Stockholm School of Economics

Master Thesis in Finance

Inter-Asset-Class Volatility–

A Forward Looking Measure Rooted in Investors' Realities

The aim of this study is to better understand the causes of repeated periods of extreme volatility in financial systems The study conceptualizes and quantifies Inter-Asset-Class Volatility (IAV) as a forward looking proxy for volatility in financial system to reframe the phenomenon in a reality oriented setting. IAV aims to capture the total revaluation potential arising from reallocations among all asset classes in the analyzed system. The cause for such volatility is related to investors' preferences best detectable in the objective functions of institutional investors that are implicitly and explicitly constrained. Constraint induced deviations in portfolio weights from those of a purely mean-variance optimizing investor are argued to cause unexpected volatility by forcing investors to leave the market as soon as they reach their allocation limits. Consequently, the market shifts from a full-participation equilibrium to a limited-participation equilibrium, in which the price impact of trading rises due to a significantly reduced market depth. Building on Pastor and Stambaugh (2003), the resulting liquidity shortage in the primarily affected asset classes is related to strongly negative returns therein. Liquidity and relative valuation spill-overs to other asset classes create the system wide phenomenon IAV seeks to define. To detect evidence for this conjecture, the measures of Delta and Tau are introduced. Delta quantifies the constraint-induced deviations from the mean-variance efficient portfolio that are AuM weighted to arrive at the potential buying or selling pressure from an investor in a respective asset class termed Tau. A simulation study involving stocks, bonds, and cash forms the basis for a correlation analysis between Tau values aggregated from three modeled investor types with Pastor and Stambaugh's (2003) aggregate liquidity series. confirming the intuition. While correlations over the entire sample period remain insignificantly small, strong negative correlations are found in the 12-month windows around a set of 9 events characterized by extremely low liquidity levels and severely negative stock returns. The idea that build ups in aggregated Tau potentially forecast volatility regime shifts is, thereby, supported, pointing to investor preferences as a possible source of excess volatility in financial markets.

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List of Abbreviations

AuM	Assets under Management
CS I	Constrained Investor I
CS II	Constrained Investor II
DP	Dividend-price ratio
EMH	Efficient Market Hypothesis
HF	Hedge Fund Investor
IAV	Inter-asset class volatility
i.i.d.	Independent and identically distributed
LIQ	Liquidity factor
MOM	Momentum factor
MV	Mean-Variance Investor
Tbill	Relative Treasury bill
TS	Term spread

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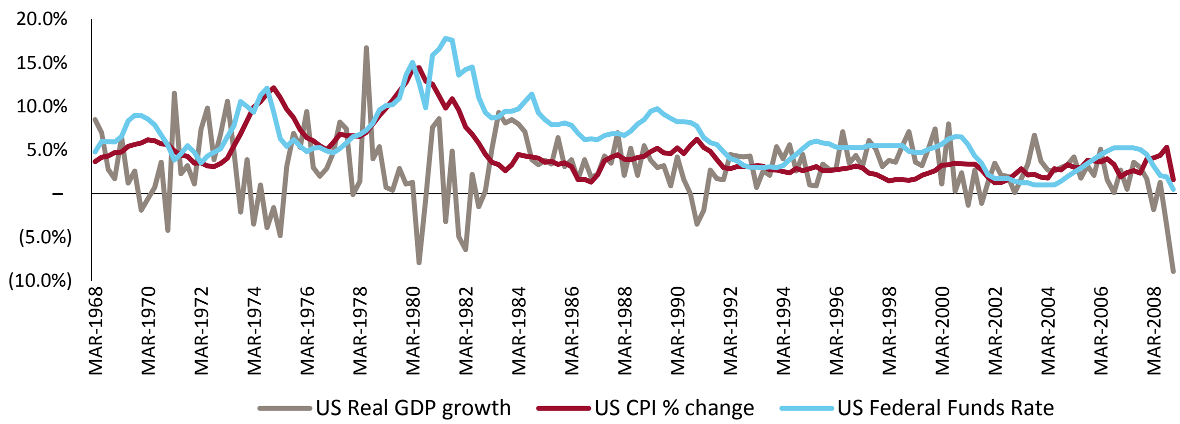
1 Introduction

1.1 Problem Outline and Objective of the Paper

The economic literature has identified a period of significantly reduced volatility in macroeconomic factors such as GDP growth, inflation, interest rates levels, and others starting in the beginning of the 1980s (Summers, 2005). This period, referred to as the "Great Moderation", has, however, only brought about a slight reduction in stock market volatility as figure 1 shows.

Figure 1: Development of quarterly macroeconomic metrics for the United States



Source: FactSet as of 04 April 2012.

When explaining the causes of the "Great Moderation", literature can be separated into the "good luck" and the "good policy" hypothesis. A period of political and economical stabilization and increasing globalization following the end of the Cold War is supported in a number of studies and would make intuitive sense as an explanation of the phenomenon (Summers, 2005). However, Giannone, Lenza and Reichlin (2008) show that such evidence in many cases relies on overly naive models. The authors criticize that univariate and low dimensional models do not fully capture the width of information used by central banks and financial market participants in their reactions to the macroeconomic environment. With this in mind, an interpretation in the sense of the "good policy" hypothesis appears closer to reality.

The latter postulates that the quality of political and economical reaction to severe externalities has increased significantly over time. Thereby, reduced volatility of macroeconomic measures such as inflation, interest rates and the like (Giannone et al., 2008) are explained.

While policy makers seem to have learned from past over and under reactions to shocks, the unchanged presence of excess volatility, understood as realized volatility that exceeds estimations based on incoming information (LeRoy & Porter, 1981), hints to the interpretation that investors have not significantly altered the way they change their portfolio policies in reaction to changes in the outside world. Two thoughts central to this paper emerge from these observations:

Firstly, investors' preferences as expressed in their reactions to outside shocks seem to be fairly persistent over time. Such preferences are understood as the hierarchy between securities or asset classes an investor applies in his/her investment decision based on the characteristics of the relevant assets in the perceived macroeconomic situation.

Secondly, the existence of excess volatility might imply a certain mismatch between expectations formed based on a shared understanding of market mechanisms and the available information at a certain point in time and the realistic circumstances investors are exposed to when making allocation decisions.

The latter becomes clear if one assumes that in a world free of restrictions on portfolio policies and frictionless markets the consensus forecast of target prices aggregated from a large number of market participants should most accurately gauge the volatility in prices over the forecast period. In this case, all participants can freely implement their preferences over which securities to buy and sell as a reaction to their views on the future state of the economy.

At its core, this paper utilizes the described differences between the utopic unconstrained world and the prevailing realities investment professionals are exposed to, to examine the causes of excess volatility in financial markets itself.

The undoubted presence of such excess volatility or overreactions in financial markets has, for instance, been attributed to behavioral biases such as over- and under extrapolation in investors' decision making (Lakonishok, Shleifer, & Vishny, 1994). This paper takes a different approach to explain the existence of excess volatility and the transitional behavior between high and low volatility regimes through time.

From the understanding that investors' actions in financial markets are crucially driven by constraints of several forms imposed on their portfolio allocations, a linkage between investors' objectives and volatility is drawn. In particular, liquidity is identified as the missing link between the two concepts. By emphasizing the role of contractual arrangements between fund managers and their clients as a source for market wide phenomena, the paper deploys an innovative angle and stands partly in line with Almazan, Brown, Carlson, and Chapman's (2004) call for more scholarly attention towards the matter.

It is argued that excess volatility results from shifts between full-participation and limited-participation equilibria induced by the implicit and explicit constraints on the realization of investors' preference. The resulting impacts on liquidity are shown to be strongly correlated with crash scenarios in the US stock market.

Based on this logic, the paper tries to develop a measure of potential volatility in single asset classes termed Tau ($\mathrm{T}_{i,t}$) and in the financial system as a whole termed Inter-Asset-Class Volatility (IAV). The conceptualization of the measure was set to describe the internal vibration of the analyzed financial system consisting of the reallocations of funds between a set of predefined asset classes (stocks, bonds, and cash). Through this set-up, the measure captures the entire risk in the system and its spillovers into individual asset classes rather than just the historical behavior of returns.

The measure further differentiates itself from former understandings of volatility via its forward looking character. The assumption of persistent preferences and contractual arrangements allows to forecast the potential valuation change in single asset classes or the entire system. In a backward looking sense, the derived measures are potentially able to tell "how bad it could have come", which amounts of wealth have been shielded through portfolio constraints, or which contribution such constraints had to a market crash.

Even though the presented results can at best be seen as approximations of the true aggregate values, direct implications from the results can be drawn for risk management, the fund management industry, and even the regulatory approach to financial markets.

A direct parameterization of macroeconomic variables into portfolio policies that maximizes individual investor's objective functions, pioneered by Brandt and Santa-Clara (2006), is used to mimic the discussed reactions to macroeconomic changes.

1.2 Course of Investigation

Section 2 presents previous work on the multi-objective character of investment decisions focusing on professional fund managers. Contrary to standard financial theory the multi-objective trade-off is separated into implicit and explicit portfolio constraints of various origins in addition to the mean-variance decision rule. From this starting point, the section lays the ground work for the development of the attempted measures by explaining the connection between existing theoretical work on the crucial link between volatility, its regime shifting character, and liquidity as a potential cause of the latter.

Based on a clear outline of the underlying understanding of financial markets and their functioning and a brief criticism of standard measures of volatility Section 3 conceptualizes the individual asset class indicator of potential volatility Tau ($\tau_{i,t}$) as well as a forward looking measure of Inter-Asset-Class Volatility(IAV). Traceable measures are constructed allowing the detection of the phenomenon. Empirical implications are derived from the articulated theoretical standpoints. Most concepts are presented for the individual investor. The aggregation of effects from clearly differentiable investor types yields a set of measures for system wide effects that allow empirical verification.

Section 4 presents the underlying empirical data and describes the methodology of the simulation study. It rests crucially on the utilized method of portfolio optimization that directly parameterizes portfolio policies from a set of conditioning or state variables describing the macroeconomic environment. In this respect, the simulation approach is clearly differentiable from the classic portfolio optimization solutions discussed in the section. Three investor types are differentiated through implicit and explicit portfolio constraints and contrasted with a mean-variance optimizing investor to generate the basis data for the constructed measures.

In section 5 results are presented and interpreted for single investors as well as on the aggregated level. The constructed measures are then related to liquidity measure to provide evidence for the theorized relationships.

Section 6 puts the confirmed results into perspective and develops implications for risk management, the fund management, and the regulatory perspective on financial markets. Section 7 concludes and presents areas of future research.

2 Literature Review

2.1 Multi-Objective Trade-Offs in Portfolio Management

In the following, several aspects are pointed out in which investors decision problems may differ from each other. Implicit areas of deviation in fund managers' objective functions are contrasted to mean-variance optimization as the classic approach to portfolio theory. Further constraints of an explicit nature are touched upon consequently. The notion implicit refers to all arguments directly affecting the optimization problem. Explicit constraints are understood as being imposed on the outcome of the decision problem ex-post. This separation is aims to separate the preference driven part of the investment decision from the obligation or contractual driven part.

2.1.1 Investor Realities

In most theoretical and practical arguments the portfolio selection or asset allocation problem is framed in terms of a rational and fully informed investor acting in the context of efficient capital markets. Capital markets are said to be efficient if security prices fully reflect all available information and adjust instantly and in an unbiased manor to new information (Fama, 1970; Malkiel, 1992). In this setting, standard approaches to portfolio selection are based on the risk and the return of individual securities or asset classes (Markowitz, 1952a) as the only two decision relevant attributes. The respective portfolio characteristics are aggregates of the latter influenced by diversification effects. [1]

This simplification in the form of a standard quadratic utility function in the Markowitz model fails to explain individuals' investment behavior (Bouri, Martel, & Chabchoub, 2002). Therefore, this paper aims to incorporate multiple additional criteria into the investor's objective or utility function termed implicit constraints. This approach stands in line with a recently developing literature on multi-criteria portfolio selection. The aim is to capture the complexity of agents' investment decisions to derive "suitable portfolios" (Bouri et al., 2002; Steuer, Qi, & Hirschberger, 2004, p. 1) as compared to simply mean-variance efficient ge-

[1] The classic set-up of the portfolio selection problem involves an investor without an additional income stream rendering his/her entire wealth in future periods an outcome of portfolio returns. These assumptions transform the selection problem into the maximization of expected utility from terminal wealth at the end of the investment period (Markowitz, 1952b).

neric solutions (Bouri et al., 2002; Brandt, Goyal, Santa-Clara, & Stroud, 2005; Pflug & Swietanowski, 1999; Steuer et al., 2004; Steuer, Qi, & Hirschberger, 2008).

A study of the existing literature by Steuer and Na (2003) shows that the average number of papers elaborating on the topic between 1973 and 2000 tripled from 1.5 per year to 4.5 in recent times. Following the study, contributions in the field can be grouped into three categories.

Overview articles such as, Spronk and Hallerbach (1997), Hallerbach and Spronk (2002a), Bana e Costa and Soares (2001) and others constitute the first category. A second undercurrent of literature aims to directly compute optimal portfolios based on a predefined set of characteristics and hence resembles Roy's (1952) approach to portfolio optimization. Papers in this spirit include Lee and Lerro (1973), Bouri, Martel and Chabchoub (2002), Bana e Costa and Soares (2004). The third category of contributions shares a characteristic that is very relevant for this study. Stemming from the classic Markowitz approach, papers such as Chow (1995), Yu (1997), Lo, Petrov, and Wierzbicki (2003), and Ehrgott, Klamroth, and Schwehm (2004) compute the multidimensional equivalent of an efficient frontier and in a second step select a final portfolio based on additional arguments. Such additional arguments are termed explicit constraints. Steuer and Ma (2003) point out that the resulting solution might either achieve optimality or lie close enough to it to end the decision process.

The terms "dominated" and "non-dominated" (p.2) introduced by Steuer, Qi and Hirschberger (2008) to describe sets of portfolio selection parameters further structure the potential differences in portfolio policies resulting from a prematurely terminated decision process. The terminology implies that portfolio policies are evaluated regarding their efficiency within the realm of the underlying objective function. The set of objective functions, however, can be ranked regarding their efficiency in terms of optimality in a benchmark decision problem.

This paper examines the situation in which the fund manager's decision process is terminated by a set of implicit and explicit constraints before a benchmark efficient policy is achieved. It is hence a study of realistic deviations from a benchmark allocation selected on theoretical grounds. The characteristics of relevant constraints are discussed in the next sections.

2.1.2 Implicit Constraints in Multi-Objective Utility Functions

Developments in the field of multi-objective portfolio optimization are often found in research streams specializing in practical fields that are by their nature exposed to multi-trade-off situations. A prominent example is the pension fund industry (de Jong, Schotman, & Werker, 2008; Hoevenaars, Molenaar, Schotman, & Steenkamp, 2008). Starting from the related literature, selected implicit objectives or criteria relevant to this study are discussed below.

Multi-objective approaches to pension fund problems often acknowledge that investment management is in most cases a service provided to one or a cohort of clients (Almazan et al., 2004). In such multi-client settings it becomes clear that non-congruencies in client backgrounds, utility functions, and expectations create a principal agent conflict between the fund manager and participants in the fund (Almazan et al., 2004; de Jong et al., 2008; Pflug & Swietanowski, 1999). To minimize agency costs from this conflict, the relationship is governed by a set of rules and constraints aiming to protect the fund participants from hazardous behavior of the manager (Blome, Fachinger, Franzen, Scheueunstuhl, & Yermo, 2007; Pflug & Swietanowski, 1999).

Due to the political and reputational sensitivity of such mandates, their success depends crucially on a correct reflection of all particularities in a multi-argument objective function (Bouri et al., 2002; Steuer et al., 2004, 2008; de Jong, 2008b; de Jong et al., 2008; Pflug & Swietanowski, 1999; van Binsbergen & Brandt, 2007) making it "the most important ingredient of any portfolio choice problem" (Brandt et al., 2009, p. 3420).

Following a classification by Steuer et al. (2008) objective functions can take into account additional stochastic and/or additional deterministic arguments. Liquidity considerations, incentives for a performance above a stochastic benchmark, or a preference for steady income streams e.g. from dividends can be seen as stochastic arguments. Portfolio turnover, the amount of short positions, and the total amount of securities held are deterministic arguments that can either be imposed explicitly (see next section) or implicitly via trading cost and infrastructures, peer pressure within firms or industries or for product positioning purposes. In the latter sense, these arguments can be classified as practitioner-oriented objectives along side with the maximization of the Sharpe or information ratio, the maintenance of pre-specified value at risk levels, outperformance against an individual or industry wide benchmark, controlling asset draw downs etc. (Brandt & Santa-Clara, 2006; Brandt et al., 2009; van Binsbergen & Brandt, 2007).

Style orientations such as value vs. growth strategies implicitly constrain the portfolio optimization by limiting the investable universe and are often used to attract client attention. It is important to note, that not all constraints are set for marketing or positioning purposes. Consider the example the above mentioned case of a pension fund managing the assets of a defined benefit plan. In such a case, the mandate only exists to fulfill the often implemented underfunding constraint. Asset allocation is to a large extend dictated by the maturity characteristics of the liability side fundamentally changing the subject of the managers preferences from terminal wealth to the required funding level.

In this sense, the literature further differentiates arguments centered in the behaviorally motivations of the fund manager him/her self such as loss aversion, ambiguity aversion or the aversion of disappointment (Brandt, Santa-Clara, & Valkanov, 2009).

Some implicit constraints discussed above may be time varying (Chapman, Evans, & Xu, 2010; Chevalier & Ellison, 1999). It is therefore rather the constant nature of explicit constraints, outlined in the next section that allows the construction of a forward looking proxy for volatility in asset markets. Due to close ties with regulatory requirements and legal concepts, the latter type of constrains varies only at the fund closure or upon a change in mandate.

2.1.3 Explicit Portfolio Weight Constraints & Other Contractual Limitations

The relevance of explicit portfolio constraints in theory and practice is undisputed. Put in the words of Brand et al. (2009): "By far the most common departure from the basic portfolio choice problem in practice is to impose constraints on the optimal portfolio weights" (p. 3421).

Nowadays, the vast majority of investment mandates given to professional fund managers contain restrictions on asset allocation, portfolio turnover, and even thematic restrictions (Almazan et al., 2004; Brandt et al., 2009). Most prominently, fund managers are subject to short-selling constraints, leverage constraints implicitly nested in no-negativity constraints on portfolio weights, margin buying impediments, and limitations to active trading in asset classes outside of the focus of the mandate. Such securities are in many cases derivatives, futures, and other exotic instruments (Almazan et al., 2004). Moreover, limitations to trade in securities with restriction on resale price and timing as an implicit liquidity constraint appear in practice (Almazan et al., 2004). Asset allocation limitations cover a wide range from upper and lower bounds on allocations to several asset classes, to single position limits and minimum and maximum cash quotas.

Drawing a clear line between the mentioned implicit and explicit constraints is not always trivial. Implicit investment constraints directly linked to managers' individual preferences such as labor market monitoring, career concerns (Fama, 1980) or peer monitoring can potentially replace explicit enforceable contracts regarding their incentivizing and risk limiting characteristics (Arnott & Stiglitz, 1991; Chevalier & Ellison, 1999; Holmström, 1999). Such constraints are implied when committing funds to large asset management firms. The above discussion shows the close connection between implicit and explicit portfolio constraints and articulates the need to include both types in the following study to achieve realistic results.

Overall, it can be said that a main difference between explicit and implicit constraints on fund managers' portfolio selection lies in the fact that explicit constraints can serve as tractable differentiating factors of the fund offering within the competitive landscape (Almazan et al., 2004). The marketing character of this interpretation is a good example for a possible divergence of mandated preferences and the fund manager's individual preferences in portfolio selection. In other words, the fact that investment management services are marketed towards clients needs might introduce a structural divergence from the actual manager's individual preferences.

2.2 Market Functioning & Volatility Regimes

The previous section presented sources of deviation in preferences between several investor types. The following paragraphs discuss how the above presented characteristics of agents participating in the market influence the state of the latter via their conscious or unconscious participation decisions. An argumentative connection between the microstructure of markets in terms of liquidity and the system wide effect of volatility is articulated.

2.2.1 From Market Participation to Excess Volatility in Asset Prices

Volatility in financial assets is traditionally attributed to the arrival of new information on future cash flows and relevant discount factors applicable to the latter (Fama, 1970; Merton, 1987b). However, volatility that exceeds predictions based on these information streams has been debated thoroughly in the literature under the notion of *excess volatility* (LeRoy & Porter, 1981; Shiller, 1981). Excess volatility has been linked to asymmetric information problems (LeRoy & Parke, 1992), noise trader activity (De Long, Shleifer, Summers, & Waldmann, 1990), and the impact of extended liquidity trading demands (Allen & Gale, 1994). Allen and Gale (1994) pronounce that high liquidity trading volumes induced by a multitude of reasons external to the financial system could account for significant parts of empirically measured excess volatility. This influence remains intact even when differing preferences from other investors allow the market to absorb or in other words net out liquidity induced trading volumes. In short, selling pressures from high demand for liquidity can cause extreme swings in asset prices that cannot be absorbed by buying power and hence the actual trading activity in the system.

Their model explains the relation between liquidity and asset price volatility based on the concepts of incomplete market participation and investors' liquidity preferences. In assuming that not all investors are active in all asset classes, the model stands in clear contrast to most asset pricing theories. The empirically justifiable rejection of full market participation (Allen & Gale, 1994; Cao, Wang, & Zhang, 2005; Vissing-Jorgensen, 1999) and its repercussions onto market liquidity are crucial to the argumentation in this paper.

Allen and Gale (1994) identify two potential equilibria that imply differing volatility regimes. In a full-participation equilibrium the market holds and provides high amounts of aggregate cash and hence strong price resilience to liquidity trades. A limited-participation equilibrium describes a situation in which mainly investors with a low liquidity preference (i.e. holding low cash levels) and a generally low risk aversion are active and implies large price impacts of liquidity trades. Countering preferences, hence, allow trading to occur and net out on an aggregate level. In the full-participation situation, countering preferences allow trading to occur and therefore net each other out on an aggregate level. Price resilience is preserved and volatility kept in check. This market characteristic is absent in limited-participation situations representing a potential coordination failure in the market (Allen & Gale, 1994). Not all orders can be filled at the prevailing price level requiring at times severe price adjustments.

This idea of *netting preferences or allocation needs* between differing investor types is carried forward in the argumentation of this paper. Contrary to Allen and Gale's (1994) approach, the understanding of limited-participation is extended to institutional investors as they control the majority of funds invested and continuously increase their dominance in financial markets (see e.g. (Gompers & Metrick, 2001)). Focusing on institutional investors, non-participation is contrastingly not seen as a deliberate decision. The behavior is rather induced through the inability to keep up directional trading in a security or asset class in which the manager has already reached his/her allocation limits. His/her potential willingness to participate in the market based on his/her personal preferences or tactical optimality seeking, collides with contracted investment restrictions forcing him/her to leave the market. The resulting loss in liquidity is evident as assets controlled by the respective investor become unavailable for trading.

The more investors are forced out of the market over a certain period of time driven by changes in state of the economy, the equilibrium character and with it the volatility regime in the market shifts. Depending on whether investors prefer to hold more or less securities than they can either asset bubbles or market crashes might be fostered as trading by unconstrained investors into the limited-participation zone hits a significantly thinner and hence less resilient market.

The latter has been identified by Grossman and Miller's (1988) as a potential cause of the 1987 stock market crash.

In section 3 of this paper the presented argumentation will be conceptualized in more detail and quantitative measures are introduced to test the predictions made.

2.2.2 Liquidity and Volatility – A Crucial Empirical Linkage

Multiple studies show that a variety of liquidity measures indicate periods of above average illiquidity in downward moving markets (Amihud, Mendelson, & Wood, 1990; Chordia, Roll, & Subrahmanyam, 2001; Grossman & Miller, 1988; Jones, 2000). While liquidity in normal market environments exhibits rather low volatility (Pastor & Stambaugh, 2003), the mentioned extreme spikes around severe downturns are a noteworthy phenomenon that will be explored in this paper.

Pastor and Stambaugh (2003) find a strong positive correlation between their constructed liquidity series and stock returns in negative return months. On the contrary, they report a close to zero correlation in positive return months. In accordance with the other mentioned studies, Pastor and Stambaugh (2003) identify May 1970 (political unrest in the

USA), November 1973 (beginning of Mideast oil embargo), October 1987 the month of the major stock market crash, and September 1998 (collapse of Long Term Capital Management and Russian debt crisis) as periods of extremely low liquidity paired with severely negative stock returns. The statistical significance of the difference in correlation lies at the heart of their conjecture that liquidity is a priced systemic risk factor. The authors hence establish a linkage between market liquidity and the volatility of asset prices.

This study attempts a backward linkage of liquidity or better illiquidity to one of its causes. Rooting illiquidity in extreme market situations in investors' preferences and the constraints imposed onto the realization of these preferences via allocation limits is a step towards a more direct linkage between investors and (extreme) volatility in asset markets.

In this logic, liquidity serves as a transmitter for indirect causality between investors' preferences and asset prices. A formal test whether this causality exists is not in the scope of this paper but represents a promising area for future research.

Studies relating to the 1987 stock market crash by Grossman and Miller (1988) as well as Amihud, Mendelson, and Wood (1990) point to an important angle on illiquidity by acknowledging a build-up tendency or in other words accumulation phase prior to crash situations. The latter property of liquidity is used in this study to detect the suggested linkage.

3 Inter-Asset-Class Volatility – Defining a Forward Looking Measure

The discussion up to this point has made clear that the relationship between investors' preferences (subject to restrictions), their influence on market participation, and the resulting liquidity effects might provide an innovative route to the understanding of volatility in asset prices. To further analyze the matter, it is necessary to conceptualize and derive traceable measures of preference induced buying and selling pressure in individual asset classes. By aggregating these measures an attempt is made to capture the system wide risk of revaluation. The following section strives to do so by starting with a brief outline of the underlying view on the structure and function of financial markets.

3.1 Understanding of Financial Markets – Distribution of Ownership & Persistent Preferences

The notion that asset prices and particularly stock prices follow a random walk lies at the basis of modern finance (Fama, 1970; Malkiel, 1992; Samuelson, 1965) and can be traced back to Bachelier's (1900) work on the theory of speculation. The recorded data up to this date suggests that this assumption is the closest we can get in the description of prices and their trajectories. Nonetheless, a thorough thought about what exchanges are, what their general purpose is, and which mechanisms govern their workings leads to the conclusion that asset prices should not follow a random trajectory.

Exchanges are man-made institutions serving the purpose of increasing the divisibility of ownership rights (stocks, bonds and other securities) and facilitating the trading of the later through a transparent matching of supply and demand. Supply and demand for the traded securities are determined by investors' preferences. In this sense, executed prices represent matches of complementary preferences for owning or selling a certain security. Unless all investors are risk neutral gamblers without a specifiable preference system, prices can hence not be random. Trades are generated from mismatching expectations about the future and mismatching preferences for security characteristic or states of the world. Volatility is a product of these mismatches (Allen & Gale, 1994).

Professional investors dominate the landscape. Their contractual obligations are identifiable and persistant over time and oblige them to trade on observable information (Ait-Sahalia & Brandt, 2001; Baker & Wurgler, 2006; Barberis, Shleifer, & Vishny, 1998; Bird & Casavechia, 2007; Kumar & Lee, 2006). The complexity of matching all preferences in the market place might give us the impression of random movements.

3.2 Current Measures of Volatility and Their Downsides

Laying the grounds for an informative proxy for future volatility requires a review of some major weaknesses of current measures of risk starting with the definition of volatility of a single asset.

Volatility definition: The term volatility technically refers to root-mean-square deviations from the mean in conventional statistical analysis (Goldstein & Taleb, 2007). It would, hence, be wrong to substitute the measure by mean deviation or other statistics. Goldstein and Taleb (2007) show in an experiment that investment professionals as well as post-graduate students in financial engineering are fully aware of the mathematical definition of volatility but fail almost completely to apply it in practical problems. Consequently, they raise the question if "… we have the wrong intuition about the right volatility, or the right intuition and the measure of volatility is the wrong one" (p.5).

Pointing to ways out of this dilemma, the authors state that “perhaps, one day, Finance will adopt a more natural metric than standard deviation” referring to the invention of expected utility as a more intuitive concept than the simple expected value rule for decision making. Along these lines, the motivation of this paper is to construct a proxy for future volatility that is intuitively grounded in the realities of the producers of the phenomenon themselves.

Backward looking measures: To measure the risk of a security it is conventionally excepted to determine the standard deviation of past returns on the asset in question (Campbell & Viceira, 2004). By the mere nature of the method, volatility or risk measured as standard deviation is always a backward looking concept that should, in efficient financial markets, not have explanatory power for the behavior of asset prices in the next period (Fama, 1970; Malkiel, 1992; Samuelson, 1965). Therefore, it is arguable that measures based on historical data are lagging decision supporting value for future periods (Pflug & Swietanowski, 1999). Artzner, Delbaen, Eber, and Heath (1999) also acknowledge that risk should not be understood as the change of value between two points in time but rather relates only to future changes in value. In this spirit, the measure proposed in this paper has a forward looking character and aims to be instructive about the future state of the financial system in question. The informational content is derived from data observable at the time of a portfolio policy decision.

Measures of multi-asset volatility: The covariance of two or more assets is commonly used to describe linear relationships between them. A positive covariance indicates that two assets move in the same direction at the same time, while a negative term shows that they move in opposite directions. A normalized extension of the concept is the correlation coefficient that indicates the strength of these relationships (Pearson, 1920; Rodgers & Nicewander, 1988). While such measures are normally calculated per single security, asset class, or portfolio little attention is given to an aggregate measure that describes the combined variations in value of all asset classes in a financial system. The here developed measure aims to provide this view. An attempt is made to assess the potential vibration in the system. In practical terms, the measure captures the fact that one can loose on the securities he/she owns and at the same time miss out on positive developments in other securities or asset classes.

3.3 Definition & Construction of a Traceable Measure

Before a formal representation for the attempted measures is derived on the individual investor level and consequently on the aggregate level, the term Inter-Asset-Class Volatility and its components are conceptually defined. Where necessary, hints are given to where the respective phenomena can be seen in the everyday life of financial markets.

3.3.1 Conceptual Definition

Describing the relevant moves:

The standard asset allocation question in a very simplified setting regards the relative expected performance of equities vs. bonds vs. cash/risk free asset in the future. Looking into the past it is often said that stocks have outperformed bonds in the long run and will, hence, be less risky/more attractive in the future (Pastor & Stambaugh, 2011). Depending on the time horizon, this is not always true (Bodie, 1994; Jagannathan & Kocherlakota, 1996). In certain macroeconomic environments the same investor prefers bonds (e.g., in a flight to safety scenario) while a low interest rates and strong industrial growth scenario advocates stocks. With changes in the macroeconomic environment these preferences change, portfolio weights are adjusted and funds are reallocated between asset classes. Such allocation changes produce volatility as one asset class is sold off yielding a.) a reduced amount of funds invested in the asset class, b.) a reduced absolute valuation of the asset class, and c.) a decreased relative valuation of the asset class compared to others. The contrary effects occur in the now favored asset class. In this sense, the number of asset classes compared only influences the magnitude of the movement per asset class while the total amount of movement remains unchanged.

Data points relevant for an investigation of the conceptualized phenomenon are the total amounts of funds invested in the individual asset classes over a specified period of time. The total size of the analyzed system is simply the sum of the individual parts. From an investor's perspective, the relative shares of funds invested in each asset class, hence, sum to one. Note that the fact that not all investors always participate in all asset classes (Allen & Gale, 1994; Brav, Constantinides, & Geczy, 2002) can easily be accommodated in this view as their individual share of funds in the asset class simply remains at zero. This implies that their contribution to the volatility in the asset class is also bound to zero, while the overall potential contribution from their portfolios is not influenced. Exclusion from one asset class does not reduce the agents influence on the aggregate system.

A conceptual particularity arises in the advent of funds withdrawn completely from the financial system understood as the investable and traded universe of securities. For the purpose of this paper, only traded securities are taken into account, excluding bank accounts from the concept. Money that completely leaves the system contributes to the volatility in the asset class that has been liquidated to generate cash (liquidity trade). Assuming the funds are used for consumption immediately after the transaction, the amount of funds invested in cash as an asset class is not altered. In the case that the investor in question breaches allocation limits with the transaction, a secondary effect on volatility in the other asset classes emerges from forced rebalancing. The opposite effects occur in the event of net new money flowing into investment funds. Such intermediate consumption and/or liquidity issues are of relevance to the concept, but will be ignored in the following analysis for simplicity reasons. A specific reason for this assumption lies in the forward looking nature of the measure to be developed. Predictions are made at the beginning of a period t given the information set available at this time. Net in and out flows are stochastic measures developing between t and $t+1$ and cannot be known at time t. Given the total size of almost any specification of a financial system, net new money is a relevant but by pure magnitude not the driving factor of volatility.

Despite the above limitations, the notion of Inter-Asset-Class Volatilitydescribes the internal vibration of a specified financial system during a certain period of time. In this sense, it can be paralleled to the idea of the temperature of a system used in physics to describe the state of the latter (Boguta & Järpe, 2010; Järpe, 2005). However, in this form, the concept is still backward looking as the relevant amounts can only be measured at the end of the period. To overcome this characteristic, the term described up to this point will be referred to as **realized inter-asset class volatility**.

To introduce a forward looking element, the notion is differentiated from **potential Inter-Asset-Class Volatility** understood as the potential price impact from restrained or non-realizable allocation intentions. The concept combines a flow of funds perspective with a liquidity perspective to indicate the impact of investors' preference to buy or sell securities over and above the limits they are explicitly or implicitly bound to.

3.3.2 Formal Representation for an Individual Investor

For conceptual clarity and empirical testing purposes that remain within the scope of this study, the calculation of the following measures will first be presented for an individual investor. The aggregation of individual contributions to an overarching measure is done in a second step.

To capture the implications of the articulated volatility concept the difference between a benchmark allocation and implementable portfolio policies subject to modifications of the objective functions and allocation limits is computed based on portfolio weight vectors as

$$\Delta_t = \mathbf{x}_t^{BM} - \mathbf{x}_t^{RE} \tag{1}$$

where $\mathbf{x}_t^{BM}$ is the vector of portfolio weights chosen by an unconstraint mean-variance investor. The weights chosen by an unconstraint mean-variance investor are chosen as a benchmark in this study for tractability reasons and because this assumed identity of economic agents lies at the ground of modern financial theory (Fama, 1970; Markowitz, 1952a).

$\mathbf{x}_t^{RE}$ is the weight vector chosen by the fund manager representing all portfolio constraints and his multi-objective trade-off.

A comparison of the constraint portfolio policies to a purely mean-variance optimized policy is used to capture the full effect of implicit and explicit constraints on the resulting measures. Multiplying Δ_t by the Assets Under Management (AuM) commanded by the individual fund manager gives an indication of how much buying or selling power/pressure he/she adds to the system that remains locked-up.

$$T_{i,t} = \Delta_t(AuM_t) \tag{2}$$

The resulting vector $T_{i,t}$ referred to as Tau, contains dollar terms indicating the dollar amount per asset class the manager would prefer to allocate differently if his/her constraints were lifted.

Dividing the total amount of assets invested in an asset class by the share of $T_{i,t}$ directed to this asset class, which can easily be separated through the structure of Δ_t, one can find the total valuation impact of the apparent portfolio mismatch and, hence, the potential volatility associated with it. As the items in Δ_t have positive or negative signs, the direction of the potential price/valuation swing can directly be elicited. A possible realization of a Tau vector for investor i with AuM of USD 5mn could be:

$$T_{i,t} = \begin{pmatrix} T_{bonds,t} = -500.000 \\ T_{stocks,t} = +700.000 \\ T_{cash,t} = -200.000 \end{pmatrix} \tag{3}$$

implying that he/she would in an unconstraint case hold USD 500.000 or 10% of his AuM less in bonds while his investment in stocks would be USD 700.000 or 14% of AuM higher. Cash holdings would decrease by USD 200.000 or 4% of AuM. Whether the negative amount in cash implies leveraging the portfolio depends on the investor's holdings at time. The same logic applies when determining whether the investor would just reduce stock or bond positions or short sell the respective asset classes.

In order to understand the magnitude of the calculated absolute valuation impact, the numbers have to be compared to the total amount of assets invested in the respective asset. Note that this refers to the dollar amounts invested not to index levels. Assuming total dollar amounts invested in bonds, stocks, and cash of USD 5bn, USD 4bn, and USD 2bn in the example above the relative valuation impacts would look as follows:

$$T_{i,t}^{rel} = \begin{pmatrix} T_{bonds,t} = -0.01\% \\ T_{stocks,t} = +0.02\% \\ T_{cash,t} = -0.02\% \end{pmatrix} \tag{4}$$

It follows directly from the calculation of $T_{i,t}$ that both the absolute and relative valuation impact of the investor scales linearly with AuM at time t. Note that the valuation impact is valid for the current valuation level and under the assumption that trading in all asset classes can be realized without a significant price impact.

3.3.3 Formal Representation of the Aggregated Measure

To arrive at a coherent measure for the entire market, the sum of $\Delta_{i,t}$ across investor types needs to be computed and AuM weighted.

$$T_{Net,t} = \sum T_{i,t} = \sum \Delta_{i,t}(AuM_{i,t}) \tag{5}$$

Simply summing the Taus calculated for individual investors produces a netting effect consistent with the intuition articulated in the previous sections. Netting reallocation intentions ($T_{i,t}$) arising from differing objective/preference functions (e.g. Hedge Fund vs. Pension Fund) reduces the amounts of negative or positive potential selling/buying pressure in the respective asset class by the amount that could be absorbed in an unconstraint trading environment. The excess of potential buying/selling pressure after netting $T_{Net,t}$ represents the amounts of potential volatility in the individual asset classes at the respective point in time.

Again, a relative comparison to the aggregate size of the analyzed financial system is necessary to scale the netted Tau values. Dividing the individual elements of $T_{Net,t}$ by the dollar amounts invested in the respective asset classes yields a relative measure $T_{Net,t}^{rel}$ for each asset class. Expressed in percentage points, the aggregated potential price impact or buying/selling pressure in the cross-section of investors is calculated. The more complete the set of investors and the precession of AuM matching to modeled investors, the more accurately dynamics and magnitudes of potential price changes can be estimated.

As mentioned in the previous section, the interpretation of the figure $T_{Net,t}$ lies close to the idea of critical temperature of the system that Boguta and Järpe (2010) borrow from the world of physics to explain shifts in volatility regimes. They consider the interaction and interdependence of traders in their decision making process as a catalyst for market overheating and crashes. A parallel can be drawn to the above presented idea of netting of individual preferences and the resulting buying and selling pressure. If investors have overly uniform preferences or views on the market, no netting in Tau occurs and the market tends towards illiquidity induced higher volatility.

Aggregating the measures from the individual asset classes to system wide measures, however, requires a slight change in perspective. Recall that the idea of Inter-Asset-Class to articulate the internal vibration of a financial system. It follows logically from this that the cross-sectional sum of Taus from all asset classes is zero. In a system of bonds, stocks, and cash the latter can be seen as a balancing account equalizing the positive or negative weights in the other asset classes. Adding the absolute values of Taus in all asset classes does not make sense either, as this would imply double counting. It is therefore proposed to add up the absolute amounts of netted Taus $T_{Net,t}^{ABS}$ in all asset classes and divide the number by 2 to arrive at the amount of aggregate Tau in the system. Dividing this amount by the total size of the system in terms of the total dollar amount held in all asset classes yields the final measure of **Absolute Inter-Asset -Class Volatility**:

$$Abs\ IAV_t = \frac{\left(\frac{T^{ABS}_{Net,t}}{2}\right)}{\sum_{i=1}^{N} \text{USD invested in asset class}_i} \tag{6}$$

The percentage figure shows the potential revaluation in the system and, thereby, represents a forward looking measure of system wide volatility. Note that the aggregation took absolute amounts into account which causes the loss of directional indications in the aggregate measure. Individual asset class measures, however, retain this quality.

In a time series sense, the measure should be compared to the realized absolute valuation change aggregated across all asset classes to see to which extend the financial system has used its full volatility potential. This ratio of realized Inter-Asset-Class Volatility to potential Inter-Asset-Class Volatility should lie between zero and one.

$$\text{Volatility Potentail Used}_t = \frac{\text{realized Abs IAV}_t}{\text{potential Abs IAV}_t};\ 0 < VPU < 1 \tag{7}$$

The realization of the volatility potential used is ex-post interpretable as an indicator for the volatility regime prevailing at time t . Interpretations about how efficient markets are and how correct the resulting prices are in periods in which only a small part of the volatility potential is used are left for further research.

A plausible conclusion from the above conceptualization could be that portfolio constraints only superficially protect investors' interests. In the sub-surface realms of liquidity they produce tail volatility on the downside. The recent crisis is a par excellence example of this!

3.4 Empirical Implications & Testable Attributes

From the conceptualization of the measures presented above a set of empirical implications can be derived. These conjectures will be discussed in the following starting from the individual investor level towards the more aggregate measures. Implications are further differentiate by their time ranges that is whether they apply for the full sample or specified sub periods. Note that modeled investors are compared to realized time series on asset class returns, liquidity, and other variables. All calculated values referring to the investors are calculated at the beginning of each period and are valid for the entire period. Return figures describe the development of an asset class during the period in question. Practically a data pair could look as follows: investor i has a delta of $\Delta_{i,t}^{stocks} = -0.2$ in stocks at the beginning of the year 2000. During the year 2000 stocks returned -20%.

The tables 1 and 2 below outline the expectations regarding the characteristics and behavior of the individual measures:

The individual constrained investors

It is important to recall that $\Delta_{i,t}$ measures what the investor would prefer to do but cannot.

Table 1: Expected behavior of Delta

$\Delta_{i,t}$	• Elements of Δ(i,t) should be weakly correlated with simple returns on the respective asset classes as the individual investor's influence on the valuation of entire asset classes is expected to be weak. • sign of the correlation might indicate if the investor's explicit and implicit constraints make him likeminded or contrarian to the overall view in the market • Magnitude and sign of the correlation are not expected to change depending on the analyzed period

Similar interpretations and expectations can be formulated for the elements of $T_{i,t}$. They differ to the extent that the relevant comparison is done with the changes in total market capitalizations of the respective asset classes. In this way dollar values are compared.

Table 2: Expected behavior of Tau

$T_{i,t}$ n	• With the incorporation of AuM into the figures, the dimensionless correlation should not change when compared to the coefficient between deltas and simple returns. • A possible deviation could occur if the modeled investor precisely resembles a real market player with very large AuM. With rising influence of the mimicked investor, correlations between individual measures and market value should increase.

Higher aggregation levels:

When the preferences of two or more investors are consolidate into one measure, the above described netting should occur. Depending on how similar the combined investors are in their explicit and implicit portfolio constraints, netting occurs more or less frequent. The magnitude of netting depends on the relative AuM sizes of the investors. The effect is expected to be the largest when constraints are highly diverging and AuM sizes are similar. It is, hence, expectable that the higher and more frequent the netting effect, the lower the $T_{Net,t}$, the lower the $T_{Net,t}^{rel}$, resulting in a lower absolute Inter-Asset-Class Volatility $Abs\ IAV_t$.

Empirically this phenomenon can be identified by testing expectations summarized in table 3 below:

Table 3: Expected behavior of Volatility Potential Used

$\text{Volatility Potentail Used}_t = \frac{\text{realized Abs IAV}_t}{\text{potential Abs IAV}_t}$	• Expected to decrease with the addition of new investors. • Adding heterogeneous investors to the simulation slows this tendency due the netting of preferences.
$\frac{\text{Change in market cap stocks}_t}{\sum T^{stocks}_{i,t}}$	• Expected to decrease with the addition of new investors. • Adding heterogeneous investors to the simulation slows this tendency due the netting of preferences.

To establish an empirical link between Inter-Asset-Class Volatility and liquidity, correlation coefficients are calculated between the values of $\left(\frac{T^{ABS}_{Net,t}}{2}\right)$ and the measure of aggregate liquidity in the stock market calculated by Pastor and Stambaugh (2003). The latter is available until December 2008 from Pastor's website[2]. Expectations regarding the analysis are displayed in table 4 below.

Table 4: Expected behavior absolut netted Tau values

$\left(\frac{T^{ABS}_{Net,t}}{2}\right)$	• Over the entire sample this coefficient is expected to be negative but limited in magnitude as on average markets can be expected to be in a full-participation equilibrium • Negative correlation implies that with rising absolute Tau values, liquidity diminishes. This relationship is expected to intensify around periods with extreme asset price volatility

4 The Empirical Study

4.1 The Empirical Data

The empirical study presented below aims to test the implications and conjectures drawn from theory and previous research on the link between investors' preference, liquidity, and finally volatility in asset prices. The above developed measures describing the concept of Inter-Asset-Class Volatility in terms of Tau are, therefore, analyzed along the entire sample. An explicit focus is put on the selected subsamples described in the following and summarized in table 5.

Several periods with of extremely low liquidity paired with severely negative stock returns have been added to the ones identified by Pastor and Stambaugh (2003) based on the available liquidity series (table 5).

[2] *http://faculty.chicagobooth.edu/...**pastor**/.../liq_data_1962_2008.txt*

Table 5: Low liquidity periods with extremely negative stock returns

Period	Situation	Value of liquidity series	Stock returns over the period (in %)
May-1970	Political unrest in the US	-0.24	-6.0%
November-1973	Beginning of middle east oil embargo	-0.297	-12%
October-1987	Major stock market crash	-0.46	-23%
August-September-1998	Collapse of LTCM and Russian debt crisis	-0.06; -0.282	-16%; -6%
April-2000	Dot-com bubble, NASDAQ all-time high March 10, 2000	-0.23	-5.0%
September-November-2000	Dot-com bubble burst	-0.17; -0.13;-0.16	-5%; -2%; -10%
September-October-2002	Bear market correction in the wake of 9/11 2001 attacks	-0.17; -0.33	-9%; +7%
March-2008	VIX index at unusual hights, recessionary signals in US	-0.29	-1%
October-2008	Collapse of Lehmann brothers	-0.24	-18%

The example of March 2008 shows that periods with extremely negative sparks in liquidity can also occur with stock markets being only slightly hit. September and October 2002 point to the possibility of stock return reversals despite further deterioration of the liquidity situation.

The study focuses on data from the US to capitalize on better availability and the impressive length of time series on record.

Basis Assets Data

As a proxy for stocks the value-weighted market index including dividends from the CRSP data set is used. A representation of bonds is taken from the WRDS database in the form of the long-term treasuries index. A proxy for cash is found in the 1-month treasury notes from the same source.

Numbers representing the overall money invested in stocks is taken from the CRSP total market value series on the value-weighted stock index used also as a proxy for stocks.

Data on money invested in bonds is taken from CRSP. Funds invested in money market instruments are used as a proxy for overall cash holdings in dollar terms. Corresponding data from 1996 to 2009 was found in the 2010 edition of the ICI Fact Book. The extrapolation of data points for the rest of the sample period is difficult as net new cash flows cannot be reliably estimated and are not included in observable yields on the instruments. Through the conceptual exclusion of net new money flows articulated in section 3 seeing the analyzed system as “closed”, a simple extrapolation via the above mentioned 1-month treasury rate is used to stay consistent.

Conditioning Variables

Dividend-price ratio (DP): Based on the CRSP value-weighted equity indices with and without dividends, the ratio is traced-out of return data in the following manner:

$$R_t^{With} = \frac{P_t + D_t}{P_{t-1}}\,;\; R_t^{Wout} = \frac{P_t}{P_{t-1}} \tag{8}$$

$$R_t^{With} - R_t^{Wout} = \frac{D_t}{P_{t-1}} \tag{9}$$

$$\frac{R_t^{Wout}}{R_t^{With} - R_t^{Wout}} = \frac{P_t}{D_t} = \frac{1 + r_t^{Wout}}{r_t^{With} - r_t^{Wout}} \tag{10}$$

Where r_t^{Wout} is the simple net return on the value weighted index.

Relative Treasury bill (Tbill): Similar to Brand & Santa-Clara (2006) the 1-year treasury bill rate obtained from the WRDS database is stochastically detrended by subtracting the 12-month moving average from the raw series.

Term spread (TS): The term spread is calculated as the difference between the yield on the 10 year and the 1 year US treasury notes based on WRSD data sets.

In line with Brand and Santa-Clara (2006) the three conditioning variables are standardized with the aim to ease the interpretation of the coefficients describing the allocation to the conditional portfolios estimated in the optimization.

Data on the 3 Fama-French factors (SMB, HML, MKT) as well as on the Momentum factor are obtained from the WRDS database. The time series for the level of aggregate liquidity, the innovations in aggregate liquidity, and the Traded Liquidity factor based on Pastor & Stambaugh (2003) are also obtained from the WRDS database. Liquidity data is also publicly available from Pastor's website mentioned earlier.

The availability of the Traded Liquidity factor constraints the length of the sample period to January 1968 to December 2008. With the coefficients estimated in this period, out of sample testing can, however, be performed for 2009 and 2010 as all other variables are available until December 2010.

Simulation data for the entire sample period are obtained via the process described in the following sections. Special attention is given to technicalities as an understanding of the method is crucially important for the reader's ability to interpret the presented results.

4.2 The Simulation Approach

All measures related to the concept of Inter-Asset-Class Volatility are based on two components: 1. Portfolio weights and 2. AuM. To analyze the measures and test their behavior against empirical data it is necessary to generate time series of both components. While the simulation of AuM is straight forward, the simulation process for constrained and unconstrained portfolio weights requires more explanation. This subsection presents the non-conventional method used and explains the benefits from and rationale for using it.

4.2.1 Direct Parameterization of Portfolio Policies

To quantify the outlined theoretical implications of difference between the chosen benchmark allocation (mean-variance optimal) and implemented portfolio weights both values have to be estimated. Both, the simple mean-variance optimal portfolio weights as well as the constraint portfolio weights are estimated as a direct parameterization of portfolio policies based on a set of state variables. In this, the approach builds directly on Brandt and Santa-Clara (2006). The approach focuses on finding the utility maximizing coefficients of the functions defining portfolio weights as linear products of conditioning variables. Differences in the utility functions underlying the maximization problems as well as a set of constraints imposed on the optimal portfolio weights are the source of divergence between the unconstrained and constrained weights.

Rational behind the methodology selection

The methodology is chosen due to its superior computational tractability when compared to other approaches for the estimation of multi-objective portfolio policies (Ait-Sahalia & Brandt, 2001; Brandt & Santa-Clara, 2006; Brandt et al., 2009). Consequently, the replicability of the method for practitioners in real life portfolio or risk management situations is significantly enhanced.

From a theoretical standpoint, the method is elegant as it does not rely on the completeness of markets given that investors only chose from a set of feasible investment strategies (Brandt & Santa-Clara, 2006). Furthermore, the direct translation of state variables describing the economic environment into portfolio policies stands fully in line with the understanding of financial markets articulated in section 3.

Mechanics & Limitations of the Method

Brandt and Santa-Clara (2006) reframe the dynamic portfolio optimization problem as a static choice between a set of mechanically managed portfolios that augment the space of investable assets. Characterizing the two types of managed portfolios “conditional” and "timing" portfolios aids the understanding of the basic intuition. Conditional portfolios play key role in this studies and are characterized below. Timing portfolios are used on the multi-period extension of the optimization problem in question and are therefore outlined in Appendix 1 together with a detailed mathematical description of the multi-period problem.

Conditional portfolios invest an amount proportional to the level of a specific conditioning variable into one of the pre-specified basis assets. In line with Campbell, Chan, and Viceira (2003) and Brandt and Santa-Clara (2006), the basis assets in the current application are stocks, bonds, and cash. The set of conditioning variables has been presented in more detail in section 4.1. Similar to Brandt and Santa-Clara (2006) the term spread, the dividend-price ratio, and the short-term Treasury bill rate are used as conditioning variables given their proven influence on the distribution of stock and bond returns (Campbell, 1991; Campbell & Shiller, 1988; Fama, 1990; Fama & French, 1989). Conditional portfolios are formed for each combination of conditioning variable and basis assets.

Breaking down this allocation into the fractions of wealth invested into the basis assets is straight forward as they are simple linear functions of the conditioning variables.

From its elegant reframing of the asset allocation problem the approach inherits two major downsides. Firstly, the approach only represents an approximation of the exact portfolio policies as presented in Cox and Huang (1989). Secondly, the approach builds on the sample moments of the long-horizon returns of assets in the expanded space and is, hence, exposed to data availability issues and resulting small sample biases when addressing long horizon problems (Brandt & Santa-Clara, 2006).

As this study focuses on the short or tactical horizon of the portfolio choice problem, the mentioned weakness of the method is not of concern. Inter-Asset-Class Volatility as the phenomenon in question is conceptualized as a period by period comparison. Therefore, this study simulates myopic or one period portfolio policies with annual and manual rebalancing for a one year and a monthly horizon. The use of timing portfolios is, hence, not necessary.

A further limitation of the approach presented by Brandt and Santa-Clara (2006) is the inability to handle endogenous conditioning variables rooted in the agent's prior behavior. Additionally, the approach is suitable only for preferences over final wealth and does not nest intermediate consumption. This limitation might cause obstacles when modeling for instance pension fund managers with alternative preferences such as relative funding ratios over stochastic liabilities and the like (de Jong, 2008b; de Jong et al., 2008; van Binsbergen &

Brandt, 2007). Regarding this matter the approach is less comprehensive than modifications of traditional portfolio selection approaches undertaken, for instance, by Campbell, Chan, and Viceira (2003) who apply Epstein-Zin preference to incorporate intermediate consumption/pay-outs.

It is important to point out that it is not the purpose of this paper to derive optimal long-term portfolio policies for different investor types. The described method solely serves to translate investor preferences into vectors of portfolio weights in a manner consistent with the underlying understanding of financial markets.

4.2.2 Technical Specifications

In the technical application of the outlined method this paper stays very close to Brand and Santa-Clara's (2006) specification as the program only serves as a data generating process for the main analysis. To ease comparison, the same notation is used as well as a very comparable data set.

Applying the methodology to practitioner oriented objective functions and comparing results to a standard mean-variance objective function differentiates this paper. Furthermore, the extension of the sampling period from 2000 to 2008 is expected to yield interesting new insides.

Portfolio weights in the conditional choice problem are parameterized as

$$x_t = \theta z_t . \tag{11}$$

θ is a matrix of coefficients while z_t is a vector of state variables. Brandt and Santa-Clara (2006) show that "this conditional portfolio choice problem is mathematically equivalent to solving an unconditional problem within an augmented asset space that includes naively managed zero-investment portfolios with excess returns of the form z_t times the excess returns of each basis asset" (p.2190).

Single period problem:

In general terms, the agent in question is an investor with a quadratic utility function over next period's wealth, maximizing the conditional expected value of the latter:

$$maxE_t\left[W_{t+1} - \frac{b_t}{2}W_{t+1}^2\right] \tag{12}$$

Indexes indicate the time when the variable is known. The wealth at the time $t+1$ is:

$$W_{t+1} = W_t\left(R_t^f + r_{t+1}^p\right) \tag{13}$$

Substituting (12) in (13) and some simplification yields the maximization problem:

$$maxE_t\left[cte + r_{t+1}^p - \frac{b_t W_t}{2\left(1 - b_t W_t R_t^f\right)}\left(r_{t+1}^p\right)^2\right] \tag{14}$$

cte is a constant given the information available at time t . Rewriting with a simplicity focus

yields

$$maxE_t\left[r_{t+1}^p - \frac{\gamma}{2}\left(r_{t+1}^p\right)^2\right]. \tag{15}$$

To accommodate the particularities of investor realities that are key to this paper the maximization problem is augmented as follows:

$$maxE_t\left[r_{t+1}^p - \frac{\gamma}{2}\left(r_{t+1}^p\right)^2 - \varphi r_{t+1}^p r_{t+1}^m - \phi r_{t+1}^p r_{t+1}^{LIQ} + \psi r_{t+1}^p r_{t+1}^{MOM}\right] \tag{16}$$

Where $r_{t+1}^p = R_{t+1}^p - R_t^f$ is the excess return of the portfolio over the return on the risk free rate. The constructed objective function is meant to mimic the manager of a typical balanced fund mandated to allocate to bonds, equities, and cash. An in-depth discussion of the additional arguments in the objective function is done in the next section. The basic set-up is nonetheless used in the following mathematical steps for efficiency reasons.

With the vector of portfolio weights in the risky asset at time t denoted as x_t the optimization problem has the following form

$$\max_{x_t} E_t\left[x_t^{T} r_{t+1} - \frac{\gamma}{2} x_t^{T} r_{t+1}\, r_{t+1}^{T} x_t - \varphi x_t^{T} r_{t+1} r_{t+1}^m - \phi x_t^{T} r_{t+1} r_{t+1}^{LIQ} + \psi x_t^{T} r_{t+1} r_{t+1}^{MOM}\right] \tag{17}$$

Note that $r_{t+1} = R_{t+1} - R_t^f$ is the vector of excess returns on the N risky assets above the risk free rate. Formulating the problem in terms of excess returns implies that the remainder of the assets is invested in the risk free asset with secure return R_t^f.

With independent and identically distributed (i.i.d.) returns the portfolio weights are constant over time implying $x_t = x$ and the conditional expectation can be replaced by an unconditional expectation. The respective static solution for the optimal portfolio weights is

$$x = \frac{1}{\gamma} E\left[r_{t+1} r_{t+1}^{\top}\right]^{-1} E\left[\left(1 - \varphi r_{t+1}^{m} - \phi r_{t+1}^{LIQ} + \psi r_{t+1}^{MOM}\right) r_{t+1}\right] \tag{18}$$

For practical implementation, population moments are substituted by sample averages (1/T terms in the sample averages cancel out):

$$x = \frac{1}{\gamma}\left[\sum_{t=1}^{T-1} r_{t+1} r_{t+1}^{\top}\right]^{-1}\left[\sum_{t=1}^{T-1}\left(1 - \varphi r_{t+1}^{m} - \phi r_{t+1}^{LIQ} + \psi r_{t+1}^{MOM}\right) r_{t+1}\right] \tag{19}$$

In the more realistic case of non i.i.d. returns where the optimal portfolio weights are linear in a vector of K state/conditioning variables $x_t = \theta z_t$, with θ being an NxK matrix, after substitution the maximization problem looks as follows

$$\max_{\theta} E_t\left[(\theta z_t)^{\top} r_{t+1} - \frac{\gamma}{2(\theta z_t)}^{\top} r_{t+1}\, r_{t+1}^{\top} (\theta z_t) - \varphi(\theta z_t)^{\top} r_{t+1} r_{t+1}^{m} - \phi(\theta z_t)^{\top} r_{t+1} r_{t+1}^{LIQ} + \psi(\theta z_t)^{\top} r_{t+1} r_{t+1}^{MOM}\right] \tag{20}$$

Following Brandt and Santa-Clara (2006) a result from linear algebra is transferred to further simplify and derive the following expression

$$(\theta z_t)^{\top} r_{t+1} = z_t^{\top} \theta^{\top} r_{t+1} = vec(\theta)^{\top} (z_t \otimes r_{t+1}) . \tag{21}$$

$vec(\theta)$ piles up the columns of the coefficient matrix θ into a vector. $\otimes$ is the Kronecker product of two matrices, in this case 1xK matrix z_t and the 1xN matrix r_{t+1} that creates a block matrix of the dimensions 1x1-KxN. On this basis we can write:

$$\tilde{x} = vec(\theta) \tag{22}$$

$$\tilde{r}_{t+1} = z_t \otimes r_{t+1} \tag{23}$$

With these adjustments the conditional problem converges to the following form:

$$\max_{\tilde{x}} E_t\left[\tilde{x}^\top \tilde{r}_{t+1} - \frac{\gamma}{2}\tilde{x}^\top \tilde{r}_{t+1}\tilde{r}_{t+1}^\top \tilde{x} - \varphi\tilde{x}^\top \tilde{r}_{t+1} r_{t+1}^{m} - \phi\tilde{x}^\top \tilde{r}_{t+1} r_{t+1}^{LIQ} + \psi\tilde{x}^\top \tilde{r}_{t+1} r_{t+1}^{MOM}\right] \quad (24)$$

Through the above transformation we know that the $\tilde{x}$ maximizes the conditional expected utility at all times t and therefore also maximizes the unconditional expected utility.

The goal is now to find the unconditional portfolio weights $\tilde{x}$ for the extended assets space with NxK assets comprising the conditional portfolios described above with returns $\tilde{r}_{t+1}$. The optimal weights are:

$$\tilde{x} = \frac{1}{\gamma}E\left[\tilde{r}_{t+1}\tilde{r}_{t+1}^{\top}\right]^{-1}E\left[\left(1 - \varphi r_{t+1}^{m} - \phi r_{t+1}^{LIQ} + \psi r_{t+1}^{MOM}\right)\tilde{r}_{t+1}\right] \quad (25)$$

$$= \frac{1}{\gamma}E\left[(z_t z_t^{\top}) \otimes \left(r_{t+1}r_{t+1}^{\top}\right)\right]^{-1}E\left[\left(1 - \varphi r_{t+1}^{m} - \phi r_{t+1}^{LIQ} + \psi r_{t+1}^{MOM}\right)(z_t \otimes r_{t+1})\right]. \quad (26)$$

For a practical application of this solution, sample means are substituted for population moments:

$$\tilde{x} = \frac{1}{\gamma}\left[\sum_{t=0}^{T}(z_t z_t^{\top}) \otimes \left(r_{t+1}r_{t+1}^{\top}\right)\right]^{-1}\left[\sum_{t=0}^{T}\left(1 - \varphi r_{t+1}^{m} - \phi r_{t+1}^{LIQ} + \psi r_{t+1}^{MOM}\right)(z_t \otimes r_{t+1})\right]. \quad (27)$$

To reconcile the weights allocated into the single basis assets, one adds the corresponding products of $\tilde{x}$ and z_t. To clarify how the final weight in each asset is calculated it is instructive to explain the structure of the vector $\tilde{x}$.

The first two elements of the vector represent the basic allocations to bonds and stocks. Note that the formulation of the maximization problem in terms of excess returns implies that the weight in cash is a residual of 1 minus the allocations to the risky assets. The following NxK elements of the vector represent coefficients that parameterize the corresponding state of the conditioning variables z_t into contributions to final weights in the risky assets. As asset classes react differently to changes in the economic environment, such coefficients are estimated for each conditioning variable in z_t per risky asset (Brandt & Santa-Clara, 2006). The final weight in a risky asset is hence given by:

$$x_t^{Stocks} = x_t^{2} + x_t^{6}z_t^{1} + x_t^{7}z_t^{2} + x_t^{8}z_t^{3}. \quad (28)$$

The investor has a basis allocation that is scaled up and down depending on the state of the economic surrounding. Recall that this view is consistent with the understanding of the function of financial markets articulated in section 3.

In its here presented form, the solution does not require any assumptions about the distribution of returns besides their stationarity as it relies only on historic data. No assumption needs to be made on how the distributions of returns depend on the state variables. Consequently, the state variables can predict time variation in the first, second, and even higher moments (with more general utility functions) of returns (Brandt, Goyal, Santa-Clara, & Stroud, 2005; Brandt & Santa-Clara, 2006). No conditional return distributions need to be estimated as the focus lies directly on the portfolio weights. The direct estimation of conditional portfolio weights makes the method robust to misspecifications of the conditional return distributions (Ait-Sahalia & Brandt, 2001).

Furthermore, due to a less noisy dependence of the portfolio weights on the state variables when compared to the dependence of the return moments on the state variables, a higher estimation precision can be achieved (Brandt & Santa-Clara, 2006).

The detailed review of the simulation approach in the here ending section builds the technical grounds for the differentiation of investor types via objective functions and weight constraints. It was intended to aid the understanding of the importance of this task for the realistic modeling of real world investors. At this point it should be stressed again that the validity of the later presented results crucially depends on the precise mimicking of the modeled agents.

4.3 Differentiating Investor Types

The theoretical insights presented above suggest that investors can be differentiated according to the implicit and explicit constraints they are subject to. This section adheres to this separation by differentiating three different investor types according to their objective functions. Secondly, explicit allocation constraints are imposed onto their portfolio policies. All three investors are contrasted against an agent maximizing expected utility of next period's wealth given a single argument objective function related only to expected excess returns of his/her portfolio and the variance thereof. This unconstrained agent serves as the benchmark for calculating the magnitudes and directional signs of deviations in portfolio policies induced by the two constrain types. Anchoring the analysis around mean-variance optimality has several advantages but represents only one of many potential applications of this deviation analysis.

4.3.1 Implicit Constraints on Objective Functions

The first constrained investor (CS I)

As mentioned in the technical specifications section, the underlying multi-argument objective function for the analysis of constraint investors aims to mimic the characteristics of a real life balanced fund manager. The specification is oriented along the prospectus of the American Balanced Fund administered by the American Funds Service Company (the full prospectus is available in Appendix 13, p.97). For the ease of reading, the function is stated again below:

$$max E_t \left[r_{t+1}^{p} - \frac{\gamma}{2} \left(r_{t+1}^{p} \right)^2 - \varphi r_{t+1}^{p} r_{t+1}^{m} - \phi r_{t+1}^{p} r_{t+1}^{LIQ} + \psi r_{t+1}^{p} r_{t+1}^{MOM} \right] \quad (16)$$

To capture the particularities of such a mandate, the investor gets penalized for covariance of the portfolio returns with the return on the equity market $-\varphi r_{t+1}^{p} r_{t+1}^{m}$ as investors in balanced funds deliberately chose the product for its slightly more defensive allocation policy. Furthermore, a disutility from covariance with the liquidity factor constructed by Pastor and Stambaugh (2003) proxies for daily liquidity promised to clients and demanded by law from the mutual fund industry. The latter idea becomes clearer if one considers forced fire sales of highly illiquid assets to meet clients instant liquidity requests in down turns. However, the fund manager has a positive utility contribution from portfolio returns co-varying with the momentum factor (Jegadeesh & Titman, 1993). This conceptualization captures a reduction in career risk (Fama, 1980) from buying into positive trends.

The risk aversion coefficient γ represents a positive constant and is set to a standard magnitude of 5. The parameter value is often used in the literature to capture the characteristics of average risk aversion (Brandt et al., 2005; Brandt & Santa-Clara, 2006; Brandt et al., 2009; Campbell, Chan, & Viceira, 2003; Campbell & Viceira, 2004; van Binsbergen & Brandt, 2007).

Additional arguments are integrated into the objective function in a linear fashion using the also positive constants $\phi; \varphi; \psi$ to determine the penalty or credit levels associated with the covariance of the portfolio's excess return with the additional factors.

Values describing the investor's tolerance levels for the covariance terms are taken from Pastor and Stambaugh's (2003) seminal work on the pricing of liquidity. The authors calculate ex-post mean-variance efficient portfolios from an investment universe containing the three Fama-French factors MKT, SMB, and HML (Fama & French, 1993, 1996), Jegadeesh and Titman's (1993) Momentum factor (MOM) and their own introduced Liquidity factor (LIQ) representing a model that explicitly incorporates a relation between liquidity and expected returns. The resulting weights can be interpreted as the contribution of the traded factors to mean-variance efficiency. Given that this study assesses deviations from mean-variance efficiency, the weight values are interpreted as factor penalties or credits depending on the form of the objective function. In this sense, Pastor and Stambaugh's (2003) remark that a pure mean-variance based analysis might not be optimal in a multi-beta pricing world lays the ground for this crucial interpretation.

In fact, all additional arguments included in the above shown objective function are nested in Pastor and Stambaugh's (2003) calculation that is based on a very similar data set and sampling period (1966-1999 compared to 1968-2008). Resulting factor penalties are shown below in table 6:

Table 6: Factor penalties for constrained investors

Factor Penalties			
Constrained Investors I & II			
Factor	**Coefficient**	Ex-post Tangency Portf. Weight	Penalty/Credit Constant
MKT	ϕ	0.177	(0.177)
LIQ	φ	0.156	(0.156)
MOM	ψ	0.119	0.119

Source: Adopted from Pastor & Stambaugh (2003), table 10.

A technically more sophisticated and potentially more precise method of determining factor tolerances would be based on finding a solution to the maximization problem via a Lagrangian Multiplier approach. The λ s corresponding to the individual implicit constraints represent the coefficients $\phi; \varphi; \psi$. There from, an estimation of tolerance levels could be achieved from the data. Due to the higher computational effort and for better comparability of the literature-based determination of tolerance levels, this option is omitted.

Additional investors

As the concept of $\tau_{Net,t}$ depends by definition on the existence of multiple investors in the system, two additional investors are modeled. The first addition to the system is a **second constrained investor (CS II)** operating with the same objective function as the first agent described above. They two types differ solely in their explicit portfolio constraints discussed in the next section.

The similarity in implicit constraints captures the underlying structure of the prevailing agency situation professional fund managers are facing, while the differences in explicit allocation limits allows to show the impact of product differentiation on the outcome of their allocation decisions. The existence of a netting effect in Tau between the two likeminded but differently constraint investors would exemplify the latter.

To better capture the internal dynamics of the analyzed financial system the second addition is a **hedge fund (HF)** type investor. From a modified objective function and very limited explicit constraints on the portfolio policy an even higher netting effect is expected. Through his/her substantially different preferences the investor is able to express directional views on asset classes in a more pronounced manner and potentially fills allocation gaps that the other two types are forced to leave open. In other words, he/she acts like Fama's piranhas (1970) and takes out inefficiencies arising from the constraints on other investors portfolios.

A mean-variance optimizing objective function that penalizes covariance of portfolio returns with the MKT factor to a high extent is used to proxy the behavior of market neutral hedge fund. While a factor penalty of 1 would be consistent with the intended allocation of such a fund, a more realistic value of 0.6 is used representing the average ex-post covariance of long-short hedge funds estimated based on the Credit Suisse/Tremont Hedge Fund Index over the period from 1994 to 2010 (Dahlquist, 2010). Comparing this figure to the value used for the other two investor types highlights the difference in preferences. The latter is further amplified by reducing the risk aversion coefficient from 5 to 3 to inject a higher risk appetite into the agent's behavior. Thereby a preference for stronger skewed and leptokurtic returns is implicitly incorporated, while the higher technical complexity is avoided. For the technical details of imposing preferences for higher order moments of returns please see Brandt, Goyal, Santa-Clara, and Stroud (2005).

As an addition to the outlined differentiation of investor types by implicit portfolio constraints, Appendix 2 presents an overview of potential other augmentations of the fund manager's investment decision problem found in the literature. A short explanation is given why they have not been implemented in this study. The following section details the differentiation of the presented investor types via explicit constraints on portfolio weights.

4.3.2 Explicit Constraints on Portfolio Weights

The imposition of explicit constraints on the allocations chosen is the most prominent and most frequent way of intervention into fund managers' decision processes (Almazan et al., 2004; Jagannathan & Ma, 2003; Roncalli, 2010; van Binsbergen & Brandt, 2007). Often, these limitations intend to protect clients or beneficiaries from miss allocations and unnecessary risks.

In a well fitting example, Pflug and Swietanowski (1999) argue that the mean variance trade-off does not sufficiently characterize the pension fund manager's decision problem. Various additional legal and organizational constraints can, however, be added to the maximization problem via linear inequalities. The technical imposition of such constraints is not uniform throughout the literature. A comprehensive discussion of a number of ways to do so and there conceptual implications and tie-ins with this paper are presented in Appendix 3.

In the following, the weight imposition mechanism applied in this paper is outlined. The process comfortably nests the possibility of testing the compatibility of portfolio constraints with views on different states of nature via a system of inequalities that can be solved for upper and lower bounds of the state variables z_t. Within these bounds allocation bands are achievable. This property potentially allows for a potential "fit assessment" of constraints given a certain macroeconomic scenario. Amongst others, Jagannathan and Ma (2003) and Roncalli (2010) have called for such a property. For a more detailed discussion please refer to Appendix 3.

Constraints are directly imposed on the final weights per basis asset calculated as:

$$x_t^b = x^1 + x^3 z_t^1 + x^4 z_t^2 + x^5 z_t^3 \tag{29}$$

$$x_t^s = x^2 + x^6 z_t^1 + x^7 z_t^2 + x^8 z_t^3 \tag{30}$$

$$x_t^c = 1 - \left(x_t^b + x_t^s\right) \tag{31}$$

Weights that cross the upper or lower bound of their specified bands are constraint to the boundary levels. Values within the relevant bounds are not further modified. This corresponds to Roncalli (2010). Note that in this sense, allocation bands with positive lower bounds also imply a no-short-sale constraint as well as a no-leverage constraint.

The resulting weights do not sum to one anymore. Drawing on Brandt, Santa-Clara, and Valkanov (2009) this is corrected in a second step through normalizing to 1 as follows:

$$x_t^{sf} = \frac{x_t^s}{x_t^b + x_t^s + x_t^f} \tag{32}$$

Where x_t^{sf} stands for the final weight for stocks in the portfolio policy.

To counter allocation band breaches resulting from normalization, the overrun in weighs in the risky assets namely stocks and bonds are buffered by the weight in cash. Buffering via weights in the least volatile asset class avoids distortions in portfolio returns and risk factor exposures from the constraining mechanism. Especially using the risk free asset as a buffer minimizes inaccuracies in the views on risky assets the manager expresses.

After having discussed the applied approach to constraint imposition, the explicit constraints used to differentiate investor types are now presented.

The first constrained investor (CS I)

Recall that the first constraint investor mimics the American Balanced Fund managed by the American Funds Service Company. Due to standing regulation the manager's decision is subject to a short-selling constraint imposing strict positivity on the weights of the risky assets as well as the risk free asset. This nests the regulatory no-leverage constraints for non-130/30 funds. Furthermore, the possible portfolio weights are subject to the following self-imposed allocation bands per asset class stated in the fund prospectus:

Equities: 50-75%

$$0.5 \leq x_t^s \leq 0.75 \tag{33}$$

Bonds: 25-50%

$$0.25 \leq x_t^b \leq 0.50 \tag{34}$$

Cash: 0-25%

$$0.00 \leq x_t^c \leq 0.25 \tag{35}$$

Aiming to show the impact of explicit constraints on investors with identical objective functions, the **second constrained investor (CS II)** is subject the following weight limits:

Equities: 20-50%

$$0.20 \leq x_t^E \leq 0.50 \tag{36}$$

Bonds: 40-60%

$$0.40 \leq x_t^B \leq 0.60 \tag{37}$$

Cash: 10-20%

$$0.10 \leq x_t^C \leq 0.20 \tag{38}$$

Allocation limits for the second investor are relatively tighter for bonds and cash but slightly wider for equities. Weights on bonds have a higher mid value and a minimum cash quota of 10% is imposed. The constraints set aims to mimic a more defensive investor with a focus on constant cash flows rather than capital gains. High liquidity needs are reflected in the cash quota. The weight limits closely resemble the “moderate” allocation offered by Fidelity Investment Managers that Canner, Mankiw, and Weil (1997) refer to when describing the apparent asset allocation puzzle. Campbell and Viceira (2002) build on the same systematization in their discussion of differences between investor types.

The third hedge fund type investor is not explicitly constrained in his/her allocation to individual asset classes. To stay within realistic and prudent limits the weight on cash has an upper bound at 10 limiting the maximum leverage of the fund to 10 times its invested equity.

5 Analysis of Concept Related Measures & Key Findings

In this section brief presentation of the results for the individual investors is followed by a more detailed presentation of the results arising in the combined scenarios. The characteristics and backgrounds of the investors have been outlined in the previous sections. AuM and their development for all investor types is proxied by a fixed percentage of the total assets in the system. This linkage eliminates unwanted effects of AuM changes onto the calculated IAV measures and makes the results comparable across periods and investors. Note again that all IAV concepts are period by period measures making a performance based AuM development unnecessary. Additionally, scenario calculation with varying investor type presence in the market is significantly eased.

All effects are studied based on three different portfolio policies. A policy with a 1-year investment horizon and annual rebalancing is compared to a 1-year horizon policy subject to monthly rebalancing and a 1-month horizon policy with respective rebalancing. The second set-up appears closest to reality given the observable frequency of conditioning variables. Note that the weight deltas etc. calculated are often intended figures and, therefore, do not have to correspond to the fund managers' actual rebalancing periods. Capturing the change in sentiment is the goal of the exercise.

5.1 The Unconstraint Mean-Variance Investor

Serving as the basis for all following deviation studies the mean-variance investor plays a crucial role in this paper. The agent's fully unconstrained portfolio policy based on the selected conditioning variables is displayed in table 7 below.

Table 7: Portfolio Policy Characteristics: Mean-Variance Investor

Portfolio Policy Characteristics				
Mean-Variance Investor				
State Variables		Annual	Annual-Monthly	Monthly
Bonds	Constant	0.255	0.255	0.529
	D/P	(0.909)	(0.909)	(0.034)
	Termspread	(0.237)	(0.237)	(0.020)
	Tbill	0.375	0.375	0.300
Stocks	Constant	0.315	0.315	0.278
	D/P	0.303	0.303	0.071
	Termspread	(1.112)	(1.112)	(0.497)
	Tbill	0.480	0.480	(0.421)
Mean Return (In-Sample)		0.047	0.084	(0.021)
Mean Excess Return (In-Sample)		(0.005)	0.027	(0.066)
Mean Return (Out-Sample)		(0.401)	(0.069)	(0.290)
Standard Deviation (In-Sample)		0.344	0.114	0.295
Standard Deviation (Out-Sample)		0.047	0.109	0.328
Sharpe Ratio (In-Sample)		(0.013)	0.237	(0.223)

Source: Own compilation.

The constants estimated for bonds and stocks can be interpreted as average weights in the asset class. Allocations to the asset classes are augmented by the linear multiplicative combination of the coefficients for each conditioning variable and its realization. The coefficients are estimated from annual data to represent a 1-year investment horizon and from monthly data to represent a 1-month investment horizon. Final weights are than calculated based on an annual rebalancing of positions using annual realizations of the conditioning variables as well as for a 1-month horizon with monthly rebalancing. Furthermore a hybrid is formed characterized by a 1-year investment horizon and monthly rebalancing. For the latter, the coefficient estimates from annual data are used.

The coefficient relating bonds to the dividend/price ratio is strongly negative in the annual estimation. This result makes intuitive sense as it implies that a rising dividend/price ratio reduces the weight invested in bonds as the stocks become more attractive in terms of cash flow yield and expected returns. It is, hence, consistent with mean-reversion properties in stock returns (Fama & French, 1988). Logically, the coefficient is much smaller in magnitude in the monthly estimation as the amount of dividends paid per month is relatively unimportant for such a short horizon. Conversely, the coefficient is strongly positive in the annual estimation for stocks and slightly positive in the monthly estimation.

A negative coefficient on the term spread indicates that positions in both risky assets are reduced if recessionary scenarios become more likely or, in other words, macroeconomic uncertainty rises and conditions worsen. With the stock coefficient being almost three times larger but equally signed, a potential interpretation could be that a pecking order or preference hierarchy emerges preferring the risk free asset over bonds over stocks as the most volatile asset. Again, the coefficient loses magnitude with a shortened optimization horizon.

An economic rationale for the positive coefficients for the 1-month treasury bill for both stocks and bonds is non-trivial to find. The basic inverse relationship between interest rates and bond prices does not seem to be reflected here. Rising interest rates might, however, be a sign of tightening monetary policy to avoid overheating of well running economy. For a short horizon, a rise in short term rates could, hence, temporarily favor stocks over directly impacted bond prices. The coefficient, however, turns negative for stocks in the monthly estimation countering this argument.

The mean-variance optimal policy seems very sensitive to the choice of rebalancing frequency as only the 1-year horizon policy with monthly rebalancing generates a positive Sharpe ratio in the sample. A clear dominance of this configuration also continues out of sample. While better mean returns are an important driver for this, the significantly reduced standard deviation of the configuration is worth mentioning.

5.2 Constraint Investors – Delta, Tau, and Correlation Analysis

Tables 8 to 10 (Appendix 4, p.84) show the coefficients underlying the respective portfolio policies for all three constrained investors. It appears at first side that the estimated coefficients and constants for the Constrained Investor I and II (identical) differ only in the third digit. This is surprising given the substantial modification of the investors' objective function compared to the mean-variance investor. A deeper look into the empirical realization shows that the introduced penalties for covariance with the market factor and covariance with the traded liquidity factor are almost exactly counterbalanced by the credit given for covariance with the momentum factor leaving only a minor downward tendency in coefficients. It therefore appears that implicit portfolio constraints have a limited influence on the differentiation of portfolio policies as long as the underlying trade-off is mean variance based.

Note however, that this realistic set of modifications to the objective function appears to shrink the coefficient structure towards the mean-variance results. The degree of shrinkage depends on the factor penalties on the countering penalties/credits for covariance with the market and momentum factors.

The portfolio policy characteristics estimated for the Hedge Fund investor are in all configurations equally signed but more pronounced than the other constrained investors as well as the mean-variance investor. This clearly reflects the significantly lowered risk aversion coefficient. Coefficients of larger magnitude imply a higher reactivity to changes in the macro environment represented by the standardized conditioning variables. As with all other investors, the relation between the average allocations to bonds and stocks changes in the 1-month horizon configuration. A potential interpretation of the tendency is the lower monthly volatility of bond returns compared to stock returns receiving increasing relevance in the shorter investment horizon.

Contrary to the countering modifications in the objective functions for the other two constrained investors, the penalty for covariance with the market factor seems to tilt the policy towards a slightly more equal average allocation to stocks and bonds. Deviating from the clear stock preference reduces the covariance with the stock based market factor.

For a detailed discussion on the performance of the estimated policies please see Appendix 4.

5.2.1 Individual Portfolio Policies - Final Weights, Deltas, and IAV contributions

Tables 11 below presents the final weights following the imposition of the above described explicit weight constraints as well as the deltas between them and the mean-variance investor's allocation for the CS I. Furthermore, the AuM scaled average contributions to the volatility in the two risky asset classes as well as the individual investors overall contribution to the aggregate Inter-Asset-Class Volatility is reported across the three portfolio configurations. Tables 12 and 13 contain the results for the other two investors and can be found in Appendix 5 (p.86).

Table 11: Final Weights – Deltas – Contributions: Constrained Investor I

Final Weights - Deltas - IAV Contributions

Constrained Investor I

Mean Weights		Annual	Annual-Monthly	Monthly
In-Sample	Cash	0.124	0.104	0.079
	Bonds	0.328	0.344	0.382
	Stocks	0.547	0.552	0.539
Out-Sample	Cash	0.250	0.208	0.147
	Bonds	0.250	0.292	0.353
	Stocks	0.500	0.500	0.500
Mean Deltas				
In-Sample	Cash	0.222	0.218	0.075
	Bonds	(0.059)	(0.079)	0.153
	Stocks	(0.164)	(0.138)	(0.229)
Out-Sample	Cash	2.175	2.296	0.787
	Bonds	(0.036)	(0.195)	0.060
	Stocks	(2.139)	(2.101)	(0.846)
Mean IAV				
In-Sample	Bonds	0.347%	(0.510%)	2.330%
	Stocks	(5.155%)	(4.314%)	(7.020%)
Mean Abs. IAV from Investor		16.932%	16.509%	4.291%
Standard Deviation of Abs. IAV from Investor		9.770%	10.737%	2.872%
AuM as % of Total Assets		10%	10%	10%

Source: Own compilation.

Weights

Average weights for the first two constrained investors are quite stable across policy configuration but differ substantially from the estimated constants presented before. The first constrained investor reduces his/her weight in the risk free asset to the benefit of bonds with increasing rebalancing frequency and shortening horizon while the weight in stocks is gradually reduced.

The second constrained investor's policy does not show a significant allocation changes with varying configurations. As the two only differ in the explicit constraints they are subject to, this might imply that the second investor's allocation bands represent a more achievable linkage between the macro environment in the sample period and the underlying objective function.

In line with this interpretation, it is observable that both allocations stay close to the mid-points of their respective allocation bands with an exception of the first investor's average weight in stocks. Explicit constraints on the CS_1 portfolio structurally imply a stock overweight.

When looking at out of sample average weights, the question of fitting constraints becomes more apparent. Average weights for both investors stay relatively stable across configuration but run into their lower (bonds and stocks) and upper (cash) boundaries at various points. A relaxation of this state with shortening horizon and rising rebalancing frequency, however, remains intact for the first investor.

Deltas

When looking at deltas for the two agents, the differing constraint sets produce significant deviations. In relation to the mean-variance investor both investors appear to be on average restrained from higher cash holdings across all configurations. In both 1-year horizon configurations the two investors are longer bonds than the mean-variance investor reverting into a shorter average bond allocation for the monthly horizon. Different preferences are observable regarding average stock weights.

While the first investor has significantly longer stock positions than the mean-variance investor, the second investor has lower relative allocation to stocks compared to the mean-variance investor in two out of three configurations. The general magnitude of deviations from the mean-variance optimal allocation can be interpreted as a hint on the constrainedness level of an agent.

Out of sample deltas suffer from extreme positions in the mean-variance policy for the annual horizons while the monthly horizon appears more interpretable.

Inter-Asset-Class Volatility contributions

The last sections of the tables report the average contribution to the potential volatility in the two risky asset classes per portfolio configuration for the respective investor. Multiplying the respective deltas with the investor's AuM set at 10% of total assets in the system yields the unrealized valuation impact the investor could have on the asset class. The numbers are reported as percentage of the total valuation of the asset class. Signs indicate the direction of the potential valuation impact. From the differing signs on the contributions to potential single asset class volatility it can be seen that preference differentials between the two investors can potentially be netted to a certain AuM dependent degree.

To aggregate the impact of the individual investor onto the system or in other words his/her contribution to IAV the absolute values of the potential valuation impacts of both asset classes are added and divided by the total size of the system. Note that the latter figure is not limited to the investor's share of the total assets in the system as the delta comes in as multiplier. Furthermore, absolute values are added implying that any delta larger than 0.5 allows an Abs. IAV larger than the share of assets. The effect of delta can easily be seen in the relatively small average contributions to asset class and Inter-Asset-Class Volatility in the monthly configurations.

A second source of preference netting might occur from the introduction of the Hedge Fund investor. Therefore, the related results are discussed separately.

Hedge Fund Weights

The third agent stays relatively close to the constants estimated in the optimization and exhibits a severe shift in average policy with shortening investment horizon.

Only a reshuffling of relative allocation into stocks occurs with an increase in rebalancing frequency but constant 1-year horizon. Interestingly, this is achieved through increased leverage in the portfolio (short cash) reflecting the higher risk tolerance. The only implicitly constrained optimization produces wild swings in weights and extreme positions out of sample. It must be argued at this point that such extreme moves are unlikely due to estimation errors as the applied method structurally avoids them to a large extend. The author argues that the formation of portfolio weights based on 1-period lagged conditioning variables induces the mentioned out of sample patterns. Bear in mind that the out of sample period starts in January 2009, the middle of the biggest financial turmoil recorded in history.

Hedge Fund Deltas

The interpretation of deltas from the Hedge Fund investor (HF) is substantially different. Taking the monthly configuration as an example, the HF is on average short 40% of its AuM in cash while the MV investor is long 10%. The resulting delta is, hence, $\Delta_t = 0.1 - (-0.4) = 0.5$. With risk aversion seen as an implicit portfolio constraint, the HF is less constrained than the MV investor due to its lower risk aversion coefficient. In periods where the HF is shorter in a security than the MV investor its contribution to single asset class volatility in terms of Tau as well as IAV in the system can net with other investors' contributions. This occurs on average between the HF and the second constrained investor in both annual configurations.

Hedge Fund Inter-Asset-Class Volatility contributions

The agent's contribution to Abs. IAV in the annual configurations is significantly lower than from the other two agents but surpasses them in the monthly set-up. This might again be related to the more extreme coefficients and the resulting higher reactivity to macroeconomic changes. Additionally, the higher degree of similarity to the MV investors or, in other words, the lower degree of restriction structurally reduces the contribution.

The frequency and impact of preference netting will be discussed in the next main section of the paper. The following paragraphs introduce measures of correlation between the simulated data, empirical returns and valuation levels.

5.2.2 Correlations to Empirical Data

Two different types of correlations are examined in the following. Firstly, the development of deltas per asset class is correlated to simple returns on the respective asset class to assess the relation between relative preferences (weights) and value developments. Secondly, the time series of Tau values is correlated to the changes in total market capitalizations of the respective asset classes. The later relation between dollar values should translate preferences into monetary valuation impact as AuM are held constant (share of total assets in the system).

As a general trend in the results presented in tables 14 to 16 (Appendix 6, p.88) the magnitude of correlations between weight deltas and simple returns as well the linear relationship between Taus and market capitalization changes in the respective asset classes decreases to values around 0.05 with increasing rebalancing frequency. This is not surprising as the annual volatility in conditioning variables is structurally larger than for the monthly horizon. Consequently, the changes in deltas and Taus are larger in magnitude and show more pronounced patterns.

Furthermore, it is of central importance for the understanding of the reported statistics that a higher correlation between deltas, Taus and return and market capitalization changes only occurs in periods in which the system enters a limited-participation equilibrium. In full-participation equilibria, if any, only a very weak correlation can be expected. Recall that in full-participation equilibria investors can fully express their preference and trade quasi unconstrained in the sense of explicit portfolio constraints. Rising magnitudes of correlations in the first and second sample halfs support this intuition. With shorter periods extreme events are not evened out by longer periods of prevailing full-participation equilibria. This would also explain changing signs from the first to the second sample half.

In general, detected correlations are expected to be positive as positive deltas imply buying pressure in an asset class that should then show positive returns in the respective period. This is not directly supported in the results shown below. A possible explanation for the negative correlations found for the full sample as well as for the first and second half of the sample can be based on the following mechanic. In the moment many investors hit their implicit or explicit constraints the apparent buying or selling pressure in the asset class transfers from the realized into the potential realm causing price developments in the asset class to flatten out or even turn negative. In this sense, the interpretation of the numbers is not 100% clear.

It appears that the results are more in line with the stated expectations for stocks rather than bonds. Magnitude and sign changes are also more frequent for this asset class. A reason for this could lie in the generally higher volatility of stocks that might cause more investors to reach their constraints more often. It might, hence, be theorized that stock markets tend to be in limited-participation equilibria more often that bond markets. Research on the frequency of regime shifts in different asset classes could yield valuable insights in future research.

The somewhat counterintuitive magnitudes and signs for a number of bond correlations can potentially be traced back to a limitation of the study set-up. Using the 10-year Tbill as a proxy for bonds might not fully capture the dynamics in bond markets.

The results for the Hedge Fund investor confirm the major identified trends across policy configurations. Interestingly, most correlations are of almost exactly similar magnitude but with reversed signs. This can be attributed to the mirrored character of the deltas for this agent. The mentioned bond anomaly prevails also for this investor.

5.3 Aggregation of Multiple Investors – Delta, Tau, and Correlation Analysis

From the combination of several investors in one financial system more indicative results are expected. The theoretical conceptualization in section 3 holds that the addition of investors with differing preferences will result in a netting of the latter. The degree to which potential IAV is thereby reduced depends, furthermore, on the relative amounts of assets managed by the investor types.

The collision of implicitly and explicitly constrained preferences in the market place does not reduce the mismatch in terms of delta or Tau for the individual investor but causes a reduction in mismatch in aggregate terms. One investor might take a position another cannot take without reaching his/her allocation limits and, thereby, implicitly reduces the aggregate mismatch.

In terms of measures, the aggregation is expected to result in IAV levels lying below the simple sum of the individual numbers in absolute terms. On the single asset class level, both reductions and increases in magnitude as well as sign changes can occur depending on the degree of differences in preferences and constraints. Very similar investors produce higher magnitude but equally signed combined values while strongly contrarian investors reduce the magnitude of the combined value and can even change its sign.

To detect and quantify these effects, the aggregated values of the two similar constrained investors I and II are reported besides the aggregate values including the strongly deviating Hedge Fund for all portfolio configurations (tables 17 to 19; Appendix 7, p.90).

5.3.1 Aggregation effects on inter-asset class volatility

The frequency of the central netting process in terms of periods and incidents (referring to individual asset classes = 3 incidents per period), is of major interest in the further analysis.

With the introduction of the strongly contrarian Hedge Fund both frequencies should increase. A higher netting frequency can be interpreted as the contribution of a single investor to the efficiency of the financial system in terms of aggregate preference matching.

Note that AuM levels are constant at 10% of total assets in the system for all investors across all configurations. In aggregation the three investors represent 30% of total assets. While the amount of investor types modeled in this study as well as the distribution of AuM appear reasonable and sufficient to detect the theorized relationships, it must be acknowledge that the robustness of reported values and predictions made increases with the number of investor types mimicked, the precision of preference elicitation, and the precision of AuM allocation. All of these dimensions are, however, empirical problems and can be addressed in later studies.

Tables 17 to 19 confirm the theoretical results. While individual asset class IAVs show equal and smaller magnitudes than the equally signed sum from individual investors. Average absolute IAV values are reduced in all portfolio configurations when the Hedge Fund investor is added to the system. The annual as well as the annual-monthly configuration show improvements of more than 30% in absolute IAV averages, while the monthly configuration improves only by 9%. In some cases such as for instance bond IAV in the monthly configuration, sign changes occur. The large difference in magnitude between the two annual and the monthly configurations can be attributed to the much less extreme deltas in the shorter horizon.

Netting

Most importantly and potentially driving the IAV results are the strong increases in netting frequencies across all configurations. The largest increase in both Share of Incidents and Share of Periods occur in the 1-year policy with annual rebalancing reaching a 10-fold increase in netting incidents and a 6-fold increase in netting periods.

Even though the high netting frequencies in the two investor case already stand in line with the theoretical predictions, the three investor aggregation at short rebalancing horizons produces netting in more than 60% of all periods. The monthly configuration boost netting in 95% of all 480 considered periods and 55% of all 1440 incidents (table 19).

Table 19: Aggregation Effects on Inter-Asset-Class Volatility: Monthly Policy

Inter Asset Class Volatility		
Aggregation Effects (Monthly)		
Mean IAV	CS_1 + CS_2	CS_1 + CS_2 + HF
Mean Abs. IAV	8.08%	7.37%
Standard Deviation of Abs. IAV	5.11%	4.20%
AuM as % of Total Assets	20%	30%
Netting	CS_1 + CS_2	CS_1 + CS_2 + HF
Netting Occurance (Incidents)	279	785
Netting Occurance (Periods)	251	454
Share of Incidents	19.38%	54.51%
Share of Periods	52.29%	94.58%

Source: Own compulation.

The fact that netting is even more frequent under this configuration than under the annual-monthly set-up, potentially hints to an effect of average rebalancing frequency in a financial system on market efficiency. Such a consideration would have wide ranging regulatory implications.

5.3.2 Correlations and Volatility Potential Used

In line with the above observations and supporting the validity of the core concepts in the paper, tables 20 to 22 (Appendix 8, p.91) report that correlations between single asset class Taus and total amounts invested in the respective asset classes turn positive on the aggregate levels for the 1-year horizon periods (except bonds with monthly rebalancing for the three investor case). This tendency seems more pronounced in the second half of the sample. The higher correlation levels in the aggregate states may suggest that the aggregate measures approximate the real world developments better than individual values. The precision of approximation seems to increase in the second half of the sample.

Interestingly, the monthly correlations appear very small. A potential interpretation is that for short horizons and frequent rebalancing, markets tend to stay within the full-participation equilibrium most of the times.

A further look into how the aggregate measures co-evolve with characteristics of the system holds further defining insides. A low co-movement of absolute IAV values with the total assets in the system qualifies the robustness of the method used, as the calculated values do not depend on the growth of the system even though AuM calculations are linked to it.

Clearly, absolute Tau values are correlated strongly positive with total assets as the AuM link appears as a direct multiplier in the determination of the number.

A core assumption of this paper is to some degree confirmed by the high positive correlations (around 0.4) between absolute Tau values and the absolute change in total assets in the system. More specifically, the difference between the later measure and the correlation between absolute Tau values and the sum of absolute changes in all asset classes reported at the bottom of the table holds interesting information. Inter-Asset-Class Volatility measures the internal vibration of the financial system and only indirectly the total value change of the asset in the system. The significantly higher correlation values in the second relation show this focus. The measure of Tau is hence sensitive to the value movements between asset classes that do not necessarily result in total system valuation changes but can still present significant inherent risks.

The addition of the Hedge Fund investor creates a significant increase in the linear relationship between Tau and both value change measures especially in the monthly configuration. The coefficients jump by 0.04 and 0.06 potentially indicating that the simulation results are more accurately calibrated to the empiric developments. For the two annual policies the coefficients are almost constant or show minor negative reaction to the Hedge Fund addition. This points again to the potential influence of rebalancing frequency and investment horizon on the efficiency contribution from individual investors to the system. The by far highest correlation values with the sum of absolute changes in all asset classes is achieved in the annual-monthly configuration confirming the intuition that the set-up is closest to reality.

Realized vs. potential inter-asset class volatility

Finally, a comparison of realized and potential IAV lends itself to complete the analysis (cf., tables 23-25, Appendix 9, p.93). As expected, the aggregation of Tau values across investors pushes the average ratio of changes in bond and stock market capitalizations below

100% of the calculated Tau values. The effect is consistent across all portfolio configurations and holds for the two and three investor case.

However, it is observable that the addition of the Hedge Fund investors increases the ratio. An intuitive result given that the detected netting in many cases reduces the amount of aggregated Tau.

The average ratio between the sum of the absolute value changes in all asset classes and the absolute Tau values reported in the last two rows of panel 1 in tables 23-25 show these numbers on the aggregate level in and out of sample. A low out of sample ratio can be interpreted as a sign of over pessimism or optimism in the market based on the in sample estimated coefficients of the weight function.

Panel two reports the full year and specific monthly values of the latter measure for the above selected extreme events. A ratio below 100% indicates that based on the here modeled investors, the analyzed crashes could have been worse than they materialized.

The distance from the potential value change to the realized value change might be interpretable as the amount of value protect through implicit and explicit portfolio constraints. Numbers above 100% imply an overreaction above the preference efficient value. Note however, that for a precise estimation, all market participants need to be correctly modeled and matched to their AuM. The numbers presented here are only of explanatory value.

Differences between the values reported in panel 2 resulting from the addition of the Hedge Fund investor are a good illustration of how the aggregate interpretation of a macro situation changes with the inclusion of differing preferences.

To illustrate this, take the annual-monthly configuration values for October 1987, September 1998, and October 2008. In the full year 1987, the measures detect a volatility potential usage of around 30% that would not spark direct interest. Focused on the month of the crash, a preference inconsistent overreaction of more than 100% is detected. In this sense, the results are in line with (MacKenzie, 2004) explanation of the crash based on the weaknesses of portfolio insurance techniques and/or irrational behavior.

On the contrary, in 1998, more than 50% of the full year volatility potential was used while September shows a 95% utilization ratio. A possible interpretation is that the adverse effect of the Russian debt crisis and the collapse of LTCM were almost fully anticipated in investor preferences when the Hedge Fund investor is included. Without the more risk tolerant agent, the precision of anticipation or recognition of potential dangers was much lower in magnitude. Non-Hedge Fund investor were overreacting to the situation or not able to combine the macro information with their implicit and explicit constraints. In other words, their preferences were not implementable in the occurring scenario.

In 2008, however, both investor sets were unable to correctly accommodate the incoming macro information. The fact that only very few hedge funds were betting against the US housing market and related securities gives credibility to this result. The set of constraints at work during the time, however, seem to have protected value as only 30-40% of potential volatility were realized.

5.4 Liquidity Relations

Findings were discussed and interpretations given. This section now seeks to present numerical support for the main theoretical idea linking the measure of Tau to volatility in asset prices. The concept of volatility regime shifts based on the transition from full-participation to limited-participation equilibria in asset markets is analyzed by examining the relationship between liquidity in the US stock market and aggregate Tau measures.

All individual investors are first examined along the full sample period. In a second step, aggregate measures are considered across several lagged periods. Thirdly, a focus on the selected extreme events yields insides on the temporal relationship between Tau and aggregate liquidity as conceptualized by Pastor & Stambaugh (2003). Recall that all events have been selected due to the parallel occurrence of extremely low liquidity and (strongly) negative stock returns. A potential link between Taus and aggregate liquidity can, hence, be related to negative stock returns.

5.4.1 Static Analysis – Full Sample

To illustrate further table 26 below shows the correlations of individual investors' Taus as well as aggregated values with the traded liquidity factor, a measure of aggregate liquidity, and innovations in aggregated liquidity along the entire sample period (1968-2008) for the annual set-up (tables 27 and 28 in Appendix 10, p. 96 display results for the other two set-ups). The focus of the analysis lies on the aggregate liquidity series in the middle of the tables. Nonetheless, especially the relation to the traded liquidity factor has room for interesting analysis when looking at the construction of trading strategies based on the developed concepts.

Table 26: Full Sample Correlations of Taus vs. Liquity Series: Annual Policy

Liquidity Relations (Annual)									
Correlations with Liquidity Series									
Correlations Tau (Net) vs.	Traded Liquidity			Aggregate Liquidity			Innovations in Liquidity		
	Cash	Bonds	Stocks	Cash	Bonds	Stocks	Cash	Bonds	Stocks
CS I	(0.133)	0.259	(0.018)	(0.044)	(0.077)	0.107	(0.029)	(0.056)	0.074
CS II	(0.140)	0.272	(0.004)	(0.048)	(0.065)	0.111	(0.033)	(0.048)	0.079
HF	0.180	(0.250)	(0.038)	0.058	0.040	(0.126)	0.042	0.029	(0.091)
CS I + CS II	(0.137)	0.266	(0.012)	(0.046)	(0.071)	0.109	(0.031)	(0.052)	0.077
CS I + CS II + HF	(0.106)	0.273	(0.034)	(0.037)	(0.092)	0.099	(0.024)	(0.068)	0.069

Source: Own compilation.

Interestingly, the level of correlation between Taus and aggregate liquidity along the sample remains at very low, second digit levels, and shows no clear patterns across configurations. The only identifiable pattern is that the numbers are in more than 50% of the cases negative. Furthermore, the correlation does not significantly change on higher aggregation levels.

These results are surprising and of a devastating nature for the validity of the developed concepts. The only promising aspect is the dominantly negative correlation figures. A rising absolute amount of unmatched preferences in the market is theoretically caused by a large number of investor colliding with their implicit and/or explicit portfolio constraints. It was argued that they, therefore, leave the market causing the transition to a limited-participation equilibrium. The latter is, hence, characterized by low liquidity levels and the resulting large price impacts of trades that cause extensive volatility. High absolute Tau levels must, hence, go hand in hand with low liquidity levels implying a strong negative correlation or even causality (not discussed in this paper).

5.4.2 Dynamic Analysis – Temporal Relationships

To trace out the temporal relationship between the two series, tables 29 to 31 (Appendix 11, p.97) additionally report the correlation coefficients of the aggregate liquidity level and the 3-month, 6-month, and 12-month leading average absolute Tau figures. For the annual policy, 1-3 years leading values are computed for the sense of completion.

Again, correlation coefficients show no significant pattern and even decrease in magnitude.

To understand why these results actually stand in favor of the theoretical construct outlined in this paper one needs to get the key characteristics right. The proposed understanding of financial markets differentiates between the full-participation and the limited-participation equilibrium in the following manner: In most time periods the majority of investors is able to translate their preferences into feasible portfolio policies. A full-participation equilibrium prevails in which potential Tau values are not sufficient to impact liquidity. A certain threshold of fully netted Taus or in other words unmatched preferences needs to build up to trigger a regime shift towards a limited-participation equilibrium.

The determination of this threshold value could be possible in terms of a percentage of total assets in the system similar to the measures presented above. Further research, however, needs to be done in this direction. In a to some degree efficient and well-balanced market, limited-participation equilibria should remain the exception as well as the strongly negative returns on the respective assets. This stands in line with research on the frequency of stock market crashes (Cutler, Poterba, & Summers, 1989; Longin, 1996). Therefore, along the entire 42 year sample period, the measured correlations between Tau and aggregate liquidity should be close to zero.

Extreme Periods – Crash Situations

In the identified extreme periods characterized by severe market dislocations the correlation between Taus prior to a crash and liquidity developments should show strong negative correlation. Results on the analysis are reported in tables 32 below and 33 in Appendix 12 (p.98).

To better show the dynamics in the examined relationship the 3-, 6-, and 12-month leading average absolute Tau values on both aggregation levels are correlated with the point liquidity (liquidity in period t with average Tau over the last 3,6,12 month including period t - panel 1a) and the average liquidity over the same 3-, 6-, and 12-month periods (panel 1b). Correlations are measured over the 12-month period around the crash month. Panels 1 a and b report results for the 3 investor case and panels 2 a and b for the 2 investor case.

Table 32: Extreme Periods Leading Correlations of Aggregated Absolute Taus with Liquity Series: Monthly Policy

Leading Correlations of Aggregated Absolute Taus with Liquity Series (Monthly)

Panel A describes the correlations between 3 month, 6 month, and 12 month leading average values of the aggregate Abs. Tau and the Aggregate Liquidity series constructed by Pastor & Stambaugh (2003) over the horizon of 12 month around the indicated month. Panel B reports correlations between the same Abs. Tau series and the 3,6, and 12 month leading average value of the Aggregate Liquidity series.

	CS I + CS II + HF					
Correlations Abs. Tau vs.	Point Liquidity - t-5-->t+5			Leading Average Liquidity - t-5-->t+5		
	3month leading	6month leading	12month leading	3month leading	6month leading	12month leading
May-1970	0.515	0.540	0.473	0.408	(0.005)	(0.578)
November-1973	(0.275)	(0.372)	(0.413)	(0.086)	0.469	0.928
October-1987	(0.519)	(0.394)	(0.096)	(0.702)	(0.814)	(0.912)
August-September-1998	0.262	0.130	0.140	0.857	0.864	0.805
April-2000	0.228	0.286	0.028	0.483	0.617	0.160
September-November-2000	(0.183)	(0.141)	(0.145)	0.087	0.516	0.894
September-October-2002	0.413	(0.065)	(0.222)	0.773	0.233	(0.858)
March-2008	0.237	0.219	0.192	0.532	0.102	(0.950)
October-2008	(0.361)	(0.316)	(0.332)	(0.577)	(0.694)	(0.117)
Mean	0.035	(0.012)	(0.042)	0.197	0.143	(0.070)
Standard Deviation	0.372	0.327	0.280	0.560	0.574	0.799
Median	0.228	(0.065)	(0.096)	0.408	0.233	(0.117)

	CS I + CS II					
Correlations Tau vs.	Point Liquidity - t-5-->t+5			Leading Average Liquidity - t-5-->t+5		
	3month leading	6month leading	12month leading	3month leading	6month leading	12month leading
May-1970	(0.374)	(0.473)	(0.659)	(0.083)	0.732	0.507
November-1973	(0.320)	0.081	0.311	(0.360)	(0.514)	(0.987)
October-1987	(0.375)	(0.262)	(0.059)	(0.524)	(0.794)	(0.911)
August-September-1998	(0.127)	(0.182)	(0.041)	(0.431)	(0.686)	(0.824)
April-2000	(0.132)	(0.173)	(0.243)	(0.657)	(0.839)	(0.913)
September-November-2000	0.240	0.272	0.208	(0.102)	(0.408)	(0.956)
September-October-2002	0.059	(0.255)	(0.202)	0.675	(0.213)	(0.849)
March-2008	(0.001)	(0.102)	(0.266)	0.478	0.595	0.936
October-2008	(0.132)	(0.078)	(0.433)	0.553	0.527	0.175
Mean	(0.129)	(0.130)	(0.154)	(0.050)	(0.178)	(0.425)
Standard Deviation	0.208	0.214	0.301	0.501	0.629	0.749
Median	(0.132)	(0.173)	(0.202)	(0.102)	(0.408)	(0.849)

Source: Own compilation.

The results confirm the intuition of strong and negative correlations. For both the annual-monthly as well as the monthly configuration the 3-, and 6-month leading results show high correlation values but mixed signs. It is noteworthy that in the monthly configuration the 2 investor set-up yields higher and more negative correlation values than the 3 investor set-up. In both configurations and across both aggregation levels, the 12-month leading correlation values show the most promising results. In 6 out of 9 periods the detected correlations are strongly negative peeking in -0.99 for the period around November 1973 under the 2 investor monthly configuration. Results across point and leading liquidities show equal patterns.

To ease the analysis, mean, standard deviation, and median values are reported at the bottom of tables 32 and 33. The highest mean and median correlations of -0.42 and -0.85, respectively, were found for the monthly 2 investor configuration considering leading average liquidity. Note that the median appears to be the better measurement here as the non-negative values of significant magnitude distort the simple mean. No clear structures in the appearance of the non-negative values can be found. In most cases, all lead length under one configuration and liquidity specification deliver positive coefficients. A change in configuration or simply liquidity specification yields differing results for the same time period. Furthermore, no event period consistently yields positive coefficients.

Under the monthly configuration the 2 investor aggregation level yields consistently negative coefficients of relevant magnitudes across both liquidity specifications also for the 3- and 6-month leading averages of Tau. This cannot be confirmed for the 3 investor set-up. Under the annual-monthly policy results are equally consistent across all lead length for the 2 and 3 investor aggregation levels. They, however, turn slightly positive for the 3- and 6-month periods when assessing leading average liquidity.

It is therefore suggested that a 12-month leading build-up of absolute Tau values has the best explanatory properties for the level of aggregate liquidity and the matching negative stock returns.

It remains for further investigation how the existing positive correlations can be explained. One direction the further analysis could take is a deeper examination of the root source of the respective crashes. An analysis of which conditioning variables transmitted the strongest impulses into portfolio policies in the respective periods could help constructing this linkage.

6 Practical Implications & Discussion of Results

The theoretically described and empirically detected phenomenon of Inter-Asset-Class Volatility has direct implications for a variety of industries and functions within financial markets. It is an indication for the implicit risk or vibration in the financial system that is, using O'Hara's (1995) words, like liquidity and pornography, "easily recognized but not so easily defined".

The measures developed to capture the notions of Delta, Tau, IAV, and Volatility Potential Used allow to quantify and evaluate the phenomenon. This section presents potential implications for the management of market related risk, the fund management industry, and for the field of regulation. To conclude the section, results are put into perspective and theoretical and empirical limitations of the study are articulated.

6.1 Implications for Risk Management

The implications drawn for the management of market related risk can be separated into backward looking assessments and forward looking estimations.

An idea that grasps both notions is the construction of a **potential volatility index**. Based on a fully calibrated model including all major investor types and their approximated preferences, the aggregate level of absolute Tau in the specified system can be tracked as an indication of potential volatility inherent in the system. As Tau contributions can be traced back to the individual agents, the index represents the values indicating the true influence individual investors or groups of investors in terms of buying or selling pressure in the system. An index of the “demand” and/or “supply” of traded securities does not exist to the knowledge of the author.

An ex-post comparison of the realized to the potential volatility as implied by the Volatility Potential Used measure can be used to price options and assess the performance or better said efficiency of hedging strategies. In a similar way, the effectiveness of explicit portfolio constraints can be quantified. Calculating the monetary value of the unutilized volatility potential might be seen as a proxy for the amount of wealth protected from forced inactivity.

At the core of the developed measures stands their forward looking nature. With incoming conditioning information at the end of one period, the potential volatility in the next period can be estimated based on investors’ realities. Therefore, the one period ahead forecast of aggregate absolute Tau represents the maximum preference compliant volatility implied by the macro environment at the beginning of the period. In this sense it is similar to, for instance, the implied volatility index (VIX). It differentiates itself from such indices via its reality rooted calculation method and the fact that it addresses the volatility between all included asset classes rather than just one. It is, therefore, of particular importance for investors who are active in more than one asset class.

Implied volatility indices capturing only equities are structurally less precise when estimating the total potential volatility in the system. An estimation of the degree of this imprecision could be an interesting future research topic.

Not only the inclusion of more asset classes might yield a higher precision of the measure. Rooting the measure in the preferences of a large share of investors captures a wider array of factors influencing volatility than tracing out implied volatility values from the pricing behavior of the limited participants in single asset derivative markets.

In general, the quality of such an index increases with the width of investors included and the precision of the estimation of their objective functions, explicit constraints, and AuM. An underlying model could be built representing proxies for investor types such as pension fund managers, balanced fund managers, and different types of hedge fund managers and the respective shares of total assets in the system.

A more granulate level could include individual investors participating in the system. The different levels of aggregation have an effect on which entity is likely to construct the index. While a proxy based index can be computed by individual asset management firms based on primary or even secondary research, a full fledged index could either be computed by exchange operators requiring the relevant data from their clients/participants or by the regulatory authorities eliciting data as a pre-requisite for market participation.

Opportunities also arise from a financial product perspective. Different option types on the constructed index itself or securities priced using implied volatilities read from the index, might be used to hedge against extreme market situations. Therefore, the products could be of high relevance for pension funds, insurance firms, and other institutions confronted with direct liabilities to their portfolios. Family offices, primarily engaged in preserving wealth, might also be counted as potential clients.

A transfer into asset pricing theory could occur via the construction of an alternative beta measure based on the inclusion of potential volatility into the concept of market risk. The differentiation between a full-participation beta and a limited-participation beta is arguable as certain asset classes or securities might react very differently to an occurring regime shift.

Given that regime shifts seem to be indicated via liquidity in the asset class or traded security the construction of a continuously priced risk factor based on potential volatility appears difficult due to the potential loading on Pastor and Stambaugh's (2003) traded liquidity factor. However, the asset pricing theory might be advanced through the introduction of a regime contingent risk factor that is primarily related to the level of constrainedness in the system, asset class, or security.

6.2 Implications for the Fund Management Industry

Implications for the fund management industry from the present results consider the fields of fund structuring in terms of rebalancing periods and client involvement, the sales process and potential conflicts of interest, and finally performance monitoring.

The core question for the fund management industry is whether the explicit weight constraints currently implemented or intended for future funds are achievable given certain macroeconomic or market environments.

The section on explicit portfolio weight constraints articulated a potential model for the implementation of weight constraints that allows the calibration of weight limits to prevailing macro conditions. Based on a system of inequalities that takes the coefficients of the portfolio policy and a given set of weight constraints as constants, upper and lower bounds for the realizations of conditioning variables can be approximated. Within these bounds, the respective weight constraints are achievable. The states of nature that are not nested in the final weights limits are times in which the funds AuM add to the overall risk in the system as measured by IAV. He/she can no longer ensure that the implemented portfolio policy, constrained by explicit weight limits, is non-dominated regarding the agreed objectives. This renders the quality of the service offered to his/her client questionable.

The existence of such situations implies a two step structure for the process of fund sales to institutional and private clients that avoids conflicts of interest. In the first step, the client is asked to choose from a predefined set of macro or market scenarios he/she either beliefs in or wants to hedge against. Depending on the scenario picked, a set of achievable investment themes and explicit portfolio constraints is present and paired with the elicited objectives of the client. A better matching of client expectations and achievable performance targets is thereby achieved.

The contradiction of clients constraining their portfolio managers after selecting them and trusting them with their money (Almazan et al., 2004) can somewhat be mitigated by further involving and informing the clients about feasible set-ups during the sales process.

In a similar sense, the permanent monitoring of the constraint-macro fit can be a crucial part of a funds active risk management. A communication mechanism involving beneficiaries of the fund could be put in place that is triggered as soon as an implied constraint breach becomes likely in the expected macroeconomic outlook. A potential recalibration of explicit constraints or rebalancing frequency might shield asset from inefficient investments.

In an ex-post view, the monitoring of the fit between portfolio constraints and the macro environment can serve as a form of performance tracking for individual managers. Setting the right constraints can be seen as core skill for fund managers prior to the classic excellence in security selection.

6.3 Regulatory Implications

The aftermath of the recent financial crisis has put significant regulatory focus on the avoidance of extreme imbalances in financial markets (Deloitte, 2010). Financial institutions undergo a series of stress tests to examine the rigidity of their funding structures to extreme adverse market developments. The resilience of banks to stress scenarios is important for the smooth functioning of credit markets, the administration and provision of the payment system, and even for the refinancing of sovereigns in many countries. However, the quality, arbitrary character, and not least the administrative efforts around the current methods of stress testing have been questioned (Rebonato, 2010).

The general idea of an alternative volatility index postulated in the implications for risk management section can potentially provide a continuous benchmarking of financial firms capital structure against the volatility potential currently present in the market as well as for the next period. Metrics that create a link between, for instance, quarterly accounting numbers and the conceptualized index could, hence, save efforts, market reactions to results, and reduce the ambiguity of long prepared statements (e.g. annual reports). Regulatory capital buffers in the form of contingent convertible bonds appear to be a step into a similar direction. Again, the construction of the underlying index could be based on regulatory required information communicated in the filing for official registration of new investment vehicles.

A major implication for practice from the presented assessment is the notion that a precise estimation of an investor’s potential impact on the total valuation of asset classes he/she trades in might allow the identification of truly systemically relevant agents. Taking the idea one step further, regulatory authorities could set limits on single investors’ contributions to potential IAV as measured by Tau. Such a regulatory effort indirectly scrutinizes the “fit” of current self-imposed portfolio constraints to the macro environment. Agents are, hence, forced to operate with feasible or realizable allocation objectives. Thereby, bubble formation and sudden crashes are mitigated.

Furthermore, the findings presented here indicated that netting effects occur more often in short rebalancing configurations. If this effect prevails in more complete models, a minimum frequency and a maximum investment horizon could be a regulatory measure to manage the efficiency of asset markets.

Exchange operators and regulators might have an ongoing interest in monitoring the development of aggregated absolute Tau values over the 6- and 12-month period as suggested in this study. As significant build ups over the 12-month period seem to indicate low liquidity periods and resulting volatility regime shifts, circuit breakers or central bank interventions can be triggered to avoid limited-participation equilibria.

6.4 Limitations & Validity of Results

At this point it has to be restated that the theoretical viewpoints developed in this paper and the empirical findings presented to show evidence of the introduced phenomena are subject to limitations on both the theoretical and empirical sides.

At first, the key assumption of marking the mean-variance investor with a commonly used risk aversion as the midpoint or benchmark allocation of the financial system and as the determent of an efficient allocation can be subject to criticism. As argued above, the rational choice of a mean-variance optimizing individual is deeply rooted in the fundaments of modern finance (Fama, 1970; Malkiel, 1992; Markowitz, 1952a, 1952b; Samuelson, 1965) and shape the common understanding of efficient markets. For the lack of a more commonly agreed option this helps the ease of understanding of deviations in the preferences of other modeled investors. Furthermore, the anchoring point of the deviation analysis does not really matter as the existence of a Delta is a sufficient argument to found later derivations upon.

When analyzing and aggregating the expressions of preferences by multiple investors into a joint model, the question of completeness arises. In this study, three deviating investor types have been modeled to present indicative results. If the modeling of all investor types or even individual organizations is possible to a satisfying degree of precision remains an open question. Whether such an elicitation and modeling effort is necessary for reliable results and efficient in terms of the rate of market entry and exit of investors also remains to be tested.

Given the vast variety in investor types and their accompanying objectives, one needs to ask whether all agents do and should consider a similar set of conditioning variables. This study uses a set of three business cycles-related variables that have been associated before with predictive powers for bond and stock returns (Ait-Sahalia & Brandt, 2001; Brandt & Santa-Clara, 2006).

As the selection of conditioning variables and the portfolio optimization process served as data generation mechanism for further analysis and did not lie at the heart of the study, the default spread has not been considered as a forth variable due to data availability issues. This stands in contrast to the Brandt and Santa-Clara's (2006) earlier application of the direct parameterization method. The omission of this variable might explain the somewhat counterintuitive correlation and volatility potential usage results for bonds. This represents an area of improvement for the implemented model and the theoretical precision of its basis.

On the empirical basis, this study seeks to achieve an efficient trade-off between width of the analysis and computational efficiency. To show the key points of the paper the inclusion of bonds, stocks, and cash as asset classes were sufficient. In future applications the number of asset classes to be considered is not limited by the applied method as it has its main strong point in its computational efficiency. For details please see section 4.

An inherent challenge in the selection of analyzed asset classes lies in finding a proxy for their past returns to be used in the coefficient estimation. Here bond returns are proxied for by an index of long term treasury bills. This does clearly not capture the entire universe of fixed income investments and potential effects on the coefficient estimation have to be taken into account in all interpretational efforts.

Furthermore, the study limits itself to annual and monthly rebalancing periods to limit computational efforts and redundancy in interpretation. However, a quarterly estimated and rebalanced policy could be of interest in the sense of completion.

It must also be stated that the core of the analysis relies on simple correlation coefficients to show linear dependencies between empirical data and the simulated measures. A limitation of the results lies, hence, in the ignorance for non-linear relationships between the analyzed time series.

Lastly, the formation of the underlying objective functions characterizing the investors was done on theoretical grounds. A direct elicitation of objective functions in cooperation with acting fund managers promises interesting theoretical insides and could increase the precision of all estimations and results. As this paper aims to provide the theoretical fundamentals for the concept of IAV, such an empirical undertaking lies out of its scope.

7 Conclusion & Future Research

It was the aim of this study to better understand the persistence of volatility in financial systems despite a moderation of volatility in the economic world. Special attention was given to the question, why extreme volatility events in the form of stock market crashes occur repeatedly. Ultimately, the goal was to derive an innovative proxy for risk, capable of detecting and forecasting the potential volatility or in other words the revaluation potential in a financial system.

The paper departs from the view that financial markets are man-made institutions with the main purposes to distribute ownership of real economic enterprises among several investors holding certain sets of preferences. Therefore, the argument was made that the causes for volatility should be related to investors' preferences. Given the distribution of control over financial asset in today's financial markets, these preferences can best be detected in the objective functions of institutional investors that are implicitly and explicitly constrained. While implicit constraints describe the multiple objectives in fund manager's objective functions, explicit constraints refer to legally required or self-imposed restrictions of portfolio policies. Together, the deviations in portfolio weights from the choice of a purely mean-variance optimizing, fully rational investor are argued to cause the occurrence of unexpected volatility in financial markets via a secondary effect.

In this logic, liquidity has been identified in the literature as a potential transmitter between investors' preferences and asset prices. Restricted by their implicit and explicit constraints, investors are in certain situations forced to leave the market as soon as they reach their allocation limits. The market shifts from a full-participation equilibrium to limited-participation equilibrium, in which the price impact of trading rises due to a significantly reduced market depth.

To detect evidence for this conjecture, the measures of Delta and Tau were introduced. Delta quantifies the constraint-induced deviations from the mean-variance efficient portfolio that are AuM weighted to arrive at the potential buying or selling pressure from a modeled investor in a respective asset class termed Tau. Aggregating Tau values from three modeled investors to infer correlations with Pastor and Stambaughs' (2003) measure of aggregate liquidity confirms the articulated intuition. High Tau values, hence, indicate a high degree of unrealized preferences and imply that a large number of investors have left the market. They should, thus, be negatively related to liquidity.

While correlations along the entire sample period remain insignificantly small, strong negative correlations are found in the 12-month windows around a set of 9 events characterized by extremely low liquidity levels and severely negative stock returns. The idea of volatility regime shifts indicated by build ups in Tau is, thereby, confirmed. The fact that the highest correlation intensities were detected in all configurations for the leading 12-month average Tau and liquidity values, indicates this time window as a likely evolution phase of shifts between participation equilibria and in a wider sense volatility regimes.

Results from the simulation study involving stocks, bonds, and cash as the investable universe, additionally indicate that limited-participation equilibria might occur more often in stock than in bond markets. This potentially indicates a structural explanation for the existence of an equity premium.

The derivation of new understanding of potential volatility, or better set, system inherent risk that is forward looking in its nature, builds on the detected mechanics. Inter-Asset-Class Volatility captures the total revaluation potential arising from reallocations among all asset classes in the analyzed financial system. It describes the combined risk from being invested in the system rather than just the change in total value.

The empirical traceability of this conceptualization and the sensitivity of the derived measure is confirmed by the high positive correlations (around 0.4) between absolute Tau values and the absolute change in total assets in the system. In fact, the significantly higher correlation between absolute Tau values and the sum of total changes in all asset classes shows that Inter-Asset-Class Volatility proxies for the internal vibration of the financial system rather than changes in its total size. The measure of Tau is, hence, sensitive to the value movements between asset classes that do not necessarily result in total system valuation changes but can still present significant inherent risks.

The key strong point of Inter-Asset-Class Volatility and the underlying approach to risk, remains in its forward looking nature. It was suggested that the persistence of investors' preferences and constraint sets allow an approximation of their reaction to changes in the macroeconomic environment based on coefficients maximizing their objective functions.

Within the limits of this study, the conjecture is confirmed by the highly positive correlation between fully netted absolute Tau values and the sum of total value changes in all asset classes along the entire sample period. Note that Tau values are calculated at the beginning of each period while value changes are measured at the end of the respective period. Therefore, correlation in this case indicates forecastability.

A major cornerstone of the here articulated understanding of financial markets and the newly derived measure of system inherent risk, is the occurrence of netting between investor preferences. The addition of investors with contrarian preferences, such as the here used Hedge Fund investor, to a financial system significantly reduces the potential revaluation risk from unrealized preferences in all simulation specifications. It is, therefore, theorized that only preferences that cannot be met on an aggregate level, capture by the netted Tau values, contribute to volatility regime shifts.

In retrospect, an assessment of the figure in comparison to the total value of a system and/or the realized value changes in the respective periods indicates the Volatility Potential Used. The measure quantifies both, the wealth shielded from excessive valuation swings and the potential preference incompliant overreactions in the markets. Past examples of both situations are given in the study.

Overall, it can be said that the presented theoretical concepts and empirical results represent a step towards a more direct linkage between investors and (extreme) volatility in asset markets. The novelty of the topic renders a simple formulation of areas for future research impractical. Interesting future research questions identified along the study are, therefore, stated within their immediate context in the following list:

- **Core Methods:** Liquidity is seen as a transmitter for indirect causality between investors' preferences and asset prices. Dufour and Taamouti (2005) introduce a suitable measure of indirect causality that captures causal relationships at horizons $h > 1$. A test whether this causality exists is not in the scope of this paper but represents a promising area of future research.
- **Simulation Approach:** On the empirical basis, this study seeks to achieve an efficient trade-off between width of the analysis and computational efficiency. To show the key points of the paper, the inclusion of bonds, stocks, and cash as asset classes were sufficient. In future applications the number of asset classes to be considered could be expanded for a more accurate representation of the financial system.

- **Volatility Regimes & Market Efficiency:** The realization of the volatility potential used is ex-post interpretable as an indicator for the volatility regime prevailing at time t . Interpretations about how efficient markets are and how correct the resulting prices are in periods in which only a small part of the volatility potential is used are left for further research.
- **Constraints-Macro Fit:** Given the estimated coefficients that maximize the fund manager's utility function, and the allocation limits he/she voluntarily imposes on his fund, it is possible to trace out the states of nature (described by the conditioning variables) that he/she considers normal or expectable within the investment horizon. This corresponds to the implied covariance matrix structure that Jagannathan and Ma's (2003) investors believe in. The states of nature that are not nested in the final weights limits are times in which the funds AuM add to the overall risk in the system, measured by Inter-Asset-Class Volatility. The possibility of such situations has direct implications for the fund management industry. Implementing the mentioned inequality approach to determine realizable portfolio constraints holds interesting insides but is not expected to add significant explanatory power to the test of inter-asset class volatility. Therefore, the application and further development is left for future research.
- **Participation Equilibria Shifts:** It appears that the results are more in line with the stated expectations for stocks rather than bonds. Magnitude and sign changes are also more frequent for this asset class. A reason for this could lie in the generally higher volatility of stocks that might cause more investors to reach their constraints more often. It might, hence, be theorized that stock markets tend to be in limited-participation equilibria more often that bond markets. Research on the frequency of regime shifts in different asset classes could yield valuable in-sights in future research.
- **Participation Equilibria Shifts:** A certain threshold of fully netted Taus or in other words unmatched preferences needs to be crossed to trigger a regime shift towards a limited-participation equilibrium. The determination of this threshold value could be possible in terms of a percentage of total assets in the system similar to the measures presented in this paper. Further research, however, needs to be done in this direction.

- **Implied Volatility Indices:** Due to their single asset nature, implied volatility indices capturing only equities are structurally less precise when estimating the total potential volatility in the system. An estimation of the degree of this impression could be an interesting future research topic.
- **Market Efficiency & Preference Netting:** The fact that netting is most frequent under the monthly configuration potentially hints at an effect of average rebalancing frequency in a financial system on market efficiency. Such a consideration would have wide ranging regulatory implications.

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9 Appendix

Appendix 1: The Multi-period optimization problem

The Multi-period problem

To understand the multi-period optimization problem it is instructive to follow Brandt and Santa-Claras' (2006) two-period example considering an investor maximizing the following mean-variance objective function:

$$maxE_t\left[r^p_{t\to t+2} - \frac{\gamma}{2}\left(r^p_{t\to t+2}\right)^2\right] \qquad (28)$$

$r^p_{t\to t+2}$ denotes the two period excess return of an investment strategy

$$r^p_{t\to t+2} = \left(R^f_t + x_t^{\top} r_{t+1}\right)\left(R^f_{t+1} + x_{t+1}^{\top} r_{t+2}\right) - R^f_t R^f_{t+1} \qquad (29)$$

$$= x_t^{\top}\left(R^f_t r_{t+1}\right) + x_{t+1}^{\top}\left(R^f_t r_{t+2}\right) + \left(x_t^{\top} r_{t+1}\right)\left(x_{t+1}^{\top} r_{t+2}\right) \qquad (30)$$

$x_t^{\top}\left(R^f_t r_{t+1}\right)$ is the two-period excess return from investing in the risky assets in the first period and in the risk free asset in the second period. Symmetrically, $x_{t+1}^{\top}\left(R^f_t r_{t+2}\right)$ is the two-period excess return of investing in the risk free asset in the first period but allocating to the risky assets in the second period. The third term $\left(x_t^{\top} r_{t+1}\right)\left(x_{t+1}^{\top} r_{t+2}\right)$ corresponds to the effect of compounding over the time horizon. It is a product of two excess returns and hence two orders of magnitude smaller than the first to terms, which represent products of gross returns and excess returns. Given the limited relative magnitude, the authors suggest to ignore the term. This convention is followed here as well. Therefore, the two-period portfolio choice problem reduces to a choice between two inter-temporal portfolios or "timing portfolios".

The sample analog for the two-period case of the optimal portfolio weights is

$$\tilde{x} = \frac{1}{\gamma}\left[\sum_{t=1}^{T-2} \tilde{r}_{t\to t+2}\tilde{r}^{\top}_{t\to t+2}\right]^{-1}\left[\sum_{t=1}^{T-H} \tilde{r}_{t\to t+2}\right] \qquad (31)$$

In this case

$$\tilde{r}_{t\to t+2} = [R]^{f}_{t+1} r_{t+1}, R^{f}_{t} r_{t+2}] \qquad (32)$$

The fractions of wealth invested in the risky assets in the first period are contained in the first set of elements in the vector $\tilde{x}$ that correspond to $R^{f}_{t+1} r_{t+1}$. The portfolio weights for the risky assets in period two are represented by the second set of elements applying to $R^{f}_{t} r_{t+2}$. Brand & Santa-Clara (2006) present a generic formulation for the set of timing portfolios in the multi-period problem:

$$\tilde{r}_{t\to t+H} = \left\{ \prod_{\substack{i=0 \\ i\neq j}}^{H-1} R^{f}_{t+i} r_{t+j+1} \right\}_{j=0}^{H-1} \qquad (33)$$

The static solution for the sample analog of the optimal portfolio weights given the augmented objective function is hence

$$\tilde{x} = \frac{1}{\gamma}\left[\sum_{t=1}^{T-H} \tilde{r}_{t\to t+H} \tilde{r}^{T}_{t\to t+H}\right]^{-1} \left[\sum_{t=1}^{T-H} \left(1 - \varphi r^{m}_{t+1} - \phi r^{LIQ}_{t+1} + \psi r^{MOM}_{t+1}\right) \tilde{r}_{t\to t+H}\right] \qquad (34)$$

Interestingly, the random components of the “timing portfolios” are non-overlapping, which contrasts the standard buy-and-hold set-up. However, the long-horizon problem stemming from small sample sizes mentioned as limitation of the approach arise. The allocation decision for the entire horizon is taken at time t rather than in an ongoing process.

The core idea of the method lies in replacing the risky returns r_{t+j+1} in equation (33) by the returns on the conditional portfolios $[(z]_{t+j} \otimes r_{t+j+1})$ (note again that the realization of the conditioning variables z_t linearly determine the allocation to the respective basis asset in the following period and, thereby, the return of the “conditional portfolios”). The portfolio weights from equation (34) are the optimal allocations to the conditional portfolios at time $t+j$. Hence, one knows which fraction of wealth is optimally allocated to a specific “conditional portfolio” in a specific period. Which exact fraction of wealth is than allocated to the basis assets depends on the state of z_t in the previous period.

Brandt and Santa-Clara (2006) point out that due to the ignorance of the compounding term, the quality of the approximation deteriorates with the horizon of the portfolio problem as well as with the rebalancing frequency. The tactical orientation of this paper suggests a 1-year horizon with monthly and annual rebalancing. By focusing on the tactical end, the vulnerability of long-term investors to asset lock-ins can be shown.

Appendix 2 – Further possible modifications to objective functions

Other possible constraints:

Besides the here implemented augmenting factors in the described objective function a variety of other implicit portfolio constraints and in that sense additional arguments in objective functions can be found in the literature.

a) Benchmark outperformance implemented through calculating risky asset excess returns above the benchmark index. This formulation captures the relative performance evaluation present in the fund management industry (Brandt & Santa-Clara, 2006; Brandt et al., 2009).
b) Penalty for covariance of the portfolio returns with a predefined portfolio or index (Brandt & Santa-Clara, 2006; Brandt et al., 2009; van Binsbergen & Brandt, 2007). This type of constraint is implemented in the above objective function regarding covariance with the equity market factor as well as the liquidity factor and the momentum factor. The constraint type, however, also nests simple formulations of asset-liability management problems as covariance with a predefined portfolio of liabilities can be penalized (de Jong, 2008b; de Jong, Schotman, & Werker, 2008). Problems involving conditional indexation of liabilities on inflation or wage levels do not lend themselves to this functional form (de Jong et al., 2008). Interesting results could, nonetheless, arise from quantifying the magnitude of conflict in allocation between portfolio policies tailored to meet liabilities subject to long-term indexation and the short-term tactical requirements such as value at risk limits that the portfolio manager has to respect. The idea is partly based on van Binsbergen and Brandt (2007).
c) Higher order expansions of expected utility allow to incorporate skeweness and kurtosis of returns. This approach can become useful when modeling more complicated allocation strategies implemented, for instance, by hedge funds (Brandt et al., 2005). For the purpose of this paper an expansion of the utility function is not considered necessary as the influence of hedge fund activity in the analyzed financial system can in a similarly explanatory way be captured by lowered risk aversion and the elimination of explicit weight constraints.

d) Behaviorally motivated objectives such as loss aversion, ambiguity aversion, and disappointment aversion allow to program investors representing different decision scientific set-ups (Bouri, Martel, & Chabchoub, 2002; Brandt et al., 2009; Kahneman & Tversky, 1979; Morton & Fasolo, 2009).

e) Augmentations of objective functions oriented at practical measures of performance and risk such as a maximization of the Sharpe or information ratios (Brandt et al., 2009), controlling drawdowns of capital (Brandt et al., 2009; Pflug & Swietanowski, 1999; van Binsbergen & Brandt, 2007), or the maintenance of a certain value at risk (Blome, Fachinger, Franzen, Scheueunstuhl, & Yermo, 2007; de Jong et al., 2008) enable the modeling of investors' realities. Sharpe ratio maximization and drawdown control are not implemented in this study as a the first corresponds to a pure mean-variance maximization and is hence counterintuitive in the multi-objective context while intermediate drawdowns correspond to intermediate consumption and are not supported by the data generating process described above. It is similarly counterintuitive to model investors optimizing a risk measure such as the value at risk when developing a new risk measure that aims to conceptually avoid some of the downsides of the previous measure. In a parallel fashion, other measures of risk used in the construction of objective functions such as mean absolute deviation or lower-semi variance both penalize only downside risk (Pflug & Swietanowski, 1999) and might, hence, distort the measure of Tau given its bi-directional character.

f) Objective functions aiming to achieve a target level of return or functions bounded between reservation (lower bound) and aspiration (upper bound) levels of return can be used to reflect clients' preferences for smooth developments of the invested capital. Several studies suggest that pensioners hold such preferences (de Jong et al., 2008; Pflug & Swietanowski, 1999). The multi-period focus of such set-ups is relevant to long-term optimization problems but does not add any explanatory value to the current study.

Appendix 3 - Explicit Portfolio Weight Constraints – Imposition Methods

The imposition of explicit constraints on the allocations chosen is the most prominent and most frequent way of intervention into the fund manager's decision process (Almazan et al., 2004; Jagannathan & Ma, 2003; Roncalli, 2010; van Binsbergen & Brandt, 2007). Often, these limitations intend to protect clients or beneficiaries from miss allocations and unnecessary risks.

In a well fitting example, Pflug and Swietanowski (1999) argue that the mean variance trade-off does not sufficiently characterize the pension fund manager's decision problem. Various additional legal and organizational constraints can, however, be added to the maximization problem via linear inequalities. How the imposition of such constraints is technically done is, however, not uniform across the literature. A comprehensive discussion of a number of ways to do so and there conceptual implications and tie-ins with this paper are presented in Appendix 3.

Inefficiencies or miss allocations might be rooted in imprudent, irrational behavior or simply inferior judgment by portfolio managers or may even have technical backgrounds. One type of technical reason for the imposition of portfolio constraints are extreme long and short positions in efficient portfolios produced by mean-variance optimizers (Black & Litterman, 1992; Frost & Savarino, 1988; Jagannathan & Ma, 2003; Roncalli, 2010). In this context portfolio constraints impeding short sales or upper and lower bounds on weights in certain securities serve two purposes: non-negativity of weights and other allocation bounds enable the implementation of optimization results for institutional investors that are restricted from short selling and are meant to reduce sampling/estimation errors and other model failures (Black & Litterman, 1992; Jagannathan & Ma, 2003; Roncalli, 2010). While extreme positions in mean-variance efficient portfolios are often related to imprecise estimations of mean vectors and especially covariance matrices of returns Green and Hollifield (1992) argue that high concentrations in weights can also be attributed to the presence of single dominant factors in the estimated covariance matrix. In this case, the imposition of constraints would result in a loss of efficiency.

In principal, the argument that constraint imposition reduces the efficiency of portfolios is consistent with idea of Inter-Asset-Class Volatility understood as a measure of risk in financial systems caused by constrained preferences. For several reasons Green and Hollifield's (1992) argument is not directly transferable: In the first place, the concept of Inter-Asset-Class Volatility is built on the direct parameterization of portfolio policies based on conditioning variables as a form of portfolio optimization that is consistent with the underlying view on financial markets as being driven by time-consistent preferences. This direct focus on portfolio weights incorporates time variations in the entire return distribution and takes into account the influence of the state variables on the individual variances and co-variances between assets. Compared to methods relying solely on the predictability of expected returns higher estimation precision is thereby achieved. The latter is further increased by the severe reduction in parameters to be estimated. For a set of N assets, only N parameters have to be estimated while classic mean-variance solutions require the estimation of N(N+1)/2 parameters to construct a meaningful covariance matrix (Brandt & Santa-Clara, 2006).

Secondly, the reliance on predictive regressions based on historical returns in standard mean-variance optimization that lies at the heart of the argument collides with the forward looking character of the concept. It can hence be argued that the choice of method avoids some of the major technical downsides of optimization engines that lead to Green and Hollifield's (1992) conclusion.

However, a theoretical argument needs to be made as well at this point. In the multi-objective world assumed in this paper the existence of portfolio constraints directly shapes the non-dominated frontier (Steuer, Qi, & Hirschberger, 2004; Steuer et al., 2008) investors are trying to position their portfolios upon. A loss in efficiency from the imposition of constraints, hence, only exists in the comparison to the unconstraint, single argument world of the mean-variance investor.

Despite the methodological mismatch, important insides between this paper and the literature can be drawn from Jaganathan and Ma's (2003) approach to the imposition of weight constraints that explicitly addresses Green and Hollifield's (1992) critique. They show that the imposition of non-negativity constraints on portfolio weights increases the efficiency of portfolios as sampling errors leading to underestimation of covariances between assets are reduced.

In their analysis of minimum variance portfolios assets with high covariance with others receive extreme negative weights. Bounding the latter to zero reduces concentration in the respective asset and causes a redistribution of weights to other assets. The same logic applies to upper bounds on portfolio weights. The authors postulate them to be equivalent to an increase in the sample covariance of the respective asset correcting for the underestimation of the term. Thereby, extreme long positions are reduced to more efficient levels. In essence, Jagannathan and Ma (2003) show that weight constrains implicitly shrink the sample covariance matrix towards the population matrix by reducing errors from sample estimation.

Additionally, they prove that imposing constraints on the estimation of the covariance matrix followed by an unconstrained optimization is equivalent to a constraint maximization using the unconstrained sample covariance matrix. Parallels can be drawn to the direct parameterization method developed by Brandt and Santa-Clara (2006) and implemented here from the fact that assuming portfolio weights linear in the conditioning variables implicitly constrains the mean vector and covariance matrix prior to the maximization (Brandt & Santa-Clara, 2006). While the maximization process is unconstrained in the current application, constraints are again imposed on the computation of final conditional portfolio policies.

The downside of Jagannathan and Ma's (2003) method of introducing weight constraints to the portfolio selection problem is that even though a reduction in sampling error is achieved, it comes at the cost of a rising possibility for specification errors. Whether the net effect of the two tendencies remains positive depends on the empirical situation (Jagannathan & Ma, 2003).

The crucial inside for this paper from Jagannathan and Ma's (2003) work is the conjecture that when fund managers voluntarily impose weight constraints on their portfolios, they implicitly state a belief in a covariance structure different from the sample estimate. As such constraints are consistent through time, at least for the life of the fund, the idea is consistent with the assumption of time consistent preferences articulated above. The implicit covariance structure the manager believes in can to some extend be interpreted as the state of nature in which his/her objective can be maximized or in other words in which his/her portfolio can be efficient or non-dominated in the sense of Steuer, Qi, and Hirschberger (2004,2009).

Jagannathan and Ma (2003) point into a similar direction by proposing that a fund manager can gauge the tightness or better set the impact of their applied constraints on the portfolio policy by assessing the differences between the implied constrained covariance matrix and the sample estimate of the measure.

Roncalli (2010) takes another step into this direction by reversing the order of analysis from examining changes in optimal weights given a set of constraints applied to the covariance matrix, to tracing out changes in the implied mean and covariance structures of returns via difference in constraint and unconstraint optimal weights. This idea comes close to the here proposed calculation of

$$\Delta_t = \mathbf{x}_t^{MV} - \mathbf{x}_t^{RE}$$

and the conjecture that the differences stem from different underlying preferences. An interesting advancement from Roncalli (2010) that corresponds to the method of constraint imposition developed later on in this paper, is the ordering of changes in the implied covariance structure relative to the sample estimate into a perturbation matrix. The structure implies that as long as none of the assets reaches its weight bounds, the weights are implemented based on the sample estimate of the covariance matrix. The covariance matrix is, however, altered in a positive direction if upper weight bounds are touched. Negative perturbation of the covariance matrix occurs in the case of lower bounds being reached.

In the spirit of the current paper it could, hence, be argued that the investor chooses the band in which he/she is participating in the mean-variance efficient market, given his/her implicit constraints, by adopting a set of explicit portfolio constraints. Once limits are reached, he/she decides to structurally leave the market. It is the manager's goal to achieve a portfolio policy consistent with his/her views on the return and covariance structure he/she believes in (Roncalli, 2010). Testing if the set of constraints used is compatible or realizable given these views is a crucial step in reaching this goal.

In the following, the weight imposition mechanism applied in this paper is outlined. The process comfortably nests a possibility of testing the compatibility of portfolio constraints with views on different states of nature via a system of inequalities that can be solved for upper and lower bounds of the state variables z_t. Within these bounds allocation bands are achievable. This property potentially allows the "fit assessment" of constraints given a certain macroeconomic scenario called for by Jagannathan and Ma (2003) and Roncalli (2010).

Constraints are directly imposed on the final weights per basis asset calculated as:

$$x_t^b = x^1 + x^3 z_t^1 + x^4 z_t^2 + x^5 z_t^3 \quad (29)$$

$$x_t^s = x^2 + x^6 z_t^1 + x^7 z_t^2 + x^8 z_t^3 \quad (30)$$

$$x_t^c = 1 - \left(x_t^b + x_t^s\right) \quad (31)$$

Weights that cross the upper or lower bound of their specified bands are constraint to the boundary levels. Values within the relevant bounds are not further modified. This corresponds to Roncalli (2010). Note that in this sense, allocation bands with positive lower bounds also imply a no-short-sale constraint as well as a no-leverage constraint.

The resulting weights do not sum to one anymore. Drawing on Brandt, Santa-Clara, and Valkanov (2009) this is corrected in a second step through normalizing to 1 as follows:

$$x_t^{s'} = \frac{x_t^s}{x_t^b + x_t^s + x_t^c} \tag{32}$$

To counter allocation band breaches resulting from normalization, the overrun in weighs in the risky assets namely stocks and bonds are buffered by the weight in cash. Buffering via weights in the least volatile asset class avoids distortions in portfolio returns and risk factor exposures from the constraining mechanism. Especially using the risk free asset as a buffer minimizes inaccuracies in the views on risky assets the manager expresses.

Interestingly, the implemented normalization yields weights that breach their limits in the following patterns:

- 1 asset class above or below limits + 2 asset classes within limits but close to limits → weights do not sum to 1
- 1 asset class above or below limits + 2 asset classes within limits and with a certain distance from the limits → weights sum to 1

The mechanical solution with the cash weight buffering overruns corrects both cases and makes the method easily implementable in practice. On the contrary, from a theoretical point of view, it might be arguable that optimality or efficiency in the portfolio can only be achieved in the second pattern. In line with Jagannathan and Ma's (2003) as well as Roncalli's (2010) arguments, a possible conjecture is that during periods in which the first pattern occurs, the implemented constraints are not achievable in an efficient way given the realized state of nature.

Clarification on the achievability of final weight constraints can be reached by graphically solving a system of linear inequalities including the upper and lower bounds of the weights. In the case of three assets, six inequalities are constructed to capture both boundaries of the allocation bands.

$$x_t^b = x^1 + x^3 z_t^1 + x^4 z_t^2 + x^5 z_t^3 \leq \overline{\mathbf{x}_t^b} \tag{39}$$

$$x_t^b = x^1 + x^3 z_t^1 + x^4 z_t^2 + x^5 z_t^3 \geq \underline{\mathbf{x}_t^b} \tag{40}$$

$$x_t^s = x^2 + x^6 z_t^1 + x^7 z_t^2 + x^8 z_t^3 \leq \overline{\mathbf{x}_t^s} \tag{41}$$

$$x_t^s = x^2 + x^6 z_t^1 + x^7 z_t^2 + x^8 z_t^3 \geq \underline{\mathbf{x}_t^s} \tag{42}$$

$$x_t^c = 1 - (x_t^b + x_t^s) \leq \overline{\mathbf{x}_t^c} \tag{43}$$

$$x_t^c = 1 - (x_t^b + x_t^s) \geq \underline{\mathbf{x}_t^c} \tag{44}$$

The inequalities depend solely on the realizations of the conditioning variables z_t^{i-j} as all other terms are constants resulting from the maximization of equation 27. The value ranges for the z_t^{i-j} variables indicated by the coordinates of the line intercepts in the graph represent upper and lower bounds within which the allocation goals of the investor can be reached (no breach of limits in final weights). This has two major implications:

1. Given the estimated coefficients that maximize the fund manager's utility function, and the allocation limits he/she voluntarily imposes on his fund, it is possible to trace out the states of nature (described by the conditioning variables) that he/she considers normal or expectable within the investment horizon. This corresponds to the implied covariance matrix structure that Jagannathan and Ma's (2003) investor believes in.
2. The states of nature that are not nested in the final weights limits are times in which the funds AuM add to the overall risk in the system measured by Inter-Asset-Class Volatility as the fund manager leaves the objective efficient or preference driven market. He/she can no longer ensure that the implemented portfolio policy constraints by explicit weight limits are non-dominated regarding the agreed objectives. This might render the quality of the service offered to his/her client questionable. The possibility of such situations has direct implications for the fund management industry.

Implementing the inequality approach developed in a personal conversation with Mrs. Lena Stiehl in May 2011 holds interesting insights but is not expected to add significant explanatory power to the test of inter-asset class volatility. Therefore, the application and further development is left for future research.

Other explicit constraints related to the topic:

Brand, Santa-Clara, and Valkanov (2009) show, based on very similar method, that the introduction of transaction costs into the optimization problem generates no trade zones around target weights. In a simulation they show that once current weights lie outside of the no trade zone it is optimal to trade to the boundary of the zone rather than to the optimal weight. Similar to the market leaving arguments presented above, transaction costs seem to induce deviations from objective efficient weights and limit trading activity and, thereby, market participation. The same effect can be expected from turnover constraints as they also limit trading towards objective efficient weights and cause the investor to leave the market at some point.

Appendix 4 – Estimated portfolio policies

The tables below give a good overview of the coefficients of the estimated portfolio policies discussed on section 5.2.1. Note that the performance data is based on allocations dictated by the final weights calculated as a consequence of the here shown coefficients.

Table 8: Portfolio Policy Characteristics: Constrained Investor I

Portfolio Policy Characteristics Constrained Investor I				
State Variables		Annual	Annual-Monthly	Monthly
Bonds	Constant	0.254	0.254	0.529
	D/P	-0.906	-0.906	-0.034
	Termspread	-0.236	-0.236	-0.020
	Tbill	0.373	0.373	0.300
Stocks	Constant	0.314	0.314	0.278
	D/P	0.301	0.301	0.071
	Termspread	-1.108	-1.108	-0.497
	Tbill	0.478	0.478	-0.421
Mean Return (In-Sample)		0.102	0.095	0.089
Mean Excess Return (In-Sample)		0.050	0.037	0.039
Mean Return (Out-Sample)		0.133	0.144	0.145
Standard Deviation (In-Sample)		0.120	0.099	0.098
Standard Deviation (Out-Sample)		0.016	0.099	0.100
Sharpe Ratio (In-Sample)		0.420	0.377	0.396

Source: Own compilation.

Table 9: Portfolio Policy Characteristics: Constrained Investor II

Portfolio Policy Characteristics Constrained Investor II				
State Variables		Annual	Annual-Monthly	Monthly
Bonds	Constant	0.254	0.254	0.529
	D/P	-0.906	-0.906	-0.034
	Termspread	-0.236	-0.236	-0.020
	Tbill	0.373	0.373	0.300
Stocks	Constant	0.314	0.314	0.278
	D/P	0.301	0.301	0.071
	Termspread	-1.108	-1.108	-0.497
	Tbill	0.478	0.478	-0.421
Mean Return (In-Sample)		0.097	0.085	0.088
Mean Excess Return (In-Sample)		0.045	0.035	0.038
Mean Return (Out-Sample)		0.077	0.098	0.145
Standard Deviation (In-Sample)		0.097	0.076	0.077
Standard Deviation (Out-Sample)		0.030	0.068	0.070
Sharpe Ratio (In-Sample)		0.470	0.462	0.488

Source: Own compilation.

Table 10: Portfolio Policy Characteristics: Hedge Fund Investor

Portfolio Policy Characteristics				
Hedge Fund Investor				
State Variables		Annual	Annual-Monthly	Monthly
Bonds	Constant	0.415	0.415	0.881
	D/P	-1.478	-1.478	-0.057
	Termspread	-0.385	-0.385	-0.033
	Tbill	0.609	0.609	0.499
Stocks	Constant	0.512	0.512	0.462
	D/P	0.492	0.492	0.118
	Termspread	-1.807	-1.807	-0.826
	Tbill	0.781	0.781	-0.700
Mean Return (In-Sample)		0.039	-0.058	0.115
Mean Excess Return (In-Sample)		-0.013	-0.102	0.064
Mean Return (Out-Sample)		-0.652	-0.448	-0.113
Standard Deviation (In-Sample)		0.559	0.487	0.192
Standard Deviation (Out-Sample)		0.077	0.536	0.181
Sharpe Ratio (In-Sample)		-0.023	-0.209	0.337

Source: Own compilation.

From a performance perspective all three investor achieve the lowest Sharp ratios in the 1-year horizon with monthly rebalancing configuration. Even though the set-up produces in two out of three cases the lowest standard deviation, returns are lower than in other settings for the CS I and CS II. The Hedge Fund investor achieves negative mean returns in all but the monthly horizon configuration. This might be due to the higher responsiveness of the policy to changes in conditioning variables that suits short horizons better. Consistently, the policy achieves the by far lowest Sharpe ratio in the 1-year horizon with monthly rebalancing configuration while the 1-month horizon policy shows significantly lower standard deviation and a much higher positive Sharpe ratio.

Interestingly, the performance of both the first and the second constrained investor improve significantly out of sample. Rising returns accompanied by only slight uplifts in standard deviation characterize both monthly rebalancing configurations for the two investors. Values reported for the annual policies do not lend themselves for relevant interpretation as the out of sample period only contains two realizations (2009 & 2010). Contrarily, the Hedge Fund investor's performance suffers from severely negative returns out of sample. It is noteworthy though that the standard deviation of returns for the policy in the monthly horizon decreases slightly compared to the in sample period.

The persistency in weights and performance for the first two constrained investors, that is absent for the Hedge Fund investor can potentially be attributed to the explicit portfolio constraints they are subject to. In the following section, final weights, the resulting deltas towards the mean-variance investor and the resulting contributions to Inter-Asset-Class Volatility will be presented.

Appendix 5: Final weights, deltas, and Inter-Asset-Class Volatility contributions

Table 12: Final Weights – Deltas – Contributions: Constrained Investor II

Final Weights - Deltas - IAV Contributions				
Constrained Investor II				
Mean Weights		Annual	Annual-Monthly	Monthly
In-Sample	Cash	0.153	0.151	0.150
	Bonds	0.511	0.499	0.508
	Stocks	0.339	0.350	0.342
Out-Sample	Cash	0.200	0.200	0.199
	Bonds	0.525	0.514	0.526
	Stocks	0.275	0.286	0.274
Mean Deltas				
In-Sample	Cash	0.194	0.171	0.005
	Bonds	(0.241)	(0.234)	0.027
	Stocks	0.045	0.063	(0.032)
Out-Sample	Cash	2.225	2.304	0.734
	Bonds	(0.311)	(0.416)	(0.113)
	Stocks	(1.914)	(1.888)	(0.621)
Mean IAV				
In-Sample	Bonds	(2.331%)	(2.786%)	0.460%
	Stocks	1.776%	1.941%	(0.916%)
Mean Abs. IAV from Investor		17.248%	16.822%	4.071%
Standard Deviation of Abs. IAV from Investor		9.929%	11.074%	2.585%
AuM as % of Total Assets		10%	10%	10%

Source: Own compilation.

Table 13: Final Weights – Deltas – Contributions: Hedge Fund Investor

Final Weights - Deltas - IAV Contributions				
Hedge Fund Investor				
Mean Weights		Annual	Annual-Monthly	Monthly
In-Sample	Cash	(0.062)	(0.103)	(0.407)
	Bonds	0.439	0.430	0.890
	Stocks	0.624	0.672	0.517
Out-Sample	Cash	3.316	3.445	0.889
	Bonds	0.348	0.158	0.687
	Stocks	(2.664)	(2.603)	(0.576)
Mean Deltas				
In-Sample	Cash	0.409	0.424	0.561
	Bonds	(0.169)	(0.166)	(0.355)
	Stocks	(0.240)	(0.259)	(0.206)
Out-Sample	Cash	(0.891)	(0.941)	0.044
	Bonds	(0.134)	(0.061)	(0.274)
	Stocks	1.025	1.002	0.230
Mean IAV				
In-Sample	Bonds	(3.376%)	(2.959%)	(5.359%)
	Stocks	(8.167%)	(8.088%)	(6.435%)
Mean Abs. IAV from Investor		11.595%	11.481%	6.004%
Standard Deviation of Abs. IAV from Investor		6.668%	6.969%	2.456%
AuM as % of Total Assets		10%	10%	10%

Source: Own compilation.

Appendix 6: Individual Portfolio Policies - Return correlations

Table 14: Correlations of Measures to Empirical Data: Constrained Investor I

Correlation Analysis						
Constrained Investor I						
Correlations	Annual		Annual-Monthly		Monthly	
Full Sample						
Delta Bonds - Bonds (Simple Returns)	(0.219)		(0.049)		0.024	
Delta Stocks - Stocks (Simple Returns)	0.042		(0.057)		0.052	
Half Sample	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Delta Bonds - Bonds (Simple Returns)	(0.341)	(0.143)	(0.042)	(0.060)	0.025	(0.104)
Delta Stocks - Stocks (Simple Returns)	(0.136)	0.218	(0.159)	0.086	0.102	0.001
Full Sample						
Tau-Bonds vs. Change in Bond Mkt Cap	0.335		0.017		0.053	
Tau-Stocks vs. Change in Stock Mkt Cap	0.092		0.098		(0.028)	
Half Sample	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Tau-Bonds vs. Change in Bond Mkt Cap	(0.535)	0.141	(0.117)	(0.046)	0.022	(0.003)
Tau-Stocks vs. Change in Stock Mkt Cap	(0.355)	0.136	(0.152)	0.122	0.166	(0.018)

Source: Own compilation.

Table 15: Correlations of Measures to Empirical Data: Constrained Investor II

Correlation Analysis						
Constrained Investor II						
Correlations	Annual		Annual-Monthly		Monthly	
Full Sample						
Delta Bonds - Bonds (Simple Returns)	(0.224)		(0.049)		0.005	
Delta Stocks - Stocks (Simple Returns)	0.042		(0.060)		0.060	
Half Sample	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Delta Bonds - Bonds (Simple Returns)	(0.334)	(0.146)	(0.042)	(0.059)	0.009	(0.006)
Delta Stocks - Stocks (Simple Returns)	(0.128)	0.215	(0.161)	0.083	0.110	0.008
Full Sample						
Tau-Bonds vs. Change in Bond Mkt Cap	0.252		(0.011)		(0.038)	
Tau-Stocks vs. Change in Stock Mkt Cap	0.079		0.097		(0.032)	
Half Sample	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Tau-Bonds vs. Change in Bond Mkt Cap	(0.569)	0.069	(0.121)	(0.056)	(0.033)	(0.042)
Tau-Stocks vs. Change in Stock Mkt Cap	(0.327)	0.112	(0.153)	0.115	0.202	(0.029)

Source: Own compilation.

Table 16: Correlations of Measures to Empirical Data: Hedge Fund Investor

Correlation Analysis						
Hedge Fund Investor						
Correlations	Annual		Annual-Monthly		Monthly	
Full Sample						
Delta Bonds - Bonds (Simple Returns)	0.218		0.051		(0.005)	
Delta Stocks - Stocks (Simple Returns)	(0.044)		0.058		(0.057)	
Half Sample	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Delta Bonds - Bonds (Simple Returns)	0.319	0.163	0.043	0.062	(0.007)	0.002
Delta Stocks - Stocks (Simple Returns)	0.129	(0.217)	0.160	(0.084)	(0.111)	0.002
Full Sample						
Tau-Bonds vs. Change in Bond Mkt Cap	(0.360)		(0.059)		(0.107)	
Tau-Stocks vs. Change in Stock Mkt Cap	(0.093)		(0.098)		0.053	
Half Sample	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Tau-Bonds vs. Change in Bond Mkt Cap	0.496	(0.142)	0.100	0.029	(0.040)	(0.008)
Tau-Stocks vs. Change in Stock Mkt Cap	0.294	(0.109)	0.150	(0.107)	(0.224)	0.068

Source: Own compilation.

Appendix 7: Aggregation effects on Inter-Asset-Class Volatility

Table 17: Aggregation Effects on Inter-Asset-Class Volatility: Annual Policy

	Inter Asset Class Volatility	
	Aggregation Effects (Annual)	
Mean IAV	CS_1 + CS_2	CS_1 + CS_2 + HF
Mean Abs. IAV	34.14%	23.63%
Standard Deviation of Abs. IAV	19.67%	14.49%
AuM as % of Total Assets	20%	30%
Netting	CS_1 + CS_2	CS_1 + CS_2 + HF
Netting Occurance (Incidents)	3	30
Netting Occurance (Periods)	3	21
Share of Incidents	2.50%	25.00%
Share of Periods	7.50%	52.50%

Source: Own compilation.

Table 18: Aggregation Effects on Inter-Asset-Class Volatility: Annual-Monthly Policy

	Inter Asset Class Volatility	
	Aggregation Effects (Annual-Monthly)	
Mean IAV	CS_1 + CS_2	CS_1 + CS_2 + HF
Mean Abs. IAV	32.64%	22.69%
Standard Deviation of Abs. IAV	22.08%	15.77%
AuM as % of Total Assets	20%	30%
Netting	CS_1 + CS_2	CS_1 + CS_2 + HF
Netting Occurance (Incidents)	148	521
Netting Occurance (Periods)	135	297
Share of Incidents	10.28%	36.18%
Share of Periods	28.13%	61.88%

Source: Own compilation.

Appendix 8: Correlations and volatility comparison

Table 20: Correlations of Aggregated Measures to Empirical Data: Annual Policy

Inter-Asset-Class Volatility

Aggregated Correlation Analysis (Annual)

Correlations per Asset Class	CS_1 + CS_2		CS_1 + CS_2 + HF	
Full Sample				
Tau-Bonds vs. Change in Bond Mkt Cap	0.295		0.245	
Tau-Stocks vs. Change in Stock Mkt Cap	0.086		0.081	
Half Sample	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Tau-Bonds vs. Change in Bond Mkt Cap	(0.554)	0.105	(0.572)	0.081
Tau-Stocks vs. Change in Stock Mkt Cap	(0.341)	0.125	(0.361)	0.131
Correlations Aggregate	CS_1 + CS_2		CS_1 + CS_2 + HF	
Full Sample				
Correlation Abs. Tau vs. Total Assets	0.819		0.763	
Correlation Abs. Tau vs. Abs. Change in Total Assets (In-Sample)	0.494		0.416	
Correlation Abs. Tau vs. Abs. Change in Total Assets (Out-Sample)	0.667		0.645	
Correlation Abs. Tau vs. Sum Abs. Changes in All Asset Classes (In-Sample)	0.494		0.497	

Source: Own compilation.

Table 21: Correlations of Aggregated Measures to Empirical Data: Annual-Monthly Policy

Inter-Asset-Class Volatility

Aggregated Correlation Analysis (Annual-Monthly)

Correlations per Asset Class	CS_1 + CS_2		CS_1 + CS_2 + HF	
Full Sample				
Tau-Bonds vs. Change in Bond Mkt Cap	0.003		(0.035)	
Tau-Stocks vs. Change in Stock Mkt Cap	0.098		0.096	
Half Sample	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Tau-Bonds vs. Change in Bond Mkt Cap	(0.117)	(0.053)	(0.126)	(0.064)
Tau-Stocks vs. Change in Stock Mkt Cap	(0.134)	0.119	(0.152)	0.123
Correlations Aggregate	CS_1 + CS_2		CS_1 + CS_2 + HF	
Full Sample				
Correlation Abs. Tau vs. Total Assets	0.796		0.722	
Correlation Abs. Tau vs. Abs. Change in Total Assets (In-Sample)	0.444		0.404	
Correlation Abs. Tau vs. Abs. Change in Total Assets (Out-Sample)	0.166		0.164	
Correlation Abs. Tau vs. Sum Abs. Changes in All Asset Classes (In-Sample)	0.578		0.562	

Source: Own compilation.

Table 22: Correlations of Aggregated Measures to Empirical Data: Monthly Policy

Inter-Asset-Class Volatility Aggregated Correlation Analysis (Monthly)				
Correlations per Asset Class	CS_1 + CS_2		CS_1 + CS_2 + HF	
Full Sample				
Tau-Bonds vs. Change in Bond Mkt Cap	0.010		(0.109)	
Tau-Stocks vs. Change in Stock Mkt Cap	(0.030)		(0.013)	
Half Sample	**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Tau-Bonds vs. Change in Bond Mkt Cap	(0.006)	(0.023)	(0.038)	(0.047)
Tau-Stocks vs. Change in Stock Mkt Cap	0.183	(0.023)	0.145	0.006
Correlations Aggregate	CS_1 + CS_2		CS_1 + CS_2 + HF	
Full Sample				
Correlation Abs. Tau vs. Total Assets	0.728		0.723	
Correlation Abs. Tau vs. Abs. Change in Total Assets (In-Sample)	0.359		0.401	
Correlation Abs. Tau vs. Abs. Change in Total Assets (Out-Sample)	(0.374)		(0.387)	
Correlation Abs. Tau vs. Sum Abs. Changes in All Asset Classes (In-Sample)	0.476		0.540	

Source: Own compilation.

Appendix 9: Realized vs. potential inter-asset class volatility

Table 23: Realized vs. Potential Inter-Asset-Class Volatility: Annual Policy

Realized vs. Potential Volatility					
Consolidated IAV (Annual)					
Realized vs. Potential Volatility		CS_1 + CS_2		CS_1 + CS_2 + HF	
Full Sample					
Mean (Change in Bond Mkt Cap / Tau-Bonds)		(5.89%)		29.36%	
Mean (Change in Stock Mkt Cap / Tau-Stocks)		(168.74%)		(14.66%)	
Half Sample		**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Mean (Change in Bond Mkt Cap / Tau-Bonds)		8.56%	(24.76%)	36.73%	22.32%
Mean (Change in Stock Mkt Cap / Tau-Stocks)		(33.35%)	(290.58%)	10.62%	(39.08%)
Mean (Sum Abs. Value Changes/Abs. Tau (In-Sample))		49.65%		82.00%	
Mean (Sum Abs. Value Changes/Abs. Tau (Out-Sample))		81.92%		98.78%	
High Volatility Events - Mean (Cum. Abs. Value Changes/Abs. Tau)					
1970	Year	26.40%		48.38%	
1973	Year	132.15%		658.29%	
1987	Year	8.70%		9.70%	
1998	Year	67.94%		140.43%	
2000	Year	32.47%		61.27%	
2002	Year	29.77%		41.00%	
2008	Year	195.12%		233.20%	
2009	Year	30.77%		37.87%	

Source: Own compilation.

Table 24: Realized vs. Potential Inter-Asset-Class Volatility: Annual-Monthly Policy

Realized vs. Potential Volatility					
Consolidated IAV (Annual-Monthly)					
Realized vs. Potential Volatility		CS_1 + CS_2		CS_1 + CS_2 + HF	
Full Sample					
Mean (Change in Bond Mkt Cap / Tau-Bonds)		15.32%		(23.30%)	
Mean (Change in Stock Mkt Cap / Tau-Stocks)		(14.29%)		(14.57%)	
Half Sample		**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Mean (Change in Bond Mkt Cap / Tau-Bonds)		53.95%	(24.98%)	8.09%	(55.89%)
Mean (Change in Stock Mkt Cap / Tau-Stocks)		12.66%	(42.30%)	3.01%	(32.81%)
Mean (Sum Abs. Value Changes/Abs. Tau (In-Sample))		14.38%		22.86%	
Mean (Sum Abs. Value Changes/Abs. Tau (Out-Sample))		6.21%		7.78%	
High Volatility Events - Mean (Cum. Abs. Value Changes/Abs. Tau)					
May 1970	Year	20.86%		47.79%	
	Month	17.01%		47.56%	
November 1973	Year	4.83%		9.14%	
	Month	9.96%		17.88%	
October 1987	Year	36.41%		35.68%	
	Month	208.59%		225.54%	
August-September 1998	Year	20.60%		57.81%	
	Month	32.72%		94.78%	
April 2000	Year	8.77%		16.79%	
	Month	8.32%		15.38%	
October 2000	Year	8.77%		16.79%	
	Month	4.27%		7.92%	
October 2002	Year	8.13%		10.09%	
	Month	11.59%		13.69%	
March 2008	Year	11.63%		13.43%	
	Month	2.30%		2.92%	
October 2008	Year	11.63%		13.43%	
	Month	28.98%		33.92%	
December 2008	Year	11.63%		13.43%	
	Month	7.97%		10.35%	
2009	Year	6.14%		7.79%	
2010	Year	6.66%		8.30%	

Source: Own compilation.

Table 25: Realized vs. Potential Inter-Asset-Class Volatility: Monthly Policy

Realized vs. Potential Volatility					
		Consolidated IAV (Monthly)			
Realized vs. Potential Volatility		CS_1 + CS_2		CS_1 + CS_2 + HF	
Full Sample					
Mean (Change in Bond Mkt Cap / Tau-Bonds)		(20.46%)		(3.52%)	
Mean (Change in Stock Mkt Cap / Tau-Stocks)		(7.03%)		4.91%	
Half Sample		**1968-88**	**1988-2008**	**1968-88**	**1988-2008**
Mean (Change in Bond Mkt Cap / Tau-Bonds)		8.72%	(50.74%)	43.47%	(52.65%)
Mean (Change in Stock Mkt Cap / Tau-Stocks)		(1.96%)	(12.30%)	75.15%	(68.28%)
Mean (Sum Abs. Value Changes/Abs. Tau (In-Sample))		55.04%		72.64%	
Mean (Sum Abs. Value Changes/Abs. Tau (Out-Sample))		20.88%		18.82%	
High Volatility Events - Mean (Cum. Abs. Value Changes/Abs. Tau)					
May 1970	Year	99.28%		95.39%	
	Month	89.08%		57.09%	
November 1973	Year	22.87%		71.03%	
	Month	49.31%		464.00%	
October 1987	Year	98.07%		32.57%	
	Month	61.62%		77.99%	
August-September 1998	Year	75.14%		87.90%	
	Month	123.68%		176.22%	
April 2000	Year	53.48%		128.93%	
	Month	60.16%		74.72%	
October 2000	Year	53.48%		128.93%	
	Month	23.51%		119.73%	
October 2002	Year	26.36%		23.93%	
	Month	39.70%		31.67%	
March 2008	Year	67.22%		44.29%	
	Month	15.16%		15.72%	
October 2008	Year	67.22%		44.29%	
	Month	166.61%		96.87%	
December 2008	Year	67.22%		44.29%	
	Month	52.13%		42.07%	
2009	Year	34.38%		25.48%	
2010	Year	16.15%		16.58%	

Source: Own compilation.

Appendix 10: Liquidity Relations – Individual view

Table 27: Full Sample Correlations of Taus vs. Liquity Series: Annual-Monthly Policy

Liquidity Relations (Annual-Monthly)

Correlations with Liquidity Series

Correlations Tau (Net) vs.	Traded Liquidity			Aggregate Liquidity			Innovations in Liquidity		
	Cash	Bonds	Stocks	Cash	Bonds	Stocks	Cash	Bonds	Stocks
CS I	(0.010)	0.058	(0.017)	(0.048)	0.045	0.038	0.006	(0.007)	(0.004)
CS II	(0.017)	0.061	(0.010)	(0.051)	0.053	0.042	0.003	(0.003)	(0.002)
HF	0.034	(0.071)	0.000	0.051	(0.045)	(0.043)	(0.002)	(0.002)	0.004
CS I + CS II	(0.013)	0.060	(0.014)	(0.050)	0.049	0.040	0.004	(0.005)	(0.003)
CS I + CS II + HF	(0.002)	0.049	(0.019)	(0.047)	0.049	0.038	0.005	(0.010)	(0.002)

Source: Own compilation.

Table 28: Full Sample Correlations of Taus vs. Liquity Series: Monthly Policy

Liquidity Relations (Monthly)

Correlations with Liquidity Series

Correlations Tau (Net) vs.	Traded Liquidity			Aggregate Liquidity			Innovations in Liquidity		
	Cash	Bonds	Stocks	Cash	Bonds	Stocks	Cash	Bonds	Stocks
CS I	0.005	0.005	(0.007)	0.000	0.070	(0.031)	0.014	0.007	(0.016)
CS II	(0.008)	0.001	0.008	(0.007)	0.058	(0.022)	0.010	(0.002)	(0.010)
HF	0.051	(0.037)	(0.039)	0.012	(0.051)	0.029	(0.004)	(0.005)	0.011
CS I + CS II	(0.001)	0.003	(0.000)	(0.003)	0.066	(0.027)	0.012	0.003	(0.013)
CS I + CS II + HF	0.031	(0.038)	(0.021)	0.003	0.043	(0.021)	0.011	(0.002)	(0.012)

Source: Own compilation.

Appendix 11: Liquidity relations – temporal relations in the aggregated view

Table 29: Full Sample Leading Correlations of Aggregated Absolute Taus with Liquity Series: Annual Policy

Liquidity Relations (Annual)

Aggregated Leading Correlations with Liquidity Series

	CS I + CS II			CS I + CS II + HF		
Correlations Tau vs.	Traded Liquidity	Aggregate Liquidity	Innovations in Liquidity	Traded Liquidity	Aggregate Liquidity	Innovations in Liquidity
Abs. Tau	0.263	0.008	0.055	0.206	0.004	0.045
1 year leading Abs. Tau	0.177	0.016	0.017	0.157	0.099	0.092
2 years leading average Abs. Tau	0.231	0.019	0.045	0.188	0.061	0.080
3 years leading average Abs. Tau	0.217	0.019	0.046	0.189	0.084	0.105

Source: Own compilation.

Table 30: Full Sample Leading Correlations of Aggregated Absolute Taus with Liquity Series: Annual-Monthly Policy

Liquidity Relations (Annual-Monthly)

Aggregated Leading Correlations with Liquidity Series

	CS I + CS II			CS I + CS II + HF		
Correlations Tau vs.	Traded Liquidity	Aggregate Liquidity	Innovations in Liquidity	Traded Liquidity	Aggregate Liquidity	Innovations in Liquidity
Abs. Tau	0.040	(0.027)	(0.022)	0.020	(0.040)	(0.022)
3 month leading average Abs. Tau	0.051	(0.031)	(0.031)	0.032	(0.041)	(0.030)
6 month leading average Abs. Tau	0.046	(0.037)	(0.035)	0.026	(0.044)	(0.034)
12 month leading average Abs. Tau	0.054	(0.040)	(0.018)	0.032	(0.042)	(0.017)

Source: Own compilation.

Table 31: Full Sample Leading Correlations of Aggregated Absolute Taus with Liquity Series: Monthly Policy

Liquidity Relations (Monthly)

Aggregated Leading Correlations with Liquidity Series

	CS I + CS II			CS I + CS II + HF		
Correlations Tau vs.	Traded Liquidity	Aggregate Liquidity	Innovations in Liquidity	Traded Liquidity	Aggregate Liquidity	Innovations in Liquidity
Abs. Tau	0.069	0.006	0.015	0.031	0.002	0.010
3 month leading average Abs.. Tau	0.069	0.005	0.015	0.027	0.001	0.006
6 month leading average Abs. Tau	0.062	0.006	0.018	0.027	0.002	0.006
12 month leading average Abs. Tau	0.056	0.029	0.038	0.029	0.024	0.024

Source: Own compilation.

Appendix 12: Liquidity relations – extreme periods and crash situations

Table 33: Extreme Periods Leading Correlations of Aggregated Absolute Taus with Liquity Series: Annual-Monthly Policy

Leading Correlations of Aggregated Absolute Taus with Liquity Series (Annual-Monthly)

Panel A describes the correlations between 3 month, 6 month, and 12 month leading average values of the aggregate Abs. Tau and the Aggregate Liquidity series constructed by Pastor & Stambaugh (2003) over the horizon of 12 month around the indicated month. Panel B reports correlations between the same Abs. Tau series and the 3,6, and 12 month leading average value of the Aggregate Liquidity series.

	CS I + CS II + HF					
Correlations Abs. Tau vs.	Point Liquidity - t-5-->t+5			Leading Average Liquidity - t-5-->t+5		
	3month leading	6month leading	12month leading	3month leading	6month leading	12month leading
May-1970	0.044	(0.246)	(0.514)	0.411	0.684	0.702
November-1973	(0.254)	(0.242)	0.177	(0.102)	(0.671)	(0.960)
October-1987	0.252	0.480	0.190	0.179	0.122	0.900
August-September-1998	(0.397)	(0.435)	(0.341)	(0.202)	(0.169)	(0.761)
April-2000	(0.243)	(0.265)	(0.299)	(0.756)	(0.948)	(0.956)
September-November-2000	(0.084)	0.041	0.144	(0.351)	(0.182)	(0.960)
September-October-2002	0.266	0.196	(0.352)	0.914	0.929	0.525
March-2008	0.210	0.146	0.064	0.598	0.238	(0.748)
October-2008	(0.010)	0.054	(0.336)	0.255	0.292	(0.135)
Mean	(0.024)	(0.030)	(0.141)	0.105	0.033	(0.266)
Standard Deviation	0.241	0.288	0.278	0.513	0.601	0.779
Median	(0.010)	0.041	(0.299)	0.179	0.122	(0.748)

	CS I + CS II					
Correlations Tau vs.	Point Liquidity - t-5-->t+5			Leading Average Liquidity - t-5-->t+5		
	3month leading	6month leading	12month leading	3month leading	6month leading	12month leading
May 1970	(0.119)	(0.313)	(0.515)	0.204	0.584	0.703
Nov 1973	(0.293)	(0.264)	0.181	(0.166)	(0.542)	(0.957)
Oct 1987	0.162	0.433	0.202	0.088	0.022	0.895
Sep 1998	(0.363)	(0.393)	(0.322)	(0.171)	0.008	(0.758)
Apr 2000	(0.250)	(0.266)	(0.297)	(0.766)	(0.954)	(0.957)
Oct 2000	(0.095)	0.017	0.141	(0.318)	(0.167)	(0.955)
Oct 2002	0.286	0.193	(0.346)	0.928	0.943	0.523
March 2008	0.158	0.091	(0.135)	0.549	0.350	(0.186)
Oct 2008	(0.018)	0.043	(0.400)	0.239	0.264	(0.053)
Mean	(0.059)	(0.051)	(0.166)	0.065	0.057	(0.194)
Standard Deviation	0.225	0.275	0.274	0.497	0.573	0.757
Median	(0.095)	0.017	(0.297)	0.088	0.022	(0.186)

Source: Own compilation.

Appendix 13: Fund Prospectus

American Funds®   The right choice for the long term®

American Balanced Fund®

Class	Ticker
A	ABALX
B	BALBX
C	BALCX
F-1	BALFX
F-2	AMBFX
529-A	CLBAX
529-B	CLBBX
529-C	CLBCX
529-E	CLBEX
529-F-1	CLBFX

Prospectus

March 1, 2011

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The U.S. Securities and Exchange Commission has not approved or disapproved of these securities. Further, it has not determined that this prospectus is accurate or complete. Any representation to the contrary is a criminal offense.

Investment objectives

The investment objectives of the fund are: (1) conservation of capital, (2) current income and (3) long-term growth of capital and income.

Fees and expenses of the fund

This table describes the fees and expenses that you may pay if you buy and hold shares of the fund. You may qualify for sales charge discounts if you and your family invest, or agree to invest in the future, at least $25,000 in American Funds. More information about these and other discounts is available from your financial professional and in the "Sales charge reductions and waivers" section on page 34 of the prospectus and on page 58 of the fund's statement of additional information.

Shareholder fees
(fees paid directly from your investment)

	Share classes				
	A and 529-A	B and 529-B	C and 529-C	529-E	F-1, F-2 and 529-F-1
Maximum sales charge (load) imposed on purchases (as a percentage of offering price)	5.75%	none	none	none	none
Maximum deferred sales charge (load) (as a percentage of the amount redeemed)	none	5.00%	1.00%	none	none
Maximum sales charge (load) imposed on reinvested dividends	none	none	none	none	none
Redemption or exchange fees	none	none	none	none	none
Maximum annual account fee (529 share classes only)	$10	$10	$10	$10	$10

Annual fund operating expenses
(expenses that you pay each year as a percentage of the value of your investment)

	Share classes				
	A	B	C	F-1	F-2
Management fees	0.24%	0.24%	0.24%	0.24%	0.24%
Distribution and/or service (12b-1) fees	0.24	1.00	1.00	0.25	none
Other expenses	0.15	0.14	0.19	0.14	0.16
Total annual fund operating expenses	0.63	1.38	1.43	0.63	0.40
	529-A	529-B	529-C	529-E	529-F-1
Management fees	0.24%	0.24%	0.24%	0.24%	0.24%
Distribution and/or service (12b-1) fees	0.22	1.00	0.99	0.50	0.00
Other expenses	0.23	0.24	0.25	0.23	0.23
Total annual fund operating expenses	0.69	1.48	1.48	0.97	0.47

Example

This example is intended to help you compare the cost of investing in the fund with the cost of investing in other mutual funds.

The example assumes that you invest $10,000 in the fund for the time periods indicated and then redeem all of your shares at the end of those periods. The example also assumes that your investment has a 5% return each year and that the fund's operating expenses remain the same. Although your actual costs may be higher or lower, based on these assumptions, your costs would be:

Share classes	1 year	3 years	5 years	10 years
A	$636	$765	$ 906	$1,316
B	640	837	955	1,452
C	246	452	782	1,713
F-1	64	202	351	786
F-2	41	128	224	505
529-A	661	822	996	1,489
529-B	670	907	1,065	1,656
529-C	270	507	865	1,868
529-E	119	348	594	1,293
529-F-1	68	190	322	698

For the share classes listed below, you would pay the following if you did not redeem your shares:

Share classes	1 year	3 years	5 years	10 years
B	$140	$437	$ 755	$1,452
C	146	452	782	1,713
529-B	170	507	865	1,656
529-C	170	507	865	1,868

Portfolio turnover

The fund pays transaction costs, such as commissions, when it buys and sells securities (or "turns over" its portfolio). A higher portfolio turnover rate may indicate higher transaction costs and may result in higher taxes when fund shares are held in a taxable account. These costs, which are not reflected in annual fund operating expenses or in the example, affect the fund's results. During the most recent fiscal year, the fund's portfolio turnover rate was 37% of the average value of its portfolio.

Principal investment strategies

The fund approaches the management of its investments as if they constituted the complete investment program of the prudent investor. The fund invests in a broad range of securities, including common stocks and investment-grade bonds (rated Baa3 or better or BBB- or better by Nationally Recognized Statistical Rating Organizations designated by the fund's investment adviser or unrated but determined to be of equivalent quality). The fund also invests in securities issued and guaranteed by the U.S. government and by federal agencies and instrumentalities. In addition, the fund may invest a portion of its assets in common stocks, most of which have a history of paying dividends, bonds and other securities of issuers domiciled outside the United States.

Normally, the fund will maintain at least 50% of the value of its assets in common stocks and at least 25% of the value of its assets in debt securities, including money market securities. Although the fund focuses on investments in medium to larger capitalization companies, the fund's investments are not limited to a particular capitalization size.

The investment adviser uses a system of multiple portfolio counselors in managing the fund's assets. Under this approach, the portfolio of the fund is divided into segments managed by individual counselors who decide how their respective segments will be invested.

The fund relies on the professional judgment of its investment adviser to make decisions about the fund's portfolio investments. The basic investment philosophy of the investment adviser is to seek to invest in attractively priced securities that, in its opinion, represent good, long-term investment opportunities. The investment adviser believes that an important way to accomplish this is through fundamental analysis, which may include meeting with company executives and employees, suppliers, customers and competitors. Securities may be sold when the investment adviser believes that they no longer represent relatively attractive investment opportunities.

Principal risks

This section describes the principal risks associated with the fund's principal investment strategies. You may lose money by investing in the fund. The likelihood of loss may be greater if you invest for a shorter period of time.

Market conditions — The prices of, and the income generated by, the common stocks, bonds and other securities held by the fund may decline due to market conditions and other factors, including those directly involving the issuers of securities held by the fund.

Investing in growth-oriented stocks — Growth-oriented stocks may involve larger price swings and greater potential for loss than other types of investments.

Investing in income-oriented stocks — Income provided by the fund may be reduced by changes in the dividend policies of, and the capital resources available at, the companies in which the fund invests.

Investing in bonds — Rising interest rates will generally cause the prices of bonds and other debt securities to fall. In addition, falling interest rates may cause an issuer to redeem, call or refinance a security before its stated maturity, which may result in the fund having to reinvest the proceeds in lower yielding securities. Longer maturity debt securities may be subject to greater price fluctuations than shorter maturity debt securities.

Bonds and other debt securities are subject to credit risk, which is the possibility that the credit strength of an issuer will weaken and/or an issuer of a debt security will fail to make timely payments of principal or interest and the security will go into default. Lower quality debt securities generally have higher rates of interest and may be subject to greater price fluctuations than higher quality debt securities.

Investing in securities backed by the U.S. government — Securities backed by the U.S. Treasury or the full faith and credit of the U.S. government are guaranteed only as to the timely payment of interest and principal when held to maturity. Accordingly, the current market values for these securities will fluctuate with changes in interest rates. Securities issued by government sponsored entities and federal agencies and instrumentalities are neither issued nor guaranteed by the U.S. government.

Investing in mortgage-backed and asset-backed securities — Many types of bonds and other debt securities, including mortgage-backed securities, are subject to prepayment risk, as well as the risks associated with investing in debt securities in general. If interest rates fall and the loans underlying these securities are prepaid faster than expected, the fund may have to reinvest the prepaid principal in lower yielding securities, thus reducing the fund's income. Conversely, if interest rates increase and the loans underlying the securities are prepaid more slowly than expected, the expected duration of the securities may be extended. This reduces the potential for the fund to invest the principal in higher yielding securities.

Thinly traded securities — There may be little trading in the secondary market for particular bonds or other debt securities, which may make them more difficult to value or sell.

Investing outside the United States — Securities of issuers domiciled outside the United States, or with significant operations outside the United States, may lose value because of political, social or economic developments in the country or region in which the issuer operates. These securities may also lose value due to changes in the exchange rate of the country's currency against the U.S. dollar. Securities markets in certain countries may be more volatile and/or less liquid than those in the United States. Investments outside the United States may also be subject to different settlement and accounting practices and different regulatory, legal and reporting standards than those in the United States. These risks may be heightened in connection with investments in developing countries.

Management — The investment adviser to the fund actively manages the fund's investments. Consequently, the fund is subject to the risk that the methods and analyses employed by the investment adviser in this process may not produce the desired results. This could cause the fund to lose value or its results to lag relevant benchmarks or other funds with similar objectives.

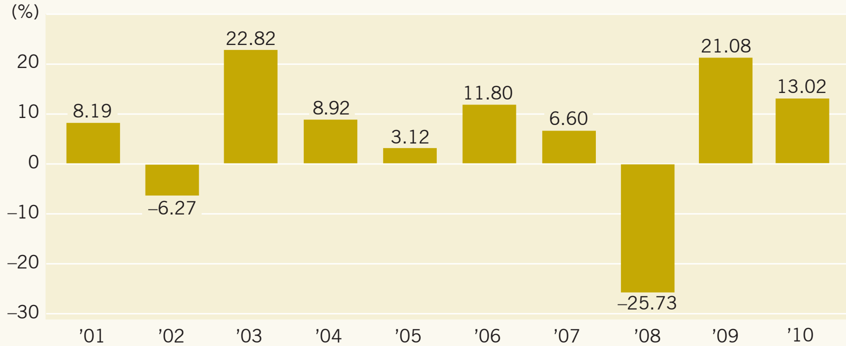
Your investment in the fund is not a bank deposit and is not insured or guaranteed by the Federal Deposit Insurance Corporation or any other governmental agency, entity or person. You should consider how this fund fits into your overall investment program.

Investment results

The following bar chart shows how the fund's investment results have varied from year to year, and the following table shows how the fund's average annual total returns for various periods compare with different broad measures of market results. This information provides some indication of the risks of investing in the fund. Lipper Balanced Funds Index includes the fund and other funds that disclose investment objectives that are reasonably comparable to the fund's objective. Past results (before and after taxes) are not predictive of future results. Updated information on the fund's results can be obtained by visiting americanfunds.com.

Calendar year total returns for Class A shares

(Results do not include a sales charge; if a sales charge were included, results would be lower.)



Highest/Lowest quarterly results during this time period were:

Highest 12.76% (quarter ended June 30, 2003)

Lowest –14.46% (quarter ended December 31, 2008)

Average annual total returns

For the periods ended December 31, 2010 (with maximum sales charge):

Share class	1 year	5 years	10 years
A – Before taxes	6.51%	2.68%	4.80%
– After taxes on distributions	6.14	1.93	3.90
– After taxes on distributions and sale of fund shares	4.60	2.07	3.78

Share class (before taxes)	Inception date	1 year	5 years	10 years	Lifetime
B	3/15/2000	7.12%	2.77%	4.77%	6.30%
C	3/15/2001	11.11	3.08	N/A	4.54
F-1	3/15/2001	12.95	3.91	N/A	5.37
F-2	8/5/2008	13.21	N/A	N/A	4.29
529-A	2/15/2002	6.46	2.61	N/A	4.45
529-B	2/15/2002	6.99	2.65	N/A	4.36
529-C	2/19/2002	11.03	3.01	N/A	4.45
529-E	3/5/2002	12.59	3.54	N/A	4.51
529-F-1	9/17/2002	13.15	4.06	N/A	6.75

Indexes	1 year	5 years	10 years
S&P 500 (reflects no deductions for sales charges, account fees, expenses or taxes)	15.08%	2.29%	1.42%
Barclays Capital U.S. Aggregate Index (reflects no deductions for sales charges, account fees, expenses or taxes)	6.54	5.80	5.84
60%/40% S&P/BC Index (reflects no deductions for sales charges, account fees, expenses or taxes)	11.66	3.75	3.39
Lipper Balanced Funds Index (reflects no deductions for sales charges, account fees or taxes)	11.90	3.91	3.71

Class A annualized 30-day yield at December 31, 2010: 1.62%
(For current yield information, please call American FundsLine® at 800/325-3590.)

After-tax returns are shown only for Class A shares; after-tax returns for other share classes will vary. After-tax returns are calculated using the highest individual federal income tax rates in effect during each year of the periods shown and do not reflect the impact of state and local taxes. Your actual after-tax returns depend on your individual tax situation and likely will differ from the results shown above. In addition, after-tax returns are not relevant if you hold your fund shares through a tax-deferred arrangement, such as a 401(k) plan, individual retirement account (IRA) or 529 college savings plan.

Management

Investment adviser

Capital Research and Management Company

Portfolio counselors

The individuals primarily responsible for the portfolio management of the fund are:

Portfolio counselor/ Fund title (if applicable)	**Portfolio counselor experience in this fund**	**Primary title with investment adviser**
Gregory D. Johnson President and Trustee	8 years	Senior Vice President – Capital World Investors
Hilda L. Applbaum Senior Vice President	12 years	Senior Vice President – Capital World Investors
Jeffrey T. Lager Senior Vice President	Less than 1 year	Senior Vice President – Capital World Investors
James R. Mulally Senior Vice President	5 years	Senior Vice President – Fixed Income, Capital Research and Management Company
John H. Smet Senior Vice President	14 years	Senior Vice President – Fixed Income, Capital Research and Management Company
Alan N. Berro Vice President	5 years	Senior Vice President – Capital World Investors
Dina N. Perry	5 years	Senior Vice President – Capital World Investors
Eugene P. Stein	Less than 1 year	Senior Vice President – Capital World Investors

Purchase and sale of fund shares

Purchase minimums (for all share classes)	
To establish an account (including retirement plan and 529 accounts)	**$250**
For a payroll deduction retirement plan account, payroll deduction savings plan account or employer-sponsored 529 account	**25**
To add to an account	**50**
For a payroll deduction retirement plan account, payroll deduction savings plan account or employer-sponsored 529 account	**25**

You may sell (redeem) shares through your dealer or financial adviser or by writing to American Funds Service Company at P.O. Box 6007, Indianapolis, Indiana 46206-6007; telephoning American Funds Service Company at 800/421-0180; faxing American Funds Service Company at 888/421-4351; or accessing our website at americanfunds.com.

Tax information

Dividends and capital gain distributions you receive from the fund are subject to federal income taxes and may also be subject to state and local taxes, unless you are tax-exempt or your account is tax-deferred.

Payments to broker-dealers and other financial intermediaries

If you purchase shares of the fund through a broker-dealer or other financial intermediary (such as a bank), the fund and the fund's distributor or its affiliates may pay the intermediary for the sale of fund shares and related services. These payments may create a conflict of interest by influencing the broker-dealer or other intermediary and your individual financial adviser to recommend the fund over another investment. Ask your individual financial adviser or visit your financial intermediary's website for more information.

Investment objectives, strategies and risks

The investment objectives of the fund are: (1) conservation of capital, (2) current income and (3) long-term growth of capital and income. The fund approaches the management of its investments as if they constituted the complete investment program of the prudent investor. The fund invests in a broad range of securities, including common stocks and investment-grade bonds (rated Baa3 or better or BBB- or better by Nationally Recognized Statistical Rating Organizations designated by the fund's investment adviser or unrated but determined to be of equivalent quality). The fund also invests in securities issued and guaranteed by the U.S. government and by federal agencies and instrumentalities. The fund invests in debt securities with a wide range of maturities. Normally, the fund will maintain at least 50% of the value of its assets in common stocks, most of which have a history of paying dividends, and at least 25% of the value of its assets in debt securities, including money market securities. Although the fund focuses on investments in medium to larger capitalization companies, the fund's investments are not limited to a particular capitalization size.

The prices of, and the income generated by, the common stocks, bonds and other securities held by the fund may decline in response to certain events taking place around the world, including those directly involving the issuers whose securities are owned by the fund; conditions affecting the general economy; overall market changes; local, regional or global political, social or economic instability; governmental or governmental agency responses to economic conditions; and currency, interest rate and commodity price fluctuations.

The growth-oriented common stocks and other equity-type securities (such as preferred stocks, convertible preferred stocks and convertible bonds) generally purchased by the fund may involve larger price swings and greater potential for loss than other types of investments.

Income provided by the fund may be reduced by changes in the dividend policies of the companies in which the fund invests and the capital resources available for dividend payments at such companies.

The prices of, and the income generated by, most bonds and other debt securities held by the fund may be affected by changing interest rates and by changes in the effective maturities and credit ratings of these securities. For example, the prices of debt securities in the fund's portfolio generally will decline when interest rates rise and increase when interest rates fall.

In addition, falling interest rates may cause an issuer to redeem, call or refinance a security before its stated maturity, which may result in the fund having to reinvest the proceeds in lower yielding securities. Longer maturity debt securities generally have higher rates of interest and may be subject to greater price fluctuations than shorter maturity debt securities.

Bonds and other debt securities are also subject to credit risk, which is the possibility that the credit strength of an issuer will weaken and/or an issuer of a debt security will fail to make timely payments of principal or interest and the security will go into default. Lower quality debt securities generally have higher rates of interest and may be subject to greater price fluctuations than higher quality debt securities.

Securities backed by the U.S. Treasury or the full faith and credit of the U.S. government are guaranteed only as to the timely payment of interest and principal when held to maturity. Accordingly, the current market values for these securities will fluctuate with changes in interest rates. Securities issued by government sponsored entities and federal agencies and instrumentalities are neither issued nor guaranteed by the U.S. government.

Many types of bonds and other debt securities, including mortgage-backed securities, are subject to prepayment risk. For example, when interest rates fall, homeowners are more likely to refinance their home mortgages and "prepay" their principal earlier than expected. The fund must then reinvest the prepaid principal in new securities when interest rates on new mortgage investments are falling, thus reducing the fund's income. Conversely, if interest rates increase, homeowners may not make prepayments to the extent expected, resulting in an extension of the expected terms of the securities backed by such mortgages. This reduces the potential for the fund to invest the principal in higher yielding securities. In addition, the values of the securities ultimately depend upon the payment of the underlying loans by individuals.

There may be little trading in the secondary market for particular bonds or other debt securities, which may make them more difficult to value or sell.

The prices of securities of issuers domiciled outside the United States or with significant operations outside the United States may decline due to conditions specific to the country or region in which the issuer is domiciled or operates, including political, economic or market changes or instability in such country or region. The securities of issuers domiciled in certain countries outside the United States may be more volatile, less liquid and/or more difficult to value than those of U.S issuers. Issuers in countries outside the United States may also be subject to different tax and accounting policies and different auditing, reporting, legal and regulatory standards. In addition, the value of investments outside the United States may be reduced by foreign taxes, including foreign withholding taxes on interest and dividends. These issues may also be subject to different government and legal systems that make it difficult for the fund to exercise its rights as a shareholder of the company. Further, there may be increased risks of delayed settlement of securities purchased or sold by the fund. These investments may also be affected by changes in the exchange rate of that country's currency against the U.S. dollar and/or currencies of other countries.

The fund's investment adviser attempts to reduce these risks through diversification of the portfolio and ongoing credit analysis, as well as by monitoring economic and legislative developments, but there can be no assurance that it will be successful at doing so.

The fund may also hold cash or money market instruments. The percentage of the fund invested in such holdings varies and depends on various factors, including market conditions and purchases and redemptions of fund shares. For temporary defensive purposes, the fund may hold a significant portion of its assets in such securities. The investment adviser may determine that it is appropriate to take such action in response to certain circumstances, such as periods of market turmoil. A larger percentage of such holdings could moderate the fund's investment results in a period of rising market prices. A larger percentage of cash or money market instruments could reduce the magnitude of the fund's loss in a period of falling market prices and provide liquidity to make additional investments or to meet redemptions.

The investment adviser to the fund actively manages the fund's investments. Consequently, the fund is subject to the risk that the methods and analyses employed by the investment adviser in this process may not produce the desired results. This could cause the fund to lose value or its results to lag relevant benchmarks or other funds with similar objectives.

The fund's investment results will depend on the ability of the fund's investment adviser to navigate the risks discussed above.

In addition to the investment strategies described above, the fund has other investment practices that are described in the statement of additional information.

Additional investment results

Unlike the table on page 5, the table below reflects the fund's results calculated without sales charges.

Average annual total returns
For the periods ended December 31, 2010 (without sales charge):

Share class	1 year	5 years	10 years
A – Before taxes	13.02%	3.91%	5.42%
– After taxes on distributions	12.62	3.15	4.51
– After taxes on distributions and sale of fund shares	8.86	3.12	4.33

Share class (before taxes)	Inception date	1 year	5 years	10 years	Lifetime
B	3/15/2000	12.12%	3.12%	4.77%	6.30%
C	3/15/2001	12.11	3.08	N/A	4.54
F-1	3/15/2001	12.95	3.91	N/A	5.37
F-2	8/5/2008	13.21	N/A	N/A	4.29
529-A	2/15/2002	12.97	3.84	N/A	5.15
529-B	2/15/2002	11.99	3.01	N/A	4.36
529-C	2/19/2002	12.03	3.01	N/A	4.45
529-E	3/5/2002	12.59	3.54	N/A	4.51
529-F-1	9/17/2002	13.15	4.06	N/A	6.75

Indexes	1 year	5 years	10 years
S&P 500 (reflects no deductions for sales charges, account fees, expenses or taxes)	15.08%	2.29%	1.42%
Barclays Capital U.S. Aggregate Index (reflects no deductions for sales charges, account fees, expenses or taxes)	6.54	5.80	5.84
60%/40% S&P/BC Index (reflects no deductions for sales charges, account fees, expenses or taxes)	11.66	3.75	3.39
Lipper Balanced Funds Index (reflects no deductions for sales charges, account fees or taxes)	11.90	3.91	3.71

Class A distribution rate at December 31, 2010: 2.01%*
(For current distribution rate information, please call American FundsLine at 800/325-3590.)

* The distribution rate is based on actual dividends paid to Class A shareholders over a 12-month period. Capital gain distributions, if any, are added back to net asset value to determine the rate.

The investment results tables above and on page 5 show how the fund's average annual total returns compare with various broad measures of market results. Standard & Poor's 500 Composite Index is a market capitalization-weighted index based on the average weighted results of 500 widely held common stocks. This index is unmanaged and its results include reinvested dividends and/or distributions, but do not reflect the effect of sales charges, commissions, account fees, expenses or taxes. Barclays Capital U.S. Aggregate Index represents the U.S. investment-grade fixed-rate bond market. This index is unmanaged and its results include reinvested dividends and/or distributions, but do not reflect the effect of sales charges, commissions, account fees, expenses or taxes. The 60%/40% S&P/BC Index blends the S&P 500 with the Barclays Capital U.S. Aggregate Index by weighting their cumulative total returns at 60% and 40%, respectively. The S&P 500 and Barclays Capital U.S. Aggregate Index are unmanaged and their results include reinvested dividends and/or distributions, but do not reflect the effect of sales charges, commissions, account fees, expenses or taxes. Lipper Balanced Funds Index is an equally weighted index of funds that seek to conserve principal by maintaining a balanced portfolio of both stocks and bonds. The results of the underlying funds in the index include the reinvestment of dividends and capital gain distributions, as well as brokerage commissions paid by the funds for portfolio transactions and other fund expenses, but do not reflect the effect of sales charges, account fees or taxes.

All fund results reflected in the "Investment results" and "Additional investment results" sections of this prospectus reflect the reinvestment of dividends and capital gain distributions, if any. Unless otherwise noted, fund results reflect any fee waivers and/or expense reimbursements in effect during the period presented.

Management and organization

Investment adviser

Capital Research and Management Company, an experienced investment management organization founded in 1931, serves as the investment adviser to the fund and other funds, including the American Funds. Capital Research and Management Company is a wholly owned subsidiary of The Capital Group Companies, Inc. and is located at 333 South Hope Street, Los Angeles, California 90071, and 6455 Irvine Center Drive, Irvine, California 92618. Capital Research and Management Company manages the investment portfolio and business affairs of the fund. The total management fee paid by the fund, as a percentage of average net assets, for the previous fiscal year appears in the Annual Fund Operating Expenses table under "Fees and expenses of the fund." Please see the statement of additional information for further details. A discussion regarding the basis for the approval of the fund's Investment Advisory and Service Agreement by the fund's board of trustees is contained in the fund's annual report to shareholders for the fiscal year ended December 31, 2010.

Capital Research and Management Company manages equity assets through two investment divisions, Capital World Investors and Capital Research Global Investors, and manages fixed-income assets through its Fixed Income division. Capital World Investors and Capital Research Global Investors make investment decisions on an independent basis.

Rather than remain as investment divisions, Capital World Investors and Capital Research Global Investors may be incorporated into wholly owned subsidiaries of Capital Research and Management Company. In that event, Capital Research and Management Company would continue to be the investment adviser, and day-to-day investment management of equity assets would continue to be carried out through one or both of these subsidiaries. Although not currently contemplated, Capital Research and Management Company could incorporate its Fixed Income division in the future and engage it to provide day-to-day investment management of fixed-income assets. Capital Research and Management Company and each of the funds it advises have applied to the U.S. Securities and Exchange Commission for an exemptive order that would give Capital Research and Management Company the authority to use, upon approval of the fund's board, its management subsidiaries and affiliates to provide day-to-day investment management services to the fund, including making changes to the management subsidiaries and affiliates providing such services. The fund's shareholders approved this arrangement at a meeting of the fund's shareholders on November 24, 2009. There is no assurance that Capital Research and Management Company will incorporate its investment divisions or exercise any authority, if granted, under an exemptive order.

Execution of portfolio transactions

The investment adviser places orders with broker-dealers for the fund's portfolio transactions. In selecting broker-dealers, the investment adviser strives to obtain "best execution" (the most favorable total price reasonably attainable under the circumstances) for the fund's portfolio transactions, taking into account a variety of factors. Subject to best execution, the investment adviser may consider investment research and/or brokerage services provided to the adviser in placing orders for the fund's portfolio transactions. The investment adviser may place orders for the fund's portfolio transactions with broker-dealers who have sold shares of funds managed by the investment adviser or its affiliated companies; however, it does not give consideration to whether a broker-dealer has sold shares of the funds managed by the investment adviser or its affiliated companies when placing any such orders for the fund's portfolio transactions. A more detailed description of the investment adviser's policies is included in the fund's statement of additional information.

Portfolio holdings

Portfolio holdings information for the fund is available on the American Funds website at americanfunds.com. To reach this information, access the fund's detailed information page on the website. A list of the fund's top 10 equity holdings, updated as of each month-end, is generally posted to this page within 14 days after the end of the applicable month. A link to the fund's complete list of publicly disclosed portfolio holdings, updated as of each calendar quarter-end, is generally posted to this page within 45 days after the end of the applicable quarter. Both lists remain available on the website until new information for the next month or quarter is posted. Portfolio holdings information for the fund is also contained in reports filed with the U.S. Securities and Exchange Commission.

A description of the fund's policies and procedures regarding disclosure of information about its portfolio holdings is available in the statement of additional information.

Multiple portfolio counselor system

Capital Research and Management Company uses a system of multiple portfolio counselors in managing mutual fund assets. Under this approach, the portfolio of a fund is divided into segments managed by individual counselors who decide how their respective segments will be invested. In addition, Capital Research and Management Company's investment analysts may make investment decisions with respect to a portion of a fund's portfolio. Investment decisions are subject to a fund's objective(s), policies and restrictions and the oversight of the appropriate investment-related committees of Capital Research and Management Company and its investment divisions. The table below shows the investment experience and role in management of the fund for each of the fund's primary portfolio counselors.

Portfolio counselor	Investment experience	Experience in this fund	Role in management of the fund
Gregory D. Johnson	Investment professional for 17 years, all with Capital Research and Management Company or affiliate	8 years	Serves as an equity portfolio counselor
Hilda L. Applbaum	Investment professional for 24 years in total; 16 years with Capital Research and Management Company or affiliate	12 years	Serves as an equity/fixed-income portfolio counselor
Jeffrey T. Lager	Investment professional for 16 years in total; 14 years with Capital Research and Management Company or affiliate	Less than 1 year	Serves as an equity portfolio counselor
James R. Mulally	Investment professional for 35 years in total; 31 years with Capital Research and Management Company or affiliate	5 years	Serves as a fixed-income portfolio counselor

Portfolio counselor	Investment experience	Experience in this fund	Role in management of the fund
John H. Smet	Investment professional for 29 years in total; 28 years with Capital Research and Management Company or affiliate	14 years	Serves as a fixed-income portfolio counselor
Alan N. Berro	Investment professional for 25 years in total; 20 years with Capital Research and Management Company or affiliate	5 years	Serves as an equity portfolio counselor
Dina N. Perry	Investment professional for 33 years in total; 19 years with Capital Research and Management Company or affiliate	5 years	Serves as an equity portfolio counselor
Eugene P. Stein	Investment professional for 40 years in total; 39 years with Capital Research and Management Company or affiliate	Less than 1 year	Serves as an equity portfolio counselor

Information regarding the portfolio counselors' compensation, their ownership of securities in the fund and other accounts they manage is in the statement of additional information.

Shareholder information

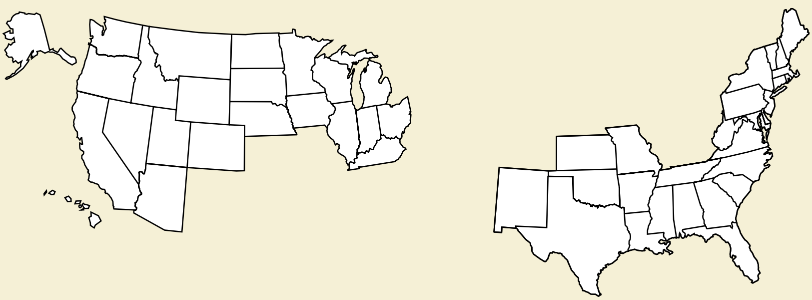
Shareholder services

American Funds Service Company®, the fund's transfer agent, offers a wide range of services that you can use to alter your investment program should your needs or circumstances change. These services may be terminated or modified at any time upon 60 days' written notice.

American Funds Service Company service areas

Call toll-free from anywhere in the United States (8 a.m. to 8 p.m. ET) | 800/421-0180

Access the American Funds website | americanfunds.com



Indiana service center
American Funds Service Company
P.O. Box 6007
Indianapolis, Indiana 46206-6007
Fax: 888/421-4351

Virginia service center
American Funds Service Company
P.O. Box 2280
Norfolk, Virginia 23501-2280
Fax: 888/421-4351

A more detailed description of policies and services is included in the fund's statement of additional information and the owner's guide sent to new American Funds shareholders entitled *Welcome*. Class 529 shareholders should also refer to the applicable program description for information on policies and services specifically relating to their account(s). These documents are available by writing to or calling American Funds Service Company. Certain privileges and/or services described on the following pages of this prospectus and in the statement of additional information may not be available to you depending on your investment dealer. Please see your financial adviser or investment dealer for more information.

Unless otherwise noted, references to Class A, B, C or F-1 shares on the following pages also refer to the corresponding Class 529-A, 529-B, 529-C or 529-F-1 shares.

Purchase, exchange and sale of shares

The fund's transfer agent, on behalf of the fund and American Funds Distributors,® the fund's distributor, is required by law to obtain certain personal information from you or any other person(s) acting on your behalf in order to verify your or such person's identity. If you do not provide the information, the transfer agent may not be able to open your account. If the transfer agent is unable to verify your identity or that of any other person(s) authorized to act on your behalf, or believes it has identified potentially criminal activity, the fund and American Funds Distributors reserve the right to close your account or take such other action they deem reasonable or required by law.

When purchasing shares, you should designate the fund or funds in which you wish to invest. If no fund is designated and the amount of your cash investment is more than $5,000, your money will be held uninvested (without liability to the transfer agent for loss of income or appreciation pending receipt of proper instructions) until investment instructions are received, but for no more than three business days. Your investment will be made at the net asset value (plus any applicable sales charge in the case of Class A shares) next determined after investment instructions are received and accepted by the transfer agent. If investment instructions are not received, your money will be invested in Class A shares of American Funds Money Market Fund® on the third business day after receipt of your investment.

If no fund is designated and the amount of your cash investment is $5,000 or less, your money will be invested in the same proportion and in the same fund or funds in which your last cash investment (excluding exchanges) was made, provided that such investment was made within the last 16 months. If no investment was made within the last 16 months, your money will be held uninvested (without liability to the transfer agent for loss of income or appreciation pending receipt of proper instructions) until investment instructions are received, but for no more than three business days. Your investment will be made at the net asset value (plus any applicable sales charge in the case of Class A shares) next determined after investment instructions are received and accepted by the transfer agent. If investment instructions are not received, your money will be invested in Class A shares of American Funds Money Market Fund on the third business day after receipt of your investment.

Valuing shares

The net asset value of each share class of the fund is the value of a single share. The fund calculates the net asset value each day the New York Stock Exchange is open for trading as of approximately 4 p.m. New York time, the normal close of regular trading. The fund will not calculate net asset values on days that the New York Stock Exchange is closed for trading. Assets are valued primarily on the basis of market quotations. However, the fund has adopted procedures for making "fair value" determinations if market quotations are not readily available or are not considered reliable. For example, if events occur between the close of markets outside the United States and the close of regular trading on the New

York Stock Exchange that, in the opinion of the investment adviser, materially affect the value of any of the fund's securities that principally trade in those international markets, those securities will be valued in accordance with fair value procedures. Use of these procedures is intended to result in more appropriate net asset values. In addition, such use will reduce, if not eliminate, potential arbitrage opportunities otherwise available to short-term investors.

Because the fund may hold securities that are primarily listed on foreign exchanges that trade on weekends or days when the fund does not price its shares, the values of securities held in the fund may change on days when you will not be able to purchase or redeem fund shares.

Your shares will be purchased at the net asset value (plus any applicable sales charge in the case of Class A shares) or sold at the net asset value next determined after American Funds Service Company receives your request, provided that your request contains all information and legal documentation necessary to process the transaction. A contingent deferred sales charge may apply at the time you sell certain Class A, B and C shares.

Purchase of Class A and C shares

You may generally open an account and purchase Class A and C shares by contacting any financial adviser (who may impose transaction charges in addition to those described in this prospectus) authorized to sell the fund's shares. You may purchase additional shares in various ways, including through your financial adviser and by mail, telephone, the Internet and bank wire.

Purchase of Class F shares

Unless otherwise noted, references in this prospectus to Class F shares refer to both Class F-1 and F-2 shares.

You may generally open an account and purchase Class F shares only through fee-based programs of investment dealers that have special agreements with the fund's distributor, through certain registered investment advisers and through other intermediaries approved by the fund's distributor. These intermediaries typically charge ongoing fees for services they provide. Intermediary fees are not paid by the fund and normally range from .75% to 1.50% of assets annually, depending on the services offered.

Purchase of Class 529 shares

Class 529 shares may be purchased only through an account established with a 529 college savings plan managed by the American Funds organization. You may open this type of account and purchase Class 529 shares by contacting any financial adviser (who may impose transaction charges in addition to those described in this prospectus) authorized to sell such an account. You may purchase additional shares in various ways, including through your financial adviser and by mail, telephone, the Internet and bank wire.

Class 529-E shares may be purchased only by employees participating through an eligible employer plan.

Accounts holding Class 529 shares are subject to a $10 account setup fee and an annual $10 account maintenance fee.

Purchase minimums and maximums

The purchase minimums described in the table on page 7 may be waived in certain cases. In addition, the fund reserves the right to redeem the shares of any shareholder for their then current net asset value per share if the shareholder's aggregate investment in the fund falls below the fund's minimum initial investment amount. See the statement of additional information for details.

For accounts established with an automatic investment plan, the initial purchase minimum of $250 may be waived if the purchases (including purchases through exchanges from another fund) made under the plan are sufficient to reach $250 within five months of account establishment.

The effective purchase maximums for Class 529-A, 529-C, 529-E and 529-F-1 shares will reflect the maximum applicable contribution limits under state law. See the applicable program description for more information.

The purchase maximum for Class C shares is $500,000 per transaction. In addition, if you have significant American Funds holdings, you may not be eligible to invest in Class C or 529-C shares. Specifically, you may not purchase Class C or 529-C shares if you are eligible to purchase Class A or 529-A shares at the $1 million or more sales charge discount rate (that is, at net asset value). See "Sales charge reductions and waivers" in this prospectus and the statement of additional information for more details regarding sales charge discounts.

Exchange

Generally, you may exchange your shares into shares of the same class of other American Funds without a sales charge. Class A, C or F-1 shares may generally be exchanged into the corresponding 529 share class without a sales charge. Class B shares may not be exchanged into Class 529-B shares. **Exchanges from Class A, C or F-1 shares to the corresponding 529 share class, particularly in the case of Uniform Gifts to Minors Act or Uniform Transfers to Minors Act custodial accounts, may result in significant legal and tax consequences, as described in the applicable program description. Please consult your financial adviser before making such an exchange.**

Exchanges of shares from American Funds Money Market Fund initially purchased without a sales charge generally will be subject to the appropriate sales charge. For purposes of computing the contingent deferred sales charge on Class B and C shares, the length of time you have owned your shares will be measured from the date of original purchase and will not be affected by any permitted exchange.

Exchanges have the same tax consequences as ordinary sales and purchases. For example, to the extent you exchange shares held in a taxable account that are worth more now than what you paid for them, the gain will be subject to taxation. See "Transactions by telephone, fax or the Internet" in this prospectus for information regarding electronic exchanges.

Please see the statement of additional information for details and limitations on moving investments in certain share classes to different share classes and on moving investments held in certain accounts to different accounts.

How to sell shares

You may sell (redeem) shares in any of the following ways:

Through your dealer or financial adviser (certain charges may apply)

- Shares held for you in your dealer's name must be sold through the dealer.
- Class F shares must be sold through intermediaries such as dealers or financial advisers.

Writing to American Funds Service Company

- Requests must be signed by the registered shareholder(s).
- A signature guarantee is required if the redemption is:
  - — more than $75,000;
  - — made payable to someone other than the registered shareholder(s); or
  - — sent to an address other than the address of record or to an address of record that has been changed within the last 10 days.
- American Funds Service Company reserves the right to require signature guarantee(s) on any redemption.
- Additional documentation may be required for redemptions of shares held in corporate, partnership or fiduciary accounts.

Telephoning or faxing American Funds Service Company or using the Internet

- Redemptions by telephone, fax or the Internet (including American FundsLine and americanfunds.com) are limited to $75,000 per American Funds shareholder each day.
- Checks must be made payable to the registered shareholder.
- Checks must be mailed to an address of record that has been used with the account for at least 10 days.

If you recently purchased shares and subsequently request a redemption of those shares, you will receive proceeds from the redemption once a sufficient period of time has passed to reasonably ensure that checks or drafts (including certified or cashier's checks) for the shares purchased have cleared (normally 10 business days).

Transactions by telephone, fax or the Internet

Generally, you are automatically eligible to redeem or exchange shares by telephone, fax or the Internet, unless you notify us in writing that you do not want any or all of these services. You may reinstate these services at any time.

Unless you decide not to have telephone, fax or Internet services on your account(s), you agree to hold the fund, American Funds Service Company, any of its affiliates or mutual funds managed by such affiliates, and each of their respective directors, trustees, officers, employees and agents harmless from any losses, expenses, costs or liabilities (including attorney fees) that may be incurred in connection with the exercise of these privileges, provided that American Funds Service Company employs reasonable procedures to confirm that the instructions received from any person with appropriate account information are genuine. If reasonable procedures are not employed, American Funds Service Company and/or the fund may be liable for losses due to unauthorized or fraudulent instructions.

Frequent trading of fund shares

The fund and American Funds Distributors reserve the right to reject any purchase order for any reason. The fund is not designed to serve as a vehicle for frequent trading. Frequent trading of fund shares may lead to increased costs to the fund and less efficient management of the fund's portfolio, potentially resulting in dilution of the value of the shares held by long-term shareholders. Accordingly, purchases, including those that are part of exchange activity that the fund or American Funds Distributors has determined could involve actual or potential harm to the fund, may be rejected.

The fund, through its transfer agent, American Funds Service Company, maintains surveillance procedures that are designed to detect frequent trading in fund shares. Under these procedures, various analytics are used to evaluate factors that may be indicative of frequent trading. For example, transactions in fund shares that exceed certain monetary thresholds may be scrutinized. American Funds Service Company also may review transactions that occur close in time to other transactions in the same account or in multiple accounts under common ownership or influence. Trading activity that is identified through these procedures or as a result of any other information available to the fund will be evaluated to determine whether such activity might constitute frequent trading. These procedures may be modified from time to time as appropriate to improve the detection of frequent trading, to facilitate monitoring for frequent trading in particular retirement plans or other accounts, and to comply with applicable laws.

In addition to the fund's broad ability to restrict potentially harmful trading as described above, the fund's board of trustees has adopted a "purchase blocking policy" under which any shareholder redeeming shares having a value of $5,000 or more from a fund will be precluded from investing in that fund for 30 calendar days after the redemption transaction. This policy also applies to redemptions and purchases that are part of exchange transactions. Under the fund's purchase blocking policy, certain purchases will not be prevented and certain redemptions will not trigger a purchase block, such as purchases and redemptions of shares having a value of less than $5,000; transactions in Class 529 shares; purchases and redemptions resulting from reallocations by American Funds Target Date Retirement Series®; retirement plan contributions, loans and distributions (including hardship withdrawals) identified as such on the retirement plan recordkeeper's system; purchase transactions involving transfers of assets, rollovers, Roth IRA conversions and IRA recharacterizations, where the entity maintaining the shareholder account is able to identify the transaction as one of these types of transactions; and systematic redemptions and purchases, where the entity maintaining the shareholder account is able to identify the transaction as a systematic redemption or purchase. Generally, purchases and redemptions will not be considered "systematic" unless the transaction is pre-scheduled for a specific date.

The fund reserves the right to waive the purchase blocking policy with respect to specific shareholder accounts in those instances where American Funds Service Company determines that its surveillance procedures are adequate to detect frequent trading in fund shares.

American Funds Service Company will work with certain intermediaries (such as investment dealers holding shareholder accounts in street name, retirement plan recordkeepers, insurance company separate accounts and bank trust companies) to apply their own procedures, provided that American Funds Service Company believes the intermediary's procedures are reasonably designed to enforce the frequent trading policies of the fund. You should refer to disclosures provided by the intermediaries with which you have an account to determine the specific trading restrictions that apply to you.

If American Funds Service Company identifies any activity that may constitute frequent trading, it reserves the right to contact the intermediary and request that the intermediary either provide information regarding an account owner's transactions or restrict the account owner's trading. If American Funds Service Company is not satisfied that the intermediary has taken appropriate action, American Funds Service Company may terminate the intermediary's ability to transact in fund shares.

There is no guarantee that all instances of frequent trading in fund shares will be prevented.

Notwithstanding the fund's surveillance procedures and purchase blocking policy, all transactions in fund shares remain subject to the right of the fund and American Funds Distributors to restrict potentially abusive trading generally (including the types of transactions described above that will not be prevented or trigger a block under the purchase blocking policy). See the statement of additional information for more information about how American Funds Service Company may address other potentially abusive trading activity in the American Funds.

Distributions and taxes

Dividends and distributions

The fund intends to distribute dividends to you, usually in March, June, September and December.

Capital gains, if any, are usually distributed in December and March. When a dividend or capital gain is distributed, the net asset value per share is reduced by the amount of the payment.

You may elect to reinvest dividends and/or capital gain distributions to purchase additional shares of this fund or other American Funds, or you may elect to receive them in cash. Dividends and capital gain distributions for 529 share classes will be reinvested automatically.

Taxes on dividends and distributions

Dividends and capital gain distributions you receive from the fund are subject to federal income taxes and may also be subject to state and local taxes, unless you are tax-exempt or your account is tax-deferred.

For federal tax purposes, dividends and distributions of short-term capital gains are taxable as ordinary income. Some or all of your dividends may be eligible for a reduced tax rate if you meet a holding period requirement. The fund's distributions of net long-term capital gains are taxable as long-term capital gains. Any dividends or capital gain distributions you receive from the fund will normally be taxable to you when made, regardless of whether you reinvest dividends or capital gain distributions or receive them in cash.

Taxes on transactions

Your redemptions, including exchanges, may result in a capital gain or loss for federal tax purposes. A capital gain or loss on your investment is the difference between the cost of your shares, including any sales charges, and the amount you receive when you sell them.

Shareholder fees

Fees borne directly by the fund normally have the effect of reducing a shareholder's taxable income on distributions. By contrast, fees paid directly to advisers by a fund shareholder for ongoing advice are deductible for income tax purposes only to the extent that they (combined with certain other qualifying expenses) exceed 2% of such shareholder's adjusted gross income.

Please see your tax adviser for more information. Holders of Class 529 shares should refer to the applicable program description for more information regarding the tax consequences of selling Class 529 shares.

Choosing a share class

The fund offers different classes of shares through this prospectus. Class A, C, F-1 and F-2 shares are available through various investment programs or accounts, including certain types of retirement plans (see limitations below). The services or share classes available to you may vary depending upon how you wish to purchase shares of the fund.

Class B and 529-B shares may not be purchased or acquired, except by exchange from Class B or 529-B shares of another fund in the American Funds family. Any other investment received by the fund that is intended for Class B or 529-B shares will instead be invested in Class A or 529-A shares and will be subject to any applicable sales charges.

Shareholders with investments in Class B and 529-B shares may continue to hold such shares until they convert to Class A or 529-A shares. However, no additional investments will be accepted in Class B or 529-B shares. Dividends and capital gain distributions may continue to be reinvested in Class B or 529-B shares until their conversion dates. In addition, shareholders invested in Class B or 529-B shares will be able to exchange those shares for Class B or 529-B shares of other American Funds offering Class B or 529-B shares until they convert.

Investors residing in any state may purchase Class 529 shares through an account established with a 529 college savings plan managed by the American Funds organization. Class 529-A, 529-B, 529-C and 529-F-1 shares are structured similarly to the corresponding Class A, B, C and F-1 shares. For example, the same initial sales charges apply to Class 529-A shares as to Class A shares. Class 529-E shares are available only to investors participating through an eligible employer plan.

Each share class represents an investment in the same portfolio of securities, but each class has its own sales charge and expense structure, allowing you to choose the class that best fits your situation. **When you purchase shares of the fund, you should choose a share class. If none is chosen, your investment will be made in Class A shares or, in the case of a 529 plan investment, Class 529-A shares.**

Factors you should consider when choosing a class of shares include:

- how long you expect to own the shares;
- how much you intend to invest;
- total expenses associated with owning shares of each class;
- whether you qualify for any reduction or waiver of sales charges (for example, Class A or 529-A shares may be a less expensive option over time, particularly if you qualify for a sales charge reduction or waiver);

- whether you plan to take any distributions in the near future (for example, the contingent deferred sales charge will not be waived if you sell your Class 529-B or 529-C shares to cover higher education expenses); and
- availability of share classes:
  - — Class C shares are not available to retirement plans that do not currently invest in such shares and that are eligible to invest in Class R shares, including employer-sponsored retirement plans such as defined benefit plans, 401(k) plans, 457 plans, 403(b) plans, and money purchase pension and profit-sharing plans; and
  - — Class F and 529-F-1 shares are generally available only to fee-based programs of investment dealers that have special agreements with the fund's distributor, to certain registered investment advisers and to other intermediaries approved by the fund's distributor.

Each investor's financial considerations are different. You should speak with your financial adviser to help you decide which share class is best for you.

Summary of the primary differences among share classes

Class A shares	
Initial sales charge	up to 5.75% (reduced for purchases of $25,000 or more and eliminated for purchases of $1 million or more)
Contingent deferred sales charge	none (except that a charge of 1.00% applies to certain redemptions made within one year following purchases of $1 million or more without an initial sales charge)
12b-1 fees	up to .25% annually (for Class 529-A shares, may not exceed .50% annually)
Dividends	generally higher than other classes due to lower annual expenses, but may be lower than Class F-1 shares, depending on relative expenses, and lower than Class F-2 shares due to 12b-1 fees
Purchase maximum	none
Conversion	none
Class B shares	
Initial sales charge	none
Contingent deferred sales charge	starts at 5.00%, declining to 0% six years after purchase
12b-1 fees	up to 1.00% annually
Dividends	generally lower than Class A and F shares due to higher 12b-1 fees and other expenses, but higher than Class C shares due to lower other expenses
Purchase maximum	Class B shares may not be purchased or acquired except by exchange from Class B shares of other American Funds
Conversion	automatic conversion to Class A or 529-A shares in the month of the eight-year anniversary of the purchase date, reducing future annual expenses
Class C shares	
Initial sales charge	none
Contingent deferred sales charge	1.00% if shares are sold within one year after purchase
12b-1 fees	up to 1.00% annually
Dividends	generally lower than other classes due to higher 12b-1 fees and other expenses
Purchase maximum	see the discussion regarding purchase minimums and maximums in “Purchase, exchange and sale of shares”
Conversion	automatic conversion to Class F-1 shares in the month of the 10-year anniversary of the purchase date, reducing future annual expenses (Class 529-C shares will not convert to Class 529-F-1 shares)
Class 529-E shares	
Initial sales charge	none
Contingent deferred sales charge	none
12b-1 fees	currently up to .50% annually (may not exceed .75% annually)
Dividends	generally higher than Class 529-B and 529-C shares due to lower 12b-1 fees, but lower than Class 529-A and 529-F-1 shares due to higher 12b-1 fees
Purchase maximum	none
Conversion	none

Summary of the primary differences among share classes

Class F-1 shares	
Initial sales charge	none
Contingent deferred sales charge	none
12b-1 fees	currently up to .25% annually (may not exceed .50% annually)
Dividends	generally higher than Class B and C shares due to lower 12b-1 fees, but may be higher than Class A shares, depending on relative expenses, and lower than Class F-2 shares due to 12b-1 fees
Purchase maximum	none
Conversion	none
Class F-2 shares	
Initial sales charge	none
Contingent deferred sales charge	none
12b-1 fees	none
Dividends	generally higher than other classes due to absence of 12b-1 fees
Purchase maximum	none
Conversion	none

Employer-sponsored retirement plans

Many employer-sponsored retirement plans are eligible to purchase Class R shares. Such eligible plans and Class R shares are described in more detail in the fund's retirement plan prospectus.

Employer-sponsored retirement plans that are eligible to purchase Class R shares may instead purchase Class A shares and pay the applicable Class A sales charge, provided that their recordkeepers can properly apply a sales charge on plan investments. These plans are not eligible to make initial purchases of $1 million or more in Class A shares and thereby invest in Class A shares without a sales charge, nor are they eligible to establish a statement of intention that qualifies them to purchase Class A shares without a sales charge. More information about statements of intention can be found under "Sales charge reductions and waivers" in this prospectus. Plans investing in Class A shares with a sales charge may purchase additional Class A shares in accordance with the sales charge table in this prospectus.

Employer-sponsored retirement plans that invested in Class A shares without any sales charge before April 1, 2004, and that continue to meet the eligibility requirements in effect as of that date for purchasing Class A shares at net asset value, may continue to purchase Class A shares without any initial or contingent deferred sales charge.

A 403(b) plan may not invest in Class A or C shares unless it was invested in Class A or C shares before January 1, 2009.

Sales charges

Class A shares

The initial sales charge you pay each time you buy Class A shares differs depending upon the amount you invest and may be reduced or eliminated for larger purchases as indicated below. The "offering price," the price you pay to buy shares, includes any applicable sales charge, which will be deducted directly from your investment. Shares acquired through reinvestment of dividends or capital gain distributions are not subject to an initial sales charge.

	Sales charge as a percentage of:		
Investment	Offering price	Net amount invested	Dealer commission as a percentage of offering price
Less than $25,000	5.75%	6.10%	5.00%
$25,000 but less than $50,000	5.00	5.26	4.25
$50,000 but less than $100,000	4.50	4.71	3.75
$100,000 but less than $250,000	3.50	3.63	2.75
$250,000 but less than $500,000	2.50	2.56	2.00
$500,000 but less than $750,000	2.00	2.04	1.60
$750,000 but less than $1 million	1.50	1.52	1.20
$1 million or more and certain other investments described below	none	none	see below

The sales charge, expressed as a percentage of the offering price or the net amount invested, may be higher or lower than the percentages described in the table above due to rounding. This is because the dollar amount of the sales charge is determined by subtracting the net asset value of the shares purchased from the offering price, which is calculated to two decimal places using standard rounding criteria. The impact of rounding will vary with the size of the investment and the net asset value of the shares. Similarly, any contingent deferred sales charge paid by you on investments in Class A shares may be higher or lower than the 1% charge described below due to rounding.

Except as provided below, investments in Class A shares of $1 million or more may be subject to a 1% contingent deferred sales charge if the shares are sold within one year of purchase. The contingent deferred sales charge is based on the original purchase cost or the current market value of the shares being sold, whichever is less.

Class A share purchases not subject to sales charges

The following investments are not subject to any initial or contingent deferred sales charge if American Funds Service Company is properly notified of the nature of the investment:

- investments in Class A shares made by endowments or foundations with $50 million or more in assets;
- investments made by accounts that are part of certain qualified fee-based programs and that purchased Class A shares before the discontinuation of your investment dealer's load-waived Class A share program with the American Funds; and
- certain rollover investments from retirement plans to IRAs (see "Rollovers from retirement plans to IRAs" in this prospectus for more information).

The distributor may pay dealers a commission of up to 1% on investments made in Class A shares with no initial sales charge. The fund may reimburse the distributor for these payments through its plans of distribution (see "Plans of distribution" in this prospectus).

Transfers from certain 529 plans to plans managed by the American Funds organization will be made with no sales charge. No commission will be paid to the dealer on such a transfer. Please see the statement of additional information for more information.

Certain other investors may qualify to purchase shares without a sales charge, such as employees of investment dealers and registered investment advisers authorized to sell American Funds and employees of The Capital Group Companies, Inc. Please see the statement of additional information for further details.

Class B and C shares

For Class B shares, a contingent deferred sales charge may be applied to shares you sell within six years of purchase, as shown in the table below. The contingent deferred sales charge is eliminated six years after purchase.

Contingent deferred sales charge on Class B shares

Year of redemption:	1	2	3	4	5	6	7+
Contingent deferred sales charge:	5%	4%	4%	3%	2%	1%	0%

Class C shares are sold without any initial sales charge. American Funds Distributors pays 1% of the amount invested to dealers who sell Class C shares. A contingent deferred sales charge of 1% applies if Class C shares are sold within one year of purchase. The contingent deferred sales charge is eliminated one year after purchase.

Any contingent deferred sales charge paid by you on redemptions of Class B or C shares, expressed as a percentage of the applicable redemption amount, may be higher or lower than the percentages described above due to rounding.

Shares acquired through reinvestment of dividends or capital gain distributions are not subject to a contingent deferred sales charge. In addition, the contingent deferred sales charge may be waived in certain circumstances. See "Contingent deferred sales charge waivers" in this prospectus. The contingent deferred sales charge is based on the original purchase cost or the current market value of the shares being sold, whichever is less. For purposes of determining the contingent deferred sales charge, if you sell only some of your shares, shares that are not subject to any contingent deferred sales charge will be sold first, followed by shares that you have owned the longest.

See “Plans of distribution” in this prospectus for ongoing compensation paid to your dealer or financial adviser for all share classes.

Automatic conversion of Class B and C shares

Class B shares automatically convert to Class A shares in the month of the eight-year anniversary of the purchase date. Class C shares automatically convert to Class F-1 shares in the month of the 10-year anniversary of the purchase date; however, Class 529-C shares will not convert to Class 529-F-1 shares. The Internal Revenue Service currently takes the position that these automatic conversions are not taxable. Should its position change, the automatic conversion feature may be suspended. If this happens, you would have the option of converting your Class B, 529-B or C shares to the respective share classes at the anniversary dates described above. This exchange would be based on the relative net asset values of the two classes in question, without the imposition of a sales charge or fee, but you might face certain tax consequences as a result.

Class 529-E and Class F shares

Class 529-E and Class F shares are sold without any initial or contingent deferred sales charge.

Sales charge reductions and waivers

To receive a reduction in your Class A initial sales charge, you must let your financial adviser or American Funds Service Company know at the time you purchase shares that you qualify for such a reduction. If you do not let your adviser or American Funds Service Company know that you are eligible for a reduction, you may not receive a sales charge discount to which you are otherwise entitled. In order to determine your eligibility to receive a sales charge discount, it may be necessary for you to provide your adviser or American Funds Service Company with information and records (including account statements) of all relevant accounts invested in the American Funds.

In addition to the information in this prospectus, you may obtain more information about share classes, sales charges and sales charge reductions and waivers through a link on the home page of the American Funds website at americanfunds.com, from the statement of additional information or from your financial adviser.

Reducing your Class A initial sales charge

Consistent with the policies described in this prospectus, you and your "immediate family" (your spouse — or equivalent if recognized under local law — and your children under the age of 21) may combine all of your American Funds investments to reduce your Class A sales charge. Certain investments in the American Funds Target Date Retirement Series may also be combined for this purpose. Please see the American Funds Target Date Retirement Series prospectus for further information. However, for this purpose, investments representing direct purchases of American Funds Money Market Fund are excluded. Following are different ways that you may qualify for a reduced Class A sales charge:

Aggregating accounts

To receive a reduced Class A sales charge, investments made by you and your immediate family (see above) may be aggregated if made for your own account(s) and/or certain other accounts, such as:

- trust accounts established by the above individuals (please see the statement of additional information for details regarding aggregation of trust accounts where the person(s) who established the trust is/are deceased);
- solely controlled business accounts; and
- single-participant retirement plans.

Concurrent purchases

You may combine simultaneous purchases (including, upon your request, purchases for gifts) of any class of shares of two or more American Funds (excluding American Funds Money Market Fund) to qualify for a reduced Class A sales charge.

Rights of accumulation

You may take into account your accumulated holdings in all share classes of the American Funds (excluding American Funds Money Market Fund) to determine the initial sales charge you pay on each purchase of Class A shares. Subject to your investment dealer's capabilities, your accumulated holdings will be calculated as the higher of *(a)* the current value of your existing holdings (as of the day prior to your additional American Funds investment) or *(b)* the amount you invested (including reinvested dividends and capital gains, but excluding capital appreciation) less any withdrawals. Please see the statement of additional information for further details. You should retain any records necessary to substantiate the historical amounts you have invested.

If you make a gift of shares, upon your request you may purchase the shares at the sales charge discount allowed under rights of accumulation of all of your American Funds accounts.

Statement of intention

You may reduce your Class A sales charge by establishing a statement of intention. A statement of intention allows you to combine all purchases of all share classes of the American Funds (excluding American Funds Money Market Fund) you intend to make over a 13-month period to determine the applicable sales charge; however, purchases made under a right of reinvestment, appreciation of your holdings, and reinvested dividends and capital gains do not count as purchases made during the statement period. Your accumulated holdings (as described and calculated under "Rights of accumulation" above) eligible to be aggregated as of the day immediately before the start of the statement period may be credited toward satisfying the statement. A portion of your account may be held in escrow to cover additional Class A sales charges that may be due if your total purchases over the statement period do not qualify you for the applicable sales charge reduction. Employer-sponsored retirement plans may be restricted from establishing statements of intention. See the discussion regarding employer-sponsored retirement plans under "Choosing a share class" in this prospectus for more information.

Right of reinvestment

If you notify American Funds Service Company, you may reinvest proceeds from a redemption, dividend payment or capital gain distribution without a sales charge in the same fund or other American Funds, provided that the reinvestment occurs within 90 days after the date of the redemption, dividend payment or distribution and is made into the same account from which you redeemed the shares or received the dividend payment or distribution. If the account has been closed, you may reinvest without a sales charge if the new receiving account has the same registration as the closed account.

Proceeds from a Class B share redemption for which a contingent deferred sales charge was paid will be reinvested in Class A shares without any initial sales charge. If you redeem Class B shares without paying a contingent deferred sales charge, you may reinvest the proceeds in Class B shares or purchase Class A shares; if you purchase Class A shares, you are responsible for paying any applicable Class A sales charges. Proceeds from any other type of redemption and all dividend payments and capital gain distributions will be reinvested in the same share class from which the original redemption, dividend payment or distribution was made. Any contingent deferred sales charge on Class A or C shares will be credited to your account. Redemption proceeds of Class A shares representing direct purchases in American Funds Money Market Fund that are reinvested in other American Funds will be subject to a sales charge.

Proceeds will be reinvested at the next calculated net asset value after your request is received by American Funds Service Company, provided that your request contains all information and legal documentation necessary to process the transaction. For purposes of this “right of reinvestment policy,” automatic transactions (including, for example, automatic purchases, withdrawals and payroll deductions) and ongoing retirement plan contributions are not eligible for investment without a sales charge. You may not reinvest proceeds in the American Funds as described in this paragraph if such proceeds are subject to a purchase block as described under “Frequent trading of fund shares” in this prospectus. This paragraph does not apply to certain rollover investments as described under “Rollovers from retirement plans to IRAs” in this prospectus.

Contingent deferred sales charge waivers

The contingent deferred sales charge on Class A, B and C shares may be waived in the following cases:

- permitted exchanges of shares, except if shares acquired by exchange are then redeemed within the period during which a contingent deferred sales charge would apply to the initial shares purchased;
- tax-free returns of excess contributions to IRAs;
- redemptions due to death or postpurchase disability of the shareholder (this generally excludes accounts registered in the names of trusts and other entities);
- for 529 share classes only, redemptions due to a beneficiary's death, postpurchase disability or receipt of a scholarship (to the extent of the scholarship award);
- redemptions due to the complete termination of a trust upon the death of the trustor/grantor or beneficiary, but only if such termination is specifically provided for in the trust document; and
- the following types of transactions, if together they do not exceed 12% of the value of an account annually (see the statement of additional information for further details about waivers regarding these types of transactions):
  - redemptions due to receiving required minimum distributions from retirement accounts upon reaching age 70½ (required minimum distributions that continue to be taken by the beneficiary(ies) after the account owner is deceased also qualify for a waiver); and
  - if you have established an automatic withdrawal plan, redemptions through such a plan (including any dividends and/or capital gain distributions taken in cash).

To have your Class A, B or C contingent deferred sales charge waived, you must inform your adviser or American Funds Service Company at the time you redeem shares that you qualify for such a waiver.

Rollovers from retirement plans to IRAs

Assets from retirement plans may be invested in Class A, C or F shares through an IRA rollover, subject to the other provisions of this prospectus. Rollovers invested in Class A shares from retirement plans will be subject to applicable sales charges. The following rollovers to Class A shares will be made without a sales charge:

- rollovers to IRAs from 403(b) plans with Capital Bank and Trust Company as custodian; and
- rollovers to IRAs that are attributable to American Funds investments, if they meet the following requirements:
  - the assets being rolled over were invested in American Funds at the time of distribution; and
  - the rolled over assets are contributed to an American Funds IRA with Capital Bank and Trust Company as custodian.

IRA rollover assets that roll over without a sales charge as described above will not be subject to a contingent deferred sales charge, and investment dealers will be compensated solely with an annual service fee that begins to accrue immediately. IRA rollover assets invested in Class A shares that are not attributable to American Funds investments, as well as future contributions to the IRA, will be subject to sales charges and the terms and conditions generally applicable to Class A share investments as described in this prospectus and the statement of additional information.

Plans of distribution

The fund has plans of distribution, or “12b-1 plans,” for certain share classes under which it may finance activities primarily intended to sell shares, provided that the categories of expenses are approved in advance by the fund’s board of trustees. The plans provide for payments, based on annualized percentages of average daily net assets, of up to .25% for Class A shares; up to .50% for Class 529-A shares; up to 1.00% for Class B and 529-B shares; up to 1.00% for Class C and 529-C shares; up to .75% for Class 529-E shares; and up to .50% for Class F-1 and 529-F-1 shares. For all share classes indicated above, up to .25% of these expenses may be used to pay service fees to qualified dealers for providing certain shareholder services. The amount remaining for each share class may be used for distribution expenses.

The 12b-1 fees paid by each share class of the fund, as a percentage of average net assets for the previous fiscal year, are indicated in the Annual Fund Operating Expenses table under “Fees and expenses of the fund” in this prospectus. Since these fees are paid out of the fund’s assets or income on an ongoing basis, over time they may cost you more than paying other types of sales charges and reduce the return of your investment. The higher fees for Class B and C shares may cost you more over time than paying the initial sales charge for Class A shares.

Other compensation to dealers

American Funds Distributors, at its expense, currently provides additional compensation to investment dealers. These payments may be made, at the discretion of American Funds Distributors, to the top 100 dealers (or their affiliates) that have sold shares of the American Funds. The level of payments made to a qualifying firm in any given year will vary and in no case would exceed the sum of *(a)* .10% of the previous year's American Funds sales by that dealer and *(b)* .02% of American Funds assets attributable to that dealer. For calendar year 2010, aggregate payments made by American Funds Distributors to dealers were less than .02% of the average assets of the American Funds. Aggregate payments may also change from year to year. A number of factors will be considered in determining payments, including the qualifying dealer's sales, assets and redemption rates, and the quality of the dealer's relationship with American Funds Distributors. American Funds Distributors makes these payments to help defray the costs incurred by qualifying dealers in connection with efforts to educate financial advisers about the American Funds so that they can make recommendations and provide services that are suitable and meet shareholder needs. American Funds Distributors will, on an annual basis, determine the advisability of continuing these payments. American Funds Distributors may also pay expenses associated with meetings conducted by dealers outside the top 100 firms to facilitate educating financial advisers and shareholders about the American Funds. If investment advisers, distributors or other affiliates of mutual funds pay additional compensation or other incentives in differing amounts, dealer firms and their advisers may have financial incentives for recommending a particular mutual fund over other mutual funds or investments. You should consult with your financial adviser and review carefully any disclosure by your financial adviser's firm as to compensation received.

Fund expenses

In periods of market volatility, assets of the fund may decline significantly, causing total annual fund operating expenses (as a percentage of the value of your investment) to become higher than the numbers shown in the Annual Fund Operating Expenses table in this prospectus.

The “Other expenses” items in the table on page 1 include custodial, legal, transfer agent and subtransfer agent/recordkeeping payments and various other expenses. Subtransfer agent/recordkeeping payments may be made to third parties (including affiliates of the fund’s investment adviser) that provide subtransfer agent, recordkeeping and/or shareholder services with respect to certain shareholder accounts in lieu of the transfer agent providing such services. The amount paid for subtransfer agent/recordkeeping services varies depending on the share class and services provided, and typically ranges from $3 to $19 per account. For Class 529 shares, an expense of up to a maximum of .10% paid to a state or states for oversight and administrative services is included as an “Other expenses” item.

Financial highlights

The Financial Highlights table is intended to help you understand the fund's results for the past five fiscal years. Certain information reflects financial results for a single share of a particular class. The total returns in the table represent the rate that an investor would have earned or lost on an investment in the fund (assuming reinvestment of all dividends and capital gain distributions). Where indicated, figures in the table reflect the impact, if any, of certain reimbursements/waivers from Capital Research and Management Company. For more information about these reimbursements/waivers, see the fund's statement of additional information and annual report. The information in the Financial Highlights table has been audited by Deloitte & Touche LLP, whose report, along with the fund's financial statements, is included in the statement of additional information, which is available upon request.

		Income (loss) from investment operations[1]			Dividends and distributions								
	Net asset value, beginning of period	Net investment income[2]	Net gains (losses) on securities (both realized and unrealized)	Total from investment operations	Dividends (from net investment income)	Distributions (from capital gains)	Total dividends and distributions	Net asset value, end of period	Total return[3,4]	Net assets, end of period (in millions)	Ratio of expenses to average net assets before reim-bursements/ waivers	Ratio of expenses to average net assets after reim-bursements/ waivers[4]	Ratio of net income to average net assets[2,4]
Class A:													
Year ended 12/31/2010	$16.21	$.40	$ 1.68	$ 2.08	$(.36)	$ —	$(.36)	$17.93	13.02%	$31,409	.63%	.63%	2.42%
Year ended 12/31/2009	13.78	.40	2.44	2.84	(.41)	—	(.41)	16.21	21.08	29,675	.67	.67	2.80
Year ended 12/31/2008	19.31	.50	(5.35)	(4.85)	(.54)	(.14)	(.68)	13.78	(25.73)	26,972	.61	.59	2.96
Year ended 12/31/2007	19.02	.53	.72	1.25	(.52)	(.44)	(.96)	19.31	6.60	37,999	.60	.58	2.68
Year ended 12/31/2006	17.82	.47	1.61	2.08	(.47)	(.41)	(.88)	19.02	11.80	35,431	.61	.58	2.57
Class B:													
Year ended 12/31/2010	16.16	.28	1.66	1.94	(.23)	—	(.23)	17.87	12.12	2,573	1.38	1.38	1.66
Year ended 12/31/2009	13.73	.29	2.44	2.73	(.30)	—	(.30)	16.16	20.24	3,305	1.43	1.43	2.06
Year ended 12/31/2008	19.25	.37	(5.34)	(4.97)	(.41)	(.14)	(.55)	13.73	(26.33)	3,455	1.38	1.35	2.18
Year ended 12/31/2007	18.96	.38	.72	1.10	(.37)	(.44)	(.81)	19.25	5.83	5,391	1.35	1.32	1.94
Year ended 12/31/2006	17.77	.33	1.60	1.93	(.33)	(.41)	(.74)	18.96	10.95	5,386	1.36	1.33	1.82

	Net asset value, beginning of period	Income (loss) from investment operations[1] Net investment income[2]	Net gains (losses) on securities (both realized and unrealized)	Total from investment operations	Dividends and distributions Dividends (from net investment income)	Distributions (from capital gains)	Total dividends and distributions	Net asset value, end of period	Total return[3,4]	Net assets, end of period (in millions)	Ratio of expenses to average net assets before reim-bursements/ waivers	Ratio of expenses to average net assets after reim-bursements/ waivers[4]	Ratio of net income to average net assets[2,4]
Class C:													
Year ended 12/31/2010	$16.14	$.27	$ 1.67	$ 1.94	$(.23)	$ —	$(.23)	$17.85	12.11%	$4,576	1.43%	1.43%	1.61%
Year ended 12/31/2009	13.72	.29	2.43	2.72	(.30)	—	(.30)	16.14	20.16	4,429	1.45	1.45	2.02
Year ended 12/31/2008	19.23	.36	(5.33)	(4.97)	(.40)	(.14)	(.54)	13.72	(26.33)	4,128	1.42	1.40	2.14
Year ended 12/31/2007	18.95	.37	.72	1.09	(.37)	(.44)	(.81)	19.23	5.73	6,078	1.40	1.37	1.89
Year ended 12/31/2006	17.76	.32	1.60	1.92	(.32)	(.41)	(.73)	18.95	10.90	5,743	1.41	1.38	1.77
Class F-1:													
Year ended 12/31/2010	16.21	.40	1.67	2.07	(.36)	—	(.36)	17.92	12.95	895	.63	.63	2.41
Year ended 12/31/2009	13.78	.41	2.44	2.85	(.42)	—	(.42)	16.21	21.13	885	.64	.64	2.85
Year ended 12/31/2008	19.31	.50	(5.35)	(4.85)	(.54)	(.14)	(.68)	13.78	(25.73)	946	.61	.58	2.96
Year ended 12/31/2007	19.02	.53	.72	1.25	(.52)	(.44)	(.96)	19.31	6.61	1,374	.59	.57	2.69
Year ended 12/31/2006	17.82	.48	1.60	2.08	(.47)	(.41)	(.88)	19.02	11.83	1,247	.59	.57	2.59
Class F-2:													
Year ended 12/31/2010	16.21	.44	1.67	2.11	(.40)	—	(.40)	17.92	13.21	228	.40	.40	2.63
Year ended 12/31/2009	13.78	.43	2.45	2.88	(.45)	—	(.45)	16.21	21.41	164	.41	.41	2.87
Period from 8/5/2008 to 12/31/2008[5]	17.44	.21	(3.59)	(3.38)	(.28)	—	(.28)	13.78	(19.51)	39	.17	.16	1.45
Class 529-A:													
Year ended 12/31/2010	16.19	.39	1.68	2.07	(.35)	—	(.35)	17.91	12.97	1,589	.69	.69	2.35
Year ended 12/31/2009	13.77	.39	2.43	2.82	(.40)	—	(.40)	16.19	20.97	1,291	.73	.73	2.73
Year ended 12/31/2008	19.29	.49	(5.34)	(4.85)	(.53)	(.14)	(.67)	13.77	(25.76)	1,030	.68	.65	2.90
Year ended 12/31/2007	19.01	.51	.72	1.23	(.51)	(.44)	(.95)	19.29	6.47	1,323	.68	.66	2.60
Year ended 12/31/2006	17.81	.47	1.60	2.07	(.46)	(.41)	(.87)	19.01	11.76	1,125	.66	.63	2.53
Class 529-B:													
Year ended 12/31/2010	16.19	.26	1.66	1.92	(.21)	—	(.21)	17.90	11.99	244	1.48	1.48	1.56
Year ended 12/31/2009	13.76	.28	2.44	2.72	(.29)	—	(.29)	16.19	20.09	284	1.53	1.53	1.95
Year ended 12/31/2008	19.28	.35	(5.34)	(4.99)	(.39)	(.14)	(.53)	13.76	(26.36)	251	1.48	1.46	2.09
Year ended 12/31/2007	19.00	.36	.71	1.07	(.35)	(.44)	(.79)	19.28	5.64	342	1.47	1.44	1.81
Year ended 12/31/2006	17.80	.31	1.61	1.92	(.31)	(.41)	(.72)	19.00	10.87	311	1.48	1.45	1.70

(The Financial Highlights table continues on the following page.)

	Net asset value, beginning of period	Income (loss) from investment operations[1] Net investment income[2]	Net gains (losses) on securities (both realized and unrealized)	Total from investment operations	Dividends and distributions Dividends (from net investment income)	Distributions (from capital gains)	Total dividends and distributions	Net asset value, end of period	Total return[3,4]	Net assets, end of period (in millions)	Ratio of expenses to average net assets before reim-bursements/waivers	Ratio of expenses to average net assets after reim-bursements/waivers[4]	Ratio of net income to average net assets[2,4]
Class 529-C:													
Year ended 12/31/2010	$16.19	$.26	$ 1.67	$ 1.93	$(.22)	$ —	$(.22)	$17.90	12.03%	$583	1.48%	1.48%	1.57%
Year ended 12/31/2009	13.76	.28	2.44	2.72	(.29)	—	(.29)	16.19	20.10	507	1.52	1.52	1.94
Year ended 12/31/2008	19.29	.35	(5.35)	(5.00)	(.39)	(.14)	(.53)	13.76	(26.40)	420	1.48	1.45	2.09
Year ended 12/31/2007	19.00	.36	.72	1.08	(.35)	(.44)	(.79)	19.29	5.70	567	1.47	1.44	1.82
Year ended 12/31/2006	17.81	.32	1.59	1.91	(.31)	(.41)	(.72)	19.00	10.81	501	1.47	1.44	1.71
Class 529-E:													
Year ended 12/31/2010	16.19	.35	1.66	2.01	(.30)	—	(.30)	17.90	12.59	92	.97	.97	2.07
Year ended 12/31/2009	13.76	.35	2.44	2.79	(.36)	—	(.36)	16.19	20.71	80	1.02	1.02	2.45
Year ended 12/31/2008	19.28	.44	(5.34)	(4.90)	(.48)	(.14)	(.62)	13.76	(25.99)	65	.97	.95	2.60
Year ended 12/31/2007	19.00	.46	.71	1.17	(.45)	(.44)	(.89)	19.28	6.18	84	.96	.94	2.32
Year ended 12/31/2006	17.80	.41	1.61	2.02	(.41)	(.41)	(.82)	19.00	11.44	73	.96	.93	2.23
Class 529-F-1:													
Year ended 12/31/2010	16.19	.43	1.67	2.10	(.39)	—	(.39)	17.90	13.15	57	.47	.47	2.57
Year ended 12/31/2009	13.76	.42	2.44	2.86	(.43)	—	(.43)	16.19	21.31	42	.52	.52	2.93
Year ended 12/31/2008	19.28	.52	(5.34)	(4.82)	(.56)	(.14)	(.70)	13.76	(25.61)	31	.47	.45	3.11
Year ended 12/31/2007	19.00	.56	.71	1.27	(.55)	(.44)	(.99)	19.28	6.71	36	.46	.44	2.82
Year ended 12/31/2006	17.80	.50	1.61	2.11	(.50)	(.41)	(.91)	19.00	11.99	28	.46	.43	2.73

	Year ended December 31 2010	2009	2008	2007	2006
Portfolio turnover rate for all classes of shares	37%	46%	41%	35%	34%

1 Based on average shares outstanding.
2 For the year ended December 31, 2010, this column reflects the impact of a corporate action event that resulted in a one-time increase to net investment income. If the corporate action event had not occurred, the Class A net investment income per share and ratio of net income to average net assets would have been lower by $.04 and .25 percentage points, respectively. The impact to the other share classes would have been similar.
3 Total returns exclude any applicable sales charges, including contingent deferred sales charges.
4 This column reflects the impact, if any, of certain reimbursements/waivers from Capital Research and Management Company. During some of the periods shown, Capital Research and Management Company reduced fees for investment advisory services.
5 Based on operations for the period shown and, accordingly, may not be representative of a full year.

Notes

For shareholder services	American Funds Service Company 800/421-0180
For retirement plan services	Call your employer or plan administrator
For 529 plans	American Funds Service Company 800/421-0180, ext. 529
For 24-hour information	American FundsLine 800/325-3590 americanfunds.com

Telephone calls you have with American Funds may be monitored or recorded for quality assurance, verification and recordkeeping purposes. By speaking to American Funds on the telephone, you consent to such monitoring and recording.

Annual/Semi-annual report to shareholders The shareholder reports contain additional information about the fund, including financial statements, investment results, portfolio holdings, a discussion of market conditions and the fund's investment strategies and the independent registered public accounting firm's report (in the annual report).

Program description The CollegeAmerica® 529 program description contains additional information about the policies and services related to 529 plan accounts.

Statement of additional information (SAI) and codes of ethics The current SAI, as amended from time to time, contains more detailed information about the fund, including the fund's financial statements, and is incorporated by reference into this prospectus. This means that the current SAI, for legal purposes, is part of this prospectus. The codes of ethics describe the personal investing policies adopted by the fund, the fund's investment adviser and its affiliated companies.

The codes of ethics and current SAI are on file with the U.S. Securities and Exchange Commission (SEC). These and other related materials about the fund are available for review or to be copied at the SEC's Public Reference Room in Washington, D.C. (202/551-8090), on the EDGAR database on the SEC's website at sec.gov or, after payment of a duplicating fee, via e-mail request to publicinfo@sec.gov or by writing to the SEC's Public Reference Section, 100 F Street, NE, Washington, D.C. 20549-1520. The codes of ethics, current SAI and shareholder reports are also available, free of charge, on our website, americanfunds.com.

E-delivery and household mailings Each year you are automatically sent an updated summary prospectus and annual and semi-annual reports for the fund. You may also occasionally receive proxy statements for the fund. In order to reduce the volume of mail you receive, when possible, only one copy of these documents will be sent to shareholders who are part of the same family and share the same household address. You may elect to receive these documents electronically in lieu of paper form by enrolling in e-delivery on our website, americanfunds.com.

If you would like to opt out of household-based mailings or receive a complimentary copy of the current SAI, codes of ethics, annual/semi-annual report to shareholders or applicable program description, please call American Funds Service Company at 800/421-0180 or write to the secretary of the fund at P.O. Box 7650, San Francisco, California 94120-7650.

Securities Investor Protection Corporation (SIPC) Shareholders may obtain information about SIPC® on its website at sipc.org or by calling 202/371-8300.

MFGEPR-911-0311M Litho in USA CGD/RRD/8002 Investment Company File No. 811-00066