
Tantrum, Chinese stock market turbulence, and even global financial crisis. Fig.II-18 displays cumulative global portfolio flows to emerging markets during recent market events. It is calculated using daily balance of payments data provided by IIF[65]. The portfolio flows include investment flows in bond and stock markets. It shows substantial stops in global portfolio flows by non-residents to emerging markets during the Covid-19 crisis, which is much larger and faster than experienced in other market events. Likewise, Fig.II-19 contrasts portfolio flows (% of stock market capitalization) in selected emerging and developed stock markets during the first two quarters of 2020. Most emerging stock markets were significantly affected by net sales of stocks by non-residents. In contrast, developed markets experienced positive net inflows indicating stock net purchases by non-residents (the U.S and U.K) or relatively small net sales (Germany) during the period.

Fig.II-18 Global portfolio flows[1] to emerging markets in the recent events



Note: 1) Cumulative non-resident portfolio flows to emerging markets since event start date (t for the global financial crisis = Sep. 08 2008; for the Taper Tantrum = May 17 2013; for the Chinese stock market turbulence = Jul. 26 2015; for the Covid-19 crisis = Jan. 21 2020)
Source: OECD (2020), IIF daily global capital flows tracker

Fig.II-19 Global portfolio flows[1] in selected emerging and developed stock markets during the Covid-19 crisis (Jan – June 2020)



Note: 1) Net incurrence of portfolio stock liabilities/stock market capitalization (%). Negative values mean net sales of stocks by non-residents in each country
Source: National balance of payments data, National sources, Author's calculation

Though these episodes focus on sudden stops in global capital inflows and brutal outflows during market stress times, foreign investors' momentum strategies also serve as a key factor in creating or reinforcing emerging stock market booms, especially when the markets are relatively small in size compared to foreign investors' trading volumes. Price fluctuations amplified by global capital flows in emerging markets often tend to be attributed to underdeveloped capital markets and immature financial institutions of recipient countries.

[65] Institute of International Finance

II.4.2. The sources of procyclical orientation of foreign investors in emerging markets

The findings raise the question of why foreign investors engage in procyclical herding in emerging stock markets. One plausible explanation is that foreign investors have information disadvantages in emerging markets. Therefore, they may form an extrapolative expectation about the future price based on recent domestic returns. Shocks to domestic returns may lead some foreign investors to revise their expectations about the prospect for emerging markets (Richards, 2004). The information asymmetry model of Brennan and Cao (1997) suggests that foreign investors might rationally derive information about future domestic returns from lagged returns. The model of Calvo and Mendoza (1998) proposes that the cost gathering on country-specific information induces rational investors to follow the herd. Especially, uninformed investors replicate selling by liquidity-squeezed informed investors because the uninformed investors mistakenly (or rationally) believe that these sales are signaling worsening fundamentals (Calvo, 1998; Kaminsky et al., 2001).

From an institutional perspective, it is important to know the composition of the foreign investor base in emerging stock markets and micro-level institutional characteristics of major foreign investor groups to understand their procyclical orientation. Broadly speaking, there are five groups of foreign investors in emerging markets, each having different degrees of preference for risks and returns (Tab.II-6), which is initially suggested by Gooptu (1993) but still valid at present, albeit with changes in relative importance of each group over time. Some terms are added or revised to consider the current market situation and be consistent with the terms used in this thesis. Despite growing retail investors in developed countries engaging directly in emerging markets via acquisitions of DRs or opening accounts with in-home brokers or local brokers of emerging countries, global portfolio flows to emerging markets are mostly channeled through global institutional investors such as investment funds, life insurance companies, or pension funds. Foreign banks and brokerage firms also account for a part of the foreign investor group.

Tab.II-6 Private foreign investor base in emerging stock markets

Category	Institutional description	Investment motivation
Investment funds	• Include various types of funds such as mutual funds, ETFs, hedge funds, PEFs. • Buy and sell stocks in a single country (Country funds), emerging markets (EME funds) or global markets (Global funds)	Seeking for high returns based on explicit trading purposes of funds
ICPFs, central bank reserves and sovereign wealth funds	• Have a longer-term time horizon for expected gains from their portfolios	Portfolio diversification, Look for stability and longer-term growth prospect in the markets in which they invest
Foreign banks and brokerage firms	• Allocate portfolios for inventory and trading purposes using their own accounts.	Inventory and trading purposes
Retail investors of developed countries	• Retail investors that directly invest in emerging stock markets via acquisitions of DRs, opening global accounts with a broker in a home country or local accounts with a local broker in a developing country	High returns, portfolio diversification
Domestic residents of developing countries with overseas holdings	• This group constitutes the dominant category of portfolio investors who were active in emerging markets of Latin America in the 1990s. • Prefer instruments that are in bearer form and provide returns in hard currency. • Kuczynski (1992) terms these funds as “Hot money” which are kept in the Latin American Bank.	Short-term high returns
Non-resident nationals of developing countries	• Could be a potential source of portfolio investments from abroad, as opposed to flight capital.	Various motivations

Source: Author’s compilation based on Gooptu (1993)

Among various foreign institutional investor groups in emerging stock markets, mutual funds and ETFs are the only class for which reliable data is available on an on-going basis. Tab.II-7 shows the shares of equity funds investing in global markets by types as of the end of 2019. Institutional interpretations of each investor group's intrinsic investment patterns, described in the previous section, can also apply to the foreign investor groups engaging in emerging markets. Open-end mutual funds account for a considerable fraction (68% of total net fund assets of emerging stock market funds) of foreign equity funds in emerging markets. Open-end mutual funds are typically prone to procyclical injections and redemptions of the retail fund investors. Likely, the open-end mutual funds investing in emerging markets are significantly driven by fund investors' behavior rather than asset managers’ decisions. Bank of France (2019) also confirms that country flows and flows to funds are closely correlated, especially for Asian countries. In general, mutual funds investing in emerging markets tend to produce higher potential returns over the long-term than those investing in developed markets to compensate for higher risks inherent to investments in emerging markets such as currency risks, political risks, regional risks, a lack of liquidity, etc. The emerging market mutual funds are suitable for high-risk-tolerant investors with long-term investment horizons. However, investors of open-end mutual funds are effectively short-horizon investors with procyclical investment patterns. Though it is known that mutual funds are retail client-oriented, Tab.II-7 shows a different aspect of emerging stock market mutual funds. Institutional investors, including ICPFs, are the main clientele of equity funds

investing in emerging stock markets (68% of total net fund assets of emerging stock market funds).[66] Institutional investors engage in emerging markets via open-end mutual funds because mutual funds are more cost-effective tools for investing in emerging markets than giving a specific mandate to their asset managers. But it is also for liquidity reasons where they can convert emerging market assets that may be illiquid into liquid assets of mutual fund shares on balance sheets.[67] Therefore, when long-term institutional investors invest in emerging markets through open-end mutual funds for liquidity purposes, they are likely to invest in the funds with a short-term investment horizon. Miyajima and Shim (2014) also confirm that notwithstanding the increased institutional investors in emerging stock market funds, inflows from both institutional and retail fund investors to the mutual funds investing in emerging markets are procyclical, buying fund shares/units when funds are outperforming and requesting redemptions when funds are underperforming. As a result, it leads asset managers to behave in a procyclical manner in emerging stock markets.

In Tab.II-7, ETFs have gained relative importance in equity funds investing in emerging markets (30% of total net fund assets of emerging stock market funds), compared to those investing in developed markets (23% of total net fund assets of developed stock market funds). Passive funds, including ETFs, track a benchmark, replicating portfolio weights of a benchmark portfolio. As described in the previous section, passive funds have procyclical mechanisms in methodologies used for constructing benchmark indices and ETF-specific structure, orienting funds toward procyclical investments. Nevertheless, ETFs have additional procyclical herding mechanisms when it comes to investing in emerging markets. It is associated with the use of emerging market benchmarks and methodologies in designing ETFs. Many dedicated emerging market funds use a limited range of benchmarks compared to those investing in developed markets. It is partly because emerging markets have fewer indices available. The analysis of Miyajima and Shim (2014) shows that mutual funds and ETFs investing in emerging markets tend to have less diverse benchmarks than those investing in developed markets. As shown in Fig.II-20, the shares of AuM linked to the top five benchmarks is larger for emerging market funds than for developed markets, for both passive and active funds. For passive funds, about 50% of AuM of total passive funds investing in emerging stock markets are linked to the top five emerging

[66] According to the EPFR database, the institutional funds are defined as funds targeting institutional investors only or those with the minimum amount of $100,000 per account. But the data is not a good proxy for their investments in global markets, because it represents only a fraction of their investments in emerging stock markets, compared to those using global custodians.

[67] Increasing investments of institutional investors in emerging markets via mutual funds or ETFs may imply certain changes in behavior of fund investors (fund inflows) that is thought to be procyclical, because institutional investors may be less sentimental to related shocks or can internalise the negative consequence of trading due to their larger market share (Chen et al, 2010), compared to retail clients. More in-depth studies are needed for clarification.

market benchmarks, whereas about 42% of AuM invested in developed markets are linked to the top five developed market benchmarks. For active funds, the top five benchmarks share about 60% of AuM of active funds investing in emerging stock markets, whereas it is about 40% in developed markets. Furthermore, benchmarks are typically highly correlated to one another. For example, comparable global emerging market local currency bond indices of JPMorgan Chase and Barclays Capital have more than an 80% overlap (Miyajima and Shim, 2014). This is because benchmark providers construct indices using similar methodologies or because benchmark indices tend to encompass the whole range of investable assets rather than a smaller subset. Amidst the growing importance of ETFs and passive funds investing in emerging markets, the concentrated use of common benchmarks by emerging market funds, similar methodologies in constructing the indices, and thereby correlated movements of emerging market indices can drive the funds to adopt similar investment strategies. In consequence, the funds investing in emerging markets are more likely to behave in the same direction and respond to external shocks in similar ways than those investing in developed markets.

Tab.II-7 Shares of equity funds investing in global markets by types

(As of the end of 2019)

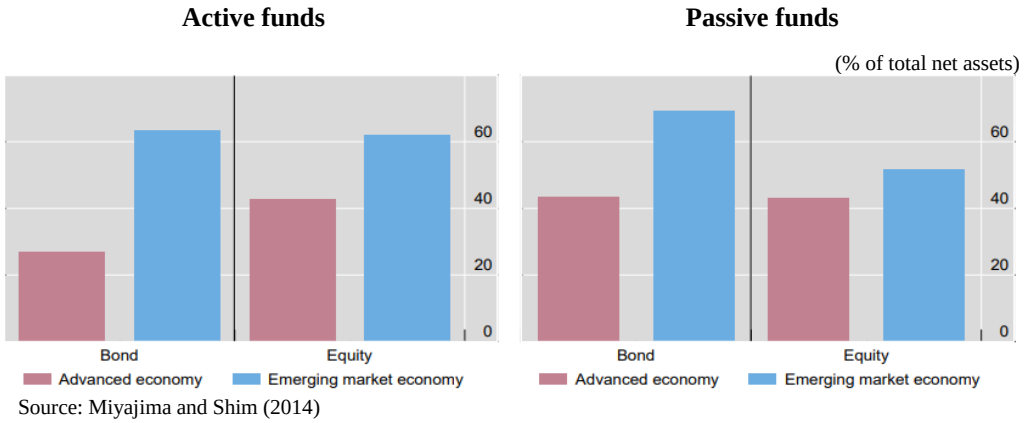
(% of total net fund assets)

	Fund structure			Fund investor		Strategy		Geography
	Open-end mutual funds	Closed-end mutual funds	ETFs	Retail	Institutional [1)]	Active funds	Passive funds	
Developed markets	76	1	23	37	63	55	45	91 (23)[2)]
Emerging markets	68	2	30	32	68	63	37	9

Notes: 1) According to the EPFR database, institutional funds are defined as funds targeting institutional investors only or those with the minimum amount of $100,000 per account. 2) The number in parentheses means the share of global funds that invest in a broad range of countries and are not limited geographically with a relative lack of investment restrictions.
Source: EPFR global database, author's calculations

Fig.II-20 Shares of top five benchmarks used by bond and equity mutual funds and ETFs

(As of the end of May 2014)



Source: Miyajima and Shim (2014)

On the other hand, supposedly long-term institutional investors, including ICPFs, central bank reserves and sovereign wealth funds, etc., generally have a longer-term investment horizon for expected gains from their portfolios based on long-term liabilities and limited redemption pressures. Therefore, they are generally concerned about getting stable and longer-term growth prospects in the markets in which they invest, while declines in funding ratios over past decades led ICPFs to seek high returns by relaxing investment constraints. Central bank reserves and sovereign wealth funds have also expanded their exposures to emerging markets for portfolio diversification. The long-term investors may have the potential to form the largest source of investable resources into the emerging markets over the long-term.

The recent empirical study of IMF (2014) supports these behavioral assumptions. IMF (2014) analyzes the investment behavior of foreign investors in emerging markets by dividing them into different institutional groups. The result shows that global mutual funds react more strongly to global financial shocks than long-term institutional investors, including large global ICPFs. Moreover, mutual funds are more likely to engage in return chasing, creating more procyclical flows. It is consistent with previous studies about the behavior of global mutual funds in emerging markets (Kaminsky et al., 2001). In contrast, long-term institutional investors do not engage in this type of behavior. Stock allocations of long-term institutional investors in emerging markets were broadly unaffected by sovereign downgrades or the Lehman Brothers shock. Long-term investors typically do not change investment strategies frequently responding to short-term market fluctuations, which is consistent with the assumption. IMF (2014) adds that herding among global stock investors is on the rise, despite improvement in information availability on emerging markets during past decades. Against this backdrop, changes in foreign investors' composition have important consequences for the aggregate behavior of foreign investors in emerging stock markets. But there is no reliable data describing the composition of the entire foreign investor base in emerging stock markets. According to a little information from estimations of IMF (2014), net portfolio inflows by mutual funds are larger than those by long-term institutional investors[68], which is consistent across regions and countries.

[68] The portfolio flows data of long-term investors including pension funds, insurance companies and some social reserve funds from various countries are collected by Bank of New York Mellon (BNY) as a custodian for many large global institutional investors domiciled in many jurisdictions throughout the world (IMF, 2014).

II.4.3. Foreign investors as an exogenous factor destabilizing emerging markets and the importance of domestic investors in terms of financial stability

Foreign investors respond to past price returns of emerging stock markets, but they are also an exogenous factor influencing future price movements in emerging stock markets. An increased presence of foreign investors in emerging markets and growing global funds exposes emerging market stock prices to global factors. In recent years, global funds with more globally diversified portfolios are growing sources of portfolio flows to emerging markets. Compared to emerging stock market funds that are relatively small (9% of total equity funds), global mutual funds have gained relative importance (23% of total equity funds) (Tab.II-7). The global funds do not have geographical constrictions for investments and invest in a broad range of countries opportunistically, moving money between emerging markets and developed markets frequently. Small changes in asset allocations of global funds can potentially cause large absolute swings in their emerging market investments.

In many cases, global portfolio flows are driven by global "push factors" such as foreign returns or global economic conditions rather than "pull factors" of recipient countries. The cross-border flows driven by global push factors lead to spreading crises to emerging markets via various channels of financial linkage, information asymmetry, or cross-market hedging practices. For example, when Malaysia is going through a crisis, foreign investors may sell stocks in Indonesian markets because uninformed foreign investors engage in rational herding, or two countries have a high degree of financial linkage. Kodres and Pritsker (1999) focus on foreign investors engaging in cross-market hedging of macroeconomic risks, where global market co-movement occurs in the absence of any relevant information or direct financial linkage across countries (Kaminsky et al., 2001).[69] As a result, if cross-border inflows and outflows from an emerging stock market are driven by global push factors, they may be an exogenous factor changing future price movements in the emerging stock market. The price effects can be significant if the emerging stock market is illiquid or relatively small in size compared to the amounts of cross-border flows.

Given foreign investors' procyclical orientation, domestic investors of emerging markets are important in maintaining domestic market stabilities. If foreign investors buy stocks in emerging

[69] For example, a negative shock to one country can lead informed investors to sell that country's assets and buy assets of other country, increasing their exposure to the idiosyncratic factor of the second country. Investors then hedge this new position by selling the assets of a third country, completing the chain of contagion from the first country to the third (Kodres and Pritsker, 1999; Kaminsky et al., 2000).

markets in certain circumstances, then it follows that domestic investors must sell them in aggregate, responding to the same circumstances. If there are enough domestic investors that can absorb foreign investors' increasing demand for stocks, destabilizing price effects of foreign investors could be offset by the domestic investors. But if the domestic investor base is skewed toward short-term investors with a procyclical orientation, the majority of domestic investors are likely to be on the same side of the large trades involving foreign investors. Once foreign investors initiate one direction trades, domestic investors with procyclical investment orientation are likely to herd the foreign investors probably by a self-referential process, considering the power of foreign investors in the future price formation in emerging markets. This can push stock prices to rise and fall far more drastically than foreign investors do initially. This can happen even if not all order flows in one direction lead to executions. Domestic investors' added buying or selling orders can pressure prices to rise or fall by influencing market liquidity. Oppositely, if the emerging market has a large group of counter-cyclical institutional investors that have the ability and willingness to absorb one direction trades of foreign investors, liquidity provisions by these counter-cyclical domestic investors may mitigate the price effects by foreign investors. There are few pieces of literature analyzing investment behaviors of both foreign and domestic investors together in a particular market. Richards (2004) finds that domestic individual investors of six Asian emerging markets tend to be more often on the other side of foreign investors' trading, behaving as contrarians with respect to recent domestic returns. But the results for domestic institutional investors are less clear due to the domestic investor group's heterogeneous nature. Grinblatt and Keloharju (2000) confirm that foreign investors and sophisticated domestic institutional investors tend to be momentum investors in the Finnish market, whereas households and less sophisticated institutions tend to be contrarians. While these studies do not give a clear picture of domestic institutional investors' behavior regarding foreign investors, they show consistently that domestic individual investors tend to be contrarians against foreign investors. Nevertheless, the reason why domestic individual investors are counter-cyclical is still puzzling. Some research suggests the possibility that counter-cyclical behavior of individual investors with regard to foreign investors is unintended due to their extensive use of limit orders (Linnainmaa, 2003; Park et al., 2003). If one group of investors uses limit orders more extensively, they will show up as contrarian investors, *ex-post*, particularly if their limit orders are not monitored less actively. Effectively, the greater use of limit orders by households is a fairly widespread phenomenon.

II.4.4. Summary

Foreign investors are procyclical investors in emerging stock markets, a stylized factor proven by existing literature and several market stress events, including the recent Covid-19 crisis. Foreign investors' procyclical orientation in emerging markets may stem from information inferiority on emerging markets, but also institutional backgrounds of foreign investor base and investment tools. The main foreign investor base is investment funds such as open-end mutual funds, ETFs, and hedge funds. Contrary to domestic investment funds, institutional investors, including ICPFs, are the main clientele of emerging market equity funds because investment funds are cost-effective tools for investing in emerging markets, in the meantime, they can convert illiquid emerging market assets into liquid assets of mutual fund shares on balance sheets. Amidst the growing importance of ETFs and passive funds investing in emerging markets, the concentrated use of common benchmarks by emerging market funds, similar methodologies in constructing the indices, and thereby correlated movements of emerging market indices can drive the funds to adopt similar investment strategies.

Foreign investors respond to past price returns of emerging stock markets but can also be an exogenous factor that can change future price movements in emerging stock markets. In recent years, global funds with more globally diversified portfolios and global portfolio flows driven by global "push factors" such as global economic conditions are growing sources of spreading global risks to emerging markets. The price effects can be significant if the emerging stock market is illiquid or relatively small in size compared to the amounts of cross-border flows. Given foreign investors' procyclical orientation, domestic investors of emerging markets are important in maintaining domestic market stability. If the emerging market has sufficient counter-cyclical investors with the ability and willingness to absorb foreign investors' procyclical trades, destabilizing price effects of foreign investors could be offset by the domestic counter-cyclical investors. But if the domestic investor base is skewed toward short-term investors with a procyclical orientation, the majority of domestic investors are likely to herd the foreign investors, further destabilizing the markets.

CHAPTER III

Measurement of procyclicality in investment behavior by a regression analysis: cross-country comparisons

The existing empirical studies addressing investors' investment behavior neglects three things predominantly. Firstly, studies concentrate on the profitability of investment strategies during a given period, and there is a lack of consideration on the collective effects of individual institutions' behaviors on market stability. Secondly, most empirical studies focus on the behavior of a single institutional sector, such as mutual funds or pension funds. This can ignore the important role of their trading counterparts in terms of financial stability, particularly when we analyze investors' behavior through trading volume data. In transaction flows, for every purchase, there should be a sale, which is contrary to order flows.[70] Therefore, beyond the question of a single institutional sector, whether it is procyclical or not, the question on trading counterparties needs to be considered: Who has an ability or willingness to absorb increasing demand of an asset by procyclical investors, in other words, who is a contrarian investor to offset the effects of procyclical investors? Does the market have enough heterogeneous institutions to offset one-direction trades of a large group? Lastly, we need to take into account information on price along with trading volume data, as the trading volume data is limited to show all willing trading amounts of all willing buyers and sellers. While the order flows of willing buyers and sellers which are not led to executions are not observed in trading volume data, they influence asset prices by changing market liquidity. Price is a function of order flows (Amihud, 2002). Therefore, the limited ability of trading volume data to represent the real demand for assets can be complemented by price information reflecting order imbalance. The approach considering both price and trading volume information allows us to analyze procyclical dynamics prompted by institutions' behavior leading to building up boom and bust market cycles or increased price volatilities. It is ultimately associated with analyzing the concept of procyclicality in investment behavior, "mutually reinforcing interactions" or "positive feedback effects" with prices.

This chapter aims to measure procyclicality in stock investment behavior of various institutional sectors from a financial stability perspective. Grounded on the definition of procyclicality in

[70] In fact, order flows in which asset demand does not necessarily match asset supply represent investors' real demand for the asset.

investment behavior as described in chapter I, we conduct a quantitative measurement on the procyclical behavior, i.e., "a tendency of increasing (decreasing) investment when the market price goes up (down)," using a regression methodology developed in previous studies. In particular, under the assumption that different institutional investor groups show different investment patterns given the institutional heterogeneity and to some extent, such heterogeneous investment patterns by sectors are a generalized nature over countries, we attempt to compare the cyclicality in investment behavior across not only major institutional sectors but also countries with developed capital markets.

This chapter is structured as follows: Section 1 introduces various methodologies of measuring procyclicality in investment behavior developed in the existing literature. Section 2 builds institutional sector- and country-heterogeneity regression models (the baseline model) and analyzes procyclicality in investment behavior across institutional sectors and countries. Section 3 builds the asymmetric regression models based on the baseline model and analyzes any changes in investment behavior depending on market conditions. Section 4 draws conclusions.

III.1. Methodologies

Various methodologies for the measurement of procyclicality in asset investments have been developed in the existing literature. Most studies seem to face two challenges. The first one is obtaining data or making indicators that disentangle the changes purely due to investors' trades from the total changes in asset holdings, excluding market revaluation effects. When one has asset holdings data of an institution evaluated at market prices, their changes between two points in time necessarily include the changes due to market revaluation as well as asset trades of the institution. In this case, the analysis on investment behavior through the changes in asset holdings can mislead interpretation of a result, probably giving the impression as if the institution behaves procyclically because the institution seemingly increases the asset holdings when the market price increases.[71] The second challenge is the reverse causality issue that Papaioannou et al. (2014) raise in the quantification of procyclicality between investment behavior of institutions and the market price. In general, financial variables interact endogenously with one another. So they emphasize that it has to be identified if the price changes cause investment behaviors of institutions or, reversely, the behaviors of institutions cause the price changes.

[71] Asset holdings data evaluated at nominal values is ideal, but data of asset holdings valued at market prices or the number of stock shares held by an institution needs some treatments for analyzing investment behavior precisely.

The basic approach for the measurement is to examine investment behavior using procyclicality or momentum trading indicators. An advantage of this indicator-based approach is that it allows us to look at a whole picture of time-varying investment trends over time and compare investment patterns across institutions and periods. The GTW indicator developed by Grinblatt et al. (1995) is an institution-level indicator designed to measure the degree to which an institution has its investment strategy in favor of stocks that have experienced high returns. It uses differenced weights of a portfolio to measure changes in the firm's asset allocation. The positive value of this indicator implies that the institution has a procyclical investment pattern, while the negative value implies a contrarian pattern. However, this measure is deficient in that the weights calculated at market prices can be changed by market revaluation as well as trades of assets. An increase in the weight due to an increase in portfolios' market values can appear as if the institution increases asset purchases during a given period. Therefore, Badrinath and Wahal (2002) introduce the adjusted GTW to correct the disadvantages of GTW. The weights in the adjusted GTW are calculated at average prices to capture the trade effects better by alleviating the price change effects. The momentum trading measure of de Haan and Kakes (2011) is based on the same idea as the GTW indicator. However, to reflect changes only due to active trading in asset holdings, the measure is corrected for passive trading whereby cash inflows are invested for periodical portfolio rebalancing. Meanwhile, certain indicators in macro-economic research are created to capture the procyclicality of financial variables co-moving with business cycles. The most straightforward measure is the correlation between cycles of a financial variable and business cycles (Kaminsky et al., 2004; Contessi et al., 2008). Similarly, Boon et al. (2014) define a measure to quantify a degree of procyclicality in pension funds' investment behavior. It compares the sign of daily net buying of stocks with that of daily market return, i.e., if an investor *i* does a positive net buying of stocks at time *t* and the market return of that day *t* is also positive, the measure is set to one, and otherwise, zero.

Another strand of measuring procyclicality is regression analysis. Cyclicality in investment behavior is measured by regressing trading volumes of a security on the lagged price change (return) of the security with controlling for macro variables and firm-specific characteristics. A positive coefficient on the lagged price change means the institution is a procyclical investor, while a negative coefficient means a contrarian investor (Duijm and Bisschop, 2015; Timmer, 2016). This methodology corresponds to the definition of procyclicality as "a tendency of increasing investment when the financial market is on upswing" or momentum trading strategy "buy past winners and sell past losers." It is advantageous in that it is an ad hoc solution to skirt around the reverse causality issue by regressing on the lagged price changes. Besides, it captures institutions' pure response to the price

changes by controlling responses to changes of other factors such as macroeconomic environments or idiosyncratic institutional characteristics. However, the regression approach has a limited ability to capture dynamic relations among variables endogenously co-evolving through interacting with one another. Investment behaviors of a large group and market prices can influence each other simultaneously or with some delay.

To this end, we could consider another possible approach to measure the endogenous relations among variables using a VAR model, whereby we can evaluate rather than detour past the reverse causality (investment behavior impacting price changes). This approach is more devoted to measuring the procyclicality of the definition "the mutually reinforcing effects among financial variables." The price change shock gives the first-round effect on institutions' investment behavior, which may give rise to feedback effects on the price changes again, in reverse. Several empirical studies attempt to analyze procyclicality using VAR models, in particular, procyclicality in the fiscal policy (Ilzetzki et al., 2008), bank lending (Leroy et al., 2017), or riskiness of bank portfolio (Marcucci et al., 2008; Caporale et al., 2013), but not yet in investment behavior of institutions in the capital market. Tab.III-1 summarizes methodologies of measuring the procyclicality of various economic variables explored in the existing literature.

Tab.III-1 Methodologies of measuring procyclicality

	Methodologies
Procyclicality (or momentum) indicator	• **GTW** (Grinblatt et al., 1995) $w_{i,j,t} = \frac{P_{i,t}H_{i,j,t}}{\sum_{i=1}^{N} P_{i,t}H_{i,j,t}}, \quad M(k) = \frac{1}{T}\sum_{t=1}^{T}\sum_{i=1}^{N}(w_{i,t} - w_{i,t-1})R_{i,t-k+1}$ (*w*: portfolio weight, *M*: momentum measure, *P*: security price, *H*: number of shares held, *R*: return of a security *i* from date *t-k* to date *t-k+1*, *i*: security, *j:* institution, *t*: time, *k*: historical benchmark period) • **Adjusted GTW** (Badrinath and Wahal, 2002) $w_{i,j,t} = \frac{AvgP_{i,t}H_{i,j,t}}{\sum_{i=1}^{N} AvgP_{i,t}H_{i,j,t}}, \quad ITM_{j,t}(k) = \sum_{i=1}^{N}(w_{i,j,t} - w_{i,j,t-1})R_{t-k}$ (*w*: redefined portfolio weight, *ITM*: redefined momentum measure, *AvgP*: average of the beginning and end-of-quarter price of securities) • **Momentum trading measure** (de Haan and Kakes, 2011) $M_t = \sum_{i=1}^{N}\left[\frac{a_{it} - \left\{cf_t \frac{A_{it}}{\sum_{j=1}^{N} A_{jt}}\right\}}{\sum_{j=1}^{N} A_{jt}} \cdot (r_{i,t-k} - r_{p,t-k})\right]$ (*N*: number of asset classes, a_{it}: net purchase of asset class, A_{it}: total value of asset class *i* at the beginning of period *t*, *cf*: net cash inflow, r_{it}: yield on asset class *i* (capital gains), r_{pt}: yield on the whole portfolio) • **Procyclicality measure** (Boon et al., 2014) $PC_{it}^{j} = \begin{cases} 1 \;\; if \; sign\,(net\; purchase_{it}) = sign\,(market\; return_t) \\ 0, \;\; otherwise \end{cases}$ (*i*: institution, *j*: asset class, *t*: time)

Regression analysis	• Procyclicality in investment behavior is measured by regressing trading volumes of a security on the lagged price change (return) of the security with controlling for macro variables and firm-specific characteristics. The positive coefficient on the lagged price change means the institution is a procyclical investor (Duijm and Bisschop, 2015; Timmer, 2016) • It corresponds to the definition of procyclicality, "a tendency of increasing investment when the financial market is on the upswing," or momentum trading strategy "buy past winners and sell past losers."
VAR analysis	• It measures endogenous relations among financial variables with first-round effects and feedback effects, simultaneously or with some delay • It is devoted to measuring the procyclicality of the definition "the mutually reinforcing interactions among financial variables." • Some studies attempt to measure procyclicality in the fiscal policy, bank lending, or riskiness of bank portfolios through this approach, but not yet in investment behavior

Source: Author's compilation

III.2. Data description and stylized facts

III.2.1. Data description

To shed light on how institutional investors respond to price changes, we use the national financial accounts of the flow of funds statistics[72] published in major countries. Though the flow of funds statistics is sectoral aggregate data, it has several advantages for this study: Firstly, its financial account data refer to net acquisition (flow) of assets due to an institutional sector's financial transactions during a given quarter. It reflects only buy and sell decisions, not changes in asset amounts due to the market revaluation. As such, it enables us to investigate a pure response of investors to price changes. Secondly, the statistics are published by financial institutional sectors and financial instruments in major countries according to a consistent standard, which allows comparison across countries and institutional sectors. Third, it is aggregate data that is not split into individual- and security-level transactions and may restrain an analysis of individual investors' behavioral dynamics. However, the aggregate demonstration representing individual institutions' collective behavior also delivers useful information for the analysis in light of financial stability because individual behaviors often do not sum to collective behavior observed in the market, and inter-individual institution flows have less importance than aggregate flows for financial stability.

[72] The flow of funds is a part of the national accounts reported regularly. It is compiled in accordance with the System of National Accounts (SNA), a standard set of recommendations of the United Nations statistics division on how to compile measures of economic activities. In particular, the financial accounts (flow data) report the increase or decrease in assets and liabilities held by economic agents due to their net acquisition of assets and net issues of liabilities, whereas financial balance sheets (stock data) report the outstanding amounts of assets and liabilities of economic agents.

We focus on the investment behavior of the three largest institutional investor sectors: investment funds, insurance companies and pension funds (ICPFs), and banks. For cross-country comparison, I expand countries of interest to the U.S, South Korea, Japan, and France, of which stock markets are large-sized relative to their GDPs and have evolved to their unique features under each specific economic and cultural circumstance during recent decades. I use their quarterly stocks transaction data in non-consolidated financial accounts of each country. The data include only trading volumes of stocks in each country's listed stock markets, excluding transactions in non-listed stock markets. The data are measured in national currencies to avoid the revaluation effect caused by exchange rate movement. Quarterly frequency is enough to examine investment patterns of institutions responding to price changes because it is generally acknowledged in empirical studies that a momentum strategy is profitable in the medium-term over 3- to 12- months as described in chapter I. Therefore, we may suppose that once investors take a procyclical investment strategy, they would continue the strategy for at least one quarter of a year. The analysis covers the period from the first quarter of 1996 to the fourth quarter of 2018 for which data are available and, besides, global economies had completed the transition into an era of the market economy. This period covers several financial crises of recent decades, such as the Asian foreign currency crisis of 1997-1998, the U.S capital market crash of 2001, the global financial crisis of 2008-2009, and the European sovereign debt crisis of 2012, which allow us to compare changes in investment behavior between normal times and stress times.

Notwithstanding the consistent standard of financial accounts, there are discrepancies in statistical treatment across countries. ICPFs include life insurance companies, private and public pension funds. However, non-consolidated financial accounts of public pension funds are only available for the U.S and Japan. France publishes only social security funds that comprise public pension funds and all other governmental units providing social security benefits. For Korea, the financial accounts of public pension funds are not available, and its financial accounts have a serial break due to reforms of the compilation methodology. Consequently, Korea's financial accounts are replaced with stock trading volumes data[73] sourced from the Korean stock exchange.[74] For Japan, financial accounts are available only for the periods of 1998 onwards.

Tab. III-2 reports the descriptive statistics of the principal variable; quarterly net buys in stocks by institutional sectors and by countries and quarterly market returns by countries. The number of

[73] The data is obtained from Korean Stock Exchange (KRX).

[74] To verify the adequacy of the data replacement, I compared the data with the financial accounts for the periods of 2003-2018 and confirmed that two data sets have consistent trends.

observations is 92 for Korea, the U.S, France, and 84 for Japan. There is a large variance in stock investments across institutional sectors and countries. For Korea, investment funds show a relatively large dispersion in net buys of stocks. For Japan, the distribution of investment funds' net buys is right-skewed, but banks' distribution is left-skewed. The distinguishing feature of the U.S data is that ICPFs are historical net sellers and show the largest dispersion in stock net buys compared to other countries and institutional sectors. For France, banks are the most active and sensitive sector among the three, given the relatively large average amounts and dispersion of net buys of stocks.

Tab.III-2 Descriptive statistics of quarterly net buys in stocks and market returns[1) 2) 3)]

(1st quarter of 1996 to 4th quarter of 2018)

(In billion national currencies)

Country	Korea				Japan			
Net buys	IFs	ICPFs	Banks	Market returns (%)	IFs	ICPFs.	Banks	Market returns (%)
N of Obs	92	92	92	92	84	84	84	84
Mean	-650.6	816.9	-323.6	0.7	390.2	190.9	-308.5	0.2
Max	7575.3	5894.8	1084.6	59.5	3901.7	3846.4	1254.8	22.1
Min	-8616.5	-5023.9	-2094.8	-54.5	-1217.0	-3346.6	-3622.1	-44.4
Std. Dev	2,627.5	1,744.1	549.3	15.5	868.2	1191.2	688.1	10.3
Skewness	0.20	0.09	-0.79	-0.08	1.84	0.15	-1.64	-0.76
Kurtosis	4.74	4.85	4.50	6.52	7.46	4.14	8.54	5.63

Country	U.S				France			
Net buys	IFs	ICPFs.	Banks	Market returns (%)	IFs	ICPFs.	Banks	Market returns (%)
N of Obs	92	92	92	92	92	92	92	92
Mean	80.7	-62.7	0.2	1.6	0.6	0.4	2.4	1.1
Max	461.5	700.6	32.3	19.0	17.3	11.0	23.3	20.2
Min	-224.1	-656.8	-39.9	-25.6	-16.2	-8.0	-34.1	-26.7
Std. Dev	143.7	248.5	7.9	8.1	6.1	3.3	9.7	8.8
Skewness	-0.20	0.46	-1.16	-0.83	0.00	0.45	-0.50	-0.63
Kurtosis	2.32	3.57	13.40	3.92	3.21	4.49	4.15	3.71

Notes: 1) IFs, ICPFs, and Banks indicate investment funds, insurance companies & pension funds, and banks, respectively. 2) Net buys refer to the net amount bought and sold by each institutional sector. 3) Positive (+) (negative (-)) net buys refer to the amount when the net buys by each sector are positive (negative). In other words, the total buys amount is greater (less) than the total sales amount. Sources: U.S. Fed, Bank of France, Bank of Korea, Bank of Japan, OECD, KRX, Author's calculation

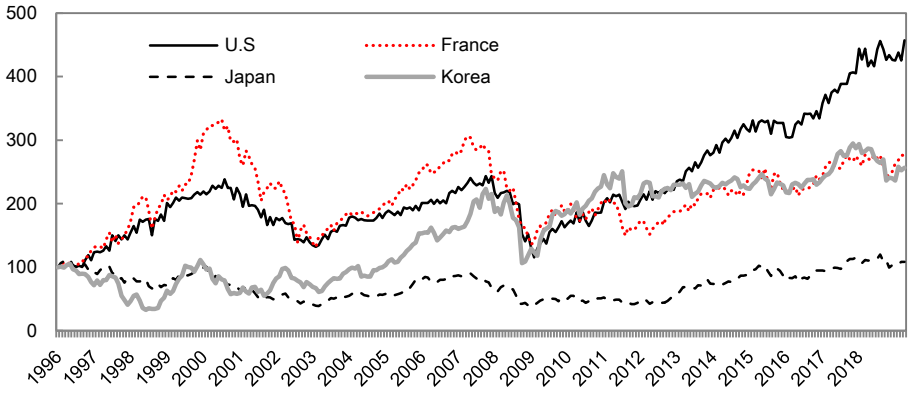
III.2.2. Historical evolutions of principal variables

(Stock price evolutions by countries)

Fig.III-1 depicts stock price evolutions by countries from 1996 to 2018. The U.S and France present relatively similar price evolutions, two cycles of boom and bust, and the following upward trend.

Stock prices saw a sharp rise with the U.S dot.com bubble in the late 1990s and, after reaching a peak in 2000, dropped dramatically following the bursting of the bubble from 2001 to 2003. The price renewed a surge grounded on long-lasting low-interest rates and credit expansions until the markets bottomed out again in the aftermath of the global financial crisis of 2008-2009. Since the crisis, the U.S has continued a spectacular upward trend of stock prices up to 2018. France saw two further partial reflux provoked by the European sovereign debt crisis in 2011-2013 and the Brexit referendum in 2016 but largely continued a long-term upward trend, albeit to a lesser extent. Korea started with a sharp decline in stock prices in the late 1990s, related to the Asian currency crisis. After two small boom and bust cycles which were caused by the U.S dot.com bubble and burst (1999-2001), and credit card debt expansions and following debt distress (2001-2003), Korea experienced a dramatic rise and fall in stock prices before and after the break out of the global financial crisis like the U.S and France. After it recovered right after the crisis, the Korean stock price index has mostly remained stable. Japanese price evolutions show an atypical feature. The stock prices of Japan have remained relatively stagnant over two decades. Despite several slight downward or upward trends, prices show quite limited movements around the price level of 1996.

Fig.III-1 Stock price evolutions by countries



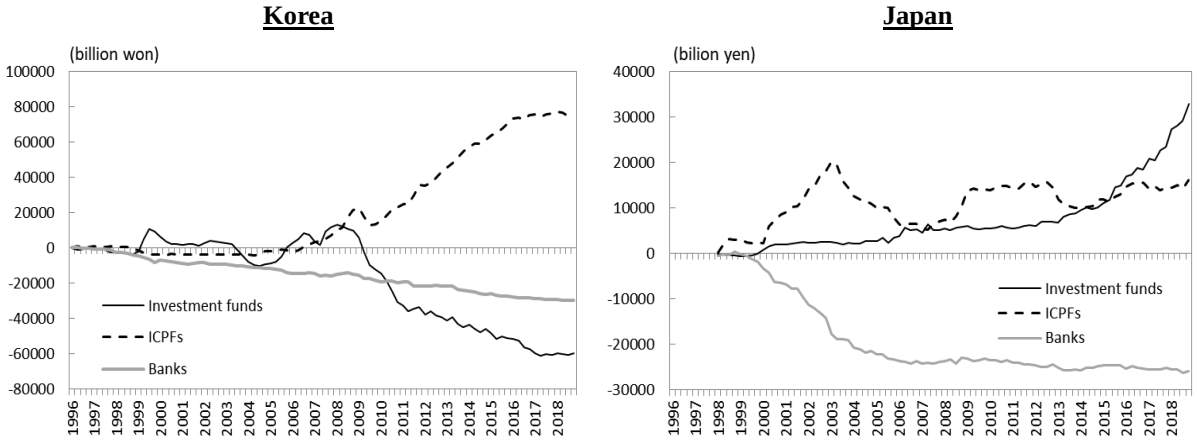
Note: 1) For comparison, stock price indices are computed to equal 100 at the reference year (Jan. 1996).
Source: Author's calculation

(Cumulative net buys in stocks by institutional investor sectors and by countries)

Fig.III-2 compares cumulative net buys of three institutional sectors in stocks in four countries over time. It demonstrates contrasting trajectories of stock investments across institutional sectors and countries. For Korea, investment funds continued an upward trend from 2004 to the global financial crisis but have shown consistent decreases in their stock holdings since the crisis. Contrary to investment funds, ICPFs have remarkably engaged in massive stock purchases since the crisis,

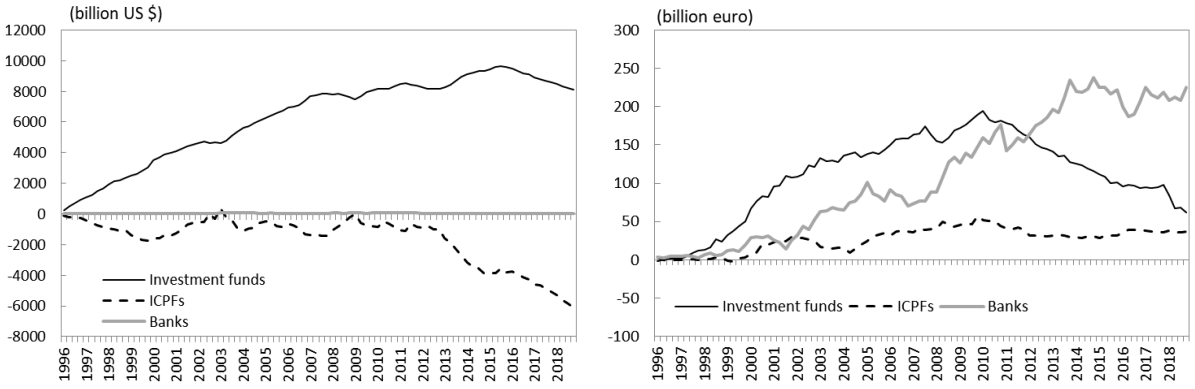
making up a significant part of stock trades in the markets. Banks have consistently reduced their stock holdings since 1996. For Japan, investment funds have consistently increased stocks, and the upward trend is significant from 2015 up to the present. ICPFs have primarily shown a slow upward trend of stock investments, making several investment cycles over the recent two decades. Japanese banking sectors continued drastic asset deleveraging in the early 2000s to improve balance sheets deteriorated by their "forbearance lending policy" of the late 1990s. Japanese banks are still in the deleveraging process, albeit to a lesser extent. Investment patterns of U.S institutional sectors are very different. Contrary to the other countries of which ICPFs have been important net buyers of stocks, U.S ICPFs tend to have reduced their stock holdings, in particular, dramatically in the 2010s. On the other hand, investment funds continuously increased stock holdings before reaching a peak in 2015. Stock investments of U.S banks are negligible relative to other sectors as they have undergone significant consolidation due to the growing similarity of the functions provided by different types of financial institutions over the two decades.[75] For France, all three institutional sectors were net buyers of stocks, contrary to other countries where some sectors were net sellers over the decades. Investment funds consistently increased their stock holdings before the European sovereign debt crisis and reduced stock holdings after that. ICPFs built up stock holdings in the early 2000s and reduced them over two years after the bursting of the U.S dot.com bubble. They have kept their stock holdings mostly unchanged up to the present. French banks are an atypical case. Contrary to the other countries' banking sectors that experienced consolidation and consistent deleveraging in stock markets, French banks have reported a remarkable rise in stock holdings over twenty years.

Fig.III-2 Cumulative net buys in stocks of institutional sectors by countries



[75] At the end of 2014, there were approximately 6,500 U.S commercial banks (U.S chartered depository institutions) insured by the FDIC, down from almost 14,000 twenty years prior (U.S. Fed, 2018)

U.S **France**



Source: OECD, U.S Fed, author's calculation

III.3. Baseline model specification and estimation results

III.3.1. Baseline model specification and explanation of variables

This section measures the procyclicality in investment behavior of the three major institutional sectors by regression analysis. We consider the investment behavior to be procyclical if an institutional sector increases (decreases) its net buys of stocks when the market return has risen (fallen). To quantify this concept of procyclicality, we follow the model specification put forward by Timmer (2016) that regresses net buys of institutional sectors in securities on the lagged price changes. It is a good reference in that it captures a pure response of institutions to the price changes with controlling for responses to changes in other factors such as macroeconomic variables. However, while Timmer (2016) conducts a panel analysis to explore the investment behavior by German institutional sectors in bond markets using security-level data, we build a sector- and country-heterogeneity regression model for cross-sector and -country comparisons to verify the heterogeneity in investment behavior. Besides, while Timmer (2016) considers only macro-economic variables and security-specific characteristics as explanatory variables, this model considers institutional characteristics as well as macro-economic variables. The baseline regression model is specified as follows:

$$Netbuys_{i,t}^{c} = \alpha_i^c + \beta_i^c Return_{t-1}^{c} + \gamma'^{c}_{i} X_{t-1}^{c} + \delta_i^c L_{i,t-1}^{c} + \varepsilon_{i,t}^{c} \quad (1)$$

$Netbuys_{i,t}^{c}$ is the net acquisition in listed stocks of an institutional sector *i* of a country *c* at quarter *t*. $Return_{t-1}^{c}$ is the market return for each country at quarter *t-1*. X_{t-1}^{c} is a vector that includes log

differences in domestic macro-economic variables composed of the overnight interbank interest rate (ΔIR_{t-1}), GDP growth rate (ΔGDP_{t-1}), inflation rate (π_{t-1}) and credit risk indicator of non-financial corporates (CR_{t-1}) for each country. The vector X does not vary by institutional sector but by country and over time. $L^{c}_{i,t-1}$ is the net inflows in liabilities of an institutional sector *i* at quarter t-1 which signifies sector-specific institutional characteristics.

The variables of market return and domestic macro-economic environments are lagged by one quarter. This is a reasonable treatment because in many cases, during the quarter t when an investment decision is taken, variables of the quarter t are not observed by investors. Some information such as GDP and the inflation rate is not available at the contemporaneous period or, especially when it comes to changes in a variable, they must include information at the end of a quarter while the transaction can be made at any time during the quarter (Timmer, 2016). What is not shown to investors cannot affect their decision. Moreover, the one-quarter lagged explanatory variables also enable us to circumvent the reverse causality issue that can occur when analyzing with contemporaneous macro-economic variables.

The stock market returns (*Return*) are approximated by the log differences in representative stock price indices for four countries of interest, S&P500, CAC40, KOSPI, and NIKKEI250. A positive coefficient on the lagged market return means the institutional sector is a procyclical investor who has positive demand elasticity to price changes (Timmer, 2016). It follows a momentum strategy by buying stocks when the market has experienced a rise in prices. In contrast, a negative coefficient signifies that the sector is a contrarian investor with negative demand elasticity to price changes. It follows a value investment strategy by buying stocks at a low price and selling at a high.

The data for the overnight interbank interest rates (ΔIR) is the federal funds rate for the U.S. and the uncollateralized call rate for the other countries.[76] The coefficient on the interest rates implies various possibilities for interpretation. A lower rate eases the economy's funding conditions, which is likely to encourage investors to buy more assets. In this case, the interbank interest rates and net buys of institutional investors in stocks display a negative relation. In the meantime, the interbank interest rate, usually a central bank's target rate, can be a proxy of the future economy's outlook. When the rates get lower, investors interpret it as a negative economic outlook of the central bank and therefore are likely to hesitate to buy stocks, possibly implying a positive relationship between the interest rates and

[76] For France, as EONIA was launched in Jan 1999, it is replaced by interbank call rate for France based on three-month money market rates that are available for the periods of interest.

net buys in stocks. The GDP growth rate (ΔGDP) is calculated by the log difference in real GDP. It indicates the productivity of the economy. High GDP growth shows that real economic activities have higher productivity, suggesting a rise in future prices, thereby encouraging investors to buy more stocks. Therefore, a positive coefficient on GDP growth rate suggests a link of investment behavior to the real economy, whereas a negative or statistically insignificant coefficient may imply a disassociation of investment behavior from the real economic activities. The inflation rate (π) is calculated by the log difference in CPI for each country. As a higher inflation rate depreciates the real value of stock returns, institutional investors are expected to sell stocks to respond to higher inflation.

The credit risk for non-financial corporates (CR) is measured by credit spreads for non-financial corporates, which is a difference between yields of government bonds and corporate bonds traded in secondary markets with the maturity matched.[77] Only for Japan, where credit spreads are not available for the periods in question, are the spreads replaced by the single year cumulated default rates for corporates.[78] A rise in credit spreads or default rates is associated with investors' growing concern about the non-financial corporate sector's credit risk, whereby stock prices can drop. When investors believe the credit risk for non-financial corporates is growing beyond a certain level up to which they can tolerate, they try to sell off their holdings of stocks and fly to a safe haven such as cash or government bonds. Conversely, when the market has consensus that corporates' credit risk is low enough to be negligible, the credit risk believed as negligible usually leads investors to search for profits, expanding investments in high-return assets such as stocks or non-investment grade bonds. Consequently, a negative coefficient on the corporate credit spreads can be interpreted as the evidence of "flight to quality" in distress times when the credit risk is high or "search for profit" in normal times when the credit risk looks low. In addition, an insignificant coefficient may imply a possibility of investors insensitive to the build-up of the credit risk in the financial system.

To reflect specific institutional characteristics of each institutional sector, we add the variable of net inflows in liabilities of each sector (L) to explanatory variables. It is net inflows in core liabilities of each institutional sector, mainly sourced from the financial account statistics; bank deposits for banks, equity investment fund shares for investment funds, and insurance reserves, annuity & pension entitlements for ICPFs, respectively. This variable captures the key structural feature of a liability side that can directly influence asset investment behavior. A positive coefficient on net inflows in liabilities

[77] For France, the credit spreads published by the Bank of France are only available for 1999 onwards, the missing data from 1996 to 1998 are set to equal the value of the first quarter of 1999, the latest available observation.

[78] The default rates are published by R&I Credit Ratings on an annual basis. The annual default rates are linearly interpolated into quarterly rates for the analysis.

indicates that institutions respond sensitively to short-term changes in their liability side, implying that positive net inflows in liabilities drive institutions to purchase stocks immediately and, oppositely, negative net inflows in liabilities force institutions to sell their stock holdings immediately. When institutions are experiencing drastic outflows in core liabilities, such a sensitive response to changes in a liability side can lead to asset fire-sales and potentially cause liquidity distress in stock markets. Otherwise, if the coefficient on net inflows in liabilities is insignificant, it may be interpreted that institutions are not sensitive to short-term changes in liabilities and can maintain their long-term investment strategy. Even if they experience abrupt liquidity shock from core liabilities, they can ride the short-term shock out.[79] Tab.III-3 summarizes data for the explanatory variables used for the analysis.

Tab.III-3 Data for explanatory variables across countries

Category	Explanatory variables	U.S (1996Q1~2018Q4)	France (1996Q1~2018Q4)	Korea (1996Q1~2018Q4)	Japan (1999Q1~2018Q4)	Expected response
Stock price	Market return ($Return_{t-1}$)	S&P500	CAC40	KOSPI	NIKKEI250	+, -
Domestic macro-economic environment (X_{t-1})	Overnight interbank interest rates (ΔIR_{t-1})	Federal funds rate	call rate[1)]	call rate[1)]	call rate[1)]	+, -
	GDP growth rate (ΔGDP_{t-1})	real GDP growth rate[2)]				+
	inflation rate (π_{t-1})	CPI growth rates[3)]				-
	Credit risk indicator (CR_{t-1})	credit spreads[4)]	credit spreads[4)]	credit spreads[4)]	Default rates[5)]	+
Sector-specific Institutional characteristics	Liability structure (L_{t-1})	Net inflows in core liabilities of each institutional sector[6)]				+

Notes: 1) Overnight uncollateralized call rate for Korea and Japan. For France, three-month uncollateralized call rate. 2) Seasonally adjusted quarterly real GDP growth. 3) Changes (%) in the same period of the previous year. 4) Spreads between yields of government bonds and corporate bonds in secondary markets with maturities matched: For the U.S, credit spreads of the 3Y-high quality market (AAA-A) corporate bond yields, for Korea, spreads of the 3Y-corporate bond (A.A.-), for France, credit spreads data published by the Bank of France are used. 5) The single year cumulated default rates (%) of corporates (numbers of defaulted corporates during the single year/numbers of rated corporates at the beginning of each year). 6) Deposits for banks, insurance reserves, annuity and pension entitlements for ICPFs, stock investment fund shares for investment funds (billions in national currency).
Sources: U.S. Fed, Bank of France, Bank of Korea, Bank of Japan, IMF, OECD, KRX, R&I Credit Ratings, National Pension Fund of Korea, Korean Financial Investment Association

III.3.2. Results for the baseline specification

The OLS regression is not suitable for estimating the baseline equation (1) because estimated error terms violate the OLS regression's assumptions on the error terms. The residuals calculated from the

[79] The results of Augmented Dicky-Fuller test (ADF) show that time series of variables used for this analysis are stationary, except for net inflows in liabilities of investment funds and ICPFs of Japan. Despite their non-stationarity, I use their level data without differencing them for consistency across countries and easy interpretation.

fitted OLS regression models for most countries present heteroscedasticity. In this case, while the OLS coefficient estimates are unbiased, the estimates of their variances are biased, causing biased inference for the coefficient estimates. Therefore, the coefficients of equation (1) are estimated using White heteroscedasticity consistent covariance matrix for efficient estimation. Furthermore, as serial correlations are detected in the residuals of the estimated regression models[80] for the U.S, the Cochrane-Orcutt procedure using AR(1) is applied to estimate U.S models to correct biased coefficient estimates problem caused by the serial correlations. Despite possible multicollinearity among macro-economic explanatory variables, several indicators confirm that multicollinearity is not present in the models.[81]

Tab.III-4 shows estimation results of the baseline specification (1) by institutional sectors and by countries. It shows that ICPFs are counter-cyclical investors in most countries, including Korea, Japan, and France. ICPFs of the countries respond negatively to positive market returns of a previous quarter, buying stocks when prices have fallen and selling them when prices have gone up. In terms of economic magnitude, a rise in the market return by one percent in the previous quarter derives ICPFs to sell 17.578 billion won of stock in Korea, 56.524 billion yen of stock in Japan, and 0.057 billion euro of stock in France on average. However, we have no evidence of U.S ICPFs' investment behavior.

Investment funds' investment patterns vary depending on the countries. For the U.S and Korea, investment funds behave in a procyclical manner in stock markets, buying stocks when prices have risen and selling stocks when prices have fallen. When the price has risen by one percent in the previous quarter, U.S investment funds buy 2.912 billion dollars of stock, and Korean investment funds buy 33.036 billion won of stock on average. However, contrary to the assumption, Japan's investment funds are counter-cyclical investors in the stock market, albeit to a lesser extent than its ICPFs. The negative coefficient indicates that Japan's investment funds sell 15.735 billion yen of stock on average when the market has experienced a one percent rise in the price in the previous quarter. Japanese investment funds are likely to offset price fluctuations prompted by potential procyclical investors and contribute to stable stock price movements over time. For France, investment funds show ambiguous figures over the whole period. They tend to buy 0.07 billion euro of stock on average when the stock price has risen by one percent in the previous quarter, but the result is not statistically insignificant.

[80] Durbin-Watson statistics of the U.S regression models for investment funds without any treatment for the serial correlations is 1.2, which indicates the existence of serial correlations in error terms.

[81] In particular, variance inflation factors (VIF) for multicollinearity calculated from the models are all below 5. This indicates that multicollinearity does not exist among variables.

Meanwhile, the model does not explain banks' investment behavior well for all the countries in question. The coefficients of banks on the lagged market return are consistently insignificant for four countries. Banks' investment behavior in stock markets appears to depend on other factors rather than price changes.

Regarding credit risk, institutional investors of Korea and Japan seem more sensitive to the credit risk of non-financial corporates compared to those of the U.S and France. Most Korea and Japan sectors, except for Japanese ICPFs, show negative coefficients on the credit risk, selling their stocks when credit risk gets higher, supposedly for "flight to a safe haven," and buying stocks when credit risk gets lower in pursuit of profits. Oppositely to the expectation, Japanese ICPFs show a positive coefficient on corporates' credit risk, buying stocks when the credit risk has increased. From their negative coefficient on the market return and positive coefficient on the credit risk, we may suppose that ICPFs of Japan play a stabilizing role in the stock markets based on their high risk-taking capacity. Meanwhile, the U.S and France's institutional sectors look insensitive to changes in credit risk as their coefficients on the credit risk are statistically insignificant, except for France's investment funds.

Net inflows in core liabilities are a strong determinant of stock investment decisions of investment funds in all countries. The coefficients of net inflows in investment fund shares are consistently positive in four countries. Larger net inflows in investment fund shares lead them to buy more stocks, and larger net outflows in fund shares lead them to sell stocks they hold. This implies that investment funds tend to respond sensitively to short-term changes in their liability side. ICPFs' responses to increased net inflows in core liabilities are quite heterogeneous. While ICPFs of Korea and the U.S have positive coefficients, ICPFs of France are not impacted by changes in net inflows on a liability side, and ICPFs of Japan have even a negative coefficient.

The coefficients on the GDP growth rate are consistently insignificant for all sectors and countries. This indicates that the real economy does not influence institutional investors' investment decisions, probably supporting the idea that investment decisions in stock markets are disassociated from real economic activities. The coefficients on interest rates vary across institutional sectors and countries. Some institutional sectors with statistically significant coefficient estimates tend to consider higher interest rates as a positive signal of the central bank for the economic outlook and decide to increase stock holdings. The increased inflation rate induces most institutional sectors to sell their stocks. Investment funds of the U.S and France and banks of the U.S show statistically significant negative

coefficients on the inflation rates. Only Japanese ICPFs respond positively to increased inflation rates, which may be associated with Japan's particular economic environment that had experienced chronic deflation during the lost decade.

Tab.III-4 Estimation results of the baseline equation (1)[1),2),3)]

	Korea			Japan		
	IFs	ICPFs	Banks	IFs	ICPFs	Banks
Market return ($Return_{t-1}$)	33.036** (2.294)	-17.578** (-2.129)	3.840 (1.002)	-15.735*** (-2.673)	-56.524*** (-4.225)	-5.343 (-0.816)
Interest rate (ΔIR_{t-1})	293.520*** (2.872)	-30.534 (-0.445)	-1.065 (-0.048)	-970.366** (-2.139)	-307.331 (-0.578)	917.489*** (2.722)
ΔGDP_{t-1}	-0.076 (-0.000)	-219.806 (-1.382)	-78.920 (-1.642)	-3.537 (-0.059)	-128.798 (-1.212)	29.049 (0.712)
inflation rate (π_{t-1})	-393.694 (-1.510)	216.884 (1.091)	56.893 (0.864)	50.223 (0.735)	186.647** (2.141)	63.682 (1.235)
Credit risk (CR_{t-1})	-656.517 (-1.249)	-663.186** (-1.920)	-235.438*** (-2.718)	-138.023* (-1.810)	359.067* (1.731)	-499.542*** (-3.413)
Net inflows in liabilities (L_{t-1})	0.062* (1.793)	0.092*** (3.462)	0.005 (0.961)	0.239*** (5.504)	-0.177** (-2.005)	0.005 (0.653)
R2	0.203	0.249	0.085	0.508	0.408	0.361
Durbin-Watson stat	1.567	1.676	1.989	1.884	1.789	2.097

	U.S			France		
	IFs	ICPFs	Banks	IFs	ICPFs	Banks
Market return ($Return_{t-1}$)	2.912** (1.950)	2.788 (0.713)	-0.016 (-0.131)	0.070 (1.006)	-0.057* (-1.806)	0.154 (1.165)
Interest rate (IR_{t-1})	30.759*** (3.694)	16.374 (1.274)	1.347*** (2.919)	1.820*** (4.814)	0.296 (1.335)	-0.210 (-0.307)
ΔGDP_{t-1}	30.566 (1.504)	25.930 (0.442)	-1.968 (-1.002)	2.118 (-1.901)	-0.515 (-0.714)	0.479 (0.172)
inflation rate (π_{t-1})	-24.016* (-1.701)	19.583 (0.719)	-1.697** (-2.048)	-1.560* (-1.901)	-0.867 (-1.599)	2.390 (1.583)
Credit risk (CR_{t-1})	14.853 (0.639)	46.161 (1.138)	-0.299 (-0.218)	-2.663** (-2.270)	-1.033 (-1.402)	2.237 (1.030)
Net inflows in liabilities (L_{t-1})	0.527** (2.396)	3.196*** (2.540)	0.024** (2.176)	0.119** (2.425)	0.050 (0.666)	-0.031 (-1.829)
R2	0.515	0.186	0.120	0.349	0.110	0.094
Durbin-Watson stat	2.168	2.114	2.155	2.359	2.419	2.090

Notes: 1) *, **, *** means that the estimated coefficient is significant at the level of 10%, 5%, and 1%, respectively. 2) Numbers in parentheses are t-statistics obtained using White robust standard errors. 3) For the U.S investment funds model, the Cochrane-Orcutt procedure using AR(1) is applied to correct serial correlation in residuals.
Source: Author's estimation

III.3.3. Model specification test and robustness check in coefficient estimations

Meanwhile, the baseline model (1) is a heterogeneity model (1) reflecting theoretical assumptions based on the institutional sectors' specificities. But we also need to verify if the heterogeneity model is econometrically appropriate. If there is no heterogeneity in investment behaviors across institutional sectors in the data source, the homogeneity model such as pooled or panel models will lead to more efficient estimation. Therefore, we conduct the model specification test following the general process suggested by Hsiao (1986). In the first step, we test the hypothesis of perfect homogeneity in data structure using Fisher's statistics 1 (F1). If the null hypothesis is accepted, the pooled panel model, a perfect homogeneity model, will be a best-fitting model.

(Fisher test 1) H_0^1: $a_i^c = a^c,\ B_i^c = B^c\ \ \forall i \in [1,N]\ \ B_i = (\beta_i^c,\ \gamma'^c_i,\ \delta_i^c)$

$$F_1 = \frac{(RSS_{1,cst1}^c - RSS_1^c)((N-1)(K+1))}{RSS_1^c/(NT-N(K+1))}$$

($RSS_{1,cst1}^c$: the residual sum of squares of the constrained model (perfect homogeneity model) of a country *c*)

If the null hypothesis (H_0^1) is rejected, we pass to the second Fisher test (F2) under the null hypothesis of heterogeneous constants but homogeneous slopes. If the null hypothesis (H_0^2) is rejected, the baseline heterogeneity model (1) can be justified. But if the null hypothesis is not rejected, we need to the third step to test the homogeneity of constants (individual effects)

(Fisher test 2) H_0^2: $B_i^c = B^c\ \ \forall i \in [1,N]\ \ B_i = (\beta_i^c,\ \gamma'^c_i,\ \delta_i^c)$

$$F_2 = \frac{(RSS_{1,cst2}^c - RSS_1^c)((N-1)K)}{RSS_1^c/(NT-N(K+1))}$$

($RSS_{1,cst2}^c$: the residual sum of squares of the constrained model (individual effect model) of a country *c*)

Tab.III-5 presents the results of Fisher's heterogeneity tests by countries. The results show that the two null hypotheses are rejected in all the countries in question. This means that institutional investor sectors have their specificities, and it is reasonable to assume the heterogeneous investment behavior across institutional sectors, which is a generalized feature observed in all countries.

Tab.III-5 Results of Fisher's heterogeneity tests

	Korea	Japan	U.S	France
Fisher test 1 (H_0^1: $a_i^c=a^c$, $B_i^c=B^c$)	F_1= 4.29 (p-value: 0.00)	F_1= 7.46 (p-value: 0.00)	F_1= 6.58 (p-value: 0.00)	F_1= 2.68 (p-value: 0.00)
Fisher test 2 (H_0^2: $B_i^c=B^c$)	F_2= 3.27 (p-value: 0.00)	F_2= 5.92 (p-value: 0.00)	F_2= 3.26 (p-value: 0.00)	F_2= 2.43 (p-value: 0.00)
Appropriate model	Heterogeneity	Heterogeneity	Heterogeneity	Heterogeneity

Source: Author's estimation

Furthermore, we need to check the robustness of the coefficient estimations of the baseline models because the limited number of observations may cause biased estimation. We modify the baseline equation by reducing explanatory variables and compare the coefficient estimates on the lagged market return for the various specifications with reduced explanatory variables. Tab.III-6 summarizes the coefficients of investment funds and ICPFs on the lagged market return.[82] Row (1) reports the estimation results of a simple regression on the lagged market return without controlling for macro-economic variables and net inflows in liabilities. Row (2) shows the results of the model with only macro-economic controls, and row (3) shows the results of the model with only net inflows in liabilities. Row (4) presents the estimates of the baseline specification, which are reported in Tab.III-4. Even with missing variables in the specifications that could cause coefficient estimates to be biased, I confirm that the results of Tab.III-4 mostly hold. ICPFs of Korea and Japan are consistently counter-cyclical investors with negative coefficients on the lagged market return for all specifications. Investment funds of Korea and the U.S demonstrate procyclical propensity consistently in response to market return movements of a previous quarter for all specifications. We can confirm that the previous results do not hold only for investment funds of Japan and ICPFs of France in certain specifications.

Tab.III-6 Summary of coefficient estimates on the lagged market return[1),2),3)]

	Control variables	Korea		Japan	
		IFs	ICPFs	IFs	ICPFs
(1)	–	26.864* (1.586)	-17.834* (-1.641)	4.926 (0.856)	-65.760*** (-5.739)
(2)	Macro controls	35.714** (2.353)	-18.296** (-2.031)	-5.954 (-1.011)	-61.484*** (-4.862)
(3)	L_{t-1}	30.243* (1.893)	-21.746** (-2.507)	-10.639** (-2.055)	-61.259*** (-5.059)
(4)	Macro controls* L_{t-1}	33.036** (2.294)	-18.578** (-2.129)	-15.735*** (-2.673)	-56.524*** (-4.225)

[82] The results of banks that do not show cyclicality in the estimation results of the baseline specification are not reported in this paper, but available on request.

	Control variables	U.S		France	
		IFs	ICPFs	IFs	ICPFs
(1)	–	3.415*** (2.610)	-4.631 (-1.443)	0.052 (0.707)	-0.007 (-0.226)
(2)	Macro controls	3.178** (2.129)	-0.469 (-0.123)	0.069 (0.967)	-0.051 (-1.466)
(3)	L_{t-1}	3.367*** (2.608)	1.844 (0.516)	0.007 (0.109)	-0.023 (-0.734)
(4)	Macro controls* L_{t-1}	2.912** (1.950)	2.788 (0.713)	0.070 (1.006)	-0.057* (-1.806)

Notes: 1) *, **, *** means that the estimated coefficient is significant at the level of 10%, 5%, and 1%, respectively. 2) Numbers in parentheses are t-statistics obtained using White robust standard errors. 3) For the U.S investment funds model, the Cochrane-Orcutt procedure is applied to correct a serial correlation in residuals. Source: Author's estimation

III.4. Asymmetric model specification and estimation results

III.4.1 Asymmetric model specification and dummy variables

A drawback of the baseline model (1) is that it is symmetric. It does not distinguish investment behavior that may change depending on market conditions. So, we need to investigate further if institutional sectors' investment behavior has an asymmetric feature depending on market cycles. This allows us to find out which sectors reinforce the cycles, pushing stock prices away from their fundamental values and which relieve the cycles, pushing prices back to the fundamental values. In boom periods, stocks may have been traded above their fundamental values, as the counter-cyclical propensity of contrarian investors would have been attenuated. In the phases of market busts, the shock and duration of market downturns also depend on how actively contrarian investors engage in asset trading and offset negative price dynamics.

To assess whether institutional investors' investment behavior changes by the phases of market cycles, we distinguish three phases of stock market cycles: Boom, bust, and adjustment phases. Then, we create two dummy variables, $D_t^{Boom,c}$ and $D_t^{Bust,c}$ to denote the boom and bust periods of each stock market respectively for each point in time, and modify the baseline specification (1) by putting the dummies in the equation. The following is the modified dummy variable regression model.

$$Netbuys_{i,t}^{c} = D_t^{Boom,c} + D_t^{Bust,c} + \beta_{1i}^{c}(Return_{t-1}^{c} * D_t^{Boom,c}) + \beta_{2i}^{c}\left(Return_{t-1}^{c} * D_t^{Bust,c}\right) + {\gamma'}_i^{c} X_{t-1}^{c} + \delta_i^{c} L_{i,t-1}^{c} + \varepsilon_{i,t}^{c} \quad (2)$$

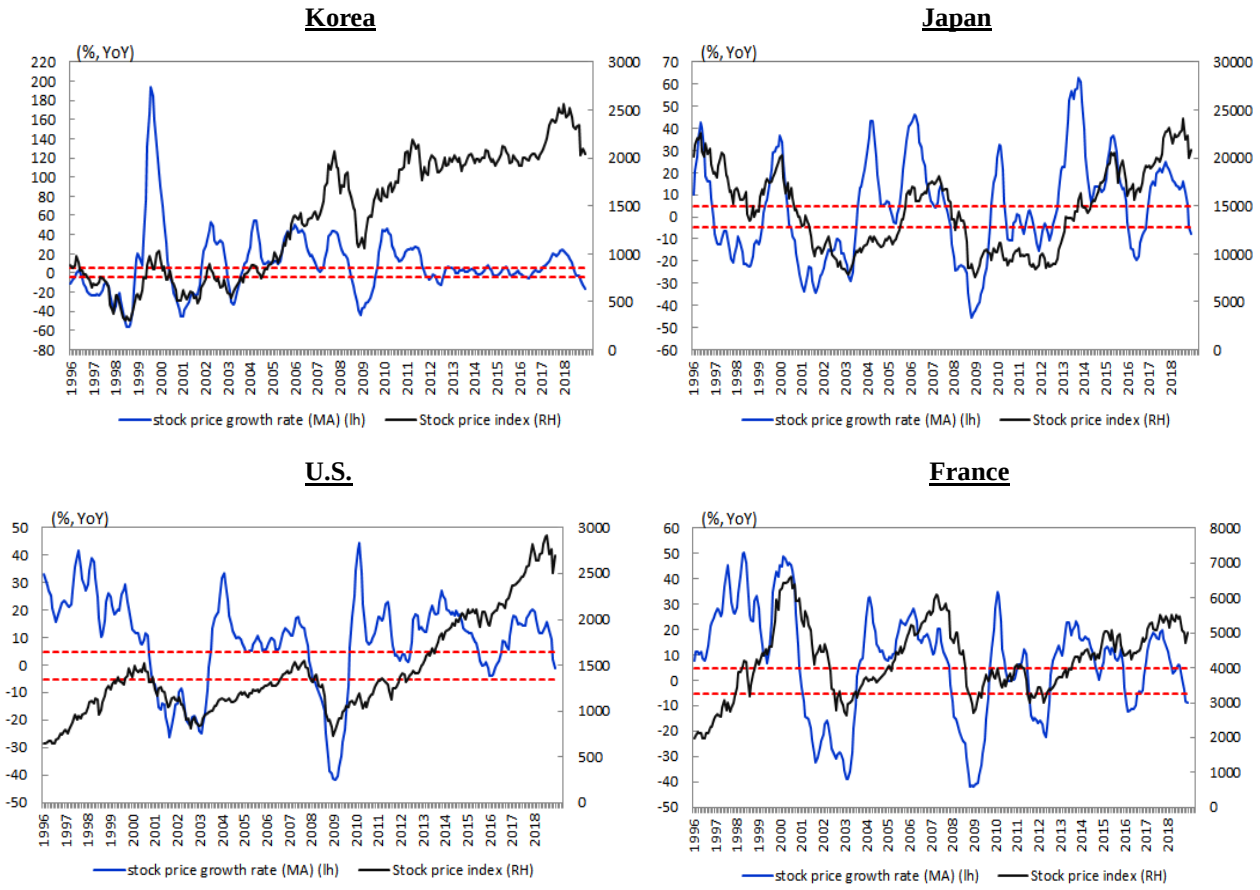
where $D_t^{Boom,c}$ equals one if the market is in boom periods, and 0 otherwise. The dummy $D_t^{Bust,c}$ equals one if the market goes through market busts or crashes and 0, otherwise.

$$D_t^{Boom,c} = \begin{cases} 1 & \text{if the stock market is in a boom phase} \\ 0 & \text{otherwise} \end{cases}$$

$$D_t^{Bust,c} = \begin{cases} 1 & \text{if the stock market is in a market bust phase} \\ 0 & \text{otherwise} \end{cases}$$

The boom, bust, and adjustment periods of each country's stock markets are detected according to the Moving Average (M.A.) method proposed by the Bank of France (2009). Those periods for which moving averages of the year-on-year growth rate of the stock price index are larger (lower) than a threshold, 5% (-5%), are identified as boom (bust) periods. The ranges between -5% and 5% are identified as adjustment periods. Fig.III-3 displays the boom, bust, and adjustment period detection results from 1996 to 2018 for four countries.

Fig.III-3 Detection of boom and bust phases of stock market cycles[1)]



Notes: 1) Those periods for which moving averages of the year-on-year growth rate of the stock price index (blue lines) is larger (lower) than a threshold, 5% (-5%) (red dotted lines) are identified as boom periods (bust periods) (Bank of France).
Source: Author's calculation

III.4.2 Results of the asymmetric model estimations

Tab.III-7 reports the coefficient estimates for the lagged market returns for boom and bust periods in the asymmetric regression model (2).[83] The coefficient estimates, $\hat{\beta}_{1i}^{c}$ and $\widehat{\beta}_{2i}^{c}$, capture the procyclicality or counter-cyclicality of a sector in boom and bust periods, respectively. Institutional investors of most countries show asymmetric investment behavior depending on market phases. For Korea, the coefficient estimate of investment funds in boom periods is positive and significant, indicating that investment funds have stronger procyclicality in boom periods, buying more stocks when prices are upward. However, in bust periods, they do not show significant cyclicality in investment behavior. The counter-cyclicality of Korean ICPFs is stronger in boom periods than bust periods. This signifies that ICPFs stabilize prices more actively when market prices surge. Interestingly, Korean banks that show no cyclicality in whole periods are dramatically procyclical in bust periods. Most market crises of recent decades, including the Asian crisis of 1997-1998, were accompanied by Korean banks' liquidity distress. The result shows how Korean banks cope with liquidity needs during market stress times, probably by selling stocks off at depreciated prices. Korean banks have the potential to generate negative price dynamics during market crashes, but there appear no counterparties that stabilize the prices during those times. The difference between the coefficients for boom and bust periods is significant, which indicates that Korean banks' investment behavior is significantly asymmetric.

For Japan, the three institutional investor groups appear mostly consistently counter-cyclical investors, regardless of whether the market is in boom or bust phases. All coefficient estimates are negative, though the degrees of counter-cyclicality are different, and some are insignificant. The significantly negative coefficients of Japanese investment funds and banks in bust periods indicate that their counter-cyclicality is pronounced in bust times. The counter-cyclicality of Japanese ICPFs is even confirmed in both boom and bust periods, while the counter-cyclicality is stronger when prices are in upturns. These results suggest that stock prices stagnating within a limited range over the last two decades (Fig.III-1) may be in part due to the collective counter-cyclical orientation embedded in Japanese institutional investors.

For the U.S, the procyclicality of U.S investment funds becomes stronger in boom periods, but there is no evidence of cyclicality in bust periods. The U.S banks, which do not show evidence of

[83] The entire outcomes of the asymmetric regression models (2) are reported in <Appendix.1>

cyclicality in whole periods, are found procyclical in boom periods, buying stocks when prices increase. From the results, it is likely to be investment funds and banks that reinforce upward price momentums of the U.S during market booms. Surprisingly, the coefficient of the U.S ICPFs is positive and significant in bust times. This indicates that the U.S ICPFs procyclically behave when prices fall or markets go through stress. It is contrary to other studies that find counter-cyclical behavior of German and Dutch ICPFs (de Haan and Kakes, 2010; Timmer, 2016).[84] Notably, there is no remarkable counter-cyclical investor group that can reduce stock market fluctuations in the U.S. Such behavioral features of U.S institutional investors may have contributed to the amplified market cycles depicted in Fig.III-1.

For France, French investment funds and banks, of which coefficients are insignificant in whole periods, show distinguished investment patterns depending on market conditions. French investment funds are procyclical in boom periods. The behavioral asymmetry of French investment funds in two phases is significant, as the difference between the two coefficients is statistically significant. French banks are procyclical when prices are both upward and downward, though we have no evidence of a behavioral pattern in whole periods. Contrary to other countries, in France, banks are the institutional investor group that is likely to amplify the most market cycles. Indeed, the somewhat larger coefficient suggests that French banks reinforce market booms more than French investment funds. In the meantime, the procyclicality of French banks is stronger when prices drop than when prices increase. French ICPFs, which behave procyclically in whole periods, have no asymmetric feature in investment behavior depending on market conditions.

Tab.III-7 Coefficient estimates of asymmetric models[1),2)]

	Korea			Japan		
	IFs	ICPFs	Banks	IFs	ICPFs	Banks
Whole periods	33.036** (2.294)	-17.578** (-2.129)	3.840 (1.002)	-15.735*** (-2.673)	-56.524*** (-4.225)	-5.343 (-0.816)
Booms ($\hat{\beta}_{1i}^{c}$)	48.058** (2.220)	-34.191** (-2.201)	-2.049 (-0.315)	-2.253 (-0.167)	-76.952*** (-4.187)	-6.718 (-0.622)
Busts ($\hat{\beta}_{2i}^{c}$)	5.964 (0.345)	-5.224 (-0.351)	10.359*** (3.510)	-12.178** (-2.260)	-18.643* (-1.825)	-16.587* (-1.917)
Difference[3)] ($\hat{\beta}_{1i}^{c}$ -$\hat{\beta}_{2i}^{c}$)	42.095 (1.379)	-28.968 (-1.259)	-12.409* (-1.693)	9.926 (0.690)	-58.309** (-2.851)	9.870 (0.711)

[84] Duijm and Bisschop (2015) find procyclicality of Dutch life-insurance companies in securities markets, while the procyclicality is probably caused by smaller life-insurance companies.

	U.S			France		
	IFs	ICPFs	Banks	IFs	ICPFs	Banks
Whole periods	2.912** (1.950)	2.788 (0.713)	-0.016 (-0.131)	0.070 (1.006)	-0.057* (-1.806)	0.154 (1.165)
Booms ($\hat{\beta}_{1i}^{c}$)	4.434** (2.199)	-1.112 (-0.215)	0.282* (1.675)	0.176* (1.742)	-0.038 (-0.804)	0.199* (1.767)
Busts ($\hat{\beta}_{2i}^{c}$)	0.774 (0.322)	10.051** (1.777)	-0.200 (-1.079)	-0.141 (-1.115)	-0.359 (-0.042)	0.301* (1.735)
Difference[3] ($\hat{\beta}_{1i}^{c}$ -$\hat{\beta}_{2i}^{c}$)	3.660 (1.222)	-11.163 (-1.584)	0.482* (1.975)	0.317* (1.940)	-0.034 (-0.348)	-0.103 (-0.497)

Notes: 1) *, **, *** means that the estimated coefficient is significant at the level of 10%, 5%, and 1%, respectively. 2) Numbers in parentheses are t-statistics obtained using White robust standard errors. 3) Wald test results under the null hypothesis, $\hat{\beta}_{1i}^{c} - \hat{\beta}_{2i}^{c} = 0$
Source: Author's calculation

III.4.3 Robustness check in estimations

Considering the limited number of observations for boom and bust periods, we check the robustness of the coefficient estimations of the asymmetric models following the same procedure as the robustness check for the baseline models above. We modify the asymmetric equation by reducing explanatory variables and compare the coefficient estimates on the lagged market return for the various specifications with reduced explanatory variables. Tab.III-8 summarizes the coefficients on the lagged market return. Row (1) reports the estimation results of a regression on the lagged market return without controlling for macro-economic variables and net inflows in liabilities. Row (2) shows the results of a model including only macro-economic controls, and row (3) shows the results of a model including only net inflows in liabilities. Row (4) presents the estimates of the asymmetric model, which are reported in Tab.III-7. Even with missing variables in the specifications that could cause coefficient estimates to be biased, we confirm that the results of Tab.III-7 largely hold, except for investment funds and banks of Japan, whose coefficient estimates are no longer statistically significant with reduced explanatory variables. The procyclicality of U.S ICPFs during the market bust times is not observed when the net inflows in liabilities are removed in the explanatory variables.

Tab.III-8 Summary of coefficient estimates on the lagged market return[1)]

	Control variables		Korea			Japan		
			IFs	ICPFs	Banks	IFs	ICPFs	Banks
(1)	–	*Booms*	**34.769***	**-31.204*****	-5.238	0.831	**-74.027*****	**-12.544***
		Busts	-1.177	-4.955	**11.648****	-0.796	**-25.268*****	-18.824
(2)	Macro controls	*Booms*	**47.236****	**-34.192****	-2.141	4.851	**-77.327*****	-5.326
		Busts	4.387	-5.223	**10.304*****	-5.289	**-22.879****	-16.460*
(3)	L_{t-1}	*Booms*	**34.620***	**-27.072****	-5.183	-4.987	**-73.036*****	**-15.294***
		Busts	-0.022	-10.196	**11.375****	-6.654	**-23.174****	-19.272
(4)	Macro controls* L_{t-1}	*Booms*	**48.058****	**-34.191****	-2.049	-2.253	**-76.952*****	-6.718
		Busts	5.964	-5.224	**10.359*****	**-12.178****	**-18.643***	**-16.587***

	Control variables		U.S			France		
			IFs	ICPFs	Banks	IFs	ICPFs	Banks
(1)	–	*Booms*	**5.259*****	-4.735	**0.274***	**0.204***	-0.019	**0.188****
		Busts	1.738	1.328	-0.229	-0.142	-0.025	0.194
(2)	Macro controls	*Booms*	**4.748****	-3.235	0.249	0.139	-0.032	**0.197***
		Busts	1.439	5.676	-0.235	-0.110	0.025	**0.337***
(3)	L_{t-1}	*Booms*	**5.036****	-0.417	**0.318***	**0.244****	-0.023	**0.189***
		Busts	1.872	**9.537***	-0.209	-0.186	-0.019	0.159
(4)	Macro controls* L_{t-1}	*Booms*	**4.434****	-1.112	**0.282***	**0.176***	-0.038	**0.199***
		Busts	0.774	**10.051****	-0.200	-0.141	-0.359	**0.301***

Notes: 1) *, **, *** means that the estimated coefficient is significant at the level of 10%, 5%, and 1%, respectively.
Source: Author's estimation

III.5. Conclusion

Until now, we have explored the investment behavior of major institutional investor groups in stock markets of four countries and asymmetric behavioral patterns depending on market conditions. If the stock market's major investor base is skewed toward short-term investors with a procyclical orientation, the market can be vulnerable to heightened price volatilities in the short-term and amplified boom and bust cycles in the medium- or long-term horizon. If the market is based on institutional investors that tend to show strong procyclicality in boom periods, their collective behavior is more likely to push the stock price higher away from fundamental values when the market

gets into boom periods. Such a market needs to be aware of prevailed stock market bubbles. If a market has a large group of institutional investors that tend to be pronouncedly procyclical in market stress times, it can experience drastic negative price dynamics during market turmoil. In such a market, market stress can easily develop into a market crisis.

Tab.III-9 summarizes the regression results. The results show that major institutional groups demonstrate heterogeneities and asymmetries in investment behavior across countries and in whichever phase of the cycle the market happens to be. The heterogeneities and asymmetries may be viewed as a result of a socio-economic configuration of the surrounding world to which each institutional sector belongs. Notwithstanding, the results lead us to some conclusions. Firstly, in most countries (Korea, the U.S, and France), investment funds show procyclical investment behavior, in particular, in boom periods. It is in line with previous empirical literature (Grinblatt et al., 1995; Raddatz and Schmukler, 2012; Timmer, 2016, etc.) and confirms the assumption that investment funds intrinsically have a procyclical orientation resulting from their balance sheet dynamics. The results imply that the procyclicality of investment funds is a strong driver of creating and reinforcing stock market booms in Korea, the U.S, and France, which could explain several dramatic booms of stock prices observed in those countries (Fig.III-1). Secondly, ICPFs show counter-cyclical investment behavior in most countries (Korea, Japan, and France), which is also in line with the assumption based on its institutional characteristics and the results of previous studies (de Haan and Kakes, 2010; Timmer, 2016). Their counter-cyclical investment strategies or portfolio rebalancing play a market-stabilizing role, probably offsetting negative price dynamics caused by procyclical investors in those countries. Thirdly, banks are mostly procyclical investors (Korea, the U.S, and France). In western countries, banks behave in a procyclical way, especially when markets are in upward phases, pushing prices higher. French banks behave procyclically both in boom and bust periods, probably amplifying market cycles. The procyclicality of Korean banks in bust periods may be a reflection of recurrent liquidity distress they experienced in the crisis history of the last two decades.

From the results, we have two contrasting cases, Japan and the U.S. Among the countries in question, the U.S stock market seems the most skewed toward procyclical institutional investors. All the institutional investor groups in question, even ICPFs, demonstrate procyclical investment behavior. The U.S ICPFs appear to abandon portfolio rebalancing and rather participate actively in procyclical investments in bust periods. On the contrary, Japan shows its unique picture. The three major institutional groups are consistently counter-cyclical investors, irrespective of market conditions. Even

investment funds consistently behave in a counter-cyclical manner. The collective counter-cyclical orientation embedded in Japanese institutional sectors may be associated with Japan's particular economic environment that had gone through the long-lasting deleveraging process of financial institutions and prevailed pessimistic market sentiments since the collapse of the bubble economy. The distinguishing behavioral features of the two economies would have generated contrasting trajectories of price evolutions, spectacular boom and bust cycles of the U.S stock markets, and stagnant price movements of Japanese markets (Fig.III-1).

Tab.III-9 Summary of results

	Korea			Japan		
	Whole periods	Booms	Busts	Whole periods	Booms	Busts
IFs	Procyclical	Procyclical (stronger)	-	Counter-cyclical	-	Counter-cyclical (attenuated)
ICPFs	Counter-cyclical	Counter-cyclical (stronger)	-	Counter-cyclical	Counter-cyclical (stronger)	Counter-cyclical (attenuated)
Banks	-	-	Procyclical	-	-	Counter-cyclical

	U.S			France		
	Whole periods	Booms	Busts	Whole periods	Booms	Busts
IFs	Procyclical	Procyclical (stronger)	-	-	Procyclical	-
ICPFs	-	-	Procyclical	Counter-cyclical	-	-
Banks	-	Procyclical	-	-	Procyclical	Procyclical

Source: Author's compilation

The regression analysis carried on so far allows us to examine how investors respond to price changes. However, it provides limited information on investment behavior for the following reasons: It does not consider dynamic feedback effects between investment behavior and prices. To capture investment behavior more accurately, we need to look into price information and its dynamic relations with investment behavior. In addition, the regressions have been undertaken without consideration of the impacts of foreign investors.[85] Foreign investors are one of the major institutional investor groups that account for a large fraction of stock market trading and are an important trading counterparty of domestic institutional investors. For some countries, foreign investors' investment behavior has a dominant power for determining the price formation and investment behavior of domestic investors.

[85] The baseline specification (1) is no longer a good model to explain behavior of foreign investors, because investment decisions of foreign investors depend on different factors such as relative portfolio returns across countries, exchange rates, etc.

Sometimes domestic investors co-move with the foreign investors to take advantage of the price dynamics caused by the latter, sometimes they passively participate in trading on the opposite side with foreign investors. The drawbacks of the regression analysis can be complemented by the VAR analysis conducted in the following chapter.

CHAPTER IV

Measurement of the mutually reinforcing interactions by a VAR analysis: focused on the Korean stock market

This chapter analyzes procyclical dynamics prompted by institutional investors using VAR models. This approach is ultimately analogous to analyzing the concept of procyclicality in investment behavior, "mutually reinforcing interactions" or "positive feedback effects" between investment behavior and price changes. The mutually reinforcing interactions must satisfy two conditions: First, increased market returns raise stock purchases (first-round effect). Second, increases in stock purchases also stimulate the market returns to rise again (feedback effect). This approach overcomes the drawback of regression analysis using trading volume data by identifying price dynamics driven by increased demand for stocks. This assumption is theoretically related to the *finance of conventions*: Demand of financial assets is assumed to be a positive function of a price, contrary to ordinary good markets' demand function. A rise in an asset price rather promotes new demand than discourages it, and the added demand boosts the price up again in reverse. As long as the major opinion in the market is that the trend will continue, even though they know the market prices are experiencing bubbles, the optimal strategy for them will be to get profits by riding the rising prices. The price movements are a signal of the major market opinion, on which investors form their expectations. The increased demand for the asset stimulates price to rise again, creating mutually reinforcing effects. As the VARs capture the endogenous relationship among variables, it provides an ideal framework for identifying mutually reinforcing effects between investment behavior and market returns in time series. It allows assessing the degree to which each institutional sector's investment behavior affects the market return over time and possible feedback effects from the market return to institutional investment behavior.

Besides the mutually reinforcing interactions between investment behavior and the market return, this chapter also attempts to analyze how and to which extent each institutional sector interacts with one another from a behavioral perspective. It may partially test the "self-referential feedback process" among institutional sectors under the hypothesis that institutions base their investment decisions on others' past behaviors. In particular, given the considerable influence of foreign investors in the price formation process of Korean stock markets, we add foreign investors as one of the major institutional

investors. It allows us to examine foreign investors' behavior responding to changes in domestic market returns and behavior of domestic institutional sectors responding to foreign investors' behavior.

The VAR analysis focuses only on the Korean stock market, where high-frequency data are available. The VAR model includes five variables; trading volumes of four institutional sectors (investment funds, ICPFs, banks, and foreign investors) and Korean stock market return. In section 1, we construct a benchmark model to analyze the mutually reinforcing interactions at a medium-term horizon using monthly data, which may contribute to finding out the existence of procyclicality causing medium-term market cycles. As a standard practice, we start by describing data and checking the results of Granger-causality tests between variables. Then we estimate the VAR models and verify the existence of procyclicality from the results of impulse-response functions and forecast error decompositions. Section 2 discusses the short-term model using daily data and proposes an analysis of procyclicality at a short-term horizon. This is linked to procyclicality causing short-term price volatilities.

IV.1. Mutually reinforcing interactions at medium-term investment horizons

IV.1.1 Data description

The data used for the monthly frequency model are monthly net buys in stocks of banks, investment funds, ICPFs, and foreign investors in the listed Korean stock market from January 1997 to June 2019, which are sourced from the Korean Stock Exchange (KRX). Monthly stock market returns are computed with long differences (%) of the monthly KOSPI index. The monthly net buys of domestic institutional investor sectors show similar characteristics to their quarterly net buy data of chapter III. Looking into foreign investors' monthly net buy data, foreign investors are a historical net buyer in Korean stock markets. The average amount of foreign investors' stock net buys is similar to that of ICPFs' net buys. However, foreign investors show a high standard deviation and large dispersion between the extreme values compared to domestic institutional investors. These statistics may imply that foreign investors have active and sensitive investment patterns in Korean stock markets. Their investment distribution is almost symmetric, not significantly skewed toward net sales or net buys.

Tab.IV-1 Descriptive statistics of monthly net buys in stocks and market returns in the Korean stock market[1) 2) 3)]

(Jan 1997 to June 2019)

(In billion won)

Net buys	IFs	ICPFs	Banks	FOR	Market returns (%)
N of Obs	270	270	270	270	270
Mean	-222.9	286.5	-110.3	187.6	0.4
Max	5303.0	3756.1	1067.6	7555.4	39.7
Min	-4636.9	-2292.4	-1578.1	-8717.8	-31.8
Std. Dev	1228.5	714.2	275.4	2302.8	7.8
Skewness	0.05	0.62	-1.22	-0.32	0.15
Kurtosis	6.55	6.27	9.73	4.66	6.61

Notes: 1) IFs, ICPFs, Banks, and FOR indicate investment funds, insurance companies & pension funds, banks, and foreign investors, respectively. 2) Net buys refer to the net amount bought and sold by each institutional sector. 3) Positive (+) (negative (-)) net buys refer to the amount when the net buys by each sector are positive (negative). In other words, the total buys amount is greater (less) than the total sales amount.
Sources: KRX, Author's calculation

IV.1.2 Granger-causality test

In econometric analyses, a question of causality between two economic variables is generally addressed based on underlying economic theories. However, in the case of investment behavior and stock prices where it is theoretically unclear which variable causes the other, the causality between the variables can be tested using the Granger-causality test, which provides preliminary indications of intertemporal interactions among variables. As the Augmented Dicky-Fuller (ADF) unit root test rejects null hypotheses for all the variables at a significance level of 1%, all the variables are regarded as stationary and used without differences. Regarding the lag structure of the VAR models, the lag order one month is selected as the optimal lag order according to the several lag length section criteria.[86]

Tab.IV-2 reports the results of the pairwise Granger-causality tests with one lag length. For the relations between the market returns and investment behavior of institutional sectors, the market returns do Granger-cause investment behavior of institutional investor sectors except for investment funds. However, the investment behavior of sectors does not Granger-cause the market returns. This implies that the market returns help predict future investment behavior of sectors at conventional significance levels, whereas a particular institutional sector's investment behavior does not help

[86] Refer to the table <Appendix.2>

predict future market returns. There is rare evidence of causalities among domestic institutional investors at monthly time horizons. However, it is notable that foreign investors do Granger-cause investment funds and ICPFs, whereas the investment behavior of major domestic institutional sectors does not Granger-cause foreign investors' investment behavior. This suggests that the past information on foreign investors' investment behavior helps predict the future behavior of major domestic institutional investors except for banks.

Tab.IV-2 Results of the pairwise Granger causality tests[1) 2)]

Regressor (A)	Dependent variable in regression (B)				
	market return	IFs	ICPFs	Banks	FOR
Market return	-	0.00	4.42**	3.98**	2.89*
IFs	2.33	-	2.15	0.02	1.03
ICPFs	1.67	0.71	-	4.17**	0.00
Banks	0.84	0.26	1.24	-	1.21
FOR	0.89	9.27***	6.03***	1.34	-

Notes: 1) The numbers in the table are F-statistics of Granger-causality tests. 2) *, **, *** means that the null hypothesis (A does not Granger-cause B) is rejected at the significance level of 10%, 5%, and 1%, respectively.
Source: Author's calculation

IV.1.3 Monthly VAR model (benchmark model) specification

We build first-order stock market VAR models described by investment behaviors of four institutional sectors and market returns. The reduced form VAR model comprises five equations where each variable is regressed by its own past values and the other four variables' past values. Hence, the VAR model to be estimated is as follows:

$$y_t^m = A_0^m + A_1^m y_{t-1}^m + \varepsilon_t \quad (1)$$

where

$$y_t^m = \begin{pmatrix} return_t^m \\ Netbuys_{if,t}^m \\ Netbuys_{ICPF,t}^m \\ Netbuys_{bank,t}^m \\ Netbuys_{f,t}^m \end{pmatrix}.$$

$return_t^m$ is the monthly returns of KOSPI on month t and $Netbuys_{i,t}^m$ is the net purchases of an institutional investor sector i in month t.

The error term in a reduced form VAR is usually interpreted as surprise movement in each variable. If the different variables in the model are correlated, then the error terms in the reduced form model are likely to be correlated across equations. In this case, one structural shock of a variable can potentially cause shocks in other variables, which can create contemporaneous relations among variables and make interpretations on results of impulse response functions problematic. Sims (1980) identifies the uncorrelated structural shocks to the VAR models by orthogonalizing the shocks using Cholesky decomposition before impulse responses or forecast error variance decompositions being computed. It is done by judiciously including contemporaneous values as regressors. However, the drawback of this approach is that the results sensitively change depending on the ordering of variables (Stock and Watson, 2001). Particularly in my VAR models, it is not easy to make the ordering of the variables for Cholesky decomposition because it is theoretically and empirically unclear to impose restrictions on which variables among our variables affect which others.[87] For this case in which appropriate restrictions are not available to identify the structural shocks, we adopt the generalized impulse response functions (GIRF) proposed by Pesaran and Shin (1997), where the results are invariant to the ordering of variables. Instead of orthogonalizing the errors by imposing restrictions, it computes the mean impulse response functions by integrating out other shocks' effects using assumed or historically observed distributions of the errors.

IV.1.4 Cumulative impulse responses between investment behavior and market returns

<Appendix.3> reports the results of cumulative impulse response functions along with 95 percent confidence bands. It shows the cumulative responses of variables to one standard deviation positive shock of the other variables. First of all, let us focus on the relations between investment behavior and market return to examine possible cyclicality driven by the investment behavior of institutional sectors. The dynamic relations between the variables in question are described in Fig.IV-1, which summarizes the <Appendix.3>. The results in the left column of Fig.IV-1 show that the unexpected rise in the monthly market return impacts institutions' investment behavior in the subsequent months. The rise in the monthly market return leads ICPFs to respond negatively, in other words, to decrease their stock holdings. This implies that ICPFs are counter-cyclical investors with regard to changes in stock market returns, which is in line with the regression result of the previous section. The effects are

[87] If residuals of the reduced form model show low correlations across equations, then the ordering of variables becomes nearly unimportant. However, my VAR model includes residuals with high correlations across some equations. The residual correlation table is not reported in this paper, but available upon request.

persistent, lasting for the subsequent ten months. It suggests that ICPFs tend to establish positions slowly, probably to limit trading impacts on the market or other institutions of similar type herd in the same direction with different speeds. Banks are net sellers responding to a positive shock of the market return stocks, but the magnitude appears negligible. Responses of investment funds are insignificant in most periods. Not surprisingly, foreign investors are net buyers to a positive shock of the monthly market return, confirming that they are momentum investors, in line with other studies (Froot et al., 2001; Richards, 2005). They purchase large amounts of stocks when the market return unexpectedly rises and sell them when the market return unexpectedly falls. Compared to the other domestic institutional investors, their cumulative responses are strong in magnitude (960 billion won of net buys in stocks in the first month) and stay persistent over time.

Let us focus on the possible feedback effect from institutional sectors on the market return. If the unexpected rise in stock buying of institutional sectors causes the market return to rise, we could say that the feedback effect exists. Looking at the results in the right column of Fig.IV-1, the effects of the unexpected rise in stock buying of investment funds and banks on the market return are statistically insignificant over all time horizons. However, market returns fall in response to unexpected net buys of ICPFs, though the response of market returns is borderline significant.[88] The feedback effect from foreign investors on the market return is significant and particularly strong. In magnitude, the unexpected one standard deviation rise in foreign investors' monthly net buys increases the market return by 3.4% in the first month. Considering the monthly average market return is 0.4% (Tab.IV-1), the increase by 3.4% caused by foreign investors' one standard deviation net buys is significant. The cumulative effects stay persistent over an extended period. It suggests that foreign investors' past behavior has predominant power in the price formation in the subsequent month.

In terms of 'mutually reinforcing interactions' between investment behavior and market return in the monthly data, the results described above lead us to conclude as follows: First, ICPFs are counter-cyclical investors and do not cause mutually reinforcing effects. They tend to sell their stocks when the market return increases. Their unexpected net buys in stocks rather decrease market returns. Investment patterns of ICPFs stabilize the Korean stock market. Second, foreign investors are substantially procyclical. We find clear evidence of both the significant first round and feedback effects for foreign investors, i.e., they buy large amounts of stocks when the market return increases

[88] It is counter-intuitional that net buys decrease market returns, but may be explained that net buys of ICPFs drive other investors to take sell positions in the subsequent periods. Trading of ICPFs has a strong autocorrelation, implying that they tend to adjust their positions slowly not to give a big impact on markets. Such trading patterns of ICPFs are likely to cause other investors to sell stocks in the subsequent periods, which may cause price to drop.

unexpectedly, and in reverse, unexpected net buys of foreign investors cause a stock market return to increase. The price impact by foreign investors remains persistent over an extended horizon. These results imply that foreign investors can trigger a price momentum and, at the same time, can be a primary contributor driving the Korean stock market to boom and bust when there is a price shock. We have no evidence of the mutually reinforcing effects for investment funds and banks in the monthly data.

Fig.IV-1 Dynamic relations between investment behavior and market return[1)2)]

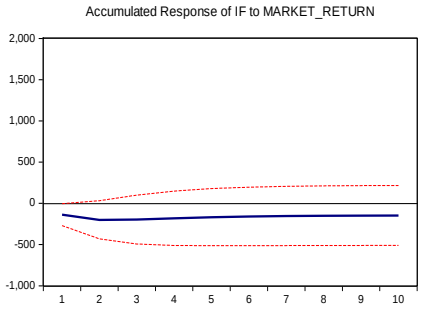
(Cumulative VAR impulse responses in the monthly data)

First-round effect
(Market return → Net buys)

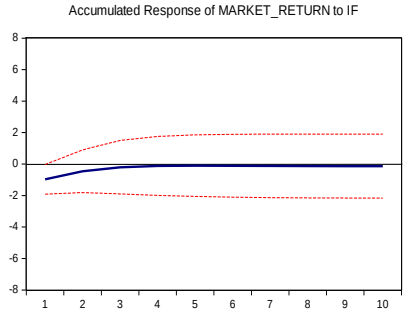
Feedback effect
(Net buys → Market return)

Investment funds

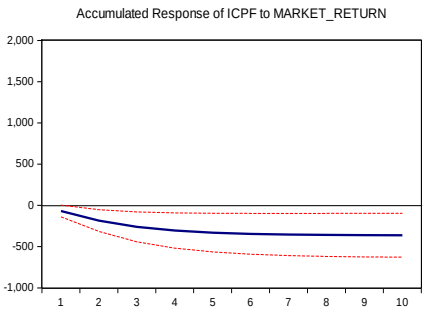
(Billion won)

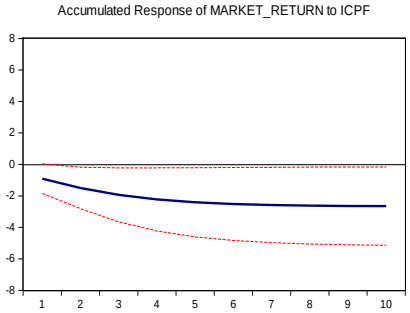


(%)

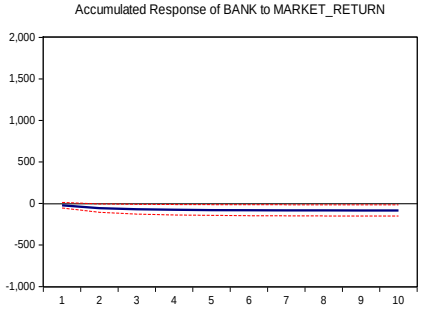


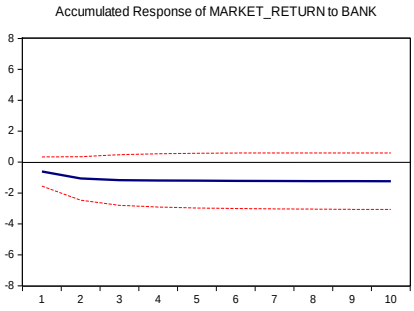
ICPFs



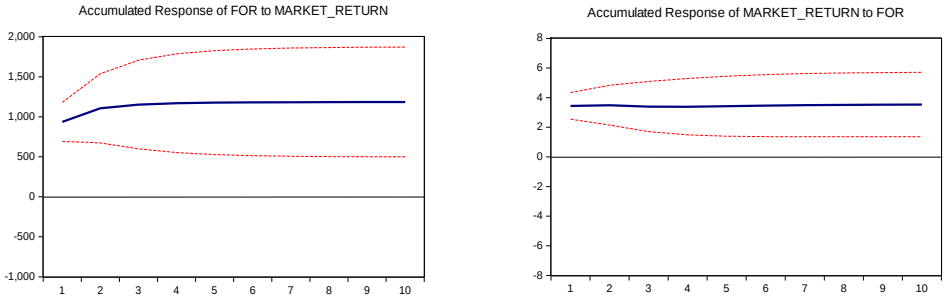


Banks





Foreign investors



Notes: 1) Cumulative responses of other variables to one standard deviation positive shock in a variable. 2) Dotted lines in red mean the 95% confidence level bands based on asymptotic standard errors. Source: Author's calculation

IV.1.5 Cumulative impulse responses between foreign investors and domestic investors

As Fig.IV-1 reports, foreign investors have a predominant power to form the future price evolutions in the Korean stock market. If foreign investors are buyers in certain circumstances, then typically, it follows that domestic investors must be sellers in aggregate in the same circumstances. So we examine cumulative VAR impulse response functions further to see which domestic institutional investors tend to trade in the opposite position of the trading of foreign investors or which herd to foreign investors.

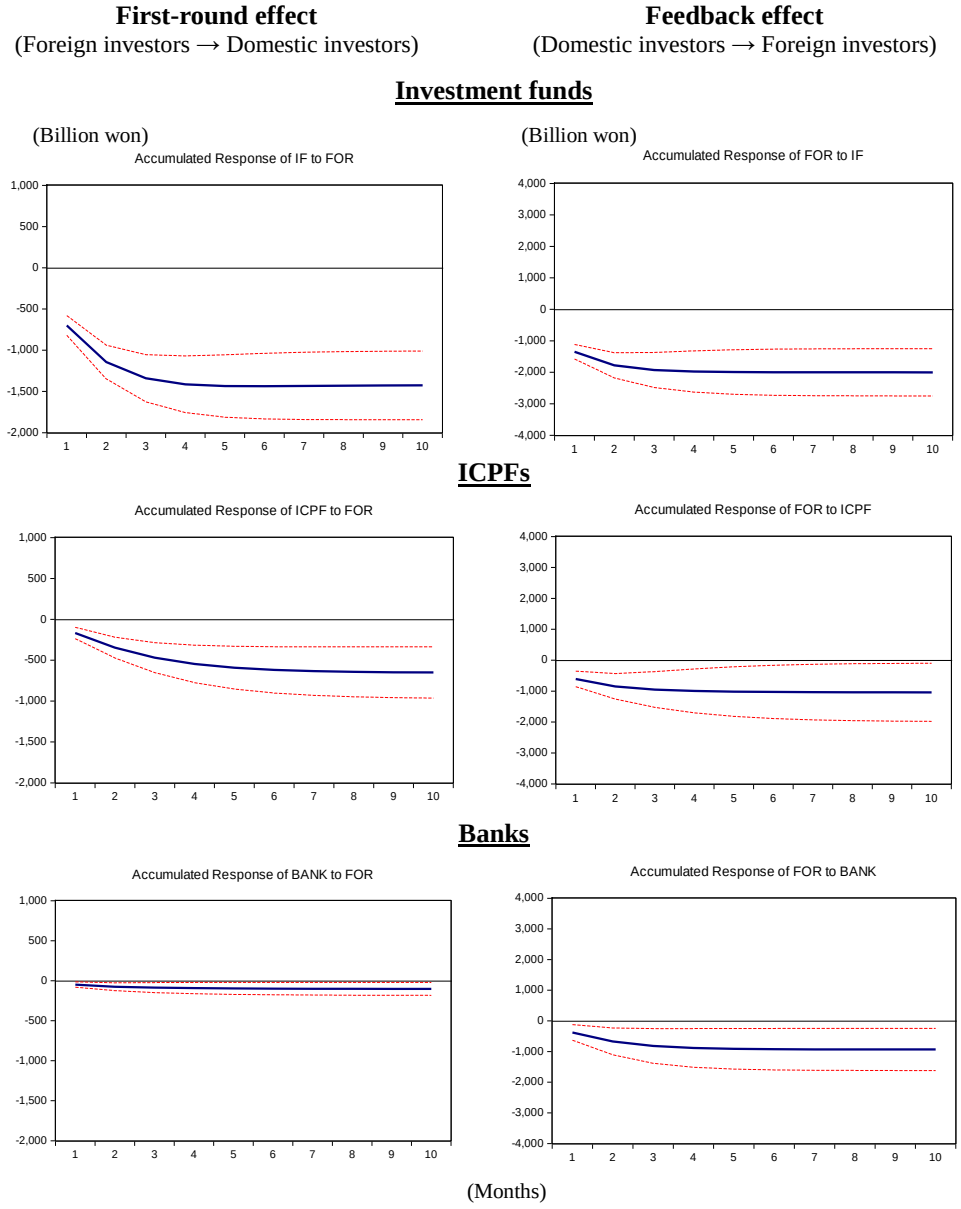
Fig.IV-2 presents cumulative responses of domestic institutional sectors to one standard deviation positive shock of foreign investors and the reverse cases. The left column results show that all the domestic institutional sectors are consistently sellers when foreign investors buy stocks unexpectedly. The responses of investment funds among three domestic institutional sectors are the strongest in magnitude, selling 700 billion won worth of stocks in the first subsequent month following one standard deviation net buys of foreign investors. From these results, we confirm that all the domestic institutional sectors consistently trade on the opposite side to foreign investors. The same result holds for the feedback effect, as shown in the right column. Foreign investors respond negatively to one standard deviation positive shock of net buys of domestic institutional investors. As a result, we can conclude that the three domestic institutional investors are trading counterparties of foreign investors, which may imply that domestic institutional investors more or less contribute to restraining increased market volatilities provoked by foreign investors by absorbing the shock from foreign investors and offsetting their destabilizing effects.

Regarding the stabilizing role of domestic investors with regard to foreign investors, however, Linnainmaa (2003) proposes a possibility that the liquidity provision of domestic investors is

unintended due to their extensive use of limit orders. Transactions by limit orders may make the domestic investors show up as contrarian investors *ex-post*, especially if the limit orders are not actively monitored (Richards, 2005). In August 2009, the proportion of transactions by limit orders in total selling transactions of Korean domestic institutional investors is around 33% (Lee, 2019). Nevertheless, the increases in market returns following net buy of foreign investors reflect an imbalance in order flows, suggesting domestic investors' limited liquidity supplies or herding to foreign investors' trading direction, thereby creating price pressures in the stock markets.

Fig.IV-2 Dynamic relations between behavior of foreign investors and domestic institutional sectors[1)2)]

(Cumulative VAR impulse responses in the monthly data)



Notes: 1) Cumulative responses of other variables to one standard deviation positive shock in a variable. 2) Dotted lines in red mean the 95% confidence level bands based on asymptotic standard errors. Source: Author's calculation

IV.1.6 Generalized forecast error decompositions (GFED)

Tab.IV-3 gives the generalized forecast error decomposition results proposed by Lanne and Nyberg, 2016).[89] [90] It displays the proportion (%) of the variance in each variable accounted for by earlier shocks in the five variables over time. Most of the variance in the variables is explained by lagged own shocks. However, the decomposition of the remaining variance provides information on which is a more important factor in explaining the variance. For the market return, at the sixth month, 15.8% of the variance in the market return is due to earlier shocks of foreign investors. Other domestic investors seem to have limited impacts on the variabilities of the market return. For investment funds, 33.5% of the variance in net buys of investment funds at the sixth month is explained by net buys of foreign investors, whereas the effects of other variables, besides foreign investors, are quite limited at the same horizon (1.7%). Compared to other investor groups, ICPFs are a highly persistent group as six months after only 20% of the variance in behavior of ICPFs are explained by shocks of other variables. The variance in foreign investors' net buys is primarily due to earlier shocks of investment funds and market return, besides their own shock. Compared to other institutional groups, foreign investors are influenced by the market return the most.

Tab.IV-3 Generalized forecast error variance decomposition (GFEVD)

(Monthly data)

	Market return					IFs				
	Market return	IFs	ICPFs	Banks	Foreign investors	Market return	IFs	ICPFs	Banks	Foreign investors
1	80.6	1.3	1.4	0.4	16.2	1.1	70.1	0.0	0.0	28.7
2	79.7	1.8	2.0	0.6	15.9	1.1	66.0	0.1	0.1	32.7
3	79.4	1.8	2.3	0.6	15.9	1.1	65.1	0.2	0.2	33.4
4	79.3	1.8	2.5	0.6	15.8	1.1	64.9	0.3	0.2	33.5
5	79.2	1.8	2.5	0.6	15.8	1.1	64.8	0.4	0.2	33.5
6	79.2	1.8	2.5	0.6	15.8	1.1	64.8	0.4	0.2	33.5

[89] The generalized forecast error decomposition (GFED) of Lanne and Nyberg (2016) is a modified version of the GFED of Pesaran and Shin (1997) so that the relative contributions to impact in each period of the shocks sum to unity, while it is based on the generalized impulse response function (GIRF) of Pesaran and Shin (1997).

[90] The results for banks which do not show cyclicality are not reported in this paper, but available upon request.

	ICPFs					Foreign investors				
	Market return	IFs	ICPFs	Banks	Foreign investors	Market return	IFs	ICPFs	Banks	Foreign investors
1	1.6	0.1	90.7	0.0	7.7	11.6	23.7	4.9	1.8	57.9
2	4.0	0.7	83.7	0.3	11.4	10.5	23.0	5.0	2.6	58.9
3	4.6	0.9	81.3	0.5	12.8	10.3	22.8	5.0	2.8	59.1
4	4.8	1.0	80.4	0.5	13.3	10.3	22.7	5.0	2.8	59.1
5	4.8	1.0	80.1	0.6	13.4	10.3	22.7	5.0	2.8	59.1
6	4.9	1.0	80.0	0.6	13.5	10.3	22.7	5.0	2.8	59.1

Source: Author's calculation

IV.2. Mutually reinforcing interactions at short-term investment horizons

Now we analyze the mutually reinforcing interactions between investment behavior and market return in the daily data set. The same procedure as the previous analysis using VAR models is conducted. This allows us to investigate the mutually reinforcing interactions between investment behavior and market return at short-term investment horizons over ten days and assess the robustness of the previous results. However, given the stylized facts of daily market returns proved by previous finance studies, to estimate a model for the conditional mean of daily market returns is not robust in usual. We may need to complement the short-term VAR model by the time-varying volatility models. Therefore, we conduct a supplementary analysis to examine the impacts of institutional investors' investment behavior on daily price volatilities by the generalized autoregressive conditional heteroscedasticity (GARCH) model. Nevertheless, this supplementary analysis by the GARCH model is the very first step, and the analysis with a more sophisticated model to examine the relations between investment behavior and conditional volatilities using daily data is left for future research.

IV.2.1. Data description

Tab.IV-4 describes principal statistics of daily net buys in stocks by four institutional investor groups and daily market returns in the Korean stock market from Jan 1, 1997, to June 30, 2019. The daily data show quite different features from the monthly data shown in Tab.IV-1. The distributions of net buys in stocks of four investor groups are highly peaked relative to the normal distribution with outliers. Foreign investors appear most sensitive in the daily data, as in the monthly data, but the distribution of banks is especially peaked and negatively skewed. Notably, the distribution of Korean

daily stock market returns is consistent with the stylized facts of daily market returns explored in previous finance studies. In other words, the conditional mean is zero and dominated by volatility. The distribution is peaked around zero and slightly negatively skewed.

Tab.IV-4 Descriptive statistics of daily net buys in stocks and market returns in the Korean stock market[1)2)3)]

(Jan 1, 1997 to June 30, 2019)

(In billion won)

Net buys	IFs	ICPFs	Banks	FOR	Market returns (%)
N of Obs	5673	5673	5673	5673	5673
Mean	-10.6	13.2	-5.1	8.4	0.0
Max	1321.5	1589.4	1196.1	1718.1	11.3
Min	-1263.9	-1225.7	-1821.9	-1309.4	-12.8
Std. Dev	124.8	72.5	48.8	211.5	1.7
Skewness	-0.2	2.32	-10.46	0.15	-0.2
Kurtosis	14.4	68.9	469.8	8.89	8.7

Notes: 1) IFs, ICPFs, Banks, and FOR indicate investment funds, insurance companies & pension funds, banks, and foreign investors, respectively. 2) Net buys refer to the net amount bought and sold by each institutional sector. 3) Positive (+) (negative (-)) net buys refer to the amount when the net buys by each sector are positive (negative). In other words, the total buys amount is greater (less) than the total sales amount.
Sources: KRX, Author's calculation

IV.2.2. Granger-causality test

As the Augmented Dicky-Fuller (ADF) unit root test rejects null hypotheses for all the daily variables at a significance level of 1%, all the variables are regarded as stationary and used without differences. The lag order three day is selected as the optimal lag order according to the SC.[91] Tab.IV-5 shows the results of the pairwise Granger-causality test. The same results hold for the causal relations between investment behavior of different sectors and market return. The market returns Granger-causes investment behavior of institutional sectors, but the reverse does not hold. Nevertheless, the results are distinguished from the previous results of Tab.IV-2 because domestic institutional sectors appear to have stronger causal relations with foreign investors and other domestic sectors. In other words, domestic institutional sectors' daily investment decisions seem to be causally related to one another.

[91] Refer to the table <Appendix.4>

Tab.IV-5 Results of the pairwise Granger-causality tests[1) 2)]

(In the daily data)

Regressor (A)	Dependent variable in regression (B)				
	market return	IFs	ICPFs	Banks	FOR
market return	-	44.68***	11.95***	2.47*	55.02***
IFs	1.40	-	4.58***	2.72**	30.64***
ICPFs	0.52	5.71***	-	1.53	3.32**
Banks	1.32	3.79***	2.55**	-	3.36**
FOR	1.41	100.91**	15.14***	6.19***	-

Notes: 1) The numbers in the table are F-statistics of Granger-causality tests. 2) *, **, *** means that the null hypothesis (A does not Granger-cause B) is rejected at the significance level of 10%, 5%, and 1%, respectively.
Source: Author's calculation

IV.2.3. Daily VAR model specification

Now, we construct the daily VAR models using daily data. The same procedure as the previous analysis is conducted. Three-day lag is selected as the optimal lag according to the SC. The short-term daily VAR models are specified as follows:

$$y_t^d = A_0^d + A_1^d\, y_{t-1}^d + \cdots + A_3^d\, y_{t-3}^d + \varepsilon_t \qquad (2)$$

where

$$y_t^d = \begin{pmatrix} return_t^d \\ Netbuys_{if,t}^d \\ Netbuys_{ICPF,t}^d \\ Netbuys_{bank,t}^d \\ Netbuys_{f,t}^d \end{pmatrix}.$$

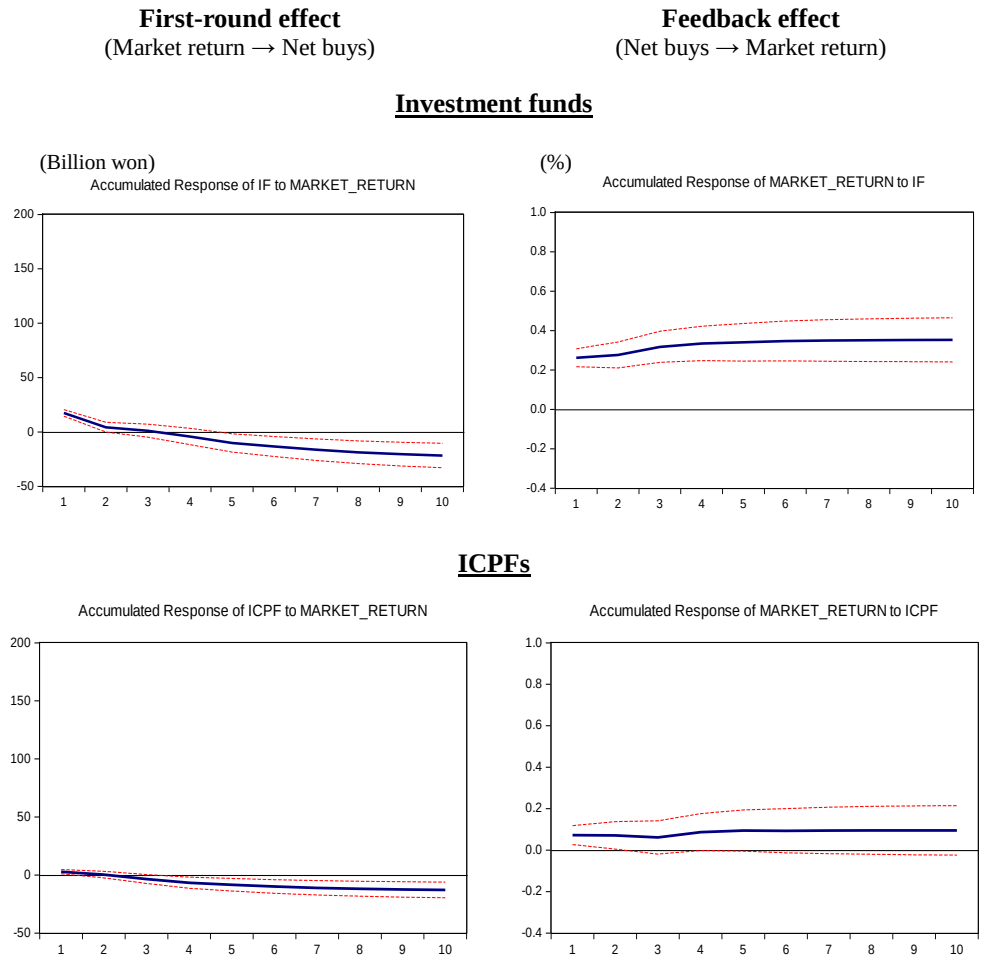
IV.2.4. Cumulative impulse responses between daily investment behavior and market returns

Fig.IV-3 depicts the cumulative impulse response functions of institutional investors and market return in the daily data, which are abstracted from the <Appendix.5>. Even in the daily data, we confirm high-frequency mutually reinforcing interactions between foreign investors and market returns. The pronounced first-round effect from the market returns to foreign investors exists, lasting

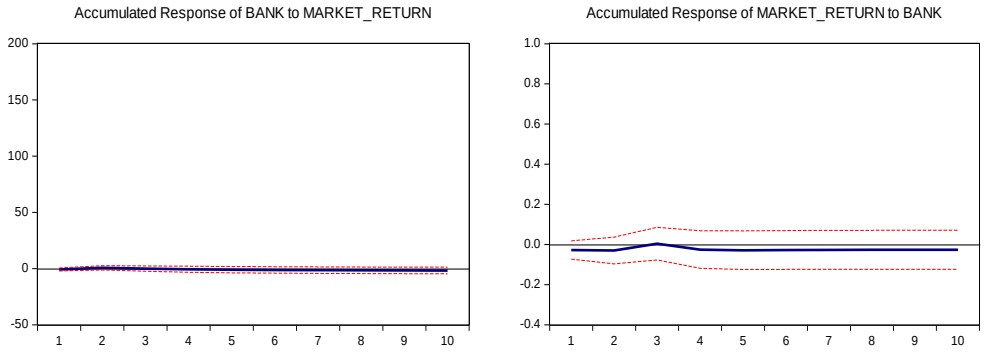
over ten days. The feedback effect of foreign investors on the market return also exists in subsequent days. In addition to foreign investors, investment funds cause mutually reinforcing interactions with the market return in the first subsequent day, displaying the first round and feedback effect with a statistical significance. When the daily market return unexpectedly rises, investment funds buy stocks in the first subsequent day, and when investment funds unexpectedly buy stocks, the market return also increases. The results suggest that foreign investors' investment behavior and investment funds potentially drive increased short-term price volatilities. ICPFs also have the potential to cause a light degree of mutually reinforcing effects with the market return in the first subsequent day. But ICPFs do not respond sensitively to daily changes in market prices and their impacts on market returns are not significant. Meanwhile, consistent with the monthly VAR analysis results, there is no clear evidence for the cyclicality of banks in the daily data as well.

Fig.IV-3 Dynamic relations between investment behavior and the market return[1)2)]

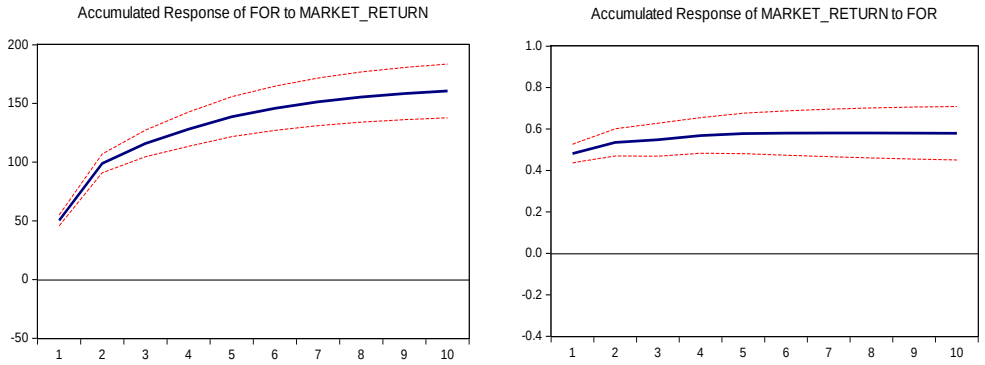
(Cumulative VAR impulse responses in the daily data)



Banks



Foreign investors



(Days)

Notes: 1) Cumulative responses of other variables to one standard deviation positive shock in a variable. 2) Dotted lines in red mean the 95% confidence level bands based on asymptotic standard errors.
Source: Author's calculation

IV.2.5. Cumulative impulse responses between foreign investors and domestic investors

Fig.IV-4 presents the cumulative responses of domestic institutional sectors to foreign investors' shock and the reverse cases in the daily data. The same results hold in the daily data as those in the monthly data. All the domestic institutional sectors are consistently sellers in the subsequent days when foreign investors buy stocks unexpectedly. The responses of investment funds among the three domestic sectors are the strongest in magnitude. This holds for the feedback effects, as shown in the results in the right column. Foreign investors respond negatively to one standard deviation positive shock of net buys of all domestic institutional sectors. Consequently, even in the daily data, it is confirmed that each domestic institutional investor sector trades on the opposite side of foreign investors as trading counterparties, which is in line with the previous results in the monthly data.

Fig.IV-4 Dynamic relations between behavior of foreign investors and domestic institutional sectors[1)2)]

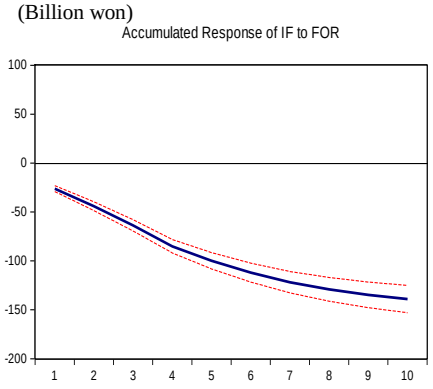
(Cumulative VAR impulse responses in the daily data)

First-round effect
(Foreign investors → Domestic investors)

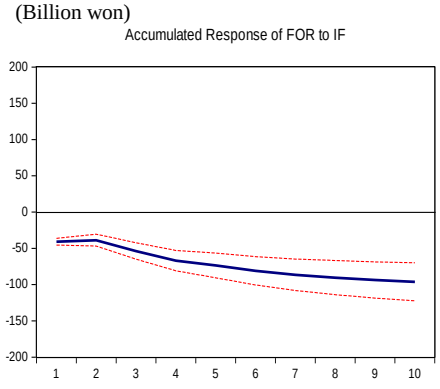
Feedback effect
(Domestic investors → Foreign investors)

Investment funds

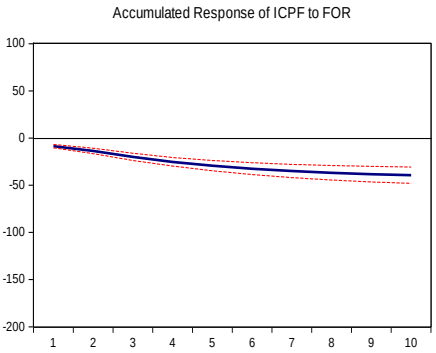
(Billion won)

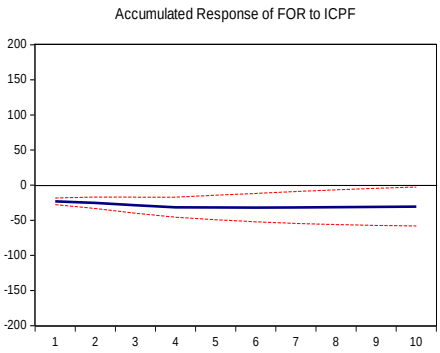


(Billion won)

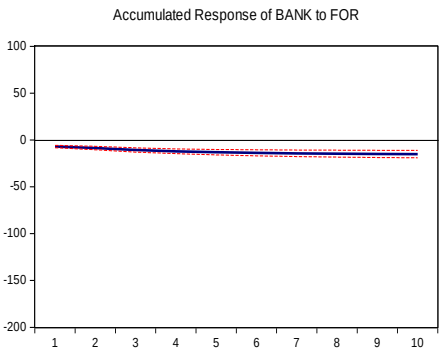


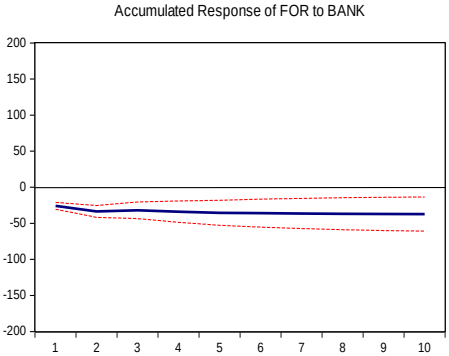
ICPFs





Banks





(Days)

Notes: 1) Cumulative responses of other variables to one standard deviation positive shock in a variable. 2) Dotted lines in red mean the 95% confidence level bands based on asymptotic standard errors.
Source: Author's calculation

IV.2.6. Generalized forecast error decompositions (GFED)

Tab.IV-6 reports the results of GFEVD in the daily data.[92] The results are consistent with Tab.IV-3, though the variables tend to be more persistent in the daily data as more proportions of the variances are accounted for by its own shocks than in the monthly data. Ten days later, most market return variance is explained by its own shocks (90.4%) and shocks of foreign investors (7.2%). The variance in net buys of investment funds is mainly due to foreign investors (14.1%) and the market return (3.4%), besides its own shocks. ICPFs are highly persistent even in the daily data, as most of variance in net buys of ICPFs are explained by lagged own shocks over time. They get limited impacts by foreign investors (3.8%) and the market return (0.9%) ten days later. Foreign investors tend to be more sensitive to daily changes in the market return than domestic institutional sectors in the daily data, distinguished from the monthly data results. This suggests that investments of foreign investors are relatively more sensitive to short-term price changes.

Tab.IV-6 Generalized forecast error variance decomposition (GFEVD)

(Daily data)

	Market return					IFs				
	Market return	IFs	ICPFs	Banks	Foreign investors	Market return	IFs	ICPFs	Banks	Foreign investors
1	90.5	2.1	0.2	0.0	7.2	2.2	92.3	0.4	0.3	4.8
2	90.5	2.1	0.2	0.0	7.2	3.2	89.1	0.5	0.4	6.8
3	90.4	2.2	0.2	0.1	7.2	3.2	86.9	0.5	0.4	9.0
:			:					:		
10	90.4	2.2	0.2	0.1	7.2	3.4	81.4	0.8	0.3	14.1

	ICPFs					Foreign investors				
	Market return	IFs	ICPFs	Banks	Foreign investors	Market return	IFs	ICPFs	Banks	Foreign investors
1	0.2	0.4	97.7	0.1	1.6	6.8	4.5	1.4	1.8	85.6
2	0.3	0.5	97.1	0.1	2.0	10.8	3.7	1.2	1.6	82.7
3	0.6	0.5	96.1	0.1	2.7	10.8	3.9	1.1	1.5	82.7
:			:					:		
10	0.9	0.5	94.6	0.2	3.8	10.6	4.3	1.1	1.4	82.7

Source: Author's calculation

[92] The results for banks that do not show any cyclicality are not reported in this paper, but available upon request.

IV.2.7. Supplementary analysis using the GARCH model: Impacts of investment behavior on daily price volatility

Finance literature proves the stylized facts of daily market returns; the conditional mean is roughly constant around zero, the distribution is highly leptokurtic and skewed compared to the normal distribution. The standard deviation of returns completely dominates the mean of returns at short horizons such as daily (Christoffersen, 2012). The daily market returns used in this section also confirm these stylized facts largely, as shown in Tab.IV-4. In this case, estimating the conditional mean of daily market returns is not easy, and the estimations of the interactions between investment behavior and market return using VAR models (Fig. IV-3) may not be robust. Therefore, we may need to conduct supplementary analysis using the generalized autoregressive conditional heteroscedasticity (GARCH) model to confirm a part of the VAR analysis results when examining the interactions at daily short horizons. We construct the simple GARCH (1,1) as follows:

$$R_t = \mu + \sigma_t \varepsilon_t, \quad \varepsilon_t \sim i.i.d\ N(0.1) \qquad (3)$$

$$\sigma_t^2 = \gamma + \delta \varepsilon_{t-1}^2 + \varphi \sigma_{t-1}^2 + \sum_{i=1}^{4} \omega_i\, Netbuys_{i,t-1} \quad \text{with } \delta + \varphi < 1$$

(i: investment funds ($i=1$), ICPFs ($i=2$), banks ($i=3$), foreign investors ($i=4$))

where R_t is daily market returns, μ is their mean value, ε_t is an error term assumed to be normally distributed and with mean equal to zero and variance equal to one. The conditional variance σ_t^2 is specified as a function of the lagged squared residual from the mean equation, ε_{t-1}^2, (ARCH term), lagged forecast variance, σ_{t-1}^2, (GARCH term), and lagged daily net buys in stocks of institutional sector i, $Netbuys_{i,t-1}$.

Tab.IV-7 reports the results of the GARCH (1,1) estimated by the maximum likelihood estimation approach. Investment funds and foreign investors' coefficient estimates are positive, whereas ICPFs' coefficient estimate is negative. This implies that investment funds and foreign investors' investment behavior are procyclical as their investment behaviors increase price volatility, which is in line with the VAR estimation results (feedback effects) in Fig.IV-3. Investment funds' procyclicality looks slightly stronger than foreign investors' procyclicality at short horizons. On the other hand, in these results, ICPFs are counter-cyclical as their investment behaviors tend to decrease price volatility, contrary to previous VAR estimations for short investment horizons. Banks' estimated coefficient is

not statistically significant. The GARCH analysis results broadly support the theoretical assumptions on institutional sectors' investment behavior and VAR analysis results for medium-term investment horizons using monthly data.

Tab.IV-7 Coefficient estimates of the GARCH (1,1)[1) 2) 3)]

(Daily data)

ARCH term ($\hat{\delta}$)	GARCH term ($\hat{\varphi}$)	Investment funds ($\widehat{\omega_1}$ x 10^3)	ICPFs ($\widehat{\omega_2}$ x 10^3)	Banks ($\widehat{\omega_3}$ x 10^3)	Foreign investors (($\widehat{\omega_3}$ x 10^3)
0.36***	0.45***	0.93***	-0.68***	-0.53	0.43***
(0.02)	(0.01)	(0.00)	(0.07)	(0.44)	(0.09)

Notes: 1) The dependent variable is a conditional variance of daily market returns (price volatility) 1) *, **, *** means that the estimated coefficient is significant at the level of 10%, 5%, and 1%, respectively. 2) Numbers in parentheses are standard errors. Source: Author's estimation

IV.3. Conclusion

This chapter measures procyclicality in investment behavior of three Korean domestic institutional investor groups and foreign investors using a VAR model, with a particular focus on the concept, "mutually reinforcing interactions between investment behavior and market returns." Based on the assumption that market prices and investment behavior of investors evolve through interactions with one another, we start with a simple behavioral model that includes equations of the market return and net buys of four institutional sectors to capture the endogenous interactions among the variables.

As a result, we find convincing evidence that ICPFs are counter-cyclical at the medium-term horizon. They tend to sell their stocks when the market return increases unexpectedly, and unexpected net buys of ICPFs decrease the market return. This suggests that investment patterns of ICPFs potentially give stabilizing effects to the Korean stock market at the medium-term horizon. Besides, we confirm that foreign investors cause mutually reinforcing interactions with the market return, displaying both the significant first round and feedback effects. It supports the argument that foreign investors' investment behavior is a destabilizing factor of Korean stock markets, leading to increased price fluctuations at a medium-term horizon. Investment funds also have the potential to cause mutually reinforcing interactions with the market return at a short-term horizon. We have no evidence for the cyclicality of banks. The findings may lead us to conclude that foreign investors and, to a lesser extent, investment funds are procyclical investors that can provoke amplified fluctuations of market cycles at the

medium-term horizon and increased price volatilities at a short-term horizon, or both. In particular, when the market enters into stress times, their mutually reinforcing interactions with the market return may aggravate the market stress and propagate stress to other sectors by giving rise to negative price dynamics in the Korean stock market. Even though ICPFs are involved in contrarian investing, their stabilizing effects in the market may be limited, considering the significant effects of foreign investors.

The results also show how institutional sectors respond to other institutional investors' investment behaviors, especially how domestic institutional investors respond to foreign investors' behavior influential in the price formation in the Korean markets. The results confirm that all the domestic institutional sectors trade on the opposite side of trading of foreign investors as trading counterparties, consistently at the medium-term and short-term horizons. This may imply that domestic institutional investors more or less contribute to absorbing the shocks from the foreign investors and thus restraining market instabilities provoked by foreign investors. The counter-cyclical role of domestic investors with regard to foreign investors may be in part unintended due to their use of limit orders.

Nevertheless, while we construct a benchmark VAR model for a medum-term horizon using monthly data, we need to take a different approach for medium-term (monthly) and short-term (daily) horizon analyses. Given the statistical specificities of daily market returns, we need more sophisticated analysis using the time-varying volatility model to examine the relations between investment behavior and conditional volatilities, which is left for future research.

CHAPTER V

Short-termism in finance and toward long-term finance

As shown in chapter III and IV, major institutional investor groups exhibit procyclical behavior in stock investments in the way of reinforcing market boom or crash, or both, albeit with some behavioral heterogeneities according to countries' specific circumstances. In the U.S, even ICPFs as supposedly long-term institutional investors behave procyclically during market stress times. In Korea, foreign investors, which are dominant stock market players, display significant procyclicality and its impacts on stock prices are intense and persistent.

The emergence of procyclical institutional investors as the major stock traders and shareholders has significantly changed the stock market and real economic activities. It has led to the short-termism of finance, undermining financial stability and economic growth. Especially, the short-termism of finance threats a critical call for finance to respond to climate change and support a transition toward a low-carbon economy. In this context, this chapter discusses the implications of institutional investors' procyclical herding on stock markets and the real economy. Section 1 describes short-termism in finance, wherein even long-term investors and individuals are obsessed with short-term quantitative performance. Section 2 analyzes how short-term procyclical investors can lead to the short-termism of corporate governance with a particular focus on microeconomic relations of institutional investors with invested corporates under the shareholder value-oriented system. Section 3 explains the macro-economic implications of procyclical herding for financial stability and the real economy. Section 4 proposes possible macro-prudential policy options to discourage procyclical herding and promote financial stability. Section 5 raises initiatives for long-term finance that can support the transition toward a low-carbon economy, a critical and urgent goal of the current capitalist system.

V.1. Institutional investors as the major shareholders and short-termism in finance

V.1.1. Emergence of institutional investors with short-term and procyclical orientation

During recent decades, institutional investors have had a greater presence in the ownership of non-financial corporates in developed countries. In the U.K, physical persons held 54% of all publicly listed stocks in the 1950s. Today, they hold only 11%. In the U.S, the portion of physical persons has decreased from 84% to 40%. In Japan, only 18% of publicly listed stocks are held by physical persons (Çelik and Isaksson, 2013). Of total institutional ownership[93] in the U.S, supposedly long-term institutional investors explain around 40% in 2015, whereas other financial institutions (OFI), including investment funds, hedge funds, etc., represent around 60%. In the Euro area, the portion of OFI is prominent, representing around 70% of total institutional ownership, whereas long-term institutional investors account for only 25% (IMF, 2016). This implies that institutional investors with procyclical orientation have emerged as the major shareholders of corporates in global stock markets.

Procyclical investment behavior of institutional investors can translate into short-termism of the investment horizon. The short-termism of investment horizon involves investors who have a preference for investment strategies that bring short-term gains relative to strategies that would show long-term rewards, even if the long-term rewards are potentially greater than the short-term gains. If investment decisions reflecting such preference are made repeatedly and become institutionalized, we could call it "short-termism of the investment horizon." The short-term duration can vary depending on the purpose of investment, investor type, market condition, etc. It can be one week to one month during market stress times. Some studies consider two years as an empirically useful rule of thumb for distinguishing the short-term from the long-term (Tonello, 2006). For some institutions, including high-frequency traders, the short-term is down to ultra-short-term like intraday or millisecond intervals. As long as institutions engage in market activities deeply on both asset and liability sides and thus are exposed to funding liquidity and market liquidity risks, it is not easy for them to have an investment horizon over multicycles of markets. As shown in chapter II, most institutional investors are not free from the funding and market liquidity pressure. An extreme example is that high-frequency trading on an ultra-short trading horizon is considered a new business model for banks during a liquidity crisis by some banking sector consultants. Effectively, during a liquidity crisis, when banks face increases in capital cost, banks may need the capacity to generate high-frequency trading returns by means of a large number of ultra-fast trades on a small amount of capital. Myopic institutional investors shaped by liquidity pressure take short-term investment horizons repeatedly and systematically, which leads to institutionalizing the short-termism of finance. Investors with short-term investment horizons concentrate on short-term performance measures, such as quarterly earnings announcements or other short-term quantitative indicators. Kochhar and David (1996) find that short-

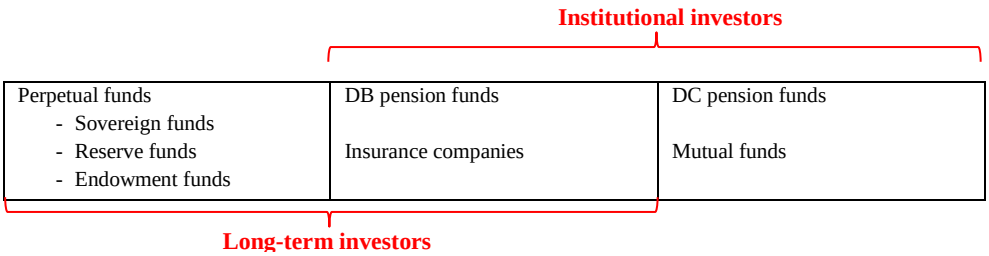
[93] This considers the ownership of domestic institutional investors, excluding the ownership of foreign investors.

term investors behave like arbitragers to "churn" or frequently turn over their portfolio of stocks in order to capitalize on all possible short-term gains. They are more interested in exploring statistical regularities of price movements, especially short-term price momentums that may continue over six months to one year, than the valuation of a corporate's long-term prospect. But in many cases, the action that is best in the short-term is not likely to be the best in the long-term.

V.1.2. Short-termism of long-term investors and short-termism as a social process

Who are long-term investors by nature? According to the definition of Aglietta et Rigot (2009), long-term investors are investors who have stable long-term liabilities and are not exposed to short-term liquidity risk. This balance sheet property of long-term investors allows them to have a long-term investment horizon and optimize their asset management in the long-term horizon. Their asset management aims to preserve their capital and obtain the investment returns corresponding with future payment obligations from liability contracts in the long term. According to the definition based on the long-term liabilities, long-term investors can be classified into three groups: DB pension funds, insurance companies, and perpetual funds (Aglietta and Rigot, 2009) (Fig.V-1). The perpetual funds, including sovereign funds, reserve funds, universities endowment funds, etc., are long-term investors having long-term liabilities and aiming to optimize asset management in the long-term. But they are not institutional investor because their liabilities do not consist of a collective money pool from individuals, but capitals of the government, universities or other public or private sectors. According to the definition, DC pension funds and mutual funds cannot be long-term investors as their liabilities are not based on long-term contracts, as described in Chapter II.

Fig.V-1 Typology of long-term investors

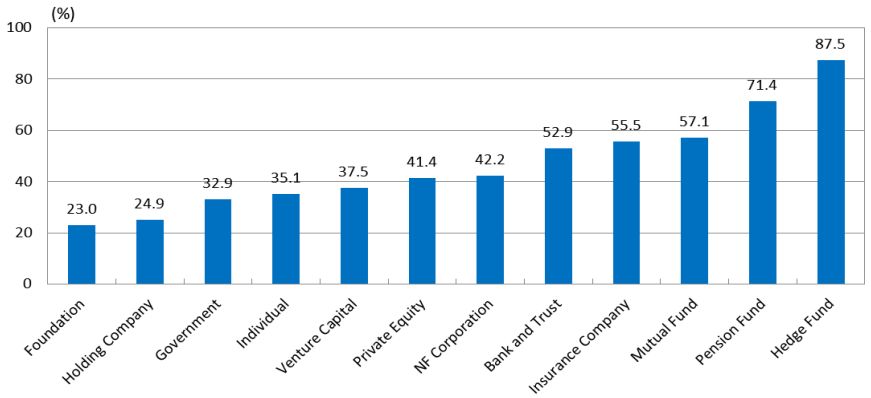


Source: Aglietta and Rigot (2009)

Albeit the long-term characteristics of long-term investors in their balance sheet structure, their investment practices, in reality, do not seem to conform with the theories and they might abandon

their role as a market stabilizer and long-term finance provider. The short-termism of long-term finance takes various forms: pursuits for high returns in short-term horizons, reduced asset holding periods, decreases in asset allocations in illiquid assets, the adaption of procyclical herding, etc. (Auvrey et al., 2016). Fig.V-2 presents the annual turnover ratios by various U.K investor types in the year 2007. The turnover ratio is typically used as an approximation of a holding period. Foundations, holding companies, governments, and individuals tend to have a low level of turnover ratios that correspond to 3 or 4 years of holding periods on average. Venture capital firms and PEFs also fall into this long-term holding category in this spectrum. They need several years to implement restructuring and resell their shares in the markets (or lead to an IPO). Banks, insurance companies, and mutual funds fall in the intermediate range of around 50% per year. Insurance companies considered as long-term investors show similar stock holding periods as that of mutual funds seen as short-term investors. More surprisingly, pension funds and hedge funds are the investor group that shows the highest turnover ratio in the range of 70-90% per year. The high turnover of hedge funds conforms to their strategies of buying and selling repeatedly in search of arbitrage gains. However, pension funds, supposedly long-term investors, turn over stock portfolios as frequently as hedge funds in reality.

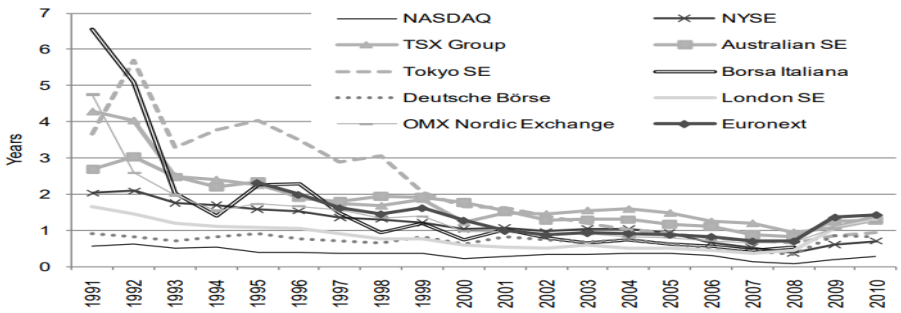
Fig.V-2 Annual turnover ratio of equity portfolio by U.K investor type



Source: Jackson and Petraki (2010)

Fig.V-3 shows long-term trends of average stock holding periods on major stock exchanges. The average stock holding periods have been declining in most stock exchanges from 1991 to 2010, which corresponds to the period when there had been a growing emergence of institutional investors as the major stock investors. Most exchanges experienced decreases in average stock holding periods by one to five years over two decades. As a result, the average holding periods on half of the exchanges stay below one year in 2010.

Fig.V-3 Average holding period[1)] in different stock exchanges



Note: 1) Average holding periods are calculated as average market capitalization divided by share trading value.
Source: OECD, World Federation of Exchanges (2010a, b)

Short-termism is a social process wherein institutions establish social relationships with an obsessive focus on short-term performance through complex and interdependent interactions. Stock markets may be one of the social places most prone to short-termism, where even individuals are not exceptional. Contrary to the traditional consensus supported by numerous empirical studies that individual investors are counter-cyclical investors, individuals equipped with technological toolkits and sharing information on social networks or stock trading communities have evolved into skilled day traders. The recent GameStop stock episode of January 2021 was the ultimate example showing how individuals coordinate efficiently to blast the stock higher through real-time SNS communications, how the emotional mob and professional short-sellers interact with each other in the face of skyrocketing stock price, and how easily the stock price can deviate from its fundamental value. The GameStop stock price surged by around 180% intraday without apparent reason. Having been on a decline of its business, GameStop was a target for professional short-sellers, most of whom are established Wall Street hedge funds. The influential community users realized that the substantial amount of GameStop stocks were being shorted and decided to turn the stock into a meme-stock. Users convinced other users, two million subscribers, to buy up the stocks, thereby increasing its value to trigger a "short-squeeze". The hedge fund short-sellers rushed to buy the stocks back to avoid bigger losses on short positions. This drove both individuals and short-sellers demand up, and the price increased further, obviously far beyond the fundamental value (*Time*, 2021)[94].

Such problematic trading occurs mainly in the secondary markets. Trading decisions on the secondary markets are mechanically or emotionally made and automatically executed by algorithms. Market prices change in milliseconds following demand and supply driven by short-term liquidity traders who are not concerned with corporates' long-term values and seek profit opportunities from short-term

[94] Time, "*So, oh, what's up with GameStop's stock?*" (25 Jan, 2021)

price movements. Capital flows between two traders in exchange but does not flow to the corporates they are trading. It contrasts with the primary market where new stocks are issued to investors and investors contribute capital to the corporate. On the secondary markets where most shareholders and companies are connected, shareholders are essentially liquidity traders, and companies are stocks, financial products with fragile and illusive market liquidity. The obsession of all financial investors with short-term liquidity is what causes speculative bubbles to develop (Orléan, 2011). It is also true for what causes a drop in prices to develop into market turmoil and crisis.

V.2. Microeconomic implications of short-term procyclical finance under the shareholder value-oriented system

Though the short-term liquidity traders trade corporates as a financial product for short-term profits, they can give significant implications for corporates' real investment decisions and the real economy, especially under the shareholder value-oriented system. It can be done by three channels: causing stock market mispricing, directly engaging in corporate governance as the major shareholders, and procyclical investment behavior menacing corporates with future price drops. This section concentrates on the microeconomic relations of institutional investors with invested corporates, ultimately leading to the disassociation of finance with the real economy.

V.2.1. The shareholder value maximization and the undesirable effects of short-term procyclical finance on corporates' resource allocations

In the contemporary capitalist market economy, stock market prices serve as a key signal for the decision-making process in corporate governance. Non-financial corporates raise equity capital in the stock markets, which is the most crucial role of the stock markets. Corporates seek to maximize their shareholders' value, and shareholders gain returns on the capital they provide. The shareholder value-oriented system, a normative ideal of corporate governance in Anglo-Saxon countries, has become a global standard following financial globalization. It is contrasting to the stakeholder value-oriented system, which is more common in the European and Asian countries, that stresses corporates' social relationships with customers, employees, suppliers, or investors. Under the shareholder value-oriented system, corporates are evaluated by how much the wealth of shareholders increased, which is often measured by the market capitalization or ROE (Return on Equity) of listed corporates. Therefore, the shareholder value maximization model aims to increase the corporate's fundamental value by

enhancing investments in promising projects and returning resulting profits to shareholders who are the owners of the corporates. The system is theoretically rooted in the EMH, where market prices fully reflect the fundamental value of a corporate, as shareholders seek as much information as possible to identify the corporates that have the best prospects and incorporate the information into the stock prices. Thereby, the market prices shall rationally guide corporations to decisions for efficient allocations of resources. A well-functioning market economy needs rational shareholders who have a self-interest to allocate their capital to the most prosperous corporates and then monitors them to ensure that they make the best use of the capital.

The considerable weight of procyclical institutional investors with a short-term investment horizon in corporate governance may give particular implications on corporates' real investments through three channels: generalized mispricing, ownership engagements, and investment behavior. First, contrary to the underlying assumption of the shareholder value maximization system, markets may have generalized mispricing caused by institutional investors with procyclical orientation. The mispricing can continuously give corporate managers a wrong signal and persistently lead them to wrong decisions for capital allocations. Since procyclical investors fail to bring new and genuine information to the real economy, resources are no longer efficiently allocated in the entire economy, which hampers sustainable economic growth.

Secondly, procyclical institutional investors give undesirable effects on corporates' resource allocations through direct involvement as the major shareholders in a corporates' decision-making process. Shareholders are given legal voting rights that allow effective monitoring and controlling of corporates. By exercising voting rights, they influence key decisions on corporate management and supervision of corporate executives in a general meeting. They appoint or revoke board members who select the CEO and approve executives' management decisions. As such, corporate executives, including the CEO, are indirectly controlled and supervised by shareholders. The critical decisions, including a dividend payout, issuance of new stocks or external borrowings, mergers or acquisitions, etc., are made in the general meeting. In line with shareholders' controlling function, corporate executives are also incentivized to make the best efforts for increasing shareholder values through incentive tools introduced to reduce the agent problem, e.g., stock options granted as compensation. Thus, executives' primary objective is to increase the corporate stock value to satisfy shareholders and, by doing so, assure their positions.

In this setting, shareholders' engagements in corporate management can be problematic when the majority shareholders are procyclical institutional investors with a short investment horizon. The impatient investors may not wait until the corporate realize profits from the project, which may be in three or more years. They may be more interested in having short-term financial gains. Consequently, both the major institutional shareholders and corporate executives are likely to have a common interest in augmenting the short-term stock price. The one share-one vote rule gives the major institutional shareholders much power in the general meeting that allows them to draw conclusions they want and to move other shareholders to align with them. The procyclical institutional shareholders likely support the corporate decisions that can increase the stock price in the short term or realize immediate profits, e.g., declaration of cash dividends or stock buy-backs, rather than using the cash in investing in long-term projects that involve uncertainties. Consequently, corporates distribute more resources to shareholders in the form of cash dividends or capital gains at the expense of investments in future projects. Corporate managers are likely to under-invest in intangible assets to inflate current earnings or invest in projects that can show results in a short time only. Corporates are forced to abandon investments in projects that are profitable enough but less profitable than the required equity return to attract investors, which may be the average stock market return or the stock returns of rival companies. They are also forced to abandon the projects that take a long-term to realize results. The aggregate abandons of investments in long-term productive and innovative projects may undermine economic growth seriously.

Some procyclical institutional investors are not motivated to exercise the voting rights for a reason for accompanying costs, specificities of investment strategies, or legal limitations. But some tend to show a high degree of ownership engagements in corporate governance, which are so-called "activist shareholders." Typically, passive mutual funds and ETFs have no incentive to actively engage in corporate decisions, while there are various investment strategies even inside the passive investment strategies. The stocks they own are not selected based on fundamental analysis but automatically selected by pre-defined composition weights of benchmark indices. While they tend to hold the stocks for a long time once they buy them, passive fund investors are not concerned about the future value of the corporates they own because they rarely have outperformance pressure. Instead, they are concerned about accompanying high costs from ownership engagements relative to fees they charge to clients. Passive mutual funds usually charge small amounts of fixed fees independent of investment performance, and ETFs do not receive fees from their clients. Therefore, they do not have the willingness to exercise voting rights, or even if they decide to intervene in governance, they will rationally adhere to low-cost voting strategies, just aligning themselves with activist shareholders or

taking a one-size-fits-all approach, which is not in the best interest of companies (Shapiro, 2017). On the other hand, some hedge funds and PEFs[95] are typically activist shareholders. One of the popular hedge fund strategies is the "active fundamental" that relies on fundamental analysis to select stocks but continuously buying and selling the stocks to gain short-term arbitraging profits. The business model of PEFs is to acquire large stocks of a company in order to resell them with capital gains within a pre-defined period, typically three to five years, after a large-scale restructuring of the company. The restructuring mainly focuses on improving "quantitative" indicators of the company within a short or medium time horizon, which are usually done by reductions in the debt ratio or employees, not by increases in the long-term fundamental value. While the liabilities of hedge funds or PEFs may be stable since they have internal tools refraining from free redemptions, their fundamental analysis primarily focuses on cash richness or fairly short-term growth potential of corporates rather than long-term value creation through productive and innovative investments. Accordingly, their ownership engagement strategies are naturally associated with a high degree of "temporary" corporate governance engagement to bring about certain changes in the corporates (Çelik and Isaksson, 2013). Especially, hedge funds push for policy decisions skewed to their own short-term quantitative interests, such as a cash dividends declaration. They often use derivatives or share lending or persuade other shareholders to influence corporates' boards and managers to increase voting power with relatively modest stock holdings. High-frequency traders seeking ultra short-term profits rely on the strategies that identify statistical regularities of prices in the large information flows. They are active traders, but they are more interested in the analysis based on extensive quantitative information flows offered in real-time on trading platforms than fundamental information about corporates in the long-term perspective. Since they hold a wide range of diversified stock portfolios for only a few seconds or milliseconds, they have minimal incentives for engagement in corporate management. Whether they do not intervene in corporate governance, do a thoughtless intervention, or are too active only for temporary engagement, the procyclical institutional investors are obviously ill-functioning to serve the long-term prospect of corporates and the real economy.

Lastly, the power of procyclical institutional investors in corporate governance also comes from their potential to influence the stock price (Auvray et al., 2016). The dominant presence of procyclical institutional shareholders gives them the potential power on future price movements. They might use an "exit" card as a disciplinary tool whereby they threaten companies that they can drop the stock price anytime by selling stocks in a mass. One study says that investment funds commonly use the

[95] PEFs may be also one of activist shareholders. But typically they tend to invest in non-listed equities rather than publicly listed equities.

threat of exit in communication with management and such threats were successful in securing their desired governance changes 40% of the time (Shapiro, 2017). Even if procyclical institutional investors account for a small fraction of the corporate capital, their potential power to influence price movements can be reinforced when other investors herd them. It may serve as a menace to corporate executives who are responsible for maximizing the corporate value. Auvray et al. (2016) also highlight, "*Shareholder size matters, but so does their behavior.*"

V.2.2. Institutional erosion of long-term finance provisions

Consequently, given the growing presence of procyclical investors, long-term investors' role in corporate governance is of greater importance in orienting companies toward long-term prospects. The stable nature of liabilities allows high risk-bearing capacity and investment strategies aiming at optimizing long-term profits. Long-term institutional investors are supposed to "buy and hold" than trade frequently. Some public long-term investors, such as public pension funds or social wealth funds, have explicit mandates that oblige them to engage actively in corporate governance for social or environmental objectives. The investment strategies backed by stable liabilities and explicit mandates for the public interest enable the long-term institutional investors to actively engage in corporate governance with responsibility and long-term perspective as owners. In theory, they neither sacrifice a long-term prospect of companies for immediate profits nor threaten companies to meet their short-term desires by procyclical investment behavior or exit. Keynes (1936) also recognized the specific potential of long-term investors,

"It is the long-term investor, he who most promotes the public interest, who will in practice come in for most criticism, wherever investment funds are managed by committees or boards or banks. For it is in the essence of his behavior that he should be eccentric, unconventional and rash in the eyes of average opinion. If he is successful, that will only confirm the general belief in his rashness; and if in the short run he is unsuccessful, which is very likely, he will not receive much mercy." (Keynes, 1936)

However, in the current financial system, the specific role of long-term institutional investors in providing long-term finance is easily eroded. The supposedly long-term institutional investors do not play a counter-cyclical role in corporate governance. In reality, they stay passive, not exercising their voting rights or exercise the voting rights for orienting companies toward short-termism (Auvray et al., 2016). Complex investment chains made by multiple asset management delegations distort understanding of who is supposed to play the shareholder's role. Once investment decisions of their

long-term resources are delegated to external asset managers, voting rights can also be delegated to asset managers by contracts. In this case, the asset management industry's short-term industry practices, such as short-term performance targets, a high degree of performance comparability across funds and asset managers, frequent evaluations and short-term delegation contracts, etc.,[96] may influence the ownership engagement of asset managers in corporate governance. External asset managers controlled by such practices are entities that maximize short-term profits and minimize costs related to ownership engagement. Therefore, in their business model, they have few motivations for actively engaging in corporate governance. Besides, once long-term resources of long-term institutional investors are pooled into speculative money of other procyclical investors, they are likely to reform into speculative money that menaces and distorts the decision-making of companies for the long-term value. Almost 40% of U.S mutual funds' assets are the assets invested by individual retirement accounts (IRAs) and DC pension plans (ICI, 2012). If long-term investors delegate asset management to hedge funds or PEFs, the long-term resources will be mobilized to push companies to realize short-term profits or focus on improving short-term quantitative indicators in order to obtain capital gains or cash dividends.

Auvray et al. (2016) estimate that about 20% of U.S DB pension funds' annual investment returns are paid for commissions to the asset management industry in the complex delegation chains. CalPERS[97], the largest U.S public pension fund, paid 739 million U.S dollars for asset management fees for 2018-2019, of which the single largest portion (261 million U.S dollars) was paid to 186 PEFs (CalPERS, 2019). It may imply that the capital of long-term institutional investors is no longer long-term capital. Increased costs in the complex asset delegation chains require investee corporates to realize higher earnings, which may be detrimental to companies in the long run because they are forced to abandon real investments less profitable than the required returns under the shareholder value maximization.[98]

Large institutional investors often rely on "ownership outsourcing" to minimize costs associated with a voting requirement. According to Çelik and Isaksson (2013), independent consultants, so-called "proxy advisors," provide arguably standardized advice on voting strategies and help clients with the

[96] Chapter III describes these industry practices of asset management industry that shorten investment horizons and fail to reward long-term investments. Refer to p.74 for details.

[97] California Public Employees' Retirement System

[98] In the case of ETFs, sponsors of ETFs or authorized participants (APs) charge no fees or very low fees to ETF investors, rather they generate profits from security lending with constituent equities. Although ETF investors are relatively free from additional payment for fees, this does not mean that they play a role of promoting real investments of companies in ownership engagement, because their business model may be more dominant than fees.

actual process of exercising voting rights.[99] CalPERS report that they depend on three proxy advisors for ownership engagement (CalPERS, 2019). According to Institutional Shareholders Services (ISS), the largest proxy advisory firm, they cover more than 40 000 shareholder meetings in over 100 different countries. To carry out this enormous task, they have 250 staff dedicated to corporate governance research. This means that each researcher, on average, has to cover 160 shareholder meetings per year and three shareholder meetings every week all year round (Çelik and Isaksson, 2013). This raises a question on the quality of the advice and the use of ready-made templates for recommendations that do not take into account company-specific characteristics.

V.2.3. Summary: ownership engagement behavior across investment strategies

Tab.V-1 presents how many institutional investors have different degrees of motivations for ownership engagement, depending on their investment strategies. Institutional investors are split into several procyclical institutional investors and long-term institutional investors. Various elements of investment strategies can influence ownership engagement behavior in corporate governance: the objective of investment, investment time horizon, the concentration of portfolios, costs, etc. Passive investment strategies are likely to give investors or asset managers a low motivation for engagement in corporate governance of individual companies they own in their portfolios because stocks are automatically selected, and cost-effectiveness may be the most critical objective of passive investing. So they are likely to do no ownership engagement or passive engagement supporting other activist shareholders, even though they hold stocks for an extended period. Compared to fundamental strategies, active quantitative investment strategies based on quantitative analysis give less incentive for ownership engagements as owners. Quantitative investing focuses more on the statistical interpretation of large quantitative information flows than companies' long-term value creation. However, even though investments are based on fundamental analysis, if they have a short-term investment horizon, their interest may be limited to cash richness or short-term growth potential that can be driven by improving companies' quantitative indicators. In this case, investors following such active fundamental strategies with a pre-defined short or medium-term horizon are more likely to be activist shareholders who push companies to realize short-term quantitative profits rather than invest in long-term projects. Typically, concentrated stocks in a portfolio enable ownership engagement more efficiently than thousands of diversified stocks. Lastly, investors who select companies based on

[99] Limited numbers of staffs who are devoted to ownership engagement is obviously an impediment to engagement in corporate governance. One survey shows that 76% of asset owners and 56% of asset managers have five or less staffs devoted to ownership engagement, which would be absolutely small numbers compared to the hundreds or thousands numbers of stocks they may hold in their portfolios (IRRC and ISS, 2011).

fundamental analysis with a long-term investment horizon are an ideal type of shareholders to companies because such investors have a high degree of responsibility as owners for promoting sustainable growth of companies and maintain a trust relationship with companies. Nevertheless, complex asset delegation chains can distort the potential role of desirable shareholders in corporate governance by delegating voting rights to external asset managers through contracts or by procyclical investment behavior of asset managers backed by long-term capital. Costs associated with ownership engagement in numerous companies and, thereby, reliance on proxy advisors would also be a reasonable impediment to ownership engagement from a long-term perspective. According to Proxy Monitor (2015, 2017)'s survey result, 32% of all shareholder proposals[100] in 2006-2014 were submitted by institutional investors associated with a labor union or public employee-affiliated pension funds. Institutional investors with a social, religious, or public policy purpose introduced 27% of shareholder proposals. It is not surprising that only 1% of shareholder proposals were submitted by other institutional investors accounting for around 60% of total share ownership in the U.S (Fig.V-3).

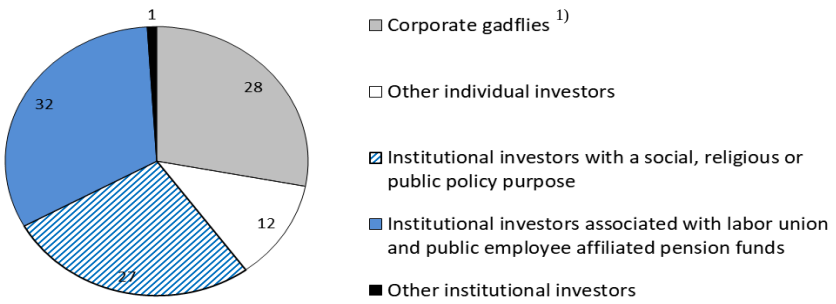
Tab.V-1 Ownership engagement by investment strategies of institutional investors

	Investment strategies	Structure of portfolio	Ownership engagement	Institutional erosion of desirable ownership engagement
Passive mutual funds and ETFs	Replication of benchmark indices, Cost-effective strategies, Buy and hold	Constituent stocks of benchmark indices	No or passive engagement	Automatic selection of stocks. No incentive for fundamental analysis, Cost-effective ownership strategies
Hedge funds and PEFs	Buying and selling companies based on fundamental (Active fundamental) or quantitative analysis (Active quantitative) to gain short or medium-term profits, Business model of buying and selling companies after restructuring	Concentrated stock portfolios	Active for temporary engagement (Activist funds)	Focus on short-term growth potential or cash richness. Objective for capital gains from increases in company value through restructuring focused on improving quantitative indicators of companies within a pre-defined period
High-frequency traders	Frequent trading in intraday or millisecond intervals based on quantitative analysis	Diversified stock portfolios	Minimal motivation for engagement	Extremely short-term investment horizon, Focus on real-time quantitative information such as order flows
Long-term institutional investors (ICPFs, social wealth funds, etc.)	Selection of companies based on fundamental analysis, Buy and hold for an extended period to gain long-term profits (Passive fundamental)	Diversified stock portfolios	Motivated for long-term productive engagement in theory, which is nevertheless institutionally eroded in reality	Asset management delegation chains, High costs accompanied by ownership engagement in large numbers of companies

Source: Author's compilation, Çelik and Isaksson (2013)

[100] Shareholders can propose recommendations about corporate governance to be voted by all shareholders at the general meeting. It is one of the active ownership engagements.

Fig.V-3 Shareholder proposals by investor type (%) (2006-2014)



Note: 1) A handful of individuals and their family members who repeatedly file common shareholder proposals at multiple companies
Source: Proxy Monitor (2015, 2017)

V.3. Macroeconomic implications of procyclical herding for financial stability and the real economy

Beyond the micro-economic relations with invested corporates, the collective investment behavior of institutional investors provides implications for financial stability and the real economy through various macro-economic co-movement channels between capital markets and the real economy. Procyclical herding of institutional investors destabilizes both capital markets and the real economy.

V.3.1. Implication for financial stability

The collective procyclical behavior of institutional investors destabilizes financial markets. It increases fluctuations of asset prices and accumulates prices' deviation from the fundamental values. Procyclical herding of institutional investors driven by mechanisms inside markets sets forth the mutually reinforcing interactions with prices, reinforcing upward price momentum, and creating asset bubbles. When the expansion force exhausts itself and a critical event occurs, markets enter into stress times. The market stress often turns into a crisis by negative price dynamics driven by procyclical herding of investors. The downward phases unfold in an abrupt and drastic manner, compared to upward phases that stretch progressively for a relatively long period. The endogenous force inside markets creates and amplifies market cycles going with recurrent booms and busts. When it comes to investors with ultra-short investment horizons in daily markets, it contributes to increased short-term price volatilities.

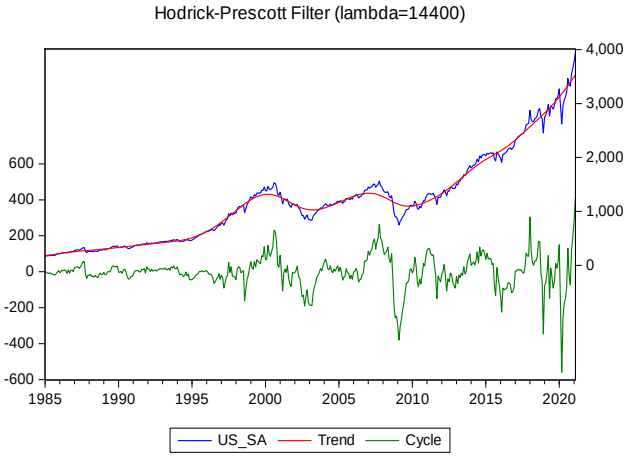
Stock market bubbles and following crashes are recurrent phenomena in history, but they have been more intense in magnitude and frequent since the early 1980s. During the Japanese asset price bubble period from 1985 to 1991, triggered by the appreciation of Japanese Yen and monetary policy easing, Japanese stock prices were dramatically inflated by more than 224 percent until the bubble burst. Along with financial deregulation, Japanese banks increased fundraising in capital markets and lending to corporates aggressively, which feeds real estate and stock investments. At the same time, as stock markets got inflated, banks expanded procyclical stock investments to meet the minimum capital requirement. Increasing stock prices attracted more investors to speculation on stocks. Stock markets started to fall drastically in early 1991 after the third tightening of monetary policy and sharp increases in lending costs. Though asset prices had dropped by 1992, the economic recession continued for more than a decade, which we call "lost decades." After the Japanese bubble burst, massive global capital moved from Japan to other East Asian counties such as South Korea, Thailand, Malaysia, and Indonesia that had achieved rapid economic growth. Investment bankers, mutual funds, and pension funds of developed countries discovered the emerging market stocks as a "new asset class" and began to acquire these stocks. The surges in global investment inflows led to stock market booms of East Asian countries from 1993 to 1997. Stock prices doubled in most East Asian countries in 1993. In Thailand, Malaysia, and Indonesia in the first half of the 1990s, stock prices increased by between 300 and 500 percent (Kindleberger, 1978/2015). The East Asian market booms collapsed in 1997 with a sudden reversal of foreign investors' capital to Thailand and contagion effects to other countries, which triggered the Asian currency crisis.

The biggest-ever upswing in U.S stock markets was from 1982 to 2000 (7.7-fold, inflation-corrected), which is larger than any other market surges from 1920 to 1929 (5.2-fold) and from 1949 to 1968 (5.1-fold) (Shiller, 2005/2015). The U.S dot.com bubble from 1994 to 2000 is one of the most prominent examples of stock market speculative bubbles in history. The sharp increases in U.S stock prices were associated with technological innovations in communications and computing, which promise unprecedented prospects for the U.S economy and cost declines in electronic stock trading. Nevertheless, the price increases from 1994 to 2000 cannot be justified by reasonable terms. The market tripled in five years, but economic indicators did not close to tripling (Shiller, 2005/2015). The dot.com bubble burst in 2000 without a critical trigger event. But it is followed by the subprime mortgage boom from 2003 to 2007, which ended up with the global financial crisis. Besides market bubbles and busts, the U.S stock market went through sudden, severe unexpected market crashes like

the Black Monday stock market crash of Oct 19, 1987, Flash Crashes of May 6, 2010, and Feb 8, 2018, which occurred without reason and hade a rapid price recovery within the day.

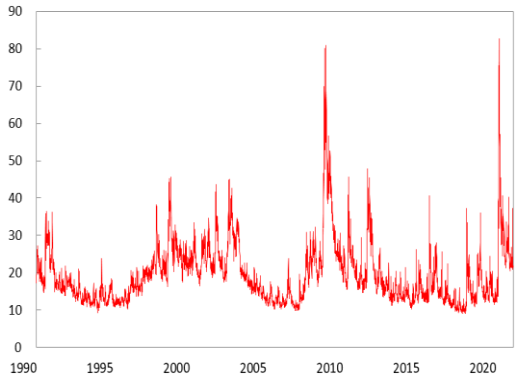
Fig.V-4 and Fig.V-5 demonstrate some evidence of the amplified market cycles and increased price volatilities in the U.S stock markets. Fig.V-4 describes the U.S stock market cycles (green line) over three decades, estimated by extracting a trend (red line) from the seasonally adjusted S&P500 (blue line) using the HP filter. It confirms that the U.S stock markets had seen market cycles accentuated since the late 1990s when institutional investors emerged as the major investors in stock markets. Fluctuations of the market cycles appear larger in the 2010s than ever. Market crashes hit more frequently and intensively in the 2000s and 2010s than before. Fig.V-5 depicts the historical VIX index of the U.S stock markets that signifies daily market volatilities. The markets have more frequent volatility clusters in the 2000s and 2010s than in the 1990s. The number of days falling in the top volatility decile, where the VIX index is over 30, is 112 days in the 1990s, 366 days in the 2000s, and 187 days in 2010s. Most of the 112 days with high volatilities in the 1990s are observed after August of 1997.

Fig.V-4 U.S stock market cycles[1)]



Note: 1) The market cycles (green line) are estimated by extracting a trend (red line) from the seasonally adjusted S&P500 (blue line) using the HP filter.
Source: Author's calculation

Fig.V-5 U.S stock market daily volatilities (VIX)



Source: Fed Saint-Louis

In figure V-4, continuous surges in U.S stock prices stand out, especially when the global financial crisis lessened, starting in 2009 and still breaking a historical record now. These dramatic increases in stock prices are associated with the central bank's quantitative easing to respond to the global financial crisis and current Covid-19 pandemic crisis. Maintaining low-target rates, major central banks created reserves to buy assets in open public markets, extending the money supply and

hopefully stimulating demand. But the massive money supply by central banks reshapes how investors invest and spend. It stimulates investors' procyclical behavior in risky asset markets like stock, cryptocurrency markets instead of stimulating investments in long-term bonds or economic activities, leading to a market bubble and hampering financial stability before the real economy benefits from it. Though the global economy may face lower revenues even in a post-Covid period, the S&P 500 skyrocketed by 68 percent from the lowest in 2020 to the end of the year. Facing the price soar, investors behave procyclically, betting on central banks' money supply and pouring massive money into stocks. There is no clarity when these massive monetary injections would be tightened. Agustin Carstens, a general manager of BIS, says, "There is no escaping if we enhance liquidity dramatically, the money will go in search for yield and certainly expose assets to mispricing (*Bloomberg*, 2021)."

V.3.2. Implication for the real economy

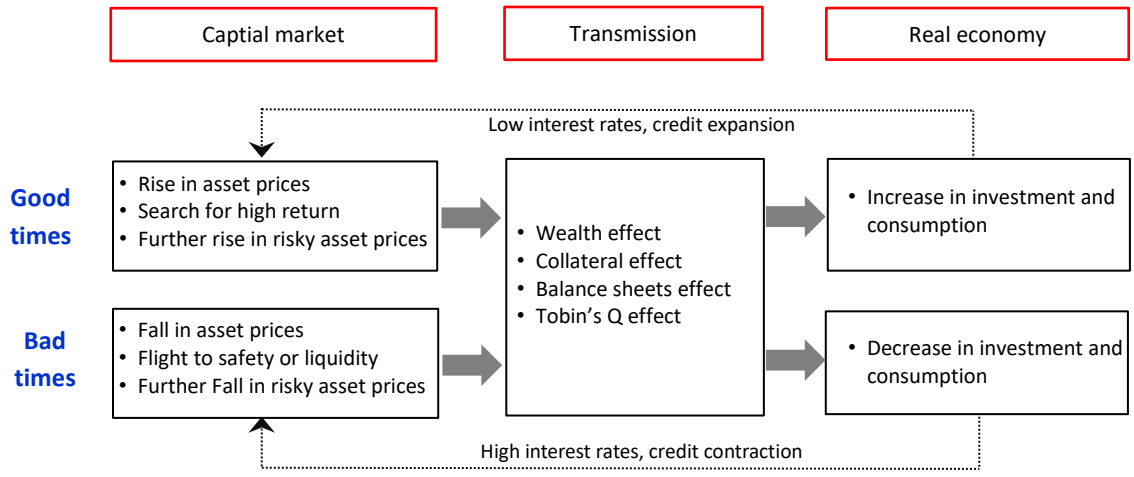
Procyclical herding of investors has undesirable implications not only on stock markets but also on the real economy. Amplified stock market price fluctuations can lead to more intense business cycles through the wealth effect (Modigliani, 1963) and collateral effect (Bernanke and Gertler, 1995). Financial asset booms appreciate the wealth of economic agents or make an illusion of increasing wealth. The increases in a security price also appreciate the collateral value of the security, which improves firms' ability to borrow. Therefore, positive feedback dynamics during good times potentially lead to the economy overheating by pumping consumption and investment. On the other hand, the decreases in a security price during bad times can shrink the aggregate demand and cause economic recessions through the wealth and collateral channels in the opposite direction. Even healthy firms or projects with net positive present value cannot finance from capital markets due to retrenchment of the markets and interruption in long-term funding sources. Furthermore, stock market price movements influence financial intermediaries' money supplies who rely on market prices to evaluate their assets' value and calculate their capital position. A rise in the asset value during good times improves the capital position of banks or insurance companies. With more capital buffers, they can extend lending to the real economy. Likewise, a fall in the asset value during bad times forces them to reduce lending to meet the capital requirements.

Keynes (1936) is the first one who observed the direct relation between the stock market price and a firm's decision of real investments in new equipment or plants, noting,

"The daily revaluations of the Stock Exchange, though they are primarily made to facilitate transfer of old investments between one individual and another, inevitably exert a decisive influence on the rate of current investment. For there is no sense in building up a new enterprise at a cost greater than that at which a similar existing enterprise can be purchased; whilst there is an inducement to spend on a new project what may seem an extravagant sum, if it can be floated off on the Stock Exchange at an immediate profit." (Keynes, 1936)

Keynes's intuition is reflected in Tobin's Q model in which a firm's investment is determined by the Q ratio, the ratio of the market value of a firm's stock to its replacement cost. A rise in the stock price stimulates the investment of firms. The risk transmission mechanism between the capital market procyclicality and the real economy is illustrated in Fig.V-4. Through these channels, the price movements of capital markets influence the real economy, and the real economic activities, in turn, influence the prices of capital markets. The co-movement of the capital market and real economy implies a significant implication of financial instability to the real economy. The stock prices are overinflated by endogenous forces of the market beyond the economy's production capacity, which leads to overproduction of the economy. When the inventory of unsold goods is too large or financial imbalance begins to break down itself, prices begin to fall. The falls in stock prices are accelerated by mutually reinforcing interactions with investors, which generate bear market dynamics on a massive scale. These are a typical pattern of finance-dominated accumulation regime or finance-led capitalism set forth in the early 1980s (Guttmann, 2014).

Fig.V-4 Risk transmission mechanism between the capital market and the real economy



Source: Author's compilation

V.4. Financial stability and macro-prudential policies to prevent procyclical herding

Given the undesirable effects of procyclical herding on financial stability, regulatory interventions may be necessary to prevent institutional investors' procyclical investments. This section raises questions about financial instability and regulatory interventions. If the procyclical herding of institutional investors destabilizes markets, should the procyclical herding be all avoided? When and to what extent can policy intervention be legitimated? More essentially, what is the desirable status of the stock market in terms of financial stability? It is hard to define the policy objective, financial stability. In this section, we find the answers to the questions. We rationalize the legitimacy of policy interventions for financial stability and then investigate existing regulatory frameworks potentially addressing institutional investors' procyclicality. Finally, we propose possible macro-prudential policy options to discourage procyclical investments by institutional investors.

V.4.1. Legitimacy of macro-prudential policies to mitigate procyclical herding

(*When and to what extent can the macro-prudential policy intervention be legitimated?*)

In an individual context, procyclical herding of institutional investors and short-termism of investment horizons are likely to be a product of rational judgment under certain institutional and social constraints each institutional group faces, rather than poor investment decisions based on irrationality or behavioral errors. However, in aggregate, the procyclical herding can have undesirable impacts on financial stability and the real economy. To some extent, such individual behavior reflects the *market failure* or the *fallacy of composition* in aggregate. That is why policy authorities need to care about institutional investors' behavior and the quality of their invested capital.

However, should the procyclicality of institutional investors or financial practices be all avoided? What is the desirable status of stock markets in terms of financial stability? Can we say that the market stagnating within limited price ranges all the time is desirable? Can we say that the most desirable market is the market made up of only "good" investors with a long-term, counter-cyclical orientation? It is a tricky question for policy authorities, especially when deciding when and to what extent they are required to intervene in the market to respond to the market failure. In terms of financial stability, Jean-Pierre Landau (2009), the former Deputy Governor of Bank of France, contends,

"Financial stability is not an end by itself. It only helps if it is conducive to better macroeconomic performance. Volatility may be driven by fundamentals. Sharp movements in asset prices may help the financial system to serve as a cushion, an absorber for exogenous economic shock. ··· ··· Not all procyclicality is bad. It depends on the casual link: Is the financial system the origin or the amplifier of destabilizing dynamics? Or does it simply react to cyclical evolution in the real economy? ··· ··· Real and significant damages occur when a financial imbalance is allowed to build for a long time with two consequences: first, asset prices significantly deviate from their fundamental trend, which creates distortions in the allocations of resources, second, those imbalances unwind suddenly and abruptly, triggering major disruptions in growth and the economic cycles." (Landau, 2009)

From his perspective, we should only be concerned by "intrinsic procyclicality," which is created *inside* and *by* the financial system. In terms of financial stability, the desirable market is the market where price movements reflect fundamentals and are not driven by endogenous amplification mechanisms inside the financial system. However, bubbles and busts are not developed by fluctuations in regular business cycles. Bubbles are sometimes triggered by productivity shocks but are not developed unless some amplification mechanisms work. This may imply the legitimacy of macro-prudential supervision in a broader range of the financial system beyond the procyclicality of bank capital.

It is neither feasible nor desirable to eliminate all procyclicality because the procyclical investments are often attributed to institutional specific structure enabling institutional investors to offer their unique financial functions to clients. Furthermore, there should be procyclical trading counterparties for supposedly long-term investors to provide counter-cyclical and long-term finance in both markets and the economy. Historically, institutional investors, particularly investment funds most prone to procyclical herding, have been less or hardly regulated by policy authorities than other investors. The first reason for the loose regulation is in traditional prudential regulations aiming at "investor protection". Mutual funds are regulated by national supervisors with a focus on investor protection. Hedge funds and PEFs are rarely regulated in most countries. It is partly because the hedge fund investors, who take high risk for high returns, are not considered subject to oversight for investor protection that traditional prudential regulations aim for, and partly because it is difficult in reality for national supervisors to regulate hedge funds, considerable numbers of which are offshore funds operating transactions, located in low-tax or tax-free countries. The second reason may be the significant heterogeneities in types, functions, and accounting systems across institutional investor groups and countries. Given the heterogeneities, institutional investors are not supervised by

consistent international regulations like banks in general. The third reason is that there is no widespread consensus on the market-destabilizing procyclicality in certain sectors such as ICPFs, high-frequency trading, and ETFs. The identification of their procyclicality is in progress, and the empirical evidence is contrasting. For these reasons, institutional investors but banks are under loose regulatory oversight or left regulated by market discipline, in other words, self-regulation.

Nevertheless, if institutional investors' investment behavior contributes to building up the system-wide risk, they should be addressed by macro-prudential policies. Macro-prudential policies aim to improve the resilience of the whole financial system instead of protecting single institutions or clients. Since the global financial crisis, international legislators and jurisdictions have made extensive efforts to establish macro-prudential policies, especially for the banking sector that has systemic importance. But expanding this framework beyond the banks is currently under debate among international policymakers.

(*Overview of existing policy measures to potentially mitigate procyclicality of banks, non-bank institutional investors, and certain market activities*)

Macro-prudential policies introduced to prevent procyclicality mainly focus on the procyclicality of the banking sector. The Basel III counter-cyclical capital buffer (CCyB) requirement ensures banks have the counter-cyclical capital buffer beyond the minimum capital requirement to help maintain the flow of credit in the economy without its solvency being questioned when broader financial system experiences stress after a period of excessive growth of credit (BCBS, 2010). Each jurisdiction can use its judgment to set the buffer's size and the regulatory time horizon based on reliable evidence on excessive credit growth associated with the build-up of system-wide risk. The counter-cyclical capital buffer can be added within a range of 0%~2.5% of the risk-weighted asset and consists entirely of the Common Equity Tier1 capital.[101]

The Basel III liquidity and leverage requirements have the aspect of the macro-prudential policy by indirectly addressing potential procyclicality in banks' investment behavior in the stock markets. Those ratios' objective is to strengthen the resilience of banks at the individual level but can relieve procyclical investment behavior and thereby market instabilities at the whole market level. The liquidity coverage ratio (LCR) requires banks to hold a certain level of liquidity buffers enough to tolerate expected cash outflows over the next 30 days in normal times. Banks can use the liquidity

[101] See "Basel III: A global regulatory framework for more resilient banks and banking systems" (BCBS, 2010) and "Guidance for national authorities operating the countercyclical buffer" (BCBS, 2010).

buffer in market stress times, whereby the liquidity buffers potentially prevent fire-sales of assets for urgent liquidity needs during market distress (BCBS, 2008, 2013)[102]. The Basel III leverage ratio is expected to mitigate banks' procyclical investments backed by procyclical leverages. Excessive taking on leverage by banks in an upward phase over-heats asset markets, which are followed by system-wide deleveraging when the market condition deteriorates. In the face of increasing withdrawal pressures, banks are forced to deleverage by unwinding loans or selling assets in a manner of amplifying downward pressures on asset prices. The leverage ratio can restrict the build-up of leverage by requiring banks to meet the minimum leverage level (3% of total assets) (BCBS, 2014).[103] Banks are less motivated to engage in procyclical investments when they are resilient to liquidity and leverage risks.

However, the market destabilizing procyclical investment tendency is more problematic for non-bank financial institutions. As non-bank financial institutions include various types of institutional investors, they are governed by highly heterogeneous regulatory frameworks. For investment funds, they are classified into the shadow banking system under the current global regulatory framework. Given the diversities of the shadow banking system across countries, international legislators take a broad principal-based approach intended to accommodate various ranges of supervisions, e.g., by proposing policy recommendations on risk management to national policy authorities, instead of establishing consistent quantitative requirements. For some risks of the shadow banking institutional investors interconnected with the banking sector, they are indirectly regulated by the Basel III capital requirement of banks transacting with the institutional investors. A wide range of policy measures currently exist at a national level, but these measures vary considerably across countries. Some countries establish the national minimum requirements for liquidity buffers[104] or leverage[105] on certain types of investment funds. While the risk management is more reinforced by measures specified in the prospectus of individual funds, national regulators do not have the right to activate such risk management tools specified in the prospectus, and thus, the use of the optional tools is left up to the discretion of asset managers in most countries. The problem is that asset managers are less motivated to activate the risk management tools for reputation reasons and, more importantly, the

[102] See "Principles for sound liquidity risk management and supervision" (BCBS, 2008) and "BaselIII: the Liquidity Coverage Ratio and liquidity risk monitoring tools" (BCBS, 2013).

[103] See "BaselIII leverage ratio framework and disclosure requirements" (BCBS, 2014).

[104] France, Germany (real estate funds), China (open-end funds) and Singapore require investment funds to hold liquid buffers (IOSCO survey results, 2015).

[105] Most countries including U.S, U.K, most EU countries (France, Germany, Spain, Netherlands, Luxemburg, Ireland), Canada, Japan, Hong Kong, Singapore, Turkey, India, South Africa have national requirements of limits on illiquid assets, asset concentration and leverage for all or certain types of investment funds (IOSCO survey results, 2015).

tools aim to investor protection and market integrity with limited attention to financial stability. Consequently, asset managers may fail to mitigate system-wide build-ups of risks. The use of the tools in the best interest of their clients may contribute to unintended negative outcomes to the financial system.

ICPFs may be the most vulnerable institutional sector to procyclical herding driven by existing regulations based on market valuations, as described in Chapter II. The solvency capital requirement of insurance companies and the funding ratio of pension funds have a strong procyclical mechanism than the capital requirement of the banking sector because their liabilities are estimated with changing market interest rates, and they generally hold large amounts of illiquid assets whose market prices are volatile. Recently, the European Solvency II Directive, a new regulatory regime for insurance companies, introduced the volatility adjustment measure in calculating the solvency capital of insurance companies, which has a counter-cyclical feature. Insurance companies are allowed to adjust the risk-free rate to mitigate the effect of short-term volatility of bond spreads on their solvency position. Thus, the volatility adjustment measure lowers solvency capital requirement in volatile times and thus prevents procyclical investment behavior of insurers (EIOPA[106], 2019).

Some regulatory measures target certain market activities causing capital market procyclicality and increasing price volatilities directly. Circuit breakers are put in place in many countries, including the U.S., to halt trading for some time during market turbulence. When prices increase or decrease sharply, the circuit breaker is triggered to halt panic selling for the market-wide level or individual securities, and in general, trading automatically resumes in some time. For one recent example, circuit breakers were triggered at the New York Stock Exchange on Mar 9 and then Mar 12, 2020, when markets quivered, responding to the global Covid-19 pandemic. Another policy measure for the capital market procyclicality is the haircut and margin practices in security financing and over-the-counter (OTC) derivatives transactions, which were identified as a source of capital market procyclicality during the global financial crisis. The dynamic of haircut-setting in secured funding has a procyclical tendency. In an upward phase, haircuts applied to securities posted as collateral for the secured funding have a tendency to decrease due to improved lending conditions, i.e., high credit rating, sufficient liquidity, low price volatilities, and increased competition towards secured lending. However, when the market condition deteriorates, haircuts increase, corresponding to a gradual erosion of the lending term. Margins of OTC derivatives transactions, which are subject to daily mark-to-market valuation and margin calls, had a similar problem. Consequently, FSB and CGFS provided recommendations for

[106] European Insurance and Occupational Pensions Authority

possible policy options to mitigate the procyclicality in haircut and margin practices.[107] BCBS and IOSCO also introduced the margin requirement for non-centrally cleared derivatives (BCBS-IOSCO, 2015).[108] The enhanced margin and haircut requirements aim, in principle, to reduce counterparty risks, but can also play a role in mitigating the capital market procyclicality by restraining excessive accumulation of non-secured exposures during expansions and reducing potential sharp credit retrenchment in downturns.[109]

Meanwhile, developing countries have mobilized macro-prudential measures to mitigate the adverse effects of procyclical global capital flows. For example, Brazil implemented a 2% financial transaction tax (IOF) on non-resident equity and fixed income portfolio inflows in 2009. The tax rate increased from 2% to 6% in 2010 but decreased to 0% in 2013 when the Taper Tantrum was triggered (Central Bank of Brazil, 2013). Indonesia required one month (28 days) long mandatory holding periods for both resident and non-resident investors on their purchases of Bank Indonesia Certificates (SBI) in 2010 and extended to six months (182 days) long in 2011 to minimize adverse impact from short-term capital inflows on monetary and financial system stability. SBI holders are not permitted to carry out a transaction of the SBIs with any parties except in the transactions conducted by participants in monetary operations with the Bank of Indonesia. But they are permitted to engage in repo transactions with the Bank of Indonesia to meet short-term liquidity needs (IMF, 2011). South Korea introduced three macro-prudential measures to reduce vulnerabilities to external shocks. Korean policy authorities limited the F/X forward position of banks in order to control banks' foreign liabilities. The tax on foreign investors' bond investments revived in 2011. In 2010, a macro-prudential levy on financial institutions' non-deposit foreign currency liabilities was introduced (Bank of Korea, 2015).

[107] See "The role of margin requirements and haircuts in procyclicality" (CGFS, 2010).
[108] See "Margin requirements for non-centrally cleared derivatives" (BCBS-IOSCO, 2015).
[109] FSB-IMF-BIS (2011), CGFS (2010), CPSS-IOSCO(2004)

Tab.V-2 Existing policy measures potentially addressing capital market procyclicality

Institutional sector or market activity	Regulatory frameworks	Measures	Intended effects
Banks	Basel III capital requirement (BCBS)	Require banks to accumulate Counter-cyclical capital buffer (CCyB)	Mitigate procyclicality of bank loans amplifying economic fluctuations
	Basel III liquidity ratio requirement (BCBS)	Require banks to have sufficient liquidity buffer (LCR)	Mitigate potential forced asset fire sales in stress times by requiring banks to have sufficient liquidity buffers in normal times and convincing them to use the buffers in stress times
	Basel III leverage ratio requirement (BCBS)	Require banks to meet the non-risk based leverage ratio	Restrain procyclical investments backed by procyclical taking on leverage
Investment funds, MMFs (Shadow banking system)	Principle-based approach at an international level (FSB, IOSCO), heterogeneous regulations on a national level	(Investment funds) The minimum requirement for liquidity buffers and leverage limits in some countries	Mitigate potential forced asset fire in stress times, Restrain procyclical investments backed by procyclical taking on leverage
		(MMFs) Recommend MMFs to have a sufficient liquidity buffer, convert from SNAV to FNAV	Ensure to respond better to fund redemptions, mitigate fund run risks, and thus prevent negative impact on the capital market
Insurance companies	Solvency II capital requirement (EU, National basis)	Volatility adjustment measure	Lower the capital requirement for insurance companies by adjusting short-term volatilities of the risk-free rate in volatile times
Stock trading	Circuit breaker (National basis)	Halt trading for some time in market turbulence	Halt fanatic buying or panic selling when prices are sharply increasing or decreasing
Security financing and OTC derivatives transactions	Policy recommendation on haircut and margin practices (FSB, CGFS)	Recommend to improve haircuts and margins practices	Improve the haircuts and margins set in a counter-cyclical way
Non-centrally cleared derivatives	Margin requirement (BCBS, IOSCO)	Require to preserve the minimum level of margin for non-centrally cleared derivative contracts	Reduce counterparty risks and restrain excessive non-secured funding during boom periods.
Global capital flows	Macro-prudential policy (Developing countries, National basis)	Financial transaction tax (Brazil), Mandatory holding periods for investors on their purchases of Bank Indonesia Certificates (Indonesia), Limit on F/X forward position, Tax of foreign investors' bond investments, Macro-prudential levy on banks' foreign liabilities (South Korea), etc.	Mitigate procyclicality in global capital inflows to developing countries, reduce vulnerabilities to external shocks, control domestic financial institutions' foreign currency liabilities.

Source: FSB, BCBS, IOSCO, CGFS, IMF

While policy authorities have enhanced the efforts in mitigating procyclical behavior of the banking sector and certain market activities, there is still a lack of regulation for preventing procyclical investments in stock markets. As investment funds are classified as the shadow banking system in the current international regulatory frameworks, they are subject to relatively loose oversight, and the regulations vary substantially across countries. There is no widespread consensus on procyclicality in their investments for some areas, such as ICPFs, high-frequency trading, and ETFs. Policy authorities appear to take the first step to recognize the systemic importance of ICPFs' long-term investments in stabilizing markets and identifying their procyclicality. Oversight for the regulatory blind spots should

be strengthened with stronger supervision and international adoption of macro-prudential policies on the vulnerable areas prone to procyclical herding to ensure financial stability.

V.4.2. Possible macro-prudential policy options to mitigate the capital market procyclicality of institutional investors

The following proposes possible macro-prudential options to mitigate the stock market procyclicality, some of which are based on the suggestions of IMF (2015) and FSB (2017). The idea is built on three pillars following the Basel banking supervision system. Pillar I corresponds to extending the minimum requirements of the banking sector to other financial sections. Pillar II is associated with enhanced discretionary supervision by national supervisors. Pillar III constitutes oversight by enhanced disclosure and market discipline.

(*Pillar I: Extending the minimum requirements of the banking sector to other financial sectors*)
One possible policy option is to extend the prudential requirements of the banking sector to other financial sectors. It can improve the resilience of both individual institutions and the entire financial system. But given the diversity of business models and risk profiles in the institutional investor groups, differentiated regulatory considerations to address vulnerabilities of each group may be warranted.

For investment funds, open-end mutual funds are most prone to procyclical herding due to liquidity mismatch and procyclical patterns of fund investors' injection and redemption. Consequently, they may need to maintain liquidity buffers enough to meet sudden large redemption requests, a spike in margin calls, and other outflows. The liquidity buffers can be used for effectively responding to large redemptions or margin calls in turbulence times, whereby funds may respond to sudden large redemptions without disposing large amounts of illiquid assets at discounted prices in turbulence times. The cost of maintaining the liquidity buffers may internalize the negative price effect externality caused by procyclical fund investors during turbulence times. Another possible option is to align investment funds' funding liquidity with their asset liquidity. It could be realized by setting the minimum redemption duration requirement where fund investors should wait to withdraw investments in the fund, especially if the fund invests in illiquid assets. The redemption duration requirement may be similar to the idea of the redemption policies, such as a notice in advance, lock-up periods, or redemption frequency limits.

Hedge funds and PEFs have vulnerability in their dependence on high leverage, which causes procyclical behavior to obtain liquidity and deleverage during market turbulence times. While their high leverage can be indirectly controlled by the capital requirement of banks (prime brokers) and haircuts on non-centrally cleared securities financing, there is generally no direct regulation for leverage limits. National policy authorities of EU countries are allowed the right to impose the leverage cap on hedge funds if the leverage level is doomed to build up the systemic risk. This tool, however, has not been used to date (FSB, 2017). Therefore, a possible option may be the international adaption of the leverage limit requirement for hedge funds and PEFs. The first challenge for this is to measure the amount of leverage consistently and accurately and develop the risk-based measure of leverage. Hedge funds make considerable use of off-balance sheet leverage as well as balance sheet leverage. The off-balance sheet leverage arises from financial derivative transactions, security lending, short-sales, etc., mainly taking the form of contingent liabilities. The identification of non-balance sheet leverage and related risks of hedge funds is much more complex than that of banks due to their complicated transaction structure.

For ICPFs, their counter-cyclical investment orientation as supposedly long-term investors should be maintained to ensure financial stability in both market boom and bust times. Some empirical studies prove the procyclicality of insurance companies, but there is no clear evidence on the procyclical investment behavior of pension funds. As shown in chapter III, the investment behaviors of ICPFs also vary depending on countries and market conditions. Therefore, policy authorities need to make further efforts for detecting and monitoring procyclicality in ICPFs' investments at first. If procyclicality is consistently detected, one desirable measure is to build up the counter-cyclical capital buffers during good times to make sure that they do not contribute to rising price momentum by restraining aggressive expansions of stock holdings during a boom period and withstand losses without selling illiquid assets during stress times. The volatility adjust measure of the European Solvency II also contains the counter-cyclical mechanism to mitigate procyclical behavior of insurance companies in volatile times. However, this measure is not effective in mitigating procyclicality in boom periods, as it does not require insurance companies to build up buffers in good times (Duijm and Bisschop, 2015). As proved in Chapter II, ICPFs contribute to rising stock prices in boom periods by increasing stock holdings in most countries. In this context, the counter-cyclical capital buffers for ICPFs may be a more efficient measure to ensure their counter-cyclical investments moderating market cycles.

(*Pillar II: Enhanced discretionary oversight by price dynamics stress-testing, intervention to risk management tools of individual institutions, regulatory flexibility including temporary halt of mark-to-market valuations in stress times*)

Supervisors and policy authorities should enhance discretionary oversight with a macro-prudential focus on institutions and markets. This includes system-wide stress-testing on the collective behavior of investors and price dynamics, discretionary decisions for a temporary halt of trading, intervention to risk managements of individual funds, and regulatory flexibility.

Policy authorities should take into account the system-wide stress-testing focused on the collective behavior of institutional investors and asset price dynamics. The system-wide stress testing may cover various institutional sectors, including foreign investors, and asset markets with an important systemic relevance in each country. It should be conducted for financial instability times, including both crisis times and the times when markets are suspected of having asset bubbles. A better understanding of institutional investors' collective behavior and its price impacts would build a base for deciding regulatory interventions and coordination with other policies, other security, or market regulators. Notably, the stress-testing for asset bubble periods would help monetary policy decisions for the pre-emptive intervention to stabilize asset prices.

National policy authorities and supervisors should have the right to discretionary interventions to risk managements of individual investment funds in an exceptional circumstance. As fund managers are not motivated to apply risk management tools for a reputational reason and do not consider system-wide aspects of financial stability, supervisors should be able to warn asset managers of large investment funds to activate them when the fund is expected to contribute to the build-up of systemic risk. Giving supervisors the power to suspend fund redemptions in an exceptional circumstance would be an efficient crisis management tool. However, the discretionary intervention should be limited only in the exceptional circumstances in the public interest of financial stability to avoid supervisory abuse and protect fund investors. Furthermore, policy authorities need to examine liquidity risk management tools of individual institutions with a macro-prudential view. The tools that are likely to increase systemic risk when activated should be avoided.

Haldane (2014) raised the "regulatory flexibility" issue as a supervisory contingency plan. The idea is that supervisors can temporarily halt the regulations having the potential to cause procyclical herding in stress times. For example, maintaining liquidity and capital buffers is a pre-emptive measure for institutions to increase the resilience to liquidity or solvency shocks. But if they are required to

maintain the liquidity and capital buffers during stress times, it could lead them to undesirable behavior such as procyclical herding. To meet the minimum level of liquidity buffers, institutions are likely to sell illiquid assets and shift to government bonds, amplifying flight for liquidity and accelerating price drops in illiquid assets. Losses of institutions resulting from decreases in the value of stocks they hold give rise to increases in solvency capital requirement (Equity SCR) during market stress times. In response, they may sell risky assets and move into risk-free assets to preserve capital. Therefore, temporary suspension of such requirements and approving institutions to use the buffers amid a market crisis could mitigate procyclical herding of institutional investors in risky asset markets. The current Basel III Liquidity Coverage Ratio (LCR) regime already includes the usability of liquidity buffers during stress times by authorities' decisions. The regulatory flexibility may also apply to the mark-to-market accounting regulations. Market participants have faced significant increases in margin requirements based on the mark-to-market valuations in most market crises since the mark-to-market valuations were implemented. During the recent market stress of the Covid-19 pandemic in March 2020, market participants also experienced increases in margin requirements of over 400% in the space of a week, driving forced asset fire-sales and procyclical downward liquidity spirals (Foley et al., 2020). The bottom prices during a market crisis likely fail to reflect the true value of stocks. Assets should not be valued to the distorted prices based on the artificial accounting rules and related requirements. When the markets are doomed to have severe dislocations during market turbulence, the temporary suspension of the mark-to-market valuations could help institutions survive temporary impairments in asset values, which may be a better way than letting them go bankrupt.

The regulatory relief measures implemented when the Covid pandemic hit are good practices of regulatory flexibility. Several jurisdictions have taken a step to relieve regulatory requirements to promote banks' credit supply and support economic recovery. It includes releasing the CCyB (EU and U.K), encourages to use of capital buffers (EU, US, U.K, Japan, Canada, etc.), and adjust supplementary leverage ratio (U.S). Some jurisdictions applied regulatory flexibility on the interpretation of accounting and prudential rules associated with banks' risk exposures by the crisis, such as the measurement of expected loss provisioning and reclassification of non-performing loans (Borio and Restoy, 2020). This experience of regulatory relief points to limitations and suggests us reflections of the regulatory flexibility. Firstly, while these regulatory relief measures aim to respond to the crisis arising from the real economy, we may a different type of regulatory flexibility depending on the crises. The crisis starting from the financial system and propagated to other sectors through interconnections of institutions like the global financial crisis of 2008-2009 will need different regulatory relief measures, i.e., adjusting liquidity regulations or the mark-to-market valuations. This

requires policy authorities to identify and pre-define available regulatory relief measures depending on various crisis scenarios. Secondly, the most relevant policy instruments to respond to a crisis exist in institutions' capital requirements. However, sizable buffers were not built up before the Covid-19 crisis, even though many jurisdictions would have wanted to enter the crisis with a larger CCyB (Carsten, 2020). Some institutions that had suffered from low profitability in business models did not use the capital buffers willingly because they found it challenging to raise capital in financial markets even in normal times. As a result, the CCyB and capital requirements as macro-prudential policy instruments are limited to respond to the crisis. This leads policy authorities should develop more various macro-prudential policy measures so that the financial system can respond to crises better.

(*Pillar III: Promoting market discipline by enhanced risk disclosure*)

Macro-prudential oversight can be improved by promoting market discipline. In this context, policy authorities need to enhance liquidity and leverage risk disclosure for investment funds. Markets may need high comparability in risks borne by each investment fund as well as fund performances. Most countries have disclosure and reporting requirements but do not require a standardized quantitative disclosure of liquidity and leverage. Given the complex strategies of hedge funds and some PEFs using security financing and opaque derivatives, the disclosure should include standardized risk-based indicators of liquidity and leverage to which each fund is exposed. With the standardized disclosure of risk-based-indicators, market participants can be educated and have a better ability to screen and select the funds. Perception of high risk-bearing can refrain retail investors from high returns-seeking behavior, whereby risky strategies of hedge funds based on high leverage could be autonomously driven out. The improved information transparency of investment funds can also reduce the principle-agent problem between ICPFs and external asset managers. This can make delegation contracts less obsessed with short-term performance and more focused on long-term optimizations. The standardized information with sufficient quality and frequency can improve supervisors' monitoring of systemic risk build-ups and stress-testing. However, policy authorities need to be cautious when deciding the degree of liquidity disclosure because too detailed information of liquidity risk in funds sometimes encourages investors' herd behavior and aggravates market instability.

(*Another considerations for short-termism of finance*)

In terms of financial stability and long-term economic growth, short stock holding periods are problematic, especially in ICPFs and high-frequency trading. Therefore, requiring the minimum stock holding periods for ICPFs and high-frequency traders may be an indirect tool to decline market-destabilizing procyclical behavior. There are already some regulatory approaches for ICPFs that

encourage them to hold stocks for a long duration. The long-term equity investment (LTEI) measure of Solvency II, set out in March 2019, reduces the risk charge of 22% for long-term equity investments when calculating the capital requirement of insurance companies. However, it is challenging to regulate trading frequencies and stock holding time of algorithmic trading, partly because it is difficult to technically define and detect high-frequency trading, partly because the disputes on impacts of high-frequency trading are still going on. The regulatory discussions to prevent potential procyclicality in intraday or milliseconds are at the very first stage.

V.5. Moving toward long-term finance: challenges for sustainable finance

Short-term profits-seeking procyclical herding and short-term finance are harmful to the real economy, leading to amplified business cycles and inefficient capital allocations, thereby undermining sustainable economic growth. Therefore, making capitals provided to the real economy stably and efficiently with a long-term perspective is the most crucial and fundamental function of the financial system. But when discussing the function of finance with regard to the real economy, we are talking about a new goal of finance beyond the long-term corporate profits and economic growth: making "sustainable finance".

The world is facing existential threats of climate change before long. We have already noticeable evidence of the effects of climate changes: The rapid increase in the frequency and magnitude of natural disasters, the melting of ice sheets in the Arctic, exponentially rising sea level, and rapid increases in CO_2 emissions by the melting of the permafrost. The current Covid-19 crisis is also not irrelevant to climate change. Both pandemic crisis and climate crisis originate from environmental degradation. They damage human health and the economy and structurally change human lifestyles across the globe. However, for the climate crisis, the impacts will be much more severe, long-lasting and irreversible, once catastrophes unfold. We should face the crisis getting worse every year without vaccinations. Fifteen years ago, when the initiatives for corporates and finance to create the long-term value of society and sustainable growth were launched in the name of Environmental, Social and Governance (ESG), the corporates and financial institutions used to ring-fence the ESG from their main business by regarding it "corporate social responsibility". However, the effects of climate change on financial stability and the real economy will be decisive, while the speed at which they are materialized is uncertain. The natural disasters resulting from climate change will hurt people, damage properties, and disrupt trades (physical risks). The losses caused by climate change will prompt parties

affected to claim compensation to those responsible for the cause, probably carbon emitters or insurance companies (liability risks). If all the risks and opportunities related to climate change are reassessed in the asset values in a disorderly manner, the markets will be exposed to financial risks that could result from the process of adjustments toward a low-carbon economy (transition risks) (Mark Carney, 2015). At this moment, in fifteen years since the ESG initiatives were launched, climate change is not a moral but material issue to corporates and the financial system. Climate changes will threaten financial resilience and longer-term prosperity. Mark Carney, the former governor of Bank of England and chairman of Financial Stability Board (FSB), also stressed, in his famous “tragedy of the horizon” speech (2015), that the financial system should finance the transition toward a low-carbon economy.

Nevertheless, it looks evident that the financial system misallocates capital in terms of the objective of shifting toward a low-carbon economy. Significant capitals are still invested in “brown” industries producing and using fossils but relatively little in “green” industries such as renewable energies, sustainable agriculture or environment protection, etc. Though the current health crisis has its root in environmental disruptions, governments are pouring vast amounts of money to save the economy with little consideration to environmental issues. This means that it is even more challenging for the private financial system to adopt green-oriented investment strategies. This is because the financial system underestimates the risks of brown investments and the opportunities of green investments. There is a high degree of uncertainties on the timing and impacts of climate change driven by fossil-based production and consumption, while the benefits from a low-carbon economy can be felt beyond generations and may not be distributed to people who currently provide capital. Incorporating the climate components in investment strategies may deteriorate institutional investors' short-term financial performance, causing conflicts with fiduciary duty for clients or beneficiaries. The values of a low-carbon economy and risks of carbon emissions not measured in a monetary term are not priced in markets. Traditional portfolio management based on CAPM and Markowitz (1952)’s Modern Portfolio Theory cannot incorporate the non-priced climate components into portfolio managements, failing in individually and socially optimal decision-making. Massive passive funds money tracking market indices are mechanically invested in the industry of oil and gas. According to 2° (2015), the S&P 500 has 10% exposure to oil and gas, which is considerable, relative to a 3% share in the U.S economy. However, the non-priced environmental values of companies imply a high probability that this will change, and the change will be sharp and sudden (OECD, 2017). Investors and markets are not only misallocating their capitals, but they are also exposed to the risk of sharp drops in prices of carbon emitters and sudden market crash occurring when markets begin to have increasing visible

signs of catastrophic climate-related damages and reflect the climate-related risks in the market prices in a disorderly manner.

Consequently, public and private sector entities have been considering policy options to reorient the financial system toward a low carbon economy. The European Commission has released an action plan to establish taxonomies regarding sustainable finance, which will be a basis for measuring climate-related risks and performances and making regulatory mechanisms. Green bonds, issued by sovereigns, local governments, banks, etc., and guaranteed by the issuers, are having growing markets. Green bonds aim to raise funds to finance climate change solutions covering a wide range of environmental projects. In 2015, FSB created the Task Force on Climate-related Financial Disclosure (TCFD), charged with developing climate-related disclosure applicable to all sectors. Corporates are encouraged to report their current carbon emissions and plan to go to net-zero emissions. It is on a voluntary basis, but some countries, including the U.K, New Zealand, and Switzerland, announced it to be mandatory in the countries. More informed investors with improved disclosure could reassess the financial asset values and change their risk management and investment strategies to those favoring low-carbon industries (FSB, 2015).

Notwithstanding the efforts, relatively little attention is given to stock market investments that can potentially play the most significant role in channeling capital to sustainable development. Indeed, institutional investors' money invested in stock markets has huge enabling power in reallocating available resources in the real economy. It can be done by their investment behavior formulating stock prices and direct ownership engagement as the major shareholders. They could deliver the right signal to investee corporates to change environmental practices or persuade corporate managers to adopt environmentally better policies. However, what could be done to reorient institutional investors toward green investments beyond imposing ethical investment responsibility? How can private sectors be aligned with the public objective? To narrow the question further, how can we facilitate the vast amount of stock-market capital to be the main channel supporting the transition toward a low carbon economy? Private finance is driven by *fear and greed*, in other words, risks and opportunities. Therefore, the key is to make investors perceive green investments as profit opportunities. Providing investors with more information through standardized disclosure on corporates' climate-related risks and opportunities is significant progress necessary for measuring and reassessing the existing assets. The offering of standardized information is also necessary for policymakers to monitor how aligned institutional investors' investment strategies with the climate-related policy objective and to establish incentive mechanisms in regulatory systems. However, as described in chapter II, often driving forces

of stock markets are not fundamental information. We know that investors have no ability and willingness to deliver the fundamental information to stock prices, and thereby the stock market is no longer efficient. Institutional investors, including supposedly long-term investors, are more incentivized to make short-term investment decisions. Even many rational and sophisticated arbitrageurs focus on profits from short-term price differences.

In this context, the first step to reorient institutional investors toward low-carbon stock investments is to develop various long-term institutional investors without short-term unstable liability contracts and stimulate their function as long-term, counter-cyclical investors. It could be achieved by simply requiring institutions to keep the minimum asset holding durations or imposing the transaction tax or correcting short-term procyclical mechanisms, and integrating long-term incentive mechanisms in regulatory frameworks like capital requirements or accounting rules. Imposing explicit low-carbon investment mandates to long-term public investors, like public pension funds and sovereign wealth funds, and asset managers in their asset management delegation contracts with long-term investors may be the way to assure their long-term investors' role. For example, in 2017, French public pension funds ERAFP announced their plans to invest €50 million into international equity funds aimed at combating climate change. The California State Teachers' Retirement System (CalSTRS) approved equity fund managers to receive up to $1 billion for ESG-related mandates (PRI, 2018). Expanding the category of long-term investors can also be considered. One option is to develop private investment funds specialized in low-carbon investments (climate-labeled funds), of which redemptions are limited for a pre-defined period. Existing national development banks could be mobilized for stock market green investments as long-term investors. Considering that a large portion of the clean energy industry is unlisted, PEFs, venture capital companies, and funds of funds (FoF) may also be long-term financing tools that unlisted low-carbon corporates can access. A new type of private investors such as crowding funds and angel investors are also emerging. Many central banks hold a considerable amount of foreign exchange reserves ($8.5 trillion in 2020, for top ten foreign reserves holding countries) far beyond the appropriate levels. While the primary purpose of the foreign exchange reserves is to keep the local currencies stable and backup urgent needs of foreign currencies in crisis times, part of the foreign reserves may be mobilized for green investments through international or regional cooperation. Some countries use part of reserves for infrastructure, and China, which holds more than $3 trillion of its assets in foreign currencies, has already used its reserves for recapitalizing state-owned banks.

We need the deepening of low-carbon markets. As investors seek new opportunities, they will need available products and resources to align portfolios with the low-carbon transitions. In this context, we could rethink the design of benchmark indices. The current market indices tracked by passive funds are calculated, applying weights based on each company's market capitalization or market liquidity. This leads massive passive fund money mechanically to be invested in CO_2-emitting industries and biased investment choices in terms of climate change. Suppose the weights of market indices are readjusted, reflecting climate-related components which we may call the fundamental value components. In that case, the massive amounts of portfolios managed by the asset management industry will be automatically adjusted toward avoiding carbon-intensive companies and capturing green companies. While index providers offer various low-carbon indices, these indices are based on important sectoral bets that limit diversification and involve significant misalignment with traditional market indices. Thus, these indices are not accessible to large institutional investors because of their risk profiles, i.e., high tracking-error compared to benchmark indices (Coeslier, 2016). Therefore, the challenge is to develop enough market benchmark indices similar to traditional market indices that include diversified stocks for avoiding tracking-error and take into account climate-related components to hedge climate-related risks (though it is insufficient). Besides the diversified market indices, markets need more tailored bespoke benchmarks to satisfy investors' existing preferences and diverse objectives for climate-related risks and opportunities.

Fundamentally, profit opportunities in stock markets depend on future price movements or market valuations. The price movements are endogenously determined by the market convention on which investors formulate a collective expectation for the future prices under radical uncertainty. When investors have a collective expectation that the society believes in the long-term validity of the low-carbon investments and the low-carbon market will find its value before long, investors will willingly adjust investments toward a low-carbon economy transition. Espagne and Aglietta (2016) argue that the convergence of individual expectations is a condition and a consequence of the harmonious functioning of a decentralized market. This convergence occurs through the emergence of institutions. Institutions themselves do not emerge spontaneously but are a product of layers of historical necessities. However, current dominant institutional inertia tends to make financial investors keep financing carbon-intensive economy. There is still deep skepticism for climate change in markets. Without acting on the collective expectation around which investors could coordinate, the transition of stock market finance toward a low-carbon economy could not be accomplished. The low-carbon economy has no precedence and not enough institutions (price, regulations, financial intermediaries, investment tools), under which it is not easy to make the market convention that investors believe they

are losing under the current carbon-intensive investment strategies and will gain profits from a low-carbon economy in the future.

Our society needs a paradigm shift capable of pushing us to transform our economic, social and political system. This new paradigm must be firmly embedded in institutional and normative contexts. We should remake our economic system fundamentally from the bottom up and, in the process, rethink the socio-political-economic nexus within which we live (Guttmann, 2018). Policymakers must intervene with setting up a wide range of credible institutions encompassing the pricing, regulations, investment tools, and financial institutions. Above all, the existence of long-term investors ensuring long-term sustainable investments is indispensable to make the market convention toward a low-carbon economy. We should develop a new corporate paradigm of governance, organization, and priorities of objectives, far away from the current dominant paradigm of shareholder value maximization. Ultimately, we may need a different type of capitalism, a more ecologically oriented system, which may be called “eco-capitalism.” (Guttmann, 2018).

CONCLUSION

This thesis is devoted to identifying institutional investors' procyclical herding in stock markets as an endogenous market destabilizer. The procyclicality investment behavior can be defined as "buying stocks when prices rise and selling them when prices fall". Procyclical herding is a collective representation of the procyclical behavior among institutional investors, potentially creating "mutually reinforcing interactions with prices".

Chapter I aims to identify the theoretical rationale of procyclical herding in relation to price movements. Given that it is essentially a result of investors' investment decisions responding to price movements and it also influences future price movements, procyclical herding can be interpreted in the existing asset pricing framework. This chapter points out that the *self-referential hypothesis* and *finance of conventions*, the French economic theories, may provide the ideal theoretical framework to interpret the procyclical herding in relation with price movements. Investors' attachment to others' behaviors or expectations in a decision-making process and their collective coordination around the price trend produce a generalized mispricing in stock markets, continuously disassociating prices from fundamental values, causing increased price volatilities and amplified market boom and bust cycles. Such investors' collective positioning with regard to price movements is in line with the concept of procyclical herding, "mutually reinforcing interactions between investment behavior and prices."

Chapter II conducts an extensive examination of procyclical mechanisms embedded in current developed stock markets, ranging from investors' expectation formation process to institutional investors' balance sheet structures to popular trading practices, and to global capital movements. The psychological and institutional mechanisms that rationally lead investors to procyclical herding are identified as follows;

- **Self-reinforcing expectation of future price movements**: Under the self-referential hypothesis and the convention theory, investors' expectations are more likely to be anchored to the majority's opinion that will determine the future price movement than the fundamental value. However, when investors have experienced a strong price trend, the price trend is considered the market convention reflecting the major market opinion which investors try to mimic. This generates a collective self-reinforcing expectation where investors experiencing an

upward (a downward) price trend form bullish (bearish) expectations for the near future instead of the mean-reverting expectation.

- **Balance sheet structures vulnerable to liquidity and leverage risks**: The structural liquidity mismatch between assets and liabilities of open-end mutual funds, high leverage dependence of hedge funds and some PEFs, and reliance on short-term wholesale funding of banks can encourage the institutions' procyclical herding. ICPFs with long-term stable liability contracts are intrinsically counter-cyclical and long-term investors, a potential market stabilizer and long-term finance provider in the real economy. However, under a prolonged low-yield environment, the market-based valuations and ALM strategies expose ICPFs to prevailed underfunding risk, under which a possible strategy of ICPFs may be a search for short-term high returns. Asset management delegations from ICPFs to external asset managers also erode the stabilizing role of ICPFs' long-term resources.
- **Popular trading practices such as passive investing and high-frequency trading**: Passive investing that replicates market cap-weighted indices mechanically encourage procyclical herding by increasing popular stocks holdings without considering corporates' fundamental values. ETFs with high liquidity and visibility may attract short-term procyclical investors whose price impacts can be transmitted to stock markets through a price co-movement channel. High-frequency traders are a new source of short-term market instability. Their ultra-short trading horizon on small amounts of capital makes them extremely sensitive to price dynamics and other traders' behavior in millisecond intervals and neglect fundamental valuations. High-frequency traders may act as endogenous market-makers providing liquidity in normal times but turn into an aggressive market destabilizer in the face of drastic price drops in stress times. Their unpredictable interactions with prices and other trading algorithms cause price overshooting, as shown in the U.S Flash Crash of May 6, 2010.
- **Procyclical orientation of foreign investors in emerging stock markets**: The major foreign investor base is investment funds such as open-end mutual funds, ETFs, and hedge funds. Contrary to domestic investment funds, the main clientele of emerging market equity funds is institutional investors like ICPFs. It is because investment funds are cost-effective but institutional investors can also convert illiquid emerging market assets into liquid assets of mutual fund shares on balance sheets. The concentrated use of common benchmarks, similar methodologies in constructing emerging market indices can also drive the funds to adopt similar investment strategies.

Chapter III measures and compares procyclicality in stock investments across three major institutional groups (investment funds, banks, and ICPFs) and four countries (U.S, France, Korea, and Japan) by a regression analysis. This is the first attempt to compare the investment behaviors by different institutional groups and countries simultaneously using consistent regression models. The regression results show that institutional investors' investment behaviors are heterogeneous across institutional groups and countries, and also asymmetric depending on the market condition. Nevertheless, the results lead us to some conclusions;

- Investment funds are procyclical investors in most countries (Korea, the U.S, and France), particularly in boom periods, implying that they are a strong driver of stock market booms in the countries. Banks are mostly procyclical investors (Korea, the U.S, and France). On the other hand, ICPFs are counter-cyclical investors in most countries (Korea, Japan, and France), playing a market-stabilizing role in the countries. These results are largely in line with the theoretical assumptions based on institutional characteristics.
- We have two contrasting cases, Japan and the U.S. The U.S stock markets seem the most skewed toward procyclical institutional investors. All the institutional investor groups in question, even ICPFs, demonstrate procyclical behavior. In contrast, the three Japanese institutional groups are all counter-cyclical investors, irrespective of the market condition. Even investment funds consistently behave in a counter-cyclical manner. The distinguishing behavioral features of two economies would have generated contrasting trajectories of price evolutions, spectacular boom and bust cycles of the U.S stock markets, and stagnant price movements of the Japanese markets.

Chapter IV conducts the in-depth analysis of measuring the concept "mutually reinforcing interactions between investment behavior and price movements" by VAR models. The analysis is applied to Korean stock markets, where high-frequency (monthly and daily) trading data are available, with five variables: market returns, trading volumes (net buys) of investment funds, banks, ICPFs, foreign investors. We examine how institutional investors' behavior and market returns interact dynamically and how domestic institutional investors respond to foreign investors' behavior. The main findings are as follows;

- Investment funds potentially cause the mutually reinforcing interactions with the market return at a short-term horizon over ten days, though the effects are not intense and persistent. ICPFs

are counter-cyclical at a medium-term horizon over ten months, whereas the counter-cyclicality is not observed at a short-term horizon. We have no evidence for the cyclicality of banks.

- Foreign investors potentially cause significant “mutually reinforcing interactions” with the market return, displaying both the significant first round and feedback effects. It supports the argument that foreign investors' investment behavior is a destabilizing factor of Korean stock markets, leading to amplified price fluctuations at both short-term and medium-term horizons.
- All the domestic Korean institutional sectors trade on the opposite side of foreign investors’ trading as trading counterparties at both short-term and medium-term horizons. This may imply that domestic institutional investors more or less absorb the shocks and mitigate market instabilities provoked by foreign investors. Domestic investors' counter-cyclical role with regard to foreign investors may be unintended due to their use of limit orders. Nevertheless, the increases in the market return following net buys of foreign investors reflect an imbalance in order flows, suggesting domestic investors’ limited liquidity provision or the possibility of some domestic investors’ herding to foreign investors.

Chapter V discusses undesirable consequences of institutional investors’ procyclical herding on stock markets and the real economy. The emergence of procyclical institutional investors as the major stock traders and shareholders has led to the short-termism of finance. Under the shareholder value-oriented system, short-term procyclical investors seriously undermine corporates’ decisions for efficient resource allocations over the long-term through generalized stock market mispricing or undesirable ownership engagement behavior in investees as the major shareholders. At a macroeconomic-level, procyclical herding creates amplified market cycles going with recurrent booms and busts, and increases short-term price volatilities when it comes to investors with ultra-short investment horizons in daily markets. The amplified market cycles influence the real economy, resulting in intense business cycles through the wealth effect and collateral effect. In this context, we should develop and incorporate macro-prudential policies for preventing procyclical herding in a broader range of the financial system beyond the banking sector. Finally, we should recover the financial system's fundamental function, making capitals provided to the real economy stably and efficiently with a long-term perspective. Especially, under existential threats of climate change, we should reorient stock markets toward sustainable finance providers to the real economy. The huge enabling power of institutional investors’ capital invested in stock markets should be mobilized to support a transition toward a low-carbon economy.

There remain challenges for more exploration. While chapter II identifies market mechanisms encouraging procyclical herding, their empirical detections are left for future research. It is challenging because it is not easy to quantitatively capture the mechanisms such as investors' expectations, high-frequency trading, or regulations on going-basis. Identifying key drivers of procyclical herding needs a different approach from the models of Chapters III and IV. It may require a procyclicality indicator constructed with pure trading volume data with market valuation effects excluded. Furthermore, while we construct a benchmark VAR model for a medium-term horizon using monthly data, we need to take a different approach for medium-term (monthly) and short-term (daily) horizon analyses. Given the statistical specificities of daily market returns, we need more sophisticated analysis using the time-varying volatility model to examine the relations between investment behavior and conditional volatilities, which is left for future research. Lastly, despite evidence of institutional investors' procyclical herding, macro-prudential policies to prevent the capital market procyclicality are under-discussed among international legislators and academic literature. We may need to expand discussion for developing macro-prudential measures aiming at procyclical institutional investors and market activities directly. Furthermore, it is now the time to think seriously about regulatory and institutional reforms for promoting long-term sustainable finance. Stock markets need institutions that can make the market convention supporting the low-carbon economy. More fundamentally, our society needs a paradigm shift capable of pushing us to transform our economic, social and political system toward a low-carbon economy.

APPENDIX

1. Estimation results of asymmetric regression model (2) [1),2)]

	Korea			Japan		
	IFs	ICPFs	Banks	IFs	ICPFs	Banks
$Return_{t-1}*D_t^{Boom,c}$	48.058** (2.220)	-34.191** (-2.201)	-2.049 (-0.315)	-2.253 (-0.167)	-76.952*** (-4.187)	-6.718 (-0.622)
$Return_{t-1}*D_t^{Bust,c}$	5.964 (0.345)	-5.224 (-0.351)	10.359*** (3.510)	-12.178** (-2.260)	-18.643* (-1.825)	-16.587* (-1.917)
Interest rate (ΔIR_{t-1})	290.404* (1.930)	-108.643 (-1.177)	-2.095 (-0.085)	-1163.347** (-2.481)	-408.803 (-0.748)	980.637** (2.592)
ΔGDP_{t-1}	-167.645 (-0.662)	134.747 (0.901)	-96.133** (-2.064)	25.393 (0.400)	-57.591 (-0.513)	-12.519 (-0.288)
inflation rate (π_{t-1})	-731.356** (-2.071)	537.192*** (2.724)	27.316 (0.445)	22.803 (0.319)	274.469*** (2.888)	46.475 (0.896)
Credit risk (CR_{t-1})	-638.158 (-1.208)	-179.362 (-0.486)	-244.197*** (-2.741)	-299.402*** (-2.953)	392.203 (1.633)	-474.291*** (-3.803)
Net inflows in liabilities (L_{t-1})	0.032 (1.573)	-0.030 (-0.001)	0.839 (0.183)	0.227*** (4.904)	-0.130 (-1.536)	0.005 (0.666)
Difference[3)] ($\hat{\beta}_{1i}^c - \hat{\beta}_{2i}^c$)	42.095 (1.379)	-28.968 (-1.259)	-12.409* (-1.693)	9.926 (0.690)	-58.309** (-2.851)	9.870 (0.711)
R2	0.338	0.117	0.082	0.546	0.462	0.389
Durbin-Watson stat	1.944	1.580	2.049	1.907	1.771	2.086

	U.S			France		
	IFs	ICPFs	Banks	IFs	ICPFs	Banks
$Return_{t-1}*D_t^{Boom,c}$	4.434** (2.199)	-1.112 (-0.215)	0.282* (1.675)	0.176* (1.742)	-0.038 (-0.804)	0.199* (1.767)
$Return_{t-1}*D_t^{Bust,c}$	0.774 (0.322)	10.051** (1.777)	-0.200 (-1.079)	-0.141 (-1.115)	-0.359 (-0.042)	0.301* (1.735)
Interest rate (ΔIR_{t-1})	26.222*** (2.738)	13.767 (1.054)	1.073** (2.400)	1.612*** (3.783)	0.138 (0.518)	0.508 (0.693)
ΔGDP_{t-1}	29.055 (1.247)	39.180 (0.680)	-1.788 (-0.959)	0.488 (0.343)	-0.590 (-0.781)	2.311 (0.972)
inflation rate (π_{t-1})	-28.013** (-2.055)	35.715 (1.325)	-1.412** (-1.789)	-2.157*** (-2.690)	-0.476 (-0.756)	2.524* (1.823)
Credit risk (CR_{t-1})	-6.897 (-0.299)	18.332 (0.418)	-0.466 (-0.320)	0.314 (0.272)	-1.707** (-2.190)	5.055*** (2.712)
Net inflows in liabilities (L_{t-1})	0.463** (2.103)	3.083** (2.458)	0.029*** (2.840)	0.122** (2.333)	0.103 (1.542)	-0.028* (-1.764)
Difference[3)] ($\hat{\beta}_{1i}^c - \hat{\beta}_{2i}^c$)	3.660 (1.222)	-11.163 (-1.584)	0.482* (1.975)	0.317* (1.940)	-0.034 (-0.348)	-0.103 (-0.497)
R2	0.533	0.274	0.245	0.335	0.129	0.179
Durbin-Watson stat	2.207	2.218	2.383	2.288	2.332	2.011

Notes: 1) *, **, *** means that the estimated coefficient is significant at the level of 10%, 5%, and 1%, respectively. 2) Numbers in parentheses are t-statistics obtained using White robust standard errors. 3) Wald test results under the null hypothesis, $\hat{\beta}_{1i}^c - \hat{\beta}_{2i}^c = 0$
Source: Author's calculation

2. Optimal lag order selection

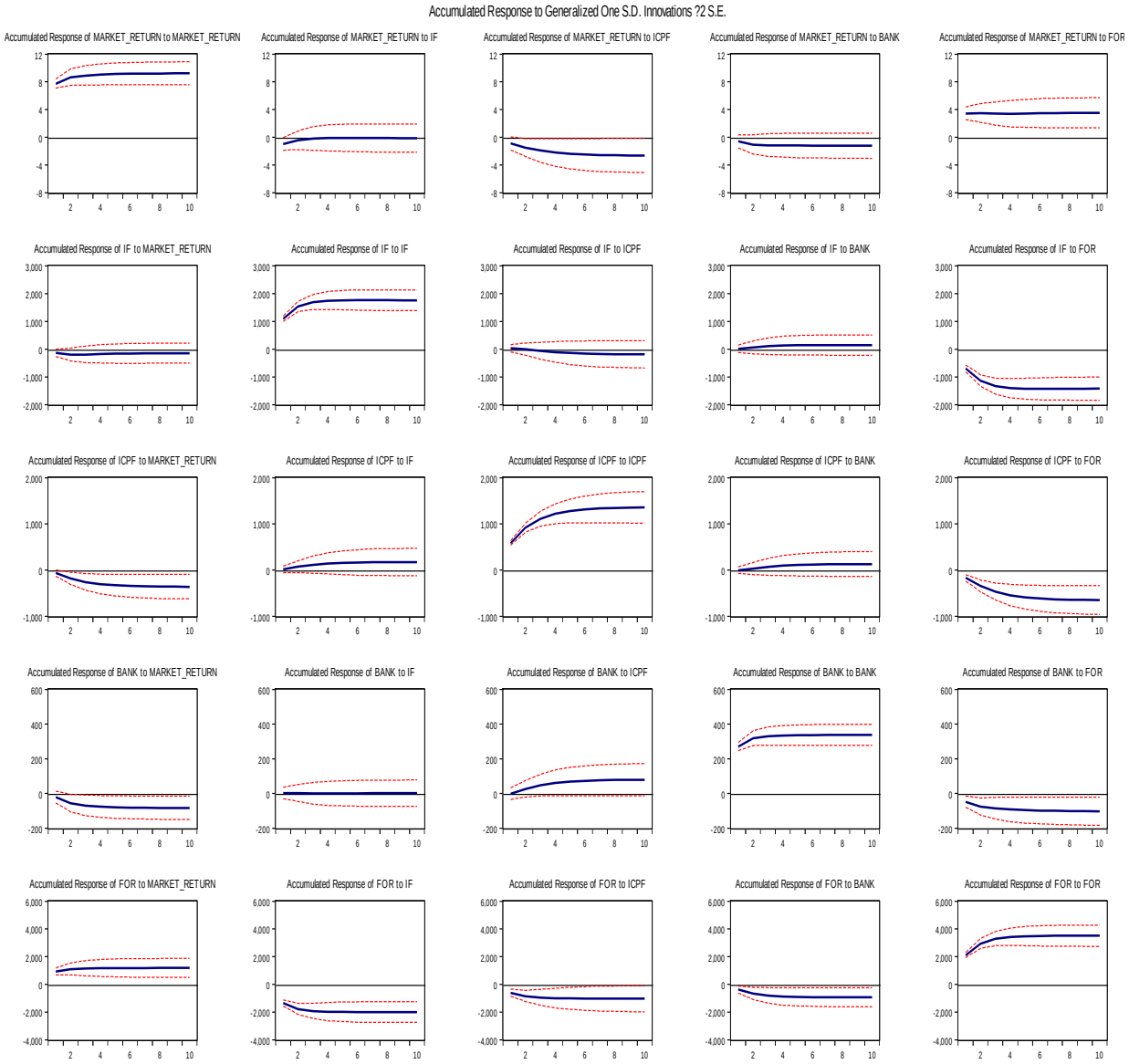
(Monthly data)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-16591.9	NA	7.24E+48	126.6937	126.7618	126.7211
1	-16477.2	224.1078	3.65e+48*	126.0091*	126.4177*	126.1734*
2	-16456.8	39.17715	3.78E+48	126.0439	126.793	126.345
3	-16430.4	49.56847	3.75E+48	126.0332	127.1228	126.4712
4	-16419.3	20.42922	4.17E+48	126.1393	127.5694	126.7141
5	-16403.1	29.10685	4.47E+48	126.2068	127.9774	126.9184
6	-16380.9	39.12370*	4.57E+48	126.2283	128.3393	127.0768
7	-16366.7	24.42996	4.98E+48	126.311	128.7626	127.2964
8	-16346.4	34.26802	5.19E+48	126.3468	129.1388	127.469

Notes: * indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

3. The cumulative VAR impulse responses

(Monthly data)



Notes: 1) Cumulative responses of other variables to one standard deviation positive shock in a variable. 2) Dotted lines in red mean the 95% confidence level bands based on asymptotic standard errors.
Source: Author's calculation

4. Optimal lag order selection

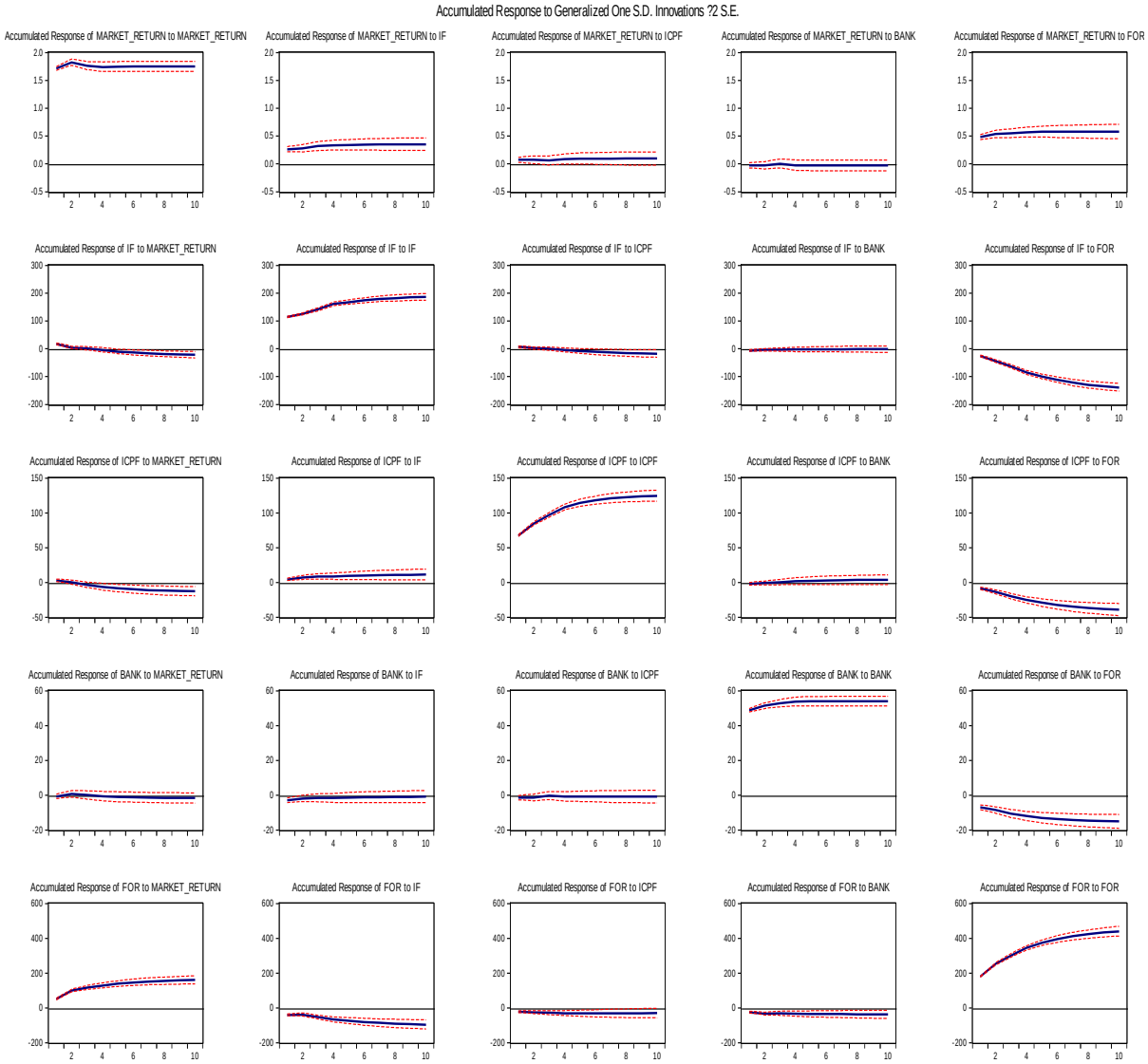
(Daily data)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-146275	NA	1.86E+16	51.65249	51.65835	51.65453
1	-144967	2613.594	1.18E+16	51.19939	51.23457	51.21164
2	-144688	557.3324	1.08E+16	51.10962	51.17412	51.13209
3	-144560	253.9621	1.04E+16	51.07349	51.16730*	51.10616
4	-144504	111.4401	1.03E+16	51.06257	51.1857	51.10545
5	-144444	119.7532	1.02E+16	51.05015	51.2026	51.10325*
6	-144420	48.18815	1.02E+16	51.05043	51.23219	51.11373
7	-144388	62.92458	1.02e+16*	51.04807*	51.25915	51.12159
8	-144368	40.13097*	1.02E+16	51.04977	51.29016	51.13349

Notes: * indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

5. The cumulative VAR impulse responses

(Daily data)



Notes: 1) Cumulative responses of other variables to one standard deviation positive shock in a variable. 2) Dotted lines in red mean the 95% confidence level bands based on asymptotic standard errors.

Source: Author's calculation

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