A Theory of Cash Hoarding: Long lasting effect of Liquidity Shock

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ABSTRACT

A neo classical model is proposed to highlight the firm's endogenous allocation decision over the liquid asset versus capital asset to the extent of firm size and liquidity shortage. Liquidity shock has a long lasting vestige on the firm's cash holding policy in the aftermath of Great recession. Precautionary demand prevails among the small firms while transaction cost concern matters for large firms. As the declining capital asset return entails liquidity hoarding, unilateral governmental sanction against the cash-hoarding may exacerbate investment among the small firms.

JEL classification: D92, F38, G01, G15, G18.

Keywords: Cash-hoarding, Precautionary demand for Liquidity, Transaction cost, Diminishing Capital asset return, Liquidity dry-up, Difference in Difference method.

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1. Introduction

In the wake of protracted economic crisis starting from the year of 2007, several governments adopt the lenient and unconventional monetary policy such as Zero Interest Rate Policy, Quantitative Easing, Credit Easing, Forward Guidance, etc., combined with the anemic economic recovery. The goal of such policy adoption among the developed countries is clearly to induce the financial institutions to make loan to the private sector so as to increase investments in the real sector and to reinvigorate the economic growth. Contrary to the wishful thoughts of the government, however, the amount of cash or cash equivalent instruments accumulated within the corporation has reached unprecedented level. Commercial banks rather increase the excess reserve in the central banks than make loans and corporations rather accumulate the cash reserve within the company than to make any *de facto* investments i.e. to launch new projects or to increase the R&D expenditure. As the global economy has faltered for the developed as well as emerging countries, most corporations seem reluctant to spend the R&D expenditure despite the governmental support. Thus it is natural for the public to decry not only the sheer size of cash reserve within the firm but also the portion of money within the asset portfolio of the corporations at hand despite the urge by the government for the corporations to do some investments.

According to the recent research, despite the substantial progress of the innovations made thus far, they are not easily translated into higher productivity and consequential economic growth, which has been dubbed as the revival of *Solow Productivity Paradox* (Acemoglu et al., 2014). As we see innovations everywhere but statistics, we may not unilaterally attribute the lackluster of economic recovery to the corporate hoarding of cash. Considering the incremental household debt and deleveraging in the financial sector, we need to analyze the corporate activity such as cash hoarding within the economy wise perspective taking into account of the household purchasing power without cutting welfare spending and governmental budget capacity to sustain the fiscal deficit without tax raising. Then we can contrive an idea to implement the policy how to incentivize the corporations to make investments.

Before 2008, in spite of the apparent worries among the scholars and warnings from the bystanders, substantial number of managers confess that they cannot stop dancing as long as the music is on. Thus a sudden change of phase would or should incur a severely biased reaction leading to several bottleneck phenomena in asset markets such as fire-sale or flight to quality, which clearly exacerbate the already feeble economy. According to Eggertsson and Krugman (2012), several economists such as Fisher, Minsky, and Koo have pointed out the possibility of these kinds of traps, which are dubbed as Minsky moment or Balance sheet deleveraging distress. In the face of prolonged secular stagnation or even the possible deflation threat, the cash may surely possess some advantage in the short run at least.

In the long run, holding cash for such a long period is clearly detrimental to economic growth let alone the financial robustness unless the economy is sustained despite the prolonged deflation. As the economy fluctuates from the boom to the recess or to the bust, the corporations are, should be, aware of the debacles and plights when faced with the shortage of liquidity. Thus, it would be strategic choice for the corporations to build up cash or cash equivalent as long as the economy swings abruptly in the short run and it is very difficult to forecast the exact timing of the start of collapse or bust due to the increased uncertainty as emphasized in Bigio (2015). Particularly when the economy is most in need of liquidity, cash becomes an indispensable asset regardless of whether money plays either role as a medium of exchange or as a storage of value or both. Thus,

the importance of money can never be exaggerated during the period of extended uncertainty.

Despite the clear lackluster of investment opportunity, hoarding cash has become a target on which people put blame as a main culprit to aggravate the economy otherwise used to provide the liquidity into the economy, to create job opportunity, and consequently to contribute to reduce the unemployment rate. However, it would be more effective and better suited for the government to start public investment than to elicit the private investment from the corporations particularly when the economy is stagnant. In this regard, the liquidity provided by the government plays a crucial role towards the recovery of economy through the expansionary fiscal policy combined with quantitative easing. At the corporate level, the mismatch of maturity between the assets and liabilities turns out to be a serious even perilous threat to the survival of firms due to the reduced pledgeability of assets. Holmström and Tirole (2011) claims that the firms hoard cash to compete for the long term assets in the fire sales from the distressed firms or the precautionary hoarding of cash results from the anticipation of market freeze. Therefore the firms tend to hoard liquidity when the secondary market for the legacy asset is expected to be illiquid as the prospect of economy is stagnant. In this regard but with nuanced tone, Summers(2015) conjured up a catch phrase 'secular stagnation' from an quite an old memoir and Krugman (2013) picked it up for a widely circulated slogan. Demographic change with lower birth rate and consequential decline of consumption is a well-founded theoretical explanation for the perpetual stagnation.

Kozlowski et al (2017) propose another explanation in light of long lasting effect of unthinkable events on the people's fear and consequential modification of peoples' decision. The current theory is consistent with the notion of harboring fear among the consumers in that firm's decision on the asset allocation is also permanently changed due to the liquidity freeze in the wake of Great recession. In order to navigate through the ocean of economy, a firm needs to manage an optimal allocation of assets and should be prepared for the upcoming turbulence. As money is invented to facilitate the commercial trade, it is not only used to measure the value of asset but also used for the storage of value. Under a certain economic situation, corporations and consumers choose to make the most of the role of value storage from the money or cash. Thus the benefit of hoarding cash might be most pronounced during the protracted economic crises. To that regard, the Great Recession would the most important event in the studies on the cash hoarding literature because it provides a window through which we can observe how the responses among the corporations vary particularly in light of cash reserves in the face of imminent predicament or an ongoing plight. Thus the year of 2007 must be a critical moment at which we can observe the way how the cash policy has been incorporated within the corporate management.

A marginal value of cash could be larger than one per unit currency particularly when the long-term assets for the firm are under the pressure of sales postulated to be a hedging tool in negative debt in Acharya et al (2007). Particularly the buildup of cash is necessary for the protection of value of fixed assets such as property plant and equipment that are subject to fire sale in case of imminent default due to the shortage of current asset used to fulfill the obligation of current liability such as interest payment etc. This would be more pronounced when the consumers succumb to the liquidity trap as a result of declining economy. It would be exacerbated due to the grim outlook of economy and soaring unemployment rate since the cash flow from the operation is likely to remain lower than the level sufficient enough to keep the operation running for a prolonged period due to the contracted aggregate demand. Then the marginal value of cash could be larger than its unit value.

2. Literature review

Modern literature on the cash holding dates back to the Keynes (1936) who postulated the precautionary demand for holding cash. Since then, there are four prominent arenas in the theoretical research on the cash holding: precautionary demand motive, transaction cost approach, agency cost literature, and the taxation motive for the multinational firms. Even though the repatriation tax motive is directly related with the cash hoarding, we omit the tax motive in the current analysis since the country specific rule is the driving force for the cash hoarding lacking generality. Consequential empirical research produces huge volume looking for empirical support towards each theory despite the countervailing hypotheses under which each theory is developed.

The parlance of precautionary demand for cash is properly addressed under the passage of uncertainty and/or risk aversion. As is well demonstrated in the wake of 2008 economic crisis, the liquidity is totally dried up in the financial market and the credit market is not working at all at the outbreak of economic crisis. The same shutdown of credit market must have happened in 1929, which urged Keynes to mention the precautionary demand of cash for consumers. Hence the uncertainty and the opaque prospect of economy could have a confounding outcome despite the apparent decrease of interest cost. Thus in the wake of crisis, the merger waves are more likely to occur when the liquidity shock is severe and wide (Maksimovic et. al., 2013)

As the opportunity cost of cash holding is the foregone earnings from the more profitable projects though riskier, the transaction cost arises because the capital market is imperfect. As the information asymmetry entails larger discount cost than normal for the external financing, cash is preferred in the face of investment opportunity. So, a certain level of cash is legitimized in a sense that the external financing entails higher cost for the firm due to the information asymmetry regarding the firm's prospect. In light of Myers (1984), the relative advantage of cash in terms of financing cost warrants the ordinal preference over the differing financing sources. Thus the financing frictions incurred by the information asymmetry determines the associated capital cost so that the cash holding is predicted to have positive relation with the extent of information asymmetry regarding the future prospect of the company. The larger the external capital cost is, the more cash holding for the distressed company.

This external capital cost could be readily extended to the precipitate liquidation of physical assets or projects particularly when the distressed firm needs liquidity. Cash strapped firm faces huge discount for the legacy asset, which was used optimally, as long as the industry wise liquidity shock prevails even though the asset is not subject to adverse selection. Simply speaking the firm cannot find a buyer with enough cash for the legacy asset within the same industry. If the legacy asset is sold for the alternative use in the other industry, its future cash-flow is lower than the current usage. Hence the transaction cost motive is related with the information asymmetry as to the prospect of firm or project (Shleifer and Vishny, 1992). Therefore, adverse selection plays crucial role in determining the magnitude of transaction cost.

Extending the window of period for the firm who is subject to the higher external capital cost, we could legitimately expect the fluctuation of the cash holding level over the cycle of economy. When the economy is in the boom, the need for cash is diminished as the liquidity is abundant for a firm to finance the new project or to continue the business under way. As the economy is declining into the upcoming recess, the external capital cost matters so that the company needs to build up and accumulate cash to maintain the current operation. It is very difficult for the firm to persevere the following years since the outbreak of 2008 economic crisis. It should be much

worse for the firms without cash buffer since the liquidity is dried up and the credit is totally frozen in the market as the majority of the firms seemed neither recognize nor admit the build-up of bubble within the economy, which entails the abrupt crash of bubbles. So it is natural to postulate the firm is in need of precautionary demand for the cash in the wake of Great Depression due to the exacerbated financing friction. Also, various extent of access difficulties to the capital market is clearly a primary reason why a constrained firm would like to hold cash for the precautionary demand as well as a portfolio of assets due to the underdevelopment of financial market. This array of research is not pursued in the current paper. We are interested in the firms with the relatively well-developed capital markets that have experienced severe dry-up of liquidity and credit during the outbreak of great recession and over the course of stagnant economic recovery.

On the other hand, the excessive cash holding is due to the inefficiency in corporate management in lieu of agency cost. The empirical researches support the opposite prediction such that the entrenched manager tends to thwart the cash reserve to make overinvestment in the far sighted project. Within the domain of business, the value of cash can never be as emphasized as in an adage that says cash is the lifeblood of business enterprise. However, holding cash was regarded as a value destroying activity in light of agency cost literature, which entails an unfettered pursuit of investment whose net present value is negative or whose prospect is too farsighted. So cash reserve is accumulated within the company if it is not disbursed to the shareholders despite the abundant free cash flow. In this regard, Liu (2013) revisited the investment–cashflow sensitivity issue in light of SME and the large firms. Then, the retained cash could be likely to be wasted on the projects that serve the manger's entrenchment at the expense of shareholders' value (Jensen, 1986).

In the ensuing agency conflict literature, the agency cost could be realized not only in the personal benefit from the accumulated cash but also in the entrenchment from the overinvestment in the long term project. Hence, the overinvestment would reduce the cash level within the firm as suggested in Harford et. al. (2007) whereas the weak governance leads to higher cash holding with the less disbursement of cash to the shareholders in Dittmar et al. (2007). In an extension of agency cost literature, Liu Y. at al (2014) look into to the role of incentive from the pension payment to the benefit of the incumbent CEO with respect to the cash hoarding. Gao et. al. (2013) compares the cash holding policy between the public firms and private firms to find the mixed result on the agency problem. Consequently, the cash level may not be appropriate indicator of the magnitude of agency cost effect.

These two distinctive arguments may result from the observation of one side of the same coin. Their claims could be plausible, however, when the economy is relatively stable following the sustainable track or oscillation of economic cycle neither in the apex of boom nor in the abyss of bust. Hence, the previous research on the cash holdings within the firm has naturally focused on the determinants of the cash holding policy under the premise that the cash does neither produce any positive profit nor interest but merely subject to the negative profit with the normal inflation. These approaches may not be appropriate for the research on the cash hoarding before and after the outbreak of Great Recession. Setting up the hypotheses based upon the aforementioned prominent theories, many empirical researchers have studied the determinants of cash-holding motives in light of the varying features of firm size, industry and country. The empirical literature starts with the country specific one, proceeds to the industry-wise, and then firm specific literature is addressed.

Country specific research has shown that the financially less constrained firms with larger

physical assets is predicted not to hold cash in lieu of transaction cost. Then the financially less constrained firm could even reduce the debt cost when the firm increases the fraction of short term debt. Sher (2014) observes that the median Japanese firms increase the cash holdings when the loan rate is declining, which is contrary to the prediction based on the transaction cost motive or precautionary demand. Thus the observed stylized facts demand the development of unified model, which could incorporate the seemingly paradoxical prediction of the extant theories. Ali and Yousaf (2103) could not find whether transaction cost approach prevails over the managerial opportunism or not in the German market. In contrast, Hilgen (2015) finds that the transaction cost issue more relevant than others among the firms in Germany. Zhang et al. (2015) compares the cash holding policy between China and Germany and do not find that the under development of financial market aggravate the agency cost problem. As for the cash policy within the specific industry, in the restaurant and real estate industry respectively are conducted by Kim et al. (2011) and Hardin et al. (2009) in light of precautionary demand, agency cost, and external financing cost. However these researches could not identify the deterministic feature that determined the variation of outcomes due to the relatively short sample period. The relationship between the financial slack and R&D investment was elucidated in Lewis (2013) but ends up with weak ties.

In relation to the cash holding, the refinancing risk is addressed in lieu of inefficient liquidation in Diamond (1991, 1993) and Sharpe (1991) whereas the continuation value surpasses the liquidation value, the fire-sale of fixed assets in Brunnermeier and Yogo (2009), and underinvestment problem as in Almeida et al. (2012) respectively. Consequently, Harford et al. (2014) claims that the refinancing risk is a crucial component in determining the level of cash holding in light of the trade-off balance between the cost of holding large cash and the benefit of reduced refinancing risk. As the fraction of shorter maturity debt is increased, the frequency of refinancing is increased so that the cash-holding level becomes larger to attenuate the risk associated with refinancing. In their analysis, it is noteworthy that the ratio of long-term debt due over the next three years to the total long-term debt is positively related with the cash-holding whereas the loan spread which is measured by the spread between the commercial *and* industry loan rate and the federal funds rate is negatively related with particularly when the credit market is lenient during the period spanning from 1980 to 2008. But the sign of the aforementioned coefficient is reversed to the significantly positive number as the credit market is evolved to become tighter over the same period. This tendency is clearly shown as the magnitude of coefficient changes from 0.619 to 1.967 when the credit market is tightening in lieu of the spread. As the coefficient becomes quite smaller (0.076) with less significance for the *tightest* periods for the credit market, this indicates that the level of cash holding is not affected by the change of spread as the liquidity is dried up and the credit market is frozen.[1] Thus these results are indicative of the sensitivity of firm's financial policy does not respond unilaterally as the lenience of credit market measured in lieu of loan rate spread varies along with the economic fluctuation, even though the federal funds rate is adjusted to counter balance the business cycle which the credit cycle precedes.

[1] Harford et al. (2014) includes the C&I rate spread to reflect the overall joint effect of credit spread on the firm's refinancing risk. However, an individual firm's spread is increased particularly when the default risk is expected to be high for the firm. Consequently, the firm responds with the increased cash holding or liquid assets to ameliorate the credit constraints. Also, as the business activity is definitely affected by the prospect of economic growth, the federal funds rate is adjusted independent of the firm's credit condition so that it may not be in compatible with the recession during which the credit market is contracted and tight. By the way, two consecutive quarter of declining real GDP is the necessary condition for the recession.

In Faulkender and Wang (2006), the marginal value of cash is declining over the level of debt, the size of extant cash holdings, and the degree of accessibility to the capital market. However, the implication of the analysis is limited to the cross sectional variation of the features of the firms under consideration. More direct and relevant measure of credit risk is adopted to estimate its effect on the cash-holding in Acharya et al. (2012), in light of the endogeneity of cash policy, which shapes the composition of asset portfolio depending upon the liability structure. Foley et al (2007) explore the relationship between the tax rate change and cash holding in US.

Ambiguous empirical results may be due to the limitation of proxy variables used to test the hypotheses as to the determinants of cash holding. Interacting features of the factors and elements clearly identified in the theories could be blurred in the empirical test. Furthermore, when the clear-cut hypotheses are developed, they have to be subject to the implicit *ceteris paribus* condition. As those hypotheses are tested against the observed outcomes, they could not maintain the consistency with the theory. Also, once salient features could be any more salient as the time goes by. The sensitivity of cash holding in light of the agency theory could be attenuated over time as the legal environment is changed accordingly. Thus the economic, and social circumstances prevent the entrenched manager from pursuing his or her own benefit at the expense of other stake holders. This tendency had been fortified and reinforced for the past several decades. For example, the required revelation of detailed information of the top five highly paid executive officers' was enacted since 1992. The legislation of Sarbanes-Oxley Act[2] in 2002, and Dodd-Frank Wall Street Reform and Consumer Protection Act in 2010 were in order. As the governance issue had received quite a spotlight for the past several years, the management team is less inclined to allocate firm's assets into cash without any rationale for the pursuit of its own benefit at the expense of enterprise value. It is noteworthy that marginal value of cash becomes larger than one even for the incumbent manger when the economy is stagnant.

Though the extant theories emphasizes a specific aspect of inherently multi-faceted motives of corporate cash holding, empirical research tends to support a certain feature which becomes dominant over others during a certain era under a certain government policy. Thus the demarcation between and among the prevailing theories on the cash holding motives is inadequately clear-cut so that the consequential empirical tests are prone to show the mixed or even opposite signs depending upon the differing sample period. Even though the hypotheses developed from the theories are tested against the longitudinal data, the relative strength of relevance to the cash holding motive may vary over the passage of time within the variables under consideration. Also for the cross-sectional data, the economic paradigm at a certain point of time are inevitably subject to modification along with the change of economic environments and social norms. Therefore we need to develop the testable hypotheses that incorporates the macroeconomic components such as GDP or prevailing interest rate as well as firm specific features such as cash ratio, capital structure and so on.

The current paper uses the data out of the accounting reports as most researches on the cash holding do. Firms raise the external financing to be used either for the buildup of liquidity or for the capital assets. Without the external financing, the firm converts the capital assets into cash through the sale in need of liquidity. With these accounting information, we conduct empirical tests to answers the questions such as why does the level of cash holding differ from each other among the group of companies, different countries, and various time periods, how should the

[2] Officially, the act is known as Public Company Accounting Reform and Investor Protection Act in the Senate and Corporate and Auditing Accountability and Responsibility Act in the House respectively.

cash-holding level evolve to optimize the marginal value of cash for the shareholders or for the incumbent manager at the expense of other stakeholders' benefit, or whether the cash holding level continually fluctuate over the trend in accordance with economic business cycle.

The cash-holding issues are addressed in light of the usage of cash within the company and how does the cash holding evolve so as to incorporate the changing business environments into the portfolio construction of assets as the economy is stagnant. As we conduct an empirical analysis with the sample firms collected from the countries listed above the data are available through the help of BUREAU van DIJK which provide the information on listed, and major unlisted/delisted, companies around the world. Throughout this paper, we set up the hypotheses stemming from the theoretical analyses as to the liquidity demand by firms based on the information-related literature. Thus our approach could help identify the fundamental features of cash in relation to the imperfect capital market.

As the yearly number of firms in the sample used in the current study is 85,559 firm-years[3] spanning from 2002 to 2015 encompassing the seven countries such as China, France, Germany, Japan, Korea, United Kingdom, and United States, the sheer size of samples in this study would allow us to take non-parametric approach without much concern over the validity of parameters. Previous studies need to adopt several technical methods to attenuate the biased estimator, which would be significantly pronounced particularly when the sample size is small. For the empirical part, we focus on the role of cash and its marginal value in relation to the value of long term assets such as property plant and equipment in light of capital expenditure and retention of the value of fixed assets to avoid the fire sale. In the following section we develop a theoretic model, which features the optimal allocation of assets in order to assure the net return out of the assets within the firm. Then we develop several testable hypotheses and conduct the empirical results. In conclusion, the discussion and policy implication are addressed.

3. Development of model

Consistent with the conventional tenet in the corporate finance literature, a firm is assumed to be a net present value maximizer. The firm incurs external financing to pursue a profitable project whose contribution to the value of the firm is positive ex ante. Considering the cost associated with the external financing and the benefit from the investment, the firm decides not only the amount but also the allocation of the external finance between the capital assets and the liquid assets. In the similar vein, Kim C. et. al. (1998) studies the firm's decision to build up the liquid asset with the costly external financing in the face of future cash-flow fluctuation. Our model differs from them in that the immediate liquidity is the primary concern that drives the build-up of liquidity asset with the declining market return of capital asset.

As a result, we could find a change of the capital assets and the liquid assets and the consequential portfolio of assets comprising with physical capital and liquid assets at the end of each fiscal year. Therefore the current model is expected to reflect the discrete feature of accounting report. In the long run, the annual observation could be dealt with in the dynamic construct but it requires quite a long period of time. Also dynamic feature could be possible if the observation frequency is increased with the monthly or daily data. However, the change of asset portfolio is not only difficult to trace but also infrequent to occur during the fiscal year[4]. Hence we

[3] These data are available at the Osiris BUREAU van DJIK

[4] Even if the firm keeps the transaction record, the details of flow is reported at the end of fiscal year in the

utilize a static yearly overlapping model which is derived from the dynamic model developed by Eisfeldt and Muir (2015).

At each year, the firm inherit the previous year factor as given such that K_{t-1}, L_{t-1} whose production function is $Y=F(K_{t-1}, L_{t-1})$. When the firm raises an external financing, part of which is converted into the net incremental capital asset k_t, the depreciation δ_t, and the other part of which is invested in the incremental liquid assets l_t. Therefore when the firm is engaged in output production via utilizing the incremental capital asset, the total incremental capital asset equal to $k_t + \delta_t$ is used as input for the additional output with the technology $0< z(t) \leq 1$ at time t. So the net increase of output thanks to the incremental capital asset is generated by the production function $z(t)(k_t + \delta_t)^{\theta}$, which is subject to the diminishing return to scale with $0 < \underline{\theta} \leq \theta \leq \overline{\theta} <1$. The exponent of production function θ could be deciphered as the incremental scale of sales revenue for example.

As for the liquid assets, we postulate that the benefit of cash as a buffer against the delinquency or default surpass the cost of positive inflation so that the firm has incentive to retain the required minimal level of cash for each fiscal period. The gross return of liquid assets $R_l >0$ is, nonetheless, assumed to remain close to one and the real rate of return of liquid assets remains relatively stable over time, even if it is subject to the significant decline when the starkly rising inflation. Also, it is appropriate that the benefit is lower than the external finance cost, otherwise banks would like to keep the cash within and decides not to lend it to the borrowers. Therefore, the direct cost of external financing is incurred as $[\pi(t)/2] \cdot e^2>0$ when $e<0$ and as zero when $e \geq 0$.

In the current paper, as we postulate no adjustment cost of capital, no depreciation of capital assets, we could narrow our focus on the external financing decision for the upcoming fiscal year. Then at the start of each point of time t, the firm's net change of capital asset and liquid asset is normalized to zero for the upcoming fiscal year. The firm decides the external finance in light of the incremental return of capital assets in relation to the external finance. As mentioned previously, the external finance cost is assumed to be always higher than the return of liquid assets without loss of generality. If the net present value of new project is positive and the internal rate of return is larger than the external finance cost, the firm decides to start the project instantly as long as the spread between the internal rate of return and its external financing cost is larger than the marginal benefit of liquid assets. Otherwise, no incremental investment is made in the liquid assets. Thus the firm's decision on the capital asset and liquid assets is determined by the relative size of the marginal return from the capital assets over the marginal benefit of liquid assets. Even with the retained earnings, the firm could build up more capital assets. As the marginal return of capital asset is decreasing over the scale within the firm, the fluctuation of business cycle matters and the change of economic growth rate could affect the portfolio of liquid assets in relation to the capital assets.

The cost of external finance is convexly increasing over the scale of external finance. The size of *net* external finance 'e' is determined by the scale of incremental investment k in capital assets and the incremental investment in liquid assets l such that the identity equation should be $e+k+l=0$ where $e \leq 0$. The implication of the identity equation $e+k+l=0$ is as follows; when $e=0$, no external financing takes place. So the firm must finance the liquidity build-up by the sale of capital

form of income statement. So the dynamic model may need quite a long longitudinal date for the empirical test.

assets that is k<0 or purchase capital assets by the erosion of liquidity assets such that l <0. Negative value of e entails external financing occurs and the firm must have made a positive incremental investment with external finance in both of them or either of them at least. As the external finance entails the debt issuance or the equity offer to the public at the stock market, we postulate that per unit cost of external finance is the weighted average cost of capital. Then, the firm's objective function looks like the one as follows because the firm only focuses on the incremental benefit and cost plus the benefit from the endowment.

$$\max_{k,l}\left[z(t)(k_t+\delta_t)^{\theta}+l_tR_l\right]-\frac{\pi}{2}{e_t}^2 \tag{1}$$

$$\text{s.t. } e_t+k_t+\delta_t+l_t=0 \text{ and } e_t\leq 0$$

The shadow price of external financing is set up for the non-positivity of external financing such that $\psi \geq 0$. As the shadow price for the external financing is incurred exogenously as the constraint ψ>0, it should be interpreted as the credit rationing, the dry-up of liquidity, the halted transaction thanks to the contagion of crisis or the economy wise shock. Thus it reflects the implicit cost that is not properly reflected in the official or market interest rate due to the incomplete financial market. With ψ =0, the external financing is available within the economy. Once the external financing becomes available, then the shadow price should be zero and what matters is the direct cost of external financing $(\pi/2)\cdot e^2$. Also the shadow price of external financing should be larger than or equal to the marginal rate return of incremental capital asset $\psi \geq \theta z(t)(k_t+\delta_t)^{\theta-1}$ for all positive k. Otherwise the firm could always find a source of external financing so that the capital asset is increased via external financing.

In this model we do not consider the effect of depreciation tax shield on external financing decision for simplicity and convenience. The presence of deprecation δ > 0 makes the magnitude of marginal production of incremental net capital more realistic at finite positive value $\theta z(\delta_t)^{\theta-1}$ when k = 0. Without positive depreciation, the marginal rate of production of incremental capital assets will be infinite at k=0+ which is quite unrealistic and violates the presence of no external financing. Thus we could postulate a constant amount of depreciation out of the incremental capital asset $\delta_t=\bar{\delta}$ over time and $\psi \geq \theta z(\bar{\delta})^{\theta-1}$without loss of generality.

$$\max_{k,l}\left[z(k_t+\delta)^{\theta}+l_tR_l\right]-\frac{\pi}{2}{e_t}^2 \text{ s.t. } e_t+k_t+\delta+l_t=0 \text{ and } e_t\leq 0 \tag{2}$$

If the external financing is not binding, the internally generated cash such as retained earnings could be used to finance the incremental capital asset if needed. Or the sale of capital asset results in for the firm to increase the liquid assets with excessive capital asset. Under the economic condition in which the external financing is not available, we could postulate that the shadow price of external financing is larger than the return of liquid asset with $R_l<\psi$. Otherwise, the firm could build up the liquid asset indefinitely where$R_l>\psi$. This case would be referred to as liquidity trap where the financial market remains frozen, even though the government flooded the economy with cash. In the following analysis we could drop the time variant since the firm decides its own portfolio allocation and external financing independently at each fiscal year.

3.1. External financing is binding

When the external financing is binding, that is, the external financing is available ψ=0, the optimal level of incremental capital and liquid assets are determined respectively as follows. The first order condition for the increment investment in the liquid assets *l* and in the capital assets *k* is as follows Firstly, if $\theta z(-e)^{\theta-1} > R_l$ is equivalent to where $-e = k + \delta + l > 0$, then the optimal liquid asset from the external financing will be zero. Consequently the first order condition of the equation (2) with respect to the incremental capital asset k is as follows$\theta z(k^* + \delta)^{\theta-1} = \pi(k^* + \delta)$. Thus,

$$\begin{aligned} l^* &= 0 \\ k^* &= \left(\frac{\theta z}{\pi}\right)^{\frac{1}{2-\theta}} - \delta \text{ where } \psi = 0 \\ -e^* &= \left(\frac{\theta z}{\pi}\right)^{\frac{1}{2-\theta}} \end{aligned} \tag{3}$$

Now the firm faces the external financing constraint but could enjoy the potential benefit through transforming the extant liquid asset into capital asset investment, since the marginal return of the incremental capital asset exceeds the marginal return of liquid asset $\theta z(-e)^{\theta-1} > R_l$, which incurs no external financing cost in lieu of Myers (1984). However, we could assume away the concern because the firm has chosen the minimal required liquid asset at the end of the last fiscal year.

Secondly, if the $\theta z(-e)^{\theta-1} \leq R_l$ and $-e = k + \delta + l > 0$, then the optimal incremental capital asset is restricted to the level that satisfies the constraint $\theta z(k^* + \delta)^{\theta-1} = R_l$ because the additional capital asset earns less than the liquid asset return R_l. Then, the optimal level of *k* and *l* are determined by the constraint $\pi(-e) = R_l$ and$\theta z(k^* + \delta)^{\theta-1} = R_l$.

$$\begin{aligned} l^* &= \frac{R_l}{\pi} - \left(\frac{\theta z}{R_l}\right)^{\frac{1}{1-\theta}} \\ k^* &= \left(\frac{\theta z}{R_l}\right)^{\frac{1}{1-\theta}} - \delta \qquad \text{where } \psi = 0 \\ -e^* &= \frac{R_l}{\pi} \end{aligned} \tag{4}$$

Given that the external financing is available, the size of external financing is determined by the ratio between the rate of return of liquid asset and the borrowing interest cost. It is noteworthy that the size of external financing is determined by the spread between the rate of return of liquid asset and the marginal cost of incremental capital asset. Taking logarithm value leads to $\ln(-e^*) = \ln R_l - \ln \pi$, which has an empirical inference as the borrowing is increased thanks to the increased return on the liquid asset and the decreased borrowing cost.

3.2. External financing is not binding

The first order condition for the incremental investment in liquid asset *l* when the external financing is not binding.

$$\psi > R_l = \theta z(\delta + l^*)^{\theta-1} \text{ where } \psi > 0 \text{ and } e = 0, l^* = -k > 0, k < 0 \tag{5}$$

The right hand side of the equation (5) results from the overinvestment in the capital asset in the previous fiscal year and relative shortage of liquid assets. Therefore the firm in the following fiscal year is required to reduce the capital asset in order to increase the liquid asset. Consequently, the firm is engaged in the sale of capital assets to increased liquid asset. On the other hand, the first order condition for the incremental capital asset k when the external financing is not binding is as follows.

$$\psi > \theta z(k^* + \delta)^{\theta-1} = R_l \text{ where } \psi>0 \text{ and } e = 0, l < 0, k^*=-l > 0 \tag{6}$$

As the external financing is blocked due to the substantial cost $\psi \geq \theta z(\delta)^{\theta-1} > 0$ where $k = 0$, the firm cannot but raise the internally generated cash to finance the needed capital asset. Thus the shadow price of external financing could be translated as the adverse selection cost in lieu of Holmström and Tirole (2011). Adverse selection tends to become severe and claim higher discount when the economy is in recess. When the economy is normal and the financial market is working, the sale of capital asset is less likely to be treated as the sale of lower quality capital asset.

Thus, via increasing the capital asset by reducing the liquid assets, the firm could reallocate the asset portfolio optimally. This implies that in the previous year, the firm has built up too much liquid asset or too small capital asset but the external financing is not available yet. As long as the marginal return of incremental capital asset is larger than the return of liquid asset, the firm will increase the incremental capital k through the sale of liquid assets or vice versa. So when the external financing is not binding, the optimal level of liquid asset is increased by the sale of capital asset or the optimal capital asset is increased by the reduction of liquid assets.

$$l^* = \left(\frac{\theta z}{R_l}\right)^{\frac{1}{1-\theta}} - \delta > 0 \quad \text{and} \quad l^* = -k^* > 0 \quad \text{when } \psi > 0 \text{ and } e = 0 \tag{7}$$

$$k^* = \left(\frac{\theta z}{R_l}\right)^{\frac{1}{1-\theta}} - \delta > 0 \quad \text{and} \quad k^* = -l^* > 0 \quad \text{when } \psi > 0 \text{ and } e = 0 \tag{8}$$

As the external financing is not available, then the marginal return of incremental capital should be a mirror image[5] of the marginal return of capital investment with external financing because the external financing availability of For the sale of capital asset to increase the liquid asset, the build-up of liquid asset continues until the marginal rate of return of capital asset is increased to be equal to the rate of return of liquid asset.

As the production function $z(k^* + \delta)^{\theta}$ is subject to the decreasing marginal rate of return for the incremental capital assets, it could be understood as the earnings before interest and taxes or EBIT. Also as the marginal rate of return from the incremental capital asset is given as $\theta z(k + \delta)^{\theta-1}$, the exponent θ is deciphered as the operational efficiency of a firm such as asset turnover ratio and the change of θ is delivered to the variation of EBIT as $\theta \epsilon [\underline{\theta}, \overline{\theta}]$ when the firm's technology $z(t)$ remains intact. Then, we could easily see that the optimal level of incremental capital k^* is increased to where the marginal rate of return over the net incremental capital $\theta z(k^* + \delta)^{\theta-1} = R_l$ is reduced as shown in the equation (8) because of the positive $\psi > 0$. This result clearly demonstrates that the rate of return for the incremental capital should be large

[5] See the Fig. 1.

enough cover the external financing cost and the shadow price of incremental liquid asset i.e. ψ.

In the Fig. 1, the north-east side of graph represents the area where the external financing is available with the binding constraint of external financing $e+k+l = 0$, $-e > 0$ and $\psi = 0$. In contrast, the north-west side of the plane shows the non-binding constraint of external financing where the shadow price of external financing is positive $\psi > 0$, $-e=0$, and $k+l=0$. Also the shadow price of external financing exceeds the marginal return of incremental capital asset. The slopes of direct cost of external financing radiate from the origin and pivots as the cost varies.

The green colored solid curvature represents the marginal production function with the exponent θ where the external financing is available and where the external financing is not available respectively. In the Northwest side of the zero point of the plane, the red colored curvature is the marginal production function of the firm is deteriorated from $\bar{\theta}$ to the lower level with $\underline{\theta}$ where $\underline{\theta} < \bar{\theta}$, as the economy remains stagnant. Therefore the fire sale of capital asset sale could result in the hoarding of liquid asset. However, as the capital asset within the firm is decreased, the marginal rate of return from the capital asset could be increased as the marginal production function is shifted from the red one $\underline{\theta}z(-k^*)^{\underline{\theta}-1}$ to the blue one. Then in the following fiscal year, the firm could transform the liquid asset into the incremental capital asset to the $-l = k$ to the point f in north-west side of the graph. Despite the disappearance of external financing market, as long as the firm can maintain the normal marginal production function with θ, the firm would use the liquid asset to invest in the capital asset as much as $g = k^* = -l^*$ along with $\bar{\theta}z(-l^*)^{\bar{\theta}-1}$.

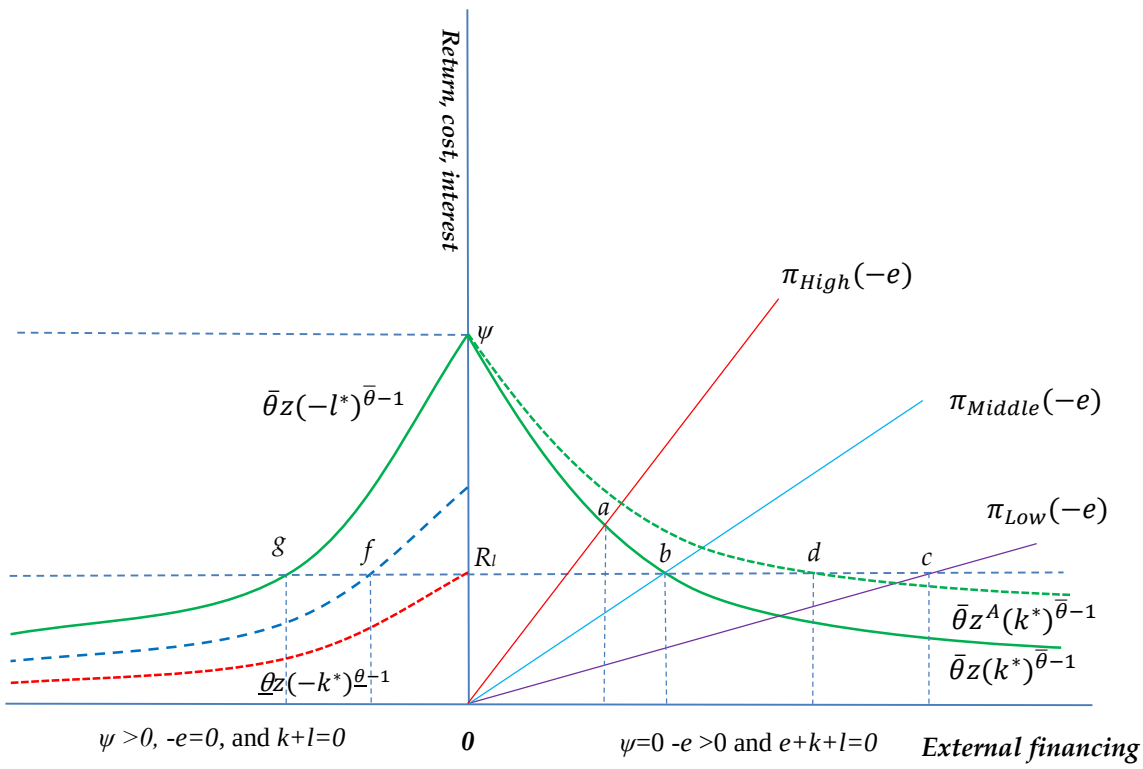

Fig. 1. Asset allocation curve with varying external financing cost: External financing cost function is denoted as $\pi(-e)$ and the marginal return of capital asset is represented as $\theta z(-e)^{\theta-1}$.

4. Dynamic external financing

5. **Model in Light of Observed Facts**

Current paper portrayed a firm as a net return maximizer of incremental external financing which entails an optimal allocation of the raised fund over the capital asset or liquid asset. Then we consider the empirical connection of the firm's decision over the liquidity hoarding through the change of several firm-specific, industry wise, and economy wise factors, which encompass technology level z, operational efficiency θ, external financing cost coefficient π, gross return or discount rate of the liquid asset R_l oscillating around 1, the growth of economy proxied by GDP growth rate implied by contemporaneous increase of θz, and the accessibility of external financing market ψ. As we look for the several empirical equivalents for the theoretical variables, we conduct several empirical tests with the proxies for the theoretical factors if available.

5.1.Observed facts in light of the Model

In the Figure 1, in the right side where borrowing occurs, the straight solid lines radiating from the zero *0* point indicate the varied level of marginal cost of external financing. As the slopes change, the marginal cost line pivots from steeper one to flatter one with the fixed point at zero *0* such that π_{High}>π_{Middle}> π_{Low}> 0 where $\pi_j(-e) = \pi_j(k + \delta + l)$. Even though different firms face different level of marginal cost of external financing in light of credit-related firm specific features such as asset size, capital structure, size of tangible asset, and several financial ratios. Therefore, the proxy variable, if possible, for the marginal cost of external financing would be the bond yield or unlevered capital cost or the weighted average capital cost for a specific firm. It is hardly identifiable for a specific firm in the sample data. Tangible asset size could be a candidate for the interest cost variation, which corresponds with the pledgeability of asset, which determines the size of discount i.e. haircut.

If the firm wants to invest in the liquid assets, the firm considers the relative advantage over the other opportunity. i.e. capital asset investment. As the dominant driver of the variation of external financing cost is the government set interest rate e.g. the federal funds rate, the rate of return of the incremental liquid asset R_l can be represented by the changing level of federal funds rate. The change of policy interest rate such as Federal Funds Rate surely have economy wise impact on the borrowing cost of external financing as well as the price of cash equivalent liquid asset and price of long term debt. However it is quite interesting the increase (decrease) of federal funds rate has positive (negative) impact on the external financing cost whereas has positive (negative) impact on the price of liquid assets and consequentially negative (positive) impact on the yield on the liquid asset. As the change of return from the incremental liquid asset is assumed to stay around 1, we could ignore the impact of Federal Funds Rate on the rate of return of liquid asset R_l is ignored in the following empirical analysis. However, the Federal Funds Rate surely have huge impact on the change of external financing cost whose magnitude is clearly amplified through the cascading effect of lending rate through the financial intermediary,

As attested in the Fig. 1 of the former section, the firm must choose the amount of additional capital asset when the external financing is available. Given that the direct external financing cost is *High* with $\pi_{High}(-e)$, the total amount of external financing is invested in the capital asset

where the incremental capital is increased to the point at a where the marginal production function crosses with the marginal external financing cost function $\pi_{High}(-e)$. As the external financing cost is reduced, the slope of marginal external financing cost function becomes flat and until it reaches at the point b the whole external financing is used up for the build-up of capital asset. Once the incremental capital asset surpasses the point b, the firm begins to hoard the liquid asset. If the marginal external financing cost is$\pi_{Low}(-e)$, then the total external financing is at the point c where $\pi_{Low}(-e^*) = R_l$ and$-e^* = c$. The incremental capital asset is $b=k^*+\delta$ and the incremental liquid asset is $l^*=c-b$ respectively.

In the production side, as the marginal rate of return from the capital asset is denoted as $\theta z(k)^{\theta-1}$, the exponent θ is deciphered as the operational efficiency of a firm in lieu of utilization of capital assets e.g. asset turnover ratio. As the firm's technology is given as z, the varying level of technology for different firms or the improvement as well as the degenerating technology level for the same firm are shown as the pivoting movement of the marginal production function from z to z^A with the fixed point at the coordinate $(0, \psi)$. Hence the curvature $\bar{\theta} z(k^*)^{\bar{\theta}-1}$ pivots to the other one $\bar{\theta} z^A(k^*)^{\bar{\theta}-1}$ upwardly or vice versa. For example, with the external financing cost as $\pi_{low}(-e)$, the size of the optimal incremental capital asset was at the point b while the incremental liquid asset is c-b when the technology level was z with$\bar{\theta} z(k^*)^{\bar{\theta}-1}$. Then as the technology level is changed from z to z^A the optimal incremental capital asset is increased from the point b to the point d and the incremental liquid asset will be decreased from c-b to c-d.

5.2. Economic Environments

Several testable hypotheses are in order. First when the external financing market is accessible and the firm is engaged in its normal operation with the full efficiency where ψ =0, $-e$ > 0, and $\theta = \bar{\theta}$, the incremental capital asset is increased with the lowering external financing cost $\pi \downarrow$. If the external financing cost π is located at $\pi \geq (\theta z/R_l)^{\frac{1}{1-\theta}} \cdot R_l = \pi_{middle}$ which is equivalent to $-e^* = k^* + \delta \leq (\theta z/R_l)^{\frac{1}{1-\theta}}$, then the positive technology shock, improved operational efficiency, and the enhanced growth rate of GDP should have positive impact on the incremental capital asset. Particularly for the firms facing relatively higher external financing cost, the monetary policy in pursuit of the external financing cost reduction could lead to the increased capital asset investment for the firms with higher external financing cost.

In contrast, if the external financing cost π is located at $\pi < (\theta z/R_l)^{\frac{1}{1-\theta}} \cdot R_l = \pi_{middle}$ which is equivalent to$-e^* = R_l/\pi$, the lowering external financing cost leads to the increase of incremental liquid asset. This result implies that the monetary policy of external financing cost reduction could lead to the increased cash hoarding for the firms facing low external financing cost unless the firms achieve either the breakthrough of technology or the enhancement of firm's operational efficiency or both. When the sample firms are classified into three groups in lieu of asset size, the firms of the firms could be used as a proxy even though we are unable to identify the individual firm's external financing cost. To that regard, the 2007 economic crisis could be a plausible period of regime change that separated the higher external financing cost versus lower external financing cost.

Also as the economy was poised to suffer from the liquidity dry-up or endure the deleveraging in the aftermath of 2007 economic crisis, the firm cannot but make a capital investment through the internally generated liquid asset as the external financing market is frozen. As the total

demand had been diminished due to the declining growth rate during the aftermath of economic crisis, the marginal production function was degenerated from $\bar{\theta}z(-l^*)^{\bar{\theta}-1}$ to $\underline{\theta}z(-k^*)^{\underline{\theta}-1}$in the north-west area of the plane in the Fig. 1. Consequently the capital asset is converted into the liquid asset from the level g to the level f. This implies the sale of existing capital asset equivalent to hoarding of cash at the expense of capital asset. Alternatively, the deleveraging is conducted through the sale of capital asset leading to the reduced total asset. The regime change of external capital asset market play a crucial role in shaping the response and formulating the firm's facing the freezing liquidity market and the consequential deleveraging.

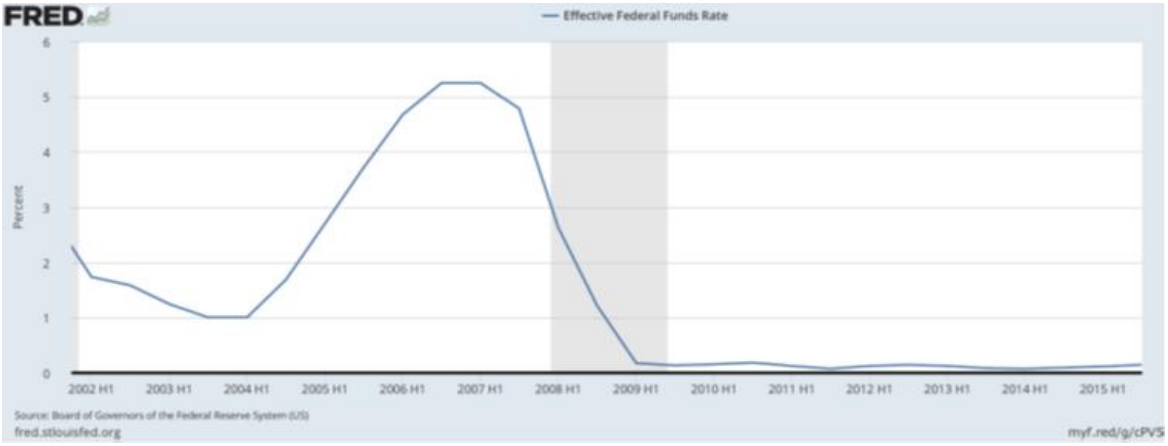

Fig. 2. Semiannual change of the federal funds rate from 2002 to 2016.

Before 2008, the economy was growing rapidly as if bubble is expanding, the federal funds rate is increased to 5.24% in the year 2007, and the Fig. 2 attests that the external financing cost is increasing due to the increasing federal funds rate. While the incremental capital is reduced, the capital asset ratio is declining thanks to the increasing total asset.

6. **Policy implication and conclusion**

As the economy is stagnant, the government uses the monetary policy to reinvigorate the economy by lowering basic interest rate such as federal funds rate. Thus the change of external financing cost is somewhat correlated with the marginal benefit of cash through the governmental intervention of Federal Reserve. Though the lowering external financing cost could help rejuvenate the economy but leads to the increased cash hoarding particularly among the *Large* firms with more than 1 billion US dollar assets. We do not know yet whether the cash hoarding is predatory purpose in order to acquire or conduct merger in the future by the *Large* firms, which is beyond the current study. But we find that the large firms tend to exploit the low external financing cost while the small firms still rely on the retained earnings of its own. This is consistent in that hedging reduces the cost of debt among the US firms in Chen et. Al. (2014).

On the other hand, if the economy is in the boom with high inflation, the Federal Reserve Board is more inclined to raise the interest rate in order to put down the economic bubble and to maintain the inflation target under control. Thus the reduction of external financing cost is negatively correlated with the marginal benefit of cash holding and this feature is more salient in the wake of Great Recession. This may indicate the effect of reduced interest rate on the cash

holding is confounded with the various firms with different asset size as the extent of financial constraint for the smaller firms is quite different from that of large firms. As a harbinger of current analysis, Macmillian et. al. (2014) empirically observe the lower growth rate of share price among the *large* cash holding firms than that of *small* cash holding firms. However, they seemed not to consider the causality concern.

The current paper attempts to propose a unified framework in which the firm's decision on the cash holding is conducted through the incremental earning literature. By focusing on the incremental allocation of external financing over the liquid asset and capital asset, we incorporate the macro-economic variation through the change of external financing cost and the shadow price of external financing market in light of frozen liquidity or even liquidity dry-up. The current theoretic model do not incorporate the information asymmetry which could be integrated in the model in the future such that the high external financing cost firm has incentive to mimic the low external financing cost via credit rating or intentional build-up of cash while the borrower would like to set the average lending rate due to the adverse selection cost.

The current theoretical model could be extended to the dynamic setup but we believe that the stylized observation based on the accounting reports are not congruent with the dynamic setup due to the features inherent to the sample data. Thus the static model would represent the nature of stock feature in the annually available accounting information. This theory can incorporate the patterns of cash-holding and the choice of cash-holding policies in light of the varying size of firms, the country-wise variation, and the fluctuation of economic condition. Following the conventional investment decision making of corporate finance literature, an incremental cash-flow approach is utilized for the company's decision on the cash-holding policy within the two stage setup. This fits well with the empirical method adopted in the current paper, in which the cash ratio is regressed against the precious year's growth rate of independent variables. We study the cash-holding policies of the firms worldwide encompassing 85,559 firm-years from the seven countries around the world spanning from 2002 to 2015. The empirical results indicate that the precautionary demand and transaction cost are the predominant factors in cash-holding. We would like to reserve the conclusive remarks on the predatory hoarding, which need further study. However, the former is dominant for the smaller firms in size while the latter factor prevails among the large firms particularly after the outbreak of economic crisis in 2008. As the economy is stagnant and the growth rate is declining, the marginal return for the investment in the capital asset is diminished and even lower than the marginal return of liquid assets. This would be more salient among the large companies within the developed countries. Also, the magnitude of cash-holding may not be a good candidate for the examination of agency cost as the cash-holding of large companies is driven by the sudden economic downturn and consequential stack up of cash within the firm. The unilateral government policy over the cash-holding level could not bring the expected outcome since the reason for cash-holding is quite different among the companies

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Biography of Author

Brief biography of Sooyoung Song

Sooyoung was born at Anyang, southern vicinity of Seoul Korea in 1961. He graduated Seoul National University in 1988 with a bachelor degree in Humanities (Linguistics). In 1991, he earned M.S. in Economics at Syracuse University US, and Ph.D. in Business at Kelley School in Indiana University in 2000. In the year of 2001, Sooyoung began his academic career at Sejong University in Seoul, then moved to Chung Ang University in 2004 and became full professor in 2010. During 2011, he came to Bloomington as a visiting scholar to Indiana University. His academic interests encompass wide range of Economics including Finance, Banking, Macro economic issues and Micro economics such as Contract Theory, Game Theory, Firm Theory and Industrial Organization. Particularly, he is concerned about History of Finance in light of economic recovery. He has participated at the several public committee and acting member of Capital market disciplinary committee. He worked as a President of Korea Association of Financial Engineering during 2016. He is married to Haekyung with two daughters Jihyun and Jiwon.