Overconfidence, Information Diffusion, and Mispricing Persistence

Online Appendix

A Model

A.I General Model

There are two assets: a risk free asset with fully elastic supply which earns a return of zero each period, and a risky asset which pays a liquidating dividend $\tilde{D}_T$ at time T. To capture the information dynamics that drive the dynamics of return predictability, we follow Hong and Stein (1999) and specify that the liquidating dividend is a sum of dividend innovations each period $t \in \{1, \ldots, T\}$.[42] That is:

$$\tilde{D}_T = D_0 + \tilde{\epsilon}_1 + \tilde{\epsilon}_2 + \cdots + \tilde{\epsilon}_T. \tag{A.1}$$

Hong and Stein (1999) specify that the innovations are mean zero. In contrast, in our specification the innovations $\tilde{\epsilon}_t \sim \mathcal{N}(\mu_\epsilon, \sigma^2)$ are *i.i.d.* draws from a distribution with constant variance σ^2 and (time invariant) mean μ_ϵ. The agents in our model do not directly observe μ_ϵ. They do have a valid, common prior distribution at time $t = 0$, $\mu_\epsilon \sim \mathcal{N}(0, \zeta^2)$, and over time agents observe, partly or completely, the realized dividend innovations (ϵ_t's) and update their beliefs about μ_ϵ based on these observations. All agents are Bayesian, but do not optimally use all information available to them.

The motivation for this specification is the following: given symmetric information at $t = 0$, all agents agree on the firm value in period $t = 0$. However, because after this point they see different parts of the information set and process this information differently, they will start to disagree about the firm's value over time. Their disagreement will be captured by different posterior distributions for μ_ϵ. One group will become relatively more optimistic, meaning they think that the firm will generate higher average cashflows going forward, and the second group will be relatively more pessimistic. Our objective in writing the model this way is to develop an understanding of how this disagreement will evolve over time, and how this disagreement will affect price dynamics.

Given our modeling assumptions, each agent's posterior distribution for μ_ϵ will be normal, but the distributions will have different means and variances. Specifically, for an agent from subgroup i, we denote the mean and variance of their posterior distribution over μ_ϵ, after observing the new information at time t, as $\mu_\epsilon \sim \mathcal{N}(\hat{\alpha}_{it}, \hat{\eta}_{it}^2)$. What kind of information different agents see and how they update their priors will define the subgroup of an agent, and will be specified later.

[42] We follow Hong and Stein (1999) and call the ϵ's dividend innovations or just innovations. An alternative term in the literature is cash-flow shocks (Barberis, Greenwood, Jin, and Shleifer, 2018).

A.II Agents

There are multiple groups of agents in our model. Each group consists of a measure of agents with identical information and preferences, and who form beliefs in the same way. The first group consists of passive investors. In aggregate, the group of passive investors demands exactly the total outstanding supply of shares, independent of the share price. The set of passive investors is further stratified into institutional and individual investors. In our setting, the only difference between these sub-groups is that institutional investors are willing to lend out shares at zero cost, while individual investors do not.[43]

Any further group of agents is assumed to be active. Each active agent forms beliefs, trades, and sets prices so as to maximize individual utility. Since the passive investors demand the total outstanding supply of shares, active agents must therefore hold zero shares in aggregate; they compete with each other on the basis of their differing beliefs about the value of the risky security. Each period t, all active agents maximize utility over their period $t+1$ wealth. Their utility is exponential with risk-aversion coefficient γ_i, where index i denotes the active agents' group.

There are no trading costs. However, as in the markets we examine later on, all active agents are required to first locate and borrow any shares they sell short. Search frictions, as specified below can lead to a borrowing cost of c_t (per period, per share), which is determined endogenously. To simplify, we assume that share lending takes place in a centralized market—so the cost c_t is the same for any agent borrowing the stock. We further assume that any active agent who buys shares does not lend out these shares.[44] In the following, we refer to active agents by using the single word agents (as opposed to passive investors, who do not trade actively).

A.III Demands and the equilibrium price

At time t, given a posterior distribution $\mu_\epsilon \sim \mathcal{N}\left(\hat{\alpha}_{it}, \hat{\eta}_{it}^2\right)$, an agent from group i expects a liquidating dividend of:

$$\mathbb{E}_{it}\left[D_T\right] = D_{it} + \hat{\alpha}_{it}(T-t). \tag{A.2}$$

where $D_{it} = D_0 + \sum_{s=1}^{t} \epsilon_{it}$ is the sum of the realized dividend innovations ϵ_t's through time t. She thinks that each upcoming piece of information will have a mean of $\hat{\alpha}_{it}$. The variance of the predictive return distribution for the upcoming dividend innovation is $\hat{\sigma}_{it}^2 = \sigma^2 + \hat{\eta}_{it}^2$, the sum of the variance of innovations and the variance of the own parameter estimate about μ_ϵ (see, for example, Brandt, 2010).

In this CARA-normal setting, myopic demand is just the expected price next period $\mathbb{E}_{it}\left[p_{t+1}\right]$, minus the current price p_t, scaled by the risk-aversion coefficient times the payoff variance. Thus, the demand function depends on an assumption regarding agents' beliefs about the

[43] This assumption is consistent with evidence presented in D'Avolio (2002) showing that lendable shares are predominantly supplied by large institutional investors like passive index funds.

[44] Note that the existence of hard-to-borrow stocks is not possible if every agent makes their shares freely available for borrowing, for example through a margin account, and brokers lend out all available shares. In equilibrium, pessimists would just short exactly the number of shares that optimists demand and shorting fees would always be zero. Our extreme assumption is made to capture the empirical regularities that stocks do become costly to borrow and that not all investors lend out their shares (see Reed, 2013, for a recent survey of the literature on short selling).

price in the next period ($\mathbb{E}_{it}[p_{t+1}]$). We assume that agents are overconfident in the sense that they believe that all other agents will agree next period that they were actually right. As a consequence, they think that there will be no disagreement in the next period, which directly implies $\mathbb{E}_{it}[c_{t+1}] = 0$ for all groups i. They further believe that the market price will be equal to their belief about the final payoff next period. As we will see shortly, this is consistent with the equilibrium price function in the sense that the equilibrium price is, in our setting, just the identical belief of all agents if there is no disagreement. Expressed mathematically, we have $\mathbb{E}_{it}[p_{t+1}] = \mathbb{E}_{it}[\mathbb{E}_{i,t+1}[D_T]]$, a term that is equal to $\mathbb{E}_{it}[D_T]$ by the law of iterated expectations. We finally obtain $\mathbb{E}_{it}[p_{t+1}] = D_{it} + \hat{\alpha}_{it}(T-t)$ by using equation (A.2).

So given an equilibrium price $p_t \leq \mathbb{E}_{it}[D_T]$, the demand of an agent in group i is positive and given by:[45]

$$d_t^i = \frac{\mathbb{E}_{it}[D_T] - p_t}{\gamma_i \hat{\sigma}_{it}^2} = \frac{D_{it} + \hat{\alpha}_{it}(T-t) - p_t}{\gamma_i \hat{\sigma}_{it}^2} \qquad \text{if } p_t \leq \mathbb{E}_{it}[D_T]\,. \tag{A.3}$$

However, if the price is above what the agent expects the payoff to be (i.e., if $p_t \geq \mathbb{E}_{it}[D_T]$), she may elect to borrow the stock and sell it. To do so, the agent must pay the per-unit cost of borrowing the shares from t to $t+1$, which we denote c_t. She will thus choose to go short if and only if what she receives from shorting (p_t) is greater than the the sum of the expected cost of buying back the share next period ($= \mathbb{E}_t[p_{t+1}] = \mathbb{E}_{it}[D_T]$) plus the cost of borrowing c_t. His demand—which will be negative—is:

$$d_i^t = \frac{\mathbb{E}_{it}[D_T] + c_t - p_t}{\gamma_i \hat{\sigma}_{it}^2} = -\frac{p_t - (D_{it} + \hat{\alpha}_{it}(T-t)) - c_t}{\gamma_i \hat{\sigma}_{it}^2} \qquad \text{if } p_t \geq \mathbb{E}_{it}[D_T] + c_t. \tag{A.4}$$

Note that, if $c_t > 0$, the demand of an agent in group i will be zero for a range of prices $\mathbb{E}_{it}[D_T] \leq p_t \leq \mathbb{E}_{it}[D_T] + c_t$. For an equilibrium p_t in this range, the agents in group i will be sidelined from the market – they will neither buy nor sell short the risky asset.

Let π_i denote a measure of agents in group i and L_t (S_t) denote the set of groups who are long (short) in period t. As shown in Appendix A.VIII, the market clearing price p_t in the stock market is

$$p_t = D_{mt} + \hat{\alpha}_{mt}(T-t) + \frac{\sum_{i \in S_t} \Pi_{it}}{\sum_{i \in (L_t \cup S_t)} \Pi_{it}} c_t \tag{A.5}$$

with

$$\Pi_{it} \equiv \frac{\pi_i}{\gamma_i \hat{\sigma}_{it}^2}, \tag{A.6}$$

$$\hat{\alpha}_{mt} \equiv \sum_{i \in (L_t \cup S_t)} \left[\frac{\Pi_{it}}{\sum_{j \in (L_t \cup S_t)} \Pi_{jt}} \hat{\alpha}_{it} \right], \tag{A.7}$$

and

$$D_{mt} \equiv \sum_{i \in (L_t \cup S_t)} \left[\frac{\Pi_{it}}{\sum_{j \in (L_t \cup S_t)} \Pi_{jt}} D_{it} \right]. \tag{A.8}$$

[45] Appendix A.VIII derives that optimal demands in period t more formally.

We can think of Π_{it} as the adjusted measure of agents belonging to group i in period t. The adjustment accounts for their risk aversion (γ_i) and their perceived parameter uncertainty ($\hat{\sigma}_{it}^2$). $\hat{\alpha}_{mt}$ is then the weighted average expectation of μ_ϵ, and D_{mt} is the weighted average of the sum of privately observed dividend innovations ϵ's. For an unconstrained stock ($c_t = 0$), equation (A.5) shows that the market price is simply a weighted average of single beliefs specified in equation (A.2). The weights depend on how aggressively a group trades. equation (A.5) shows further that constrained stocks are overpriced relative to the average market belief and that the degree of overpricing is proportional to the per-share shorting cost c_t.

A.IV The cost of borrowing shares

Consistent with US institutional restrictions, we require that stock must be borrowed before it can be sold short.[46] Borrowing costs are determined in equilibrium, and are the price at which the supply of shares are equal to the demand from agents (as in Blocher, Reed, and Van Wesep, 2013). The supply is determined by the costs of finding new shares to borrow. We model the supply of shares X_t to the lending market as a function of the borrowing cost c_t as:

$$X_t = \lambda Q + \frac{1}{\tau} c_t \tag{A.9}$$

where Q is the number of shares outstanding. The intuition for this specification is as follows: first, a fraction λ of the passive investors are always willing to lend out their shares in the lending market, regardless of the borrowing cost. We can think of this as institutional lending supply, coming from index funds, pension funds, etc., that have set up a stock lending program. As long as the demand to borrow shares is less than the institutional supply of λQ, the institutions compete in the lending market, driving the cost of borrowing to zero. However, after the institutional lending supply is exhausted, finding additional shares to borrow requires the payment of search costs.

We implicitly assume that the lending market is a perfectly functioning market, meaning that each stock borrower must pay the equilibrium cost per stock c_t and not the marginal cost of finding his own additional share. We can imagine a clearinghouse that collects the supply and demand schedule and then sets the equilibrium price for lending accordingly. The passive investors earn the rents from lending their shares but, by assumption, this does not affect their decision to hold the underlying shares. Similarly, those who can find shares to borrow at a cost of less than c_t are (effectively) assumed to borrow those shares at the equilibrium cost of c_t. The per-unit borrowing cost c_t, for every share borrowed, is therefore equal to the marginal cost, that is the cost of finding the last share that is borrowed. Furthermore, c_t is also equal to the average search cost per share.

Rearranging equation (A.9) gives the cost per share of borrowing stock as a function of the total number of shares borrowed (X_t):

$$c_t\left(X_t\right) = max\left(0, \tau\left(X_t - \lambda Q\right)\right). \tag{A.10}$$

[46] Further, stock may only be borrowed for the purpose of short selling. Thus, the number of shares borrowed is at all times equal to the number of shares sold short.

The first derivative with respect to short-interest X_t (for $X_t > \lambda Q$) is equal to $\frac{\partial c}{\partial X_t} = \tau$. τ is the amount by which the borrowing cost c_t increases for each additional share borrowed. Consistent with the empirical evidence documented by Kolasinski, Reed, and Ringgenberg (2013), we specify that marginal search costs increase with the number of shares borrowed, and in our specification they increase linearly in X_t, once demand exceeds the institutional supply. Note also that, *ceteris paribus*, borrowing a share is cheaper for stocks with higher institutional lending supply.
Market clearing on the lending market requires

$$\lambda Q + \frac{1}{\tau} c_t \geq \sum_{i \in S_t} \Pi_{it} \left(p_t - (D_{it} + \hat{\alpha}_{it}(T-t)) - c_t \right). \tag{A.11}$$

Substituting in the equilibrium price from equation (A.5) and solving for c_t yields:

$$c_t = max \left\{ 0; \frac{\tau \left[\sum_{i \in S_t} \Pi_{it} (D_{mt} - D_{it} + (\hat{\alpha}_{mt} - \hat{\alpha}_{it})(T-t)) - \lambda Q \right]}{1 + \tau \left[\sum_{i \in S_t} \Pi_{it} \left(1 - \frac{\sum_{j \in S_t} \Pi_{jt}}{\sum_{j \in (L_t \cup S_t)} \Pi_{jt}} \right) \right]} \right\}. \tag{A.12}$$

Intuitively, costs increase with the adjusted measure of short-sellers ($\sum_{i \in S_t} \Pi_{it}$), and with the magnitude of the short-sellers' disagreement with the market beliefs ($(D_{mt} - D_{it} + (\hat{\alpha}_{mt} - \hat{\alpha}_{it})(T-t))$). Further intuition for equation (A.12) is given in Appendix A.IX.
An equilibrium in period t is a situation where market clearing conditions (A.5) and (A.12) hold and where each agent acts optimally given the equilibrium prices and shorting costs. Note that this also implies that agents in set L_t choose optimally a positive demand, agents in set S_t prefer a negative demand, and agents who are in neither set have a zero demand in equilibrium.

A.V Heterogeneous Agents

In this subsection, we specify an application of the general model outlined above. Specifically we specify that, in addition to the set of passive investors, there are two groups of actively trading agents. Each group has its own set of biases and/or information disadvantages.
As noted earlier, the key assumptions that drive the information processing of our two types of agents are that: (1) informed agents are *overconfident* (Daniel, Hirshleifer, and Subrahmanyam, 1998), and (2) the uninformed *newswatchers*, who receive this information slowly, are not overconfident.
The informed agents are all "quick", in that they receive all new information immediately. They perceive each signal to be a private signal, as all other market participants are unable to fully observe their signal ϵ_t at time t. Consistent with Daniel, Hirshleifer, and Subrahmanyam (1998), their overconfidence about their signal leads them to overestimate signal precision, and thus to overweight the signal. In contrast, the newswatchers see only a part of ϵ_t in the upcoming periods. They form beliefs by Bayesian updating, but they ignore the information contained in prices.

A.VI Timing of Information

We define $\delta_t = \epsilon_t - \mu_\epsilon$ as the (mean zero) surprise component of each dividend innovation release. Following Hong and Stein (1999), each surprise δ_t is decomposed into n sub-surprises δ_t^{t+i}, $i \in [0; (n-1)]$, with mean zero and variance σ^2/n.
The overconfident agents see the entire innovation $\epsilon_{Ot} = \epsilon_t = \mu_\epsilon + \delta_{Ot} = \mu_\epsilon + \sum_{j=t}^{t+n-1} \delta_t^j$ at time t. The newswatchers see signals based on sub-surprises one after another. Specifically, newswatchers observe a signal ϵ_{Nt} based on all sub-surprises with superscript t at time $n \leq t < T$, i.e.,

$$\epsilon_{Nt} = \mu_\epsilon + \delta_{Nt} = \mu_\epsilon + \sum_{j=t-n+1}^{t} \delta_j^t \tag{A.13}$$

Table A.1: Timing of surprises.
Sub-surprises are aggregated into surprises for overconfident agents and newswatchers. The table shows an example with $T = 5$ and $n = 3$. Overconfident agents see all information immediately, while information diffuses slowly to newswatchers.

Period	1	2	3	4	5	Overconfident
Surprise 1	δ_1^1	δ_1^2	δ_1^3			$\delta_{O1} = \sum_{t=1}^{3} \delta_1^t$
Surprise 2		δ_2^2	δ_2^3	δ_2^4		$\delta_{O2} = \sum_{t=2}^{4} \delta_2^t$
Surprise 3			δ_3^3	δ_3^4	δ_3^5	$\delta_{O3} = \sum_{t=3}^{5} \delta_3^t$
Surprise 4				δ_4^4	δ_4^5 δ_4^6	$\delta_{O4} = \sum_{t=4}^{6} \delta_4^t$
Surprise 5					δ_5^5 δ_5^6 δ_5^7	$\delta_{O5} = \sum_{t=5}^{7} \delta_5^t$
Newswatchers	$\delta_{N1} = \delta_1^1$	$\delta_{N2} = \sum_{j=1}^{2} \delta_j^2$	$\delta_{N3} = \sum_{j=1}^{3} \delta_j^3$	$\delta_{N4} = \sum_{j=2}^{4} \delta_j^4$	$\delta_{N5} = \sum_{j=3}^{5} \delta_j^5$ $+ \sum_{j=4}^{5} \delta_j^6 + \delta_5^7$	

Table A.1 illustrates the timing of information for a information diffusion period of $n = 3$. Each surprise δ_t has its own row in the table and is the sum of sub-surprises δ_t^{t+i}, $i \in [0; (n-1)]$. The signal's surprise component of overconfident agents (δ_{Ot}'s) are exactly equal to these row sums. The newswatchers see one sub-surprise from each previous period that lies in $[t-n+1; t]$. The surprise component δ_{Nt} of their signal is the column sum in Table A.1. Newswatchers think that all of their signals δ_{Nt} have variance σ^2, which is correct except for a start- and an end-effect.[47] For example, their signal in period 3 is the sum of three sub-surprises that originate in periods one, two, and three, respectively.

[47] See Table A.1. In the first periods, there are not enough sub-surprises available and equation (A.13) effectively becomes $\epsilon_{Nt} = \mu_\epsilon + \sum_{j=1}^{t} \delta_j^t$. In the final period $t = T$, newswatchers are assumed to observe all remaining information and equation (A.13) reads $\epsilon_{Nt} = \mu_\epsilon + \sum_{j=t-n+1}^{t} \delta_j^t + \sum_{j=t-n+2}^{t} \delta_j^{t+1} + \cdots + \sum_{j=t}^{t} \delta_j^{t+n-1}$.

A.VII Formation of Beliefs

In period 0, we assume that the common prior distribution of all agents accurately reflects the distribution from which μ_ϵ was drawn. In each following period, overconfident and newswatchers observe their dividend innovation ϵ_{Ot} and ϵ_{Nt}, respectively. Subsequently, trading takes place. After trading has taken place in the last period, D_T is paid out.

Agents form beliefs about the unknown value of μ_ϵ at time t after having seen their innovation ϵ_{Ot} or ϵ_{Nt} and before trading takes place. Newswatchers assume that the signal is drawn from a normal distribution with a mean equal to the unknown mean μ_ϵ and known variance σ^2. The informed (and overconfident) agents incorrectly believe that their signals have variance $\kappa\sigma^2$ with $0 < \kappa < 1$ lower than the true variance σ^2.

All agents use Bayes' rule to combine their prior belief about μ_ϵ and their signal ϵ_{Ot} or ϵ_{Nt} into a posterior belief. The beliefs of overconfident agent evolve according to $\hat{\alpha}_{Ot} = \frac{\hat{\alpha}_{O,t-1}\kappa\sigma^2 + \epsilon_{Ot}\eta_t^2}{\hat{\eta}^2_{O,t-1} + \kappa\sigma^2}$. Newswatchers' belief in period t is equal to $\hat{\alpha}_{Nt} = \frac{\hat{\alpha}_{N,t-1}\sigma^2 + \epsilon_{Nt}\eta_t^2}{\hat{\eta}^2_{N,t-1} + \sigma^2}$. The posterior variances are $\hat{\eta}^2_{Ot} = \frac{\hat{\eta}^2_{O,t-1}\kappa\sigma^2}{\hat{\eta}^2_{O,t-1} + \kappa\sigma^2}$ and $\hat{\eta}^2_{Nt} = \frac{\hat{\eta}^2_{N,t-1}\sigma^2}{\hat{\eta}^2_{N,t-1} + \sigma^2}$, respectively. Agents base their demands in period t on these beliefs.

A.VIII Solving the Model

An agent of group i maximizes the expected utility of his wealth next period. The heterogeneous agent model can be solved by using backward induction.

In period $T-1$, optimal demands follow from solving a standard static CARA-normal portfolio choice problem and are given by

$$\frac{\mathbb{E}_{i,T-1}\left[p_T - p_{T-1}\right]}{\gamma_i Var_{i,T-1}\left[p_T - p_{T-1}\right]} = \frac{D_{i,T-1} + \hat{\alpha}_{i,T-1} - p_{T-1}}{\gamma_i \hat{\sigma}^2_{i,T-1}} \tag{A.14}$$

if an agent is long in the stock or

$$-\frac{\mathbb{E}_{i,T-1}\left[p_{T-1} - p_T\right] - c_{T-1}}{\gamma_i Var_{i,T-1}\left[p_T - p_{T-1}\right]} = -\frac{p_{T-1} - (D_{i,T-1} + \hat{\alpha}_{i,T-1}) - c_{T-1}}{\gamma_i \hat{\sigma}^2_{i,T-1}} \tag{A.15}$$

if an agent is short and has to pay the per-unit cost of borrowing the shares from $T-1$ to T, which we denote c_{T-1}. Following Barberis, Greenwood, Jin, and Shleifer (2018), we assume that agents perceive the conditional variance of price changes to be equal to the predictive posterior variance of the upcoming dividend innovation.

Let π_i be a measure of agents in group i and L_{T-1} (S_{T-1}) be the set of groups who are long (short) in period $T-1$. Market clearing on the stock market requires

$$\sum_{i \in L_{T-1}} \pi_i \left(\frac{D_{i,T-1} + \hat{\alpha}_{i,T-1} - p_{T-1}}{\gamma_i \hat{\sigma}^2_{i,T-1}} \right) = \sum_{i \in S_{T-1}} \pi_i \left(\frac{p_{T-1} - (D_{i,T-1} + \hat{\alpha}_{i,T-1}) - c_{T-1}}{\gamma_i \hat{\sigma}^2_{i,T-1}} \right) \tag{A.16}$$

Solving equation (A.16) for p_{T-1} yields

$$p_{T-1} = D_{m,T-1} + \hat{\alpha}_{m,T-1} + \frac{\sum_{i\in S_{T-1}} \Pi_{i,T-1}}{\sum_{i\in(L_{T-1}\cup S_{T-1})} \Pi_{i,T-1}} c_{T-1} \tag{A.17}$$

with $\Pi_{i,T-1} \equiv \frac{\pi_i}{\gamma_i \hat{\sigma}^2_{i,T-1}}$, $\hat{\alpha}_{m,T-1} \equiv \sum_{i\in(L_{T-1}\cup S_{T-1})} \left[\frac{\Pi_{i,T-1}}{\sum_{j\in(L_{T-1}\cup S_{T-1})} \Pi_{j,T-1}} \hat{\alpha}_{i,T-1}\right]$, and $D_{m,T-1} \equiv \sum_{i\in(L_{T-1}\cup S_{T-1})} \left[\frac{\Pi_{i,T-1}}{\sum_{j\in(L_{T-1}\cup S_{T-1})} \Pi_{j,T-1}} D_{i,T-1}\right]$.

In period $T-2$, agents maximize the expected utility of wealth in $T-1$. Their demand is equal to

$$\frac{\mathbb{E}_{i,T-2}\left[p_{T-1}\right] - p_{T-2}}{\gamma_i \hat{\sigma}^2_{i,T-2}} \tag{A.18}$$

if the agent is long or

$$-\frac{p_{T-2} - \mathbb{E}_{i,T-2}\left[p_{T-1}\right] - c_{T-2}}{\gamma_i \hat{\sigma}^2_{i,T-2}} \tag{A.19}$$

if the agent is short.

We assume that agents belief that next period all agents will hold the same belief as they do. As argued in more detail in the main text, this assumption implies that $\mathbb{E}_{i,T-2}\left[p_{T-1}\right] = \mathbb{E}_{i,T-2}\left[\mathbb{E}_{i,T-1}\left[D_T\right]\right] = D_{i,T-2} + 2\hat{\alpha}_{i,T-2}$. After substituting $\mathbb{E}_{i,T-2}\left[p_{T-1}\right] = D_{i,T-2} + 2\hat{\alpha}_{i,T-2}$ into equations (A.18) and (A.19), market clearing on the stock market requires

$$\sum_{i\in L_{T-2}} \pi_i \left(\frac{D_{i,T-2} + 2\hat{\alpha}_{i,T-2} - p_{T-2}}{\gamma_i \hat{\sigma}^2_{i,T-2}}\right) = \sum_{i\in S_{T-2}} \pi_i \left(\frac{p_{T-2} - \left(D_{i,T-2} + 2\hat{\alpha}_{i,T-2}\right) - c_{T-2}}{\gamma_i \hat{\sigma}^2_{i,T-2}}\right). \tag{A.20}$$

The equilibrium price in period $T-2$ is given by

$$p_{T-2} = D_{m,T-2} + 2\hat{\alpha}_{m,T-2} + \frac{\sum_{i\in S_{T-2}} \Pi_{i,T-2}}{\sum_{i\in(L_{T-2}\cup S_{T-2})} \Pi_{i,T-2}} c_{T-2}. \tag{A.21}$$

Proceeding with backward induction from period $T-3$ to period 1, long demands, short demands, and the market clearing price p_t are given by equations (A.3) to (A.8).

A.IX Developing an Intuition for the Equilibrium Shorting Fee

We start with a hypothetical world in which search costs of the set of short sellers S_t are covered by a third party, while, at the same time, the set of short sellers S_t is fixed. That is, other agents, who are not part of the set S_t in an equilibrium with positive shorting costs, are not allowed to sell short shares in our thought experiment. In such a world, short sellers belonging to S_t can short for free and their shorting demand is

$$\sum_{i\in S_t} \Pi_{it}\left(p_t - \left(D_{it} + \hat{\alpha}_{it}(T-t)\right)\right) \tag{A.22}$$

Substitution of the equilibrium price from equation (A.5) into (A.22) and setting $c_t = 0$ yields

$$\sum_{i\in S_t} \Pi_{it} \left(D_{mt} - D_{it} + (\hat{\alpha}_{mt} - \hat{\alpha}_{it})(T-t) \right) \tag{A.23}$$

Subtracting free lending supply λQ from equation (A.23) and multiplying with τ gives the shorting costs per share implied by this zero-cost demand. This expression is equal to the numerator of the equilibrium per-share shorting fee (see equation (A.12)). Multiplying the per-share shorting fee with short interest yields the total shorting costs implied by the zero-cost demand (and paid by the third party) as

$$\tau \left[\sum_{i\in S_t} \Pi_{it} \left(D_{mt} - D_{it} + (\hat{\alpha}_{mt} - \hat{\alpha}_{it})(T-t) \right) - \lambda Q \right] \left[\sum_{i\in S_t} \Pi_{it} \left(D_{mt} - D_{it} + (\hat{\alpha}_{mt} - \hat{\alpha}_{it})(T-t) \right) \right] \tag{A.24}$$

Think now of a world in which short seller have to cover their shorting costs. This will affect equilibrium quantities and thereby the shorting demand of short sellers. Assume that per-share shorting costs rise from 0 to the new equilibrium level c_t. This has two effects on shorting demand. First, shorting demand will go down because the short seller now has to cover per-unit costs c_t. We call this the direct effect. Individual demand functions are given by $\frac{p_t - (D_{it} + \hat{\alpha}_{it}(T-t)) - c_t}{\gamma_i \hat{\sigma}_{it}^2}$ (see equation (A.4)), so total demand decreases by $\sum_{i\in S_t} \Pi_{it} c_t$ due to the direct effect. Second, the equilibrium price will rise due to the non-zero shorting costs by $\frac{\sum_{i\in S_t} \Pi_{it}}{\sum_{i\in(L_t\cup S_t)} \Pi_{it}} c_t$ (see equation (A.5)). Short sellers would now like to short more due to the increased price. We call this the indirect effect. Because of the indirect effect, aggregated demand goes up by $\sum_{i\in S_t} \Pi_{it} \frac{\sum_{i\in S_t} \Pi_{it}}{\sum_{i\in(L_t\cup S_t)} \Pi_{it}} c_t$. The total effect is the sum of the direct and the indirect effect. The total shorting costs change from the expression in equation (A.24) to

$$C_t = c_t X_t = \tau \left[\sum_{i\in S_t} \Pi_{it} \left(D_{mt} - D_{it} + (\hat{\alpha}_{mt} - \hat{\alpha}_{it})(T-t) - c_t + \frac{\sum_{i\in S_t} \Pi_{it}}{\sum_{i\in(L_t\cup S_t)} \Pi_{it}} c_t \right) - \lambda Q \right] \left[\sum_{i\in S_t} \Pi_{it} \left(D_{mt} - D_{it} + (\hat{\alpha}_{mt} - \hat{\alpha}_{it})(T-t) - c_t + \frac{\sum_{i\in S_t} \Pi_{it}}{\sum_{i\in(L_t\cup S_t)} \Pi_{it}} c_t \right) \right] \tag{A.25}$$

Dividing equation (A.25) by the total shorting demand X_t implicitly defines the new shorting costs per share

$$c_t = \tau \left[\sum_{i\in S_t} \Pi_{it} \left(D_{mt} - D_{it} + (\hat{\alpha}_{mt} - \hat{\alpha}_{it})(T-t) - c_t + \frac{\sum_{i\in S_t} \Pi_{it}}{\sum_{i\in(L_t\cup S_t)} \Pi_{it}} c_t \right) - \lambda Q \right] \tag{A.26}$$

Solving (A.26) for c_t yields the equilibrium shorting cost per share (if aggregated shorting demand exceeds institutional lending supply) as given in equation (A.12).

B Empirical Details

B.I Supplemental Data

To gain insights into the types of stocks in our portfolios, we calculate *idiosyncratic volatility (IVOL)*. It is based on daily CRSP returns and calculated as the residual standard deviation of a monthly regression of daily firm-excess returns on the three Fama and French (1993) factors, following Ang, Hodrick, Xing, and Zhang (2006).

Annual book-equity data is from Compustat. To calculate the monthly updated *book-to-market ratio*, we divide the most recently observed book-value by the sum of the most recent market equity of all equity securities (PERMNOs) associated with the company (PERMCO). Following Fama and French (1993), we assume that the book-value of calendar-year $t-1$ can be observed by investors starting at the end of June of year t.

Markit provides data on lending fees starting in August 2004.[48] We use the *indicative fee* (a proxy for marginal costs) and *simple average fee* (equal weight average of all contracts for a particular security) of the end of the month to assess the costs of short-selling within our portfolios.

One additional proxy that we use for short-sale costs is the put-call-parity violation, following Ofek, Richardson, and Whitelaw (2004). We measure it by the *volatility spread*, i.e., the open-interest-weighted average difference of implied volatilities of matched call/put option pairs. The volatility spread measure is provided by WRDS Option Suite, is based on data from Option Metrics and follows the calculation in Cremers and Weinbaum (2010).[49]

B.II Additional Data Cleaning

We identify some issues with the short interest data as well as the institutional ownership data. These issues shrink our sample and induce additional noise, which should strictly weaken our results. First, suppose a firm is identified as having high short interest but really had low short interest. We might include this firm in the constrained winner portfolio, while it really was not constrained. If the firm displays "regular" returns, it will bias the results of the portfolio towards a too high return. Second, we increase our sample size and thus the pool of potentially constrained firms, which again should reduce noise.

The short interest data come from four different sources. Compustat is available from 1973, but only starts NASDAQ coverage from July 2003. We have additional files from each exchange, NYSE (1988/01 – 2005/07), AMEX (1995/01 – 2005/07) and NASDAQ (1988/06 – 2008/07, except February and July of 1990). One file typically covers one month of data for one exchange. The format varies widely – most files have tickers, some do not. Tickers typically have the share class appended at the end. In CRSP, the share class is sometimes included in the ticker and sometimes it is not. Ordinary matching on tickers misses some

[48] From August 2004 Markit data frequency is weekly and daily coverage begins in July 2006.

[49] We filter time-to-expiration between 30 and 365 days, moneyness between .8 and .95 for out-of-the-money puts, .95 to 1.05 for near-the-money Puts and .95 to 1.05 for near-the-money calls, and weight by open interest.

stocks with multiple share classes and all files that do not include tickers. We thus apply the following procedure to improve matching:

- Within each file we identify issues of the same company by name matching.
- We identify the share class from the name or the ticker within multiple issue companies.
- We match by ticker where uniquely possible.
- We match by ticker and share class where uniquely possible.
- We match the remaining firms by name and share class.

The name matching procedure for identifying multiple issues within files and for matching CRSP names with short interest file names first standardizes names by removing unnecessary whitespaces and punctuation, harmonizing abbreviations and acronyms and removing additional information (like "Class A" or "Incorporated"). We then calculate the Levenshtein distance to assess name similarity. We discount common words like "American" and put more weight on the unique part of company names. Additionally, we allow for word rotation.

In an early version of the paper we had 1,488,655 firm month observations with short interest until December 2014. After applying the procedure above and allowing for firms from all four sources within any given month, we end up with 1,652,034 firm month observations, an 11% increase, 2/3 of which come from the new matching and 1/3 comes from allowing all sources within a month. Our short interest data now covers 97% of all observations in CRSP in our full sample period.

There are also some apparent issues with institutional ownership data, which have recently been confirmed by WRDS.[50] We identify a few cases where institutional ownership decreases in one quarter by more than 50pp and increases by more than 50pp in the next quarter again. For example, Halliburton's institutional ownership falls from 83% to 0% in 06/2008 and is back at a level of 79% in the following quarter again. Thereby, Halliburton ends up in the corner portfolio in one month, while it is highly unlikely that it was actually short-sale constrained.

We fix this issue by setting institutional ownership to the previous observation if we observe an extreme decrease of more than 50pp that reverses by more than 50pp in the following quarter. This happens 809 times in the sample – but even very few observations like Halliburton can have an influence on value-weighted portfolio returns. This fix further reduces noise in our results.

[50] See the note issued by WRDS on March 6, 2017, concerning "Data Quality problems in Thomson Reuters Ownership.,"

B.III Calculation of Abnormal Announcement Returns

For the abnormal return $AR_{i,t}$ for calendar day t, we estimate CAPM-betas from daily returns for each individual stock i, where $m-12, m-1$ refers to the estimation window, which encompasses the 12 months prior to the earnings announcement month. Abnormal return $AR_{i,t}$ is then the difference between stock i's excess return $R_{i,t}$ and $\beta^{Mkt}_{i;m-12,m-1} \cdot MktRF_t$:

$$AR_{i,t} = R_{i,t} - \beta^{Mkt}_{i;m-12,m-1} MktRF_t$$

We then cumulate the abnormal returns for each individual stock over event days d up to D:

$$CAR_{i,D} = \sum_{d=-21}^{D} AR_{i,d}$$

and normalize by $CAR_{i,0}$:

$$CAR^0_{i,D} = CAR_{i,D} - CAR_{i,0}$$

The average CAR (ACAR) for all stocks in portfolio p is weighted by the buy-and-hold weight $w_{i,p,m}$, i.e., the weight at portfolio formation times the change in the value of that investment up to the day before the announcement:

$$ACAR^0_{D,p} = \sum_{m \in M} \sum_{j \in I_{p,m}} w_{i,p,m} CAR^0_{i,p,m,D}$$

where $w_{i,p,m} = \frac{W'_{i,p,m}}{\sum_{m \in M} \sum_{j \in I_{p,m}} W'_{j,p,m}}$ and $W'_{i,p,m} = \sum_{\tau \in T_m} \frac{ME_{i,\tau}}{\sum_{j \in J_{p,\tau}} ME_{j,\tau}} (1 + RET^x_{i;\tau,D-21})$. $I_{p,m}$ is the set of firms in portfolio p in month m when we measure earnings announcements; and $J_{p,\tau}$ is the set of firms in portfolio p at the end of formation-month τ. $ME_{i,\tau}$ is market equity (PRC*SHROUT) of firm i in formation month τ; and $RET^x_{i;\tau,D-21}$ is the ex-dividend return between the end of the formation month τ and 21 days prior to the earnings announcemnt in month m. T_m are all months to be considered to determine whether a stock belongs to portfolio p ($m-12$ to$m-1$ in Panel A; $m-60$ to $m-13$ in Panel B). We need the summation in the calculation of $W'_{i,p,m}$ to consider the possibility that a stock could have been allocated to portfolio p multiple times during the lookback-period T_m. $W'_{i,p,m}$ can be interpreted as the dollar-amount invested in firm i 21 days prior to an earnings announcement in an overlapping buy-and-hold portfolio. M are all months where we measure earnings announcement returns (1993/06 to 2018/12 in Panel A; 1998/06 to 2018/12 in Panel B of Figure 4).

C Additional Empirical Results

C.I Dynamics of Disagreement

In this subsection, we generate some stylized empirical facts about the dynamics of the disagreement process.

We use earnings forecast dispersion data as a proxy for any form of disagreement (and remain agnostic about which form it is), and examine, using this proxy, how disagreement evolves over time.[51]

Analyst-forecasts of fiscal-year-end earnings are from Institutional Broker's Estimate System (IBES). We use the summary file unadjusted for stock splits, to avoid the bias induced by ex-post split adjustment, as pointed out by Diether, Malloy, and Scherbina (2002). *Earnings-forecast-dispersion (EFD)* is the standard-deviation of forecasts normalized by the absolute value of its mean. We eliminate values where the mean forecast is between -0.1 and +0.1, as very low mean forecasts lead to extremely large values that bias results.[52]

To analyze the dynamics of beliefs, we first sort stocks into 10 portfolios based on the preceding year's change in earnings forecast dispersion. Average characteristics of these portfolios are shown in Table C.1.

Figure C.1 plots earnings forecast dispersion from 1 year before until 5 years after portfolio formation. The high change portfolio distinctly reverses to a similar level as before within roughly 5 years, consistent with the resolution of disagreement hypothesis.[53] The timing is consistent with the return patterns we observe, where constrained winners lose significantly in value for roughly 5 years. The second highest change portfolio already exhibits a much lower increase in disagreement, indicating that large changes are very rare. There seems to be a small predictability in the other direction, as the low change portfolio slightly bounces up after portfolio formation. This increase is tiny in magnitude compared to the predictability of the high change portfolio, though, and the level arrives nowhere near its previous high, but rather in the neighborhood of all other stocks after 5 years.

In Table C.2 we predict future changes in earnings forecast dispersion over 1 year with positive and negative earnings forecast dispersion changes over the past year, using the Fama and MacBeth (1973) procedure. The results confirm that positive past changes strongly predict negative future changes. In contrast, including negative past changes to the regression barely increases the time-series average of the cross-sectional R^2. The coefficient estimate for positive past changes is larger by an order of magnitude than that of the negative past changes.

[51] While earnings forecast dispersion has been used in the literature to proxy for disagreement, it is only available for larger stocks where we typically do not observe binding short-sale constraints. For example, only 20% of the stock-month observations that we identify to have low institutional ownership (i.e., in the bottom 30%) have non-missing earnings forecast dispersion. Hence, to study returns, in the previous sections, we resort to the proxy generated by our model, i.e., a high past return accompanied by high short interest. By doing so, we assume that dynamics of earnings forecast dispersion apply to the dynamics of latent disagreement of all stocks in general, including those where earnings forecast dispersion is not available.

[52] As an alternative specification, we follow Johnson (2004) and use total assets to normalize. Results are available upon request and do not change any conclusions, consistent with the findings in Johnson (2004).

[53] Johnson (2004) suggests to normalize the standard deviation of earnings forecasts by total assets per share, but finds his results changing very little. Our conclusions are also unaffected—results are available upon request.

Table C.1: Descriptive statistics of earnings forecast dispersion change sorted portfolios.

Stocks are sorted based on their past 1-year change in earnings forecast dispersion into 10 portfolios. The time-series average of the number of stocks in the portfolios is displayed in the first column. The next columns show the time series mean of monthly value-weighted portfolio averages of market equity in B$, return of the previous year (skipping the last month) in %, institutional ownership ratio (IOR), short-interest in %, and SIRIO (short interest divided by institutional ownership) in %, all in the month of portfolio formation (t-1). The sample period is 1988/07 to 2018/12.

ΔEFD-Portf.	No. of stocks	ME_{t-1}	$Return_{t-12-t-2}$	IOR_{t-1}	SIR_{t-1}	$SIRIO_{t-1}$	EFD_{t-1}	EFD_{t-12}
1	251	23.75	15.46	63.44	4.08	12.15	16.56	79.96
2	250	36.20	15.20	64.07	2.88	7.25	5.96	12.09
3	250	61.83	16.01	62.56	2.15	4.98	3.51	5.92
4	250	65.71	14.65	62.52	1.87	4.30	2.36	3.46
5	250	73.45	14.08	62.37	1.70	3.77	1.82	2.32
6	251	75.25	11.73	61.63	1.68	3.73	2.13	2.04
7	250	68.77	8.78	61.66	1.97	4.70	3.50	2.74
8	250	57.21	4.65	61.41	2.39	5.83	6.31	4.01
9	250	36.91	-1.80	62.43	3.15	8.33	13.32	7.54
10	251	20.05	-10.22	62.88	4.47	13.02	109.82	21.91

We conclude that the dynamics of beliefs approximately follow a two-state Markov process. Most stocks in the US cross-section have low levels of disagreement and fluctuate around that level. Occasionally, we observe large unpredictable jumps in disagreement. These are followed by resolution of disagreement, which is the only stylized fact we identify that is predictable with ex-ante available information. Except for this, past disagreement in beliefs does not help predict future disagreement. In particular, stocks where disagreement came down in the past are not more likely to become high disagreement stocks in the future again than other stocks.

Figure C.1: Dynamics of earnings forecast dispersion.
Stocks are sorted based on their past 1-year change in earnings forecast dispersion into 10 portfolios. Their level of earnings forecast dispersion is tracked over time, from 12 months before until 60 months after portfolio formation (t=0).

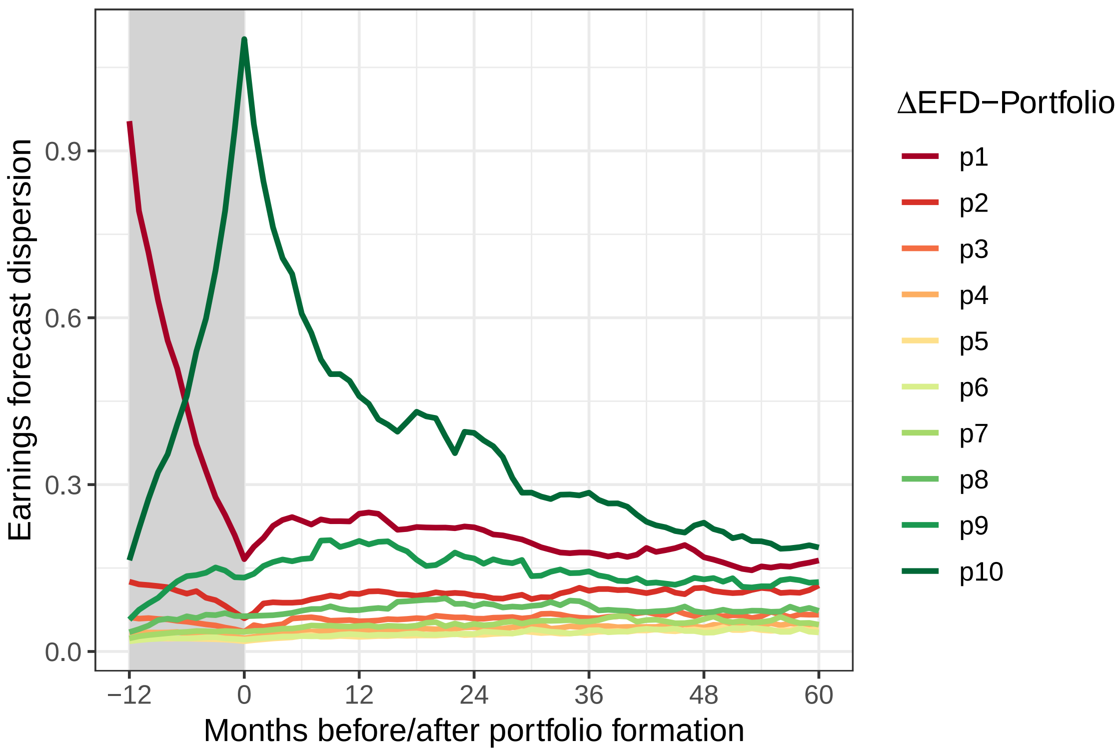

Table C.2: Fama-MacBeth regressions of future changes on past changes in earnings forecast dispersion.
The change in earnings forecast dispersion over one calendar year is regressed on positive (Column 1) and both positive and negative changes (column 2) in earnings forecast dispersion over the previous calendar year in the cross-section of stocks. We value-weight observations in the cross-sectional regressions by their market capitalization. Following the Fama and MacBeth (1973) procedure, the time-series average of the regression coefficients is presented. Standard errors are calculated following Newey and West (1987). The time-series average of the cross-sectional R^2 is presented in the last row. The sample period is 1988 to 2017.

	(1)	(2)
Intercept	0.0320 (8.35)	0.0284 (8.28)
Positive change in disagreement (t-13 to t-1)	−0.9126 (−47.53)	−0.9111 (−48.85)
Negative change in disagreement (t-13 to t-1)		−0.0616 (−0.95)
R^2	0.4256	0.4445

C.II Equity Issuance

Financial economists have now accumulated substantial empirical evidence consistent with the view that manager's try to time the market in their capital structure choices (see Baker and Wurgler, 2002, and the references therein). CFO's themselves state that they are reluctant to issue equity if they perceive their market valuation to be below the fundamental value (Graham and Harvey, 2001). Following this logic, managers who view their equity to be overvalued should issue equity to let current shareholders benefit from high market valuations. Although, perceived overvaluation is much less common than perceived undervaluation among corporate managers (Graham and Harvey, 2001, p. 219), we hypothesize that at least some managers of firms in the constrained winner portfolio think their equity is overvalued.

To test this idea, we look at the composite equity issuance measure of Daniel and Titman (2006). They define this quantity as the part of the change in a firm's market capitalization that cannot be explained by a firm's stock return (see also Pontiff and Woodgate, 2008). We build the composite equity issuance measure for each firm over a six-month time period, starting three months before portfolio formation (at the end of month t) and ranging to three months after portfolio formation. The individual measure is defined as

$$\iota_{t-2,t+3} = \log\left(\frac{ME_{t+3}}{ME_{t-2}}\right) - \log\left(1 + r_{t-2,t+3}\right) \tag{C.1}$$

where t is the month of portfolio formation. The composite equity issuance measure of a portfolio is calculated as the value-weighted average of individual composite equity issuance measures. We build $\iota_{t-2,t+3}$ for all 27 portfolios. The quantity measures the net effect of all issuance activity like equity issues, employee stock option plans, share repurchases or cash dividends around the time of portfolio formation, i.e., around the time where constrained winners are supposed to be overpriced due to a positive shock to disagreement.

Table C.3 presents the results. Consistent with previous literature, winner stocks tend to issue equity on average. The issuance in Table C.3 is highest in the bottom-right-corner for all momentum buckets, and constrained winners and losers issue about twice as much as constrained medium-momentum stocks. For example, 7.54 percentage points of the increase in market capitalization of constrained winners cannot be attributed to their stock returns. Similarly, constrained losers issue substantially more than other loser stocks. Constrained stocks as a group are therefore much higher net issuers of equity than the groups of firms in any other portfolio, consistent with the idea that managers of these constrained stocks consider their equity to be overvalued and that they are trying to use this window of opportunity in favor of their shareholders. Given that most managers appear to be overoptimistic regarding their own firm's prospects (Ben-David, Graham, and Harvey, 2013), we consider the differences in the composite equity issuance measure to be substantial.

Table C.3: Composite equity issuance.
This table shows time-series averages of the value-weighted composite equity issuance measure of the 9 winner (Panel A), 9 medium-momentum (Panel B) and 9 loser (Panel C) portfolios. The composite equity issuance measure of a firm is the part of the change in a firm's market capitalization that cannot be explained by a firm's stock return, following Daniel and Titman (2006). It is calculated over a six-month horizon, starting three months prior to portfolio formation and ranging to three months after portfolio formation. The sample period is 1988/07 to 2018/12.

Panel A: Winners

	Hi IOR	M	Lo IOR	Lo-Hi
Lo SIR	0.45	−0.17	1.78	1.33 (2.75)
M	−0.09	−0.24	2.85	2.94 (5.06)
Hi SIR	2.86	2.45	7.54	4.68 (8.30)
Hi-Lo	2.41	2.62	5.76	
t	(5.76)	(8.65)	(10.10)	

Panel B: Medium Momentum

	Hi IOR	M	Lo IOR	Lo-Hi
Lo SIR	−0.92	−1.29	−0.50	0.43 (1.44)
M	−0.92	−1.15	0.70	1.62 (5.82)
Hi SIR	1.02	0.92	3.73	2.71 (6.98)
Hi-Lo	1.94	2.22	4.23	
t	(6.76)	(6.39)	(9.59)	

Panel C: Losers

	Hi IOR	M	Lo IOR	Lo-Hi
Lo SIR	0.61	−0.38	3.57	2.95 (4.09)
M	−0.78	−0.40	2.97	3.75 (10.24)
Hi SIR	0.58	2.24	6.82	6.24 (6.61)
Hi-Lo	−0.03	2.61	3.25	
t	(−0.07)	(4.37)	(4.88)	

D Additional Figures and Tables

Figure D.1: CAR of constrained portfolios.
We first calculate abnormal returns for each holding month k by regressing the time-series of month-k excess returns on the CAPM-MktRF factor. Returns are then cumulated and plotted for the constrained winner and constrained loser portfolio, with stocks that were not constrained winners in the past 5 years.

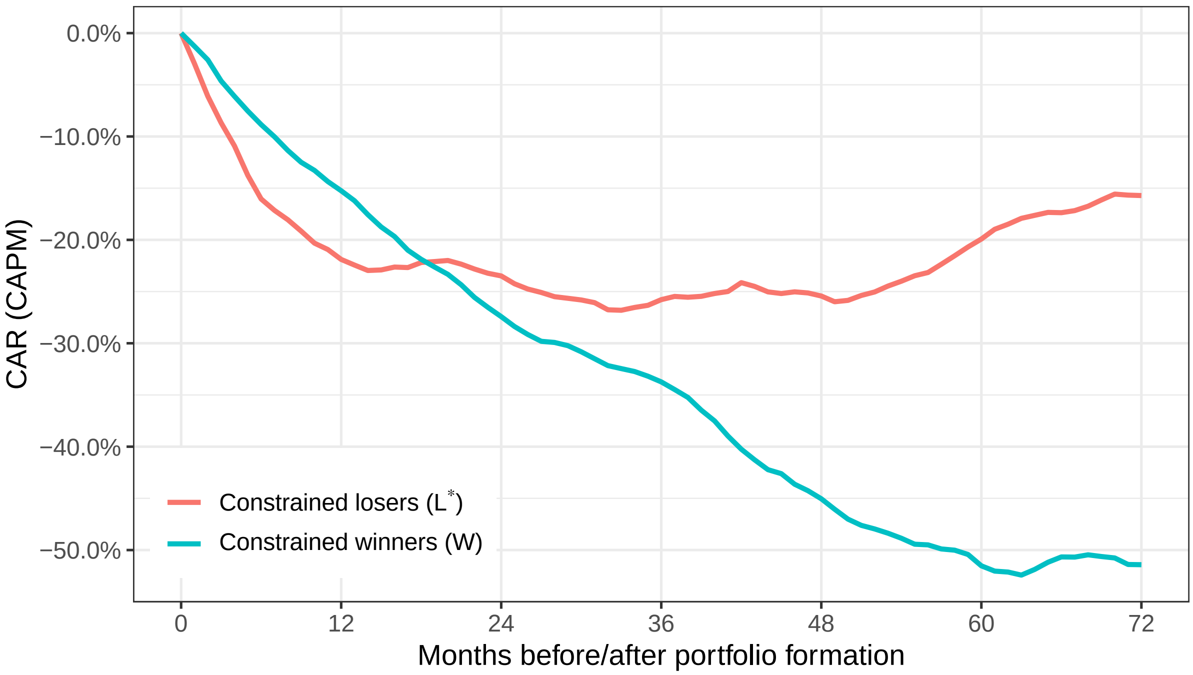

Table D.1: Calendar-time buy-and-hold portfolio returns of stocks sorted into 3/10 portfolios on past 11-month return within months $t-12$ to $t-1$ prior to formation.

See caption to Table 3. Here, we do not focus on constrained stocks, but simply sort based on past-11-month-return (skipping one month) into three (30/70-percent breakpoints, Panel A) and ten (Panel B) portfolios, respectively. The sample-period is 1927/12 to 2018/12.

	W	L	W-L
Panel A: CAPM regressions – 30/70-percentile breakpoints			
Intercept	0.13	-0.25	0.37
	(2.45)	(-3.01)	(3.06)
MktRF	1.00	1.28	-0.27
	(24.31)	(16.77)	(-2.31)
R^2	0.9213	0.8545	0.1114
No. of months	1,093	1,093	1,093
IR	0.2829	-0.3015	0.3150
Panel B: CAPM regressions – decile breakpoints			
Intercept	0.16	-0.54	0.70
	(1.50)	(-4.00)	(4.05)
MktRF	1.10	1.51	-0.40
	(13.56)	(23.18)	(-2.83)
R^2	0.7944	0.7569	0.1142
No. of months	1,093	1,093	1,093
IR	0.1842	-0.4093	0.4046

Table D.2: Calendar-time buy-and-hold portfolio returns of stocks sorted into 3/10 portfolios on past 11-month return within months $t-60$ to $t-13$ prior to formation.

See caption to Table 3. Here, we do not focus on constrained stocks, but simply sort based on past-11-month-return (skipping one month) into three (30/70-percent breakpoints, Panel A) and ten (Panel B) portfolios, respectively. The other difference to Table 3 is that we hold stocks that were allocated to one of the portfolios at some point during months $\{t-60, ..., t-13\}$ before formation. The sample-period is 1931/12 to 2018/12.

	W	L	W-L
Panel A: CAPM regressions – 30/70-percentile breakpoints			
Intercept	-0.02	0.09	-0.11
	(-0.62)	(1.97)	(-1.73)
MktRF	1.03	1.15	-0.12
	(41.11)	(28.47)	(-1.83)
R^2	0.9779	0.9451	0.0877
No. of months	1,045	1,045	1,045
IR	-0.0717	0.2304	-0.1964
Panel B: CAPM regressions – decile breakpoints			
Intercept	-0.09	0.11	-0.20
	(-1.29)	(1.27)	(-2.01)
MktRF	1.15	1.29	-0.14
	(21.39)	(40.72)	(-1.97)
R^2	0.9089	0.8566	0.0594
No. of months	1,045	1,045	1,045
IR	-0.1644	0.1444	-0.2417

Table D.3: Explaining the returns of constrained portfolios.
We regress monthly portfolio excess returns of constrained portfolios on well-known factor-portfolios. Panels A and B report results for the constrained winners (W) and constrained losers that were not constrained winners in the past 5 years ($L(\notin W)$), with 12-month calendar-time buy-and-hold portfolios, and in Panels C and D, we use a 48-month holding period, skipping 12 months. Column (1) shows the raw average of that strategy, (2) displays results from a CAPM regression on the market excess return. (3) represents results from a Fama and French (1993) 3-factor regression. In (4) we add momentum, and in (5), IVOL as in Ang, Hodrick, Xing, and Zhang (2006). (6) and (7) add the short- and a long-term reversal from Ken French and the value-weighted CME factor from Drechsler and Drechsler (2016), respectively. (8) includes all of the aforementioned. Newey and West (1987) t-statistics are shown in parentheses.

Panel A: W from months $(t-12)$—$(t-1)$

	1	2	3	4	5	6	7	8
Intercept	-0.26	-1.22	-1.18	-1.19	-1.07	-1.22	-0.93	-0.95
	(-0.60)	(-4.03)	(-4.72)	(-4.12)	(-3.65)	(-5.58)	(-3.23)	(-3.59)
MktRF		1.48	1.29	1.29	1.20	1.23	1.11	1.04
		(14.40)	(17.97)	(20.20)	(16.94)	(20.15)	(12.18)	(11.27)
HML			-0.22	-0.22	-0.09	-0.33	-0.04	-0.08
			(-2.42)	(-1.71)	(-0.74)	(-2.70)	(-0.49)	(-0.73)
SMB			1.00	1.00	0.80	0.91	0.82	0.73
			(8.72)	(9.64)	(6.26)	(6.57)	(10.52)	(7.06)
MOM				0.01	0.09	0.02	0.09	0.13
				(0.11)	(0.80)	(0.29)	(1.04)	(1.68)
IVOL					0.15			0.05
					(4.07)			(1.01)
STRev						0.24		0.23
						(2.98)		(3.03)
LTRev						0.24		0.11
						(2.04)		(1.04)
CMEVW							-0.29	-0.26
							(-4.61)	(-4.06)
R^2	0.0000	0.5963	0.7703	0.7704	0.7772	0.7835	0.8012	0.8115
No. of months	295	295	295	295	295	295	295	295
IR	-0.1108	-0.8056	-1.0339	-1.0407	-0.9485	-1.0956	-0.8739	-0.9165

Table D.3: (continued)

Panel B: L^* from months $(t-12)$—$(t-1)$								
	1	2	3	4	5	6	7	8
Intercept	-0.81	-1.94	-1.94	-1.45	-1.10	-1.38	-1.07	-0.90
	(-1.32)	(-4.82)	(-5.23)	(-4.00)	(-2.76)	(-3.40)	(-3.18)	(-2.76)
MktRF		1.74	1.54	1.29	1.03	1.29	1.02	0.94
		(12.14)	(11.30)	(16.05)	(11.00)	(13.66)	(13.48)	(9.80)
HML			-0.04	-0.29	0.08	-0.60	-0.03	-0.08
			(-0.15)	(-1.78)	(0.37)	(-3.10)	(-0.16)	(-0.39)
SMB			1.15	1.24	0.68	0.98	0.98	0.51
			(7.51)	(7.67)	(3.08)	(6.16)	(5.62)	(2.48)
MOM				-0.67	-0.45	-0.73	-0.54	-0.49
				(-5.65)	(-3.24)	(-5.66)	(-4.58)	(-3.08)
IVOL					0.43			0.28
					(3.32)			(2.47)
STRev						-0.11		-0.10
						(-0.77)		(-0.79)
LTRev						0.73		0.52
						(3.62)		(3.53)
CMEVW							-0.43	-0.30
							(-5.24)	(-3.74)
R^2	0.0000	0.4772	0.5957	0.6754	0.7081	0.6942	0.7151	0.7383
No. of months	295	295	295	295	295	295	295	295
IR	-0.2599	-0.8555	-0.9735	-0.8147	-0.6524	-0.7966	-0.6380	-0.5594

Table D.3: (continued)

Panel C: W from months $(t-60)$—$(t-13)$								
	1	2	3	4	5	6	7	8
Intercept	0.03	-0.68	-0.73	-0.69	-0.58	-0.68	-0.57	-0.52
	(0.05)	(-2.82)	(-4.14)	(-5.12)	(-4.36)	(-4.64)	(-3.33)	(-2.53)
MktRF		1.48	1.34	1.31	1.19	1.31	1.22	1.16
		(19.02)	(19.39)	(16.37)	(16.83)	(14.00)	(17.80)	(15.05)
HML			-0.19	-0.22	-0.06	-0.26	-0.13	-0.05
			(-1.72)	(-2.96)	(-1.18)	(-2.07)	(-2.05)	(-0.37)
SMB			0.64	0.65	0.42	0.62	0.56	0.41
			(5.71)	(6.08)	(2.94)	(4.47)	(4.62)	(3.15)
MOM				-0.07	0.01	-0.08	-0.03	0.02
				(-0.98)	(0.19)	(-1.16)	(-0.38)	(0.27)
IVOL					0.18			0.14
					(4.09)			(2.38)
STRev						-0.03		-0.02
						(-0.24)		(-0.14)
LTRev						0.10		0.02
						(0.66)		(0.10)
CMEVW							-0.15	-0.10
							(-3.39)	(-2.46)
R^2	0.0000	0.7440	0.8332	0.8353	0.8480	0.8362	0.8460	0.8526
No. of months	247	247	247	247	247	247	247	247
IR	0.0117	-0.6012	-0.8095	-0.7695	-0.6639	-0.7611	-0.6570	-0.6044

Table D.3: (continued)

Panel D: L^* from months $(t-60)$—$(t-13)$								
	1	2	3	4	5	6	7	8
Intercept	0.88	0.21	0.11	0.20	0.35	0.22	0.34	0.40
	(1.74)	(0.71)	(0.44)	(0.77)	(1.36)	(0.84)	(1.27)	(1.49)
MktRF		1.40	1.25	1.17	1.03	1.15	1.06	0.98
		(19.36)	(18.57)	(17.88)	(14.04)	(16.12)	(13.51)	(12.35)
HML			0.03	-0.04	0.16	-0.22	0.06	0.02
			(0.36)	(-0.48)	(1.92)	(-2.35)	(0.85)	(0.23)
SMB			0.80	0.84	0.56	0.69	0.73	0.44
			(9.77)	(10.74)	(5.74)	(7.71)	(9.88)	(4.25)
MOM				-0.17	-0.06	-0.19	-0.12	-0.08
				(-2.46)	(-0.77)	(-2.62)	(-1.91)	(-0.97)
IVOL					0.23			0.17
					(4.70)			(3.30)
STRev						0.04		0.05
						(0.59)		(0.74)
LTRev						0.42		0.33
						(3.89)		(2.91)
CMEVW							-0.17	-0.10
							(-3.31)	(-1.85)
R^2	0.0000	0.6421	0.7528	0.7639	0.7829	0.7763	0.7779	0.7962
No. of months	247	247	247	247	247	247	247	247
IR	0.3880	0.1581	0.0941	0.1828	0.3313	0.2029	0.3207	0.3939

Table D.4: Calendar-time buy-and-hold portfolio returns of stocks that were constrained within months $t-60$ to $t-1$ prior to formation.
See caption to Table 3. The only difference here is a holding-period of 60 instead of 12 months.

	L^*	L^W	L^W-L^*	L	M	W	W-L	W-L^*
Panel A: Raw excess returns								
Average	0.50	0.11	-0.39	0.30	0.18	-0.02	-0.32	-0.52
	(0.95)	(0.20)	(-1.81)	(0.56)	(0.40)	(-0.04)	(-1.63)	(-2.11)
No. of months	247	247	247	247	247	247	247	247
AvgN	243	223		427	381	424		
SR	0.2108	0.0440	-0.2805	0.1301	0.0924	-0.0093	-0.2984	-0.4023
Panel B: CAPM regressions								
Intercept	-0.20	-0.61	-0.40	-0.41	-0.43	-0.74	-0.33	-0.53
	(-0.67)	(-1.69)	(-1.56)	(-1.40)	(-2.00)	(-2.93)	(-1.62)	(-2.18)
MktRF	1.48	1.51	0.03	1.50	1.28	1.51	0.01	0.03
	(18.57)	(20.64)	(0.43)	(26.80)	(24.53)	(16.64)	(0.09)	(0.25)
R^2	0.6525	0.5968	0.0010	0.6926	0.7522	0.7356	0.0001	0.0009
IR	-0.1442	-0.3763	-0.2924	-0.3150	-0.4523	-0.6289	-0.3021	-0.4133
Panel C: Four-factor regressions								
Intercept	-0.18	-0.60	-0.42	-0.40	-0.50	-0.78	-0.38	-0.59
	(-0.71)	(-2.41)	(-1.46)	(-2.01)	(-2.98)	(-5.09)	(-2.18)	(-2.76)
MktRF	1.20	1.19	-0.02	1.21	1.10	1.35	0.14	0.14
	(18.67)	(15.61)	(-0.22)	(22.50)	(21.55)	(14.97)	(1.18)	(1.33)
HML	-0.10	-0.49	-0.39	-0.26	-0.03	-0.28	-0.02	-0.18
	(-1.08)	(-4.63)	(-3.16)	(-3.22)	(-0.51)	(-2.86)	(-0.22)	(-1.74)
SMB	0.93	1.13	0.20	0.99	0.76	0.65	-0.34	-0.28
	(11.57)	(12.14)	(2.12)	(13.46)	(16.07)	(6.12)	(-2.36)	(-2.23)
MOM	-0.24	-0.18	0.06	-0.19	-0.05	-0.02	0.17	0.22
	(-3.53)	(-2.44)	(0.85)	(-3.46)	(-1.38)	(-0.29)	(2.13)	(2.17)
R^2	0.7946	0.8236	0.1211	0.8724	0.8932	0.8334	0.1171	0.1059
IR	-0.1693	-0.5607	-0.3202	-0.4796	-0.7976	-0.8343	-0.3673	-0.4848

Table D.5: Constrained 48-month (skipping 12) calendar-time buy-and-hold portfolios - Spanning.

This table shows spanning regressions for constrained calendar-time buy-and-hold portfolios containing constrained stocks from months $((t-60) — (t-13))$. Portfolio formation is described in the caption to Table 4. In columns 1 to 4 (columns 5 to 8) excess returns of constrained winners (losers) are regressed on the excess return of a portfolio of constrained losers (winners) as well as a portfolio that combines all five constrained portfolios with equal weight (Constr). The four Fama-French-Carhart factors are also included in some regressions. Newey and West (1987) t-statistics are shown in parentheses.

	W	W	W	W	L	L	L	L
Intercept	-0.37	-0.53	-0.34	-0.45	0.49	0.17	0.06	0.14
	(-2.24)	(-4.75)	(-2.66)	(-4.01)	(2.77)	(0.91)	(0.72)	(1.89)
L	0.87	0.37						
	(20.40)	(6.36)						
W					0.91	0.37		
					(14.33)	(2.90)		
Oth			0.99	0.58			1.09	1.17
			(23.94)	(7.23)			(91.90)	(26.36)
MktRF		0.84		0.62		0.73		-0.14
		(7.26)		(4.31)		(4.84)		(-2.58)
HML		-0.12		-0.13		-0.14		-0.08
		(-1.82)		(-2.19)		(-2.28)		(-2.00)
SMB		0.35		0.20		0.70		-0.06
		(3.66)		(2.25)		(5.51)		(-2.06)
MOM		-0.03		-0.04		-0.09		-0.05
		(-0.40)		(-0.52)		(-1.34)		(-2.48)
R^2	0.7928	0.8533	0.8358	0.8648	0.7928	0.8627	0.9725	0.9751

Table D.6: Characteristics of portfolios sorted on IOR, SIR and past-return. This table shows time-series averages of value-weighted mean characteristics of the 9 winner and 9 loser portfolios in the month of portfolio formation. Panel A displays the average number of stocks. Following are average market equity in billion US dollars (Panel B), return from month t-12 to the end of month t-2 in percent (Panel C), change in short interest from 11.5 months ago to 2 weeks ago in percentage points (Panel G), institutional ownership in percent of number of shares outstanding (Panel D) and the change over the preceding year (Panel E), level of short interest two weeks prior to portfolio formation (Panel F), the ratio of book equity of the previous December to last month's market equity in percent (Panel H) and the average standard deviation of daily idiosyncratic returns in each portfolio (daily, in %) over the month prior to formation (Ang, Hodrick, Xing, and Zhang, 2006, Panel I). Panels J and K show levels and changes over the preceding 12 months in turnover. Panel L presents the ratio of short interest to institutional ownership (SIRIO) as in Drechsler and Drechsler (2016). The open-interest weighted average of differences in implied volatilities between matched put and call option pairs at month-end, as in Cremers and Weinbaum (2010) is shown in Panel M. Panels N and O display the level and change (over the preceding 12 months) in the Markit Indicative loan fee, and Panels P and Q the level and change in the Markit simple average loan fee.

	Winners			Losers		
	Hi IOR	M	Lo IOR	Hi IOR	M	Lo IOR
Panel A: Number of stocks						
Lo SIR	27	129	203	17	125	269
M	187	263	117	98	219	164
Hi SIR	239	147	49	185	180	87
Panel B: Average Market Equity (B$)						
Lo SIR	22.22	112.29	20.25	10.50	61.07	16.14
M	38.37	78.45	13.71	16.00	57.99	6.18
Hi SIR	14.86	19.51	3.64	5.74	11.87	2.04
Panel C: Formation Period Return (%)						
Lo SIR	44	45	53	-25	-27	-33
M	45	45	59	-24	-27	-36
Hi SIR	57	62	85	-31	-34	-45
Panel D: Institutional Ownership (IOR, %)						
Lo SIR	78.17	48.77	13.71	77.33	47.37	12.43
M	77.67	55.34	16.64	77.64	53.64	15.66
Hi SIR	83.12	55.76	17.36	81.71	54.03	17.07

Table D.6: (continued)

	Winners			Losers		
	Hi IOR	M	Lo IOR	Hi IOR	M	Lo IOR
Panel E: Change in IOR over preceding year (PP)						
Lo SIR	3.85	1.93	-1.34	2.93	-0.67	-2.54
M	2.14	1.94	-1.61	0.62	-0.69	-3.52
Hi SIR	4.70	4.51	0.00	1.40	-0.79	-4.75
Panel F: Short-interest (SIR, %)						
Lo SIR	0.50	0.49	0.30	0.49	0.47	0.28
M	1.88	1.55	1.59	2.06	1.67	1.81
Hi SIR	7.27	6.61	7.66	8.28	7.44	8.25
Panel G: Change in SIR over preceding year (PP)						
Lo SIR	-0.61	-0.25	-0.23	-0.45	-0.34	-0.34
M	-0.51	-0.29	-0.18	-0.14	0.01	-0.23
Hi SIR	0.31	0.51	2.66	1.86	1.49	1.00
Panel H: Book-to-market ratio (%)						
Lo SIR	45	45	48	89	85	79
M	31	34	36	55	60	65
Hi SIR	31	31	29	60	65	68
Panel I: Idiosyncratic volatility (%, daily)						
Lo SIR	1.44	1.52	2.17	2.22	2.44	3.43
M	1.38	1.35	2.16	1.81	1.84	2.97
Hi SIR	1.79	1.92	3.09	2.21	2.42	3.69
Panel J: Turnover (%)						
Lo SIR	10.22	9.68	5.72	11.18	9.46	5.42
M	15.61	14.24	11.29	18.47	17.42	11.24
Hi SIR	29.56	28.85	36.77	32.44	30.72	29.50
Panel K: Change in turnover over preceding year (PP)						
Lo SIR	-0.49	-0.40	0.99	0.63	-0.33	-1.62
M	-0.63	-0.74	1.71	2.25	2.59	-2.09
Hi SIR	0.96	3.05	17.25	4.58	1.72	-6.12

Table D.6: (continued)

	Winners			Losers		
	Hi IOR	M	Lo IOR	Hi IOR	M	Lo IOR
Panel L: SIRIO (%)						
Lo SIR	0.62	0.82	8.62	0.56	0.98	13.70
M	2.35	2.73	27.86	2.54	3.05	47.57
Hi SIR	8.44	12.44	124.67	9.81	14.81	116.89
Panel M: Option volatility spread (%)						
Lo SIR	0.15	-0.23	-0.57	-0.13	0.20	-1.20
M	-0.35	-0.33	-1.21	-0.29	-0.17	-1.08
Hi SIR	-0.71	-1.27	-4.87	-1.00	-1.46	-5.32
Panel N: Ind.Fee (%)						
Lo SIR	0.41	0.44	1.09	0.65	0.55	2.28
M	0.41	0.41	1.21	0.43	0.43	2.04
Hi SIR	0.55	0.93	6.06	0.98	1.50	7.27
Panel O: Change in Ind.Fee over preceding year (PP)						
Lo SIR	-0.06	-0.06	-0.11	-0.02	-0.06	-0.00
M	-0.04	-0.07	-0.25	-0.03	-0.03	-0.19
Hi SIR	-0.22	-0.50	1.15	0.32	0.27	1.46
Panel P: Simple Avg. Fee (SAF, %)						
Lo SIR	0.27	0.32	0.88	0.31	0.30	1.94
M	0.30	0.32	0.73	0.31	0.32	1.25
Hi SIR	0.47	0.80	4.04	0.88	1.45	6.01
Panel Q: Change in SAF over preceding year (PP)						
Lo SIR	-0.14	0.04	-0.44	-0.10	-0.03	0.41
M	-0.01	-0.02	-0.23	-0.02	-0.02	-0.22
Hi SIR	-0.15	-0.56	0.24	0.25	0.27	1.79

Table D.7: Characteristics of portfolios sorted on residual institutional ownership (RIOR), SIR and past-return.

This table shows time-series averages of value-weighted mean characteristics of the 9 winner and 9 loser portfolios in the month of portfolio formation. The variables are the same as in Table D.6. However, here we sort on residual IOR (as in Nagel (2005)) instead of IOR.

	Winners			Losers		
	Hi RIOR	M	Lo RIOR	Hi RIOR	M	Lo RIOR
Panel A: Number of stocks						
Lo SIR	65	143	161	128	141	161
M	140	255	177	157	188	146
Hi SIR	168	175	94	176	177	103
Panel B: Average Market Equity (B$)						
Lo SIR	4.08	21.95	107.56	1.29	7.12	62.77
M	5.83	25.77	83.40	3.72	10.31	59.21
Hi SIR	4.52	13.15	25.78	2.48	5.46	14.66
Panel C: Formation Period Return (%)						
Lo SIR	48	47	46	-34	-30	-27
M	51	47	43	-30	-27	-26
Hi SIR	59	58	61	-33	-33	-33
Panel D: Institutional Ownership (IOR, %)						
Lo SIR	73.04	58.60	41.44	60.45	45.61	33.76
M	85.73	75.35	56.70	79.60	70.51	51.11
Hi SIR	90.31	75.87	52.49	86.17	71.57	47.33

Table D.7: (continued)

	Winners			Losers		
	Hi RIOR	M	Lo RIOR	Hi RIOR	M	Lo RIOR
Panel E: Change in IOR over preceding year (PP)						
Lo SIR	5.37	2.58	0.92	2.01	-0.11	-1.49
M	5.38	2.13	1.10	1.91	-0.05	-1.04
Hi SIR	7.41	4.84	1.18	2.59	0.49	-2.58
Panel F: Short-interest (SIR, %)						
Lo SIR	0.42	0.47	0.48	0.37	0.41	0.45
M	2.13	1.84	1.54	2.21	2.02	1.63
Hi SIR	8.76	6.47	6.30	9.42	7.50	7.08
Panel G: Change in SIR over preceding year (PP)						
Lo SIR	-0.52	-0.48	-0.26	-0.57	-0.48	-0.27
M	-0.62	-0.52	-0.30	-0.38	-0.23	0.07
Hi SIR	0.94	0.10	0.45	2.15	1.37	1.70
Panel H: Book-to-market ratio (%)						
Lo SIR	60	47	41	111	86	67
M	40	33	31	79	59	55
Hi SIR	32	31	30	66	61	63
Panel I: Idiosyncratic volatility (%, daily)						
Lo SIR	1.90	1.67	1.59	3.18	2.88	2.62
M	1.75	1.47	1.26	2.34	2.02	1.77
Hi SIR	1.99	1.86	1.80	2.41	2.34	2.34
Panel J: Turnover (%)						
Lo SIR	9.56	9.99	8.83	7.48	9.19	8.45
M	17.12	15.92	13.82	16.76	18.41	16.75
Hi SIR	32.03	29.09	30.22	31.89	32.19	31.85
Panel K: Change in turnover over preceding year (PP)						
Lo SIR	1.43	0.60	-0.54	-1.53	-1.35	-0.03
M	1.38	-0.29	-1.20	-0.01	1.16	2.81
Hi SIR	2.83	1.41	2.57	3.45	2.89	2.62

Table D.7: (continued)

	Winners			Losers		
	Hi RIOR	M	Lo RIOR	Hi RIOR	M	Lo RIOR
Panel L: SIRIO (%)						
Lo SIR	0.51	0.84	2.31	0.82	1.14	6.23
M	2.50	2.44	5.43	2.73	3.12	8.93
Hi SIR	9.95	9.23	45.66	11.18	11.46	51.96
Panel M: Option volatility spread (%)						
Lo SIR	0.19	0.11	-0.46	0.28	-0.10	-0.10
M	-0.45	-0.38	-0.30	-0.44	-0.27	-0.16
Hi SIR	-0.84	-0.85	-1.38	-1.04	-1.14	-1.96
Panel N: Ind.Fee (%)						
Lo SIR	0.50	0.50	0.49	0.88	1.12	0.82
M	0.42	0.42	0.45	0.49	0.48	0.53
Hi SIR	0.64	0.67	1.27	1.05	1.34	2.23
Panel O: Change in Ind.Fee over preceding year (PP)						
Lo SIR	-0.09	-0.08	-0.07	-0.19	-0.01	-0.04
M	-0.05	-0.06	-0.07	-0.05	-0.06	-0.03
Hi SIR	-0.21	-0.29	-0.57	0.34	0.28	0.43
Panel P: Simple Avg. Fee (SAF, %)						
Lo SIR	0.32	0.31	0.33	0.48	0.59	0.43
M	0.32	0.31	0.33	0.34	0.34	0.37
Hi SIR	0.54	0.58	1.07	0.93	1.26	2.05
Panel Q: Change in SAF over preceding year (PP)						
Lo SIR	-0.15	-0.05	0.01	-0.14	0.02	-0.11
M	-0.04	-0.03	-0.03	-0.03	-0.04	-0.03
Hi SIR	-0.16	-0.22	-0.67	0.31	0.28	0.28

Table D.8: Size distribution of constrained winner portfolio.
This table shows the number of stocks and the market-capizalization share of these stocks within the value-weighted constrained winner portfolio by size-quintile. The last four columns show excess returns, as well as CAPM-, FF3- and Fama-French-Carhart- (FFC) alphas of the five sub-portfolios split by size quintile.

Size quintile	No of stocks	Mkt.Cap-share	Exc. Return	CAPM-α	FF3-α	Carhart-α
1	7.54	1.47	-0.44 (-0.80)	-1.24 (-1.84)	-1.23 (-2.23)	-1.22 (-1.68)
2	16.58	10.64	-0.30 (-0.63)	-1.17 (-2.49)	-1.08 (-2.96)	-1.11 (-2.47)
3	17.01	26.33	-0.85 (-1.73)	-1.82 (-4.11)	-1.80 (-4.82)	-2.06 (-5.76)
4	9.28	32.89	-0.26 (-0.42)	-1.28 (-2.16)	-1.17 (-1.91)	-1.40 (-2.19)
5	2.17	28.67	0.65 (1.30)	0.12 (0.29)	0.22 (0.46)	0.02 (0.04)
All	52.58	100.00	-0.35 (-0.75)	-1.26 (-3.29)	-1.22 (-3.67)	-1.40 (-4.19)

Table D.9: Improving small-/medium-cap momentum strategies.
Shown are annualized Sharpe Ratios and monthly average excess returns as well as CAPM- and Fama-French αs of different momentum strategies. WML refers to the long-short "Winner minus Loser" portfolio and "Winners refers" to a long-only strategy that buys just past-winner stocks. "Regular" means that we form value-weighted portfolios from the universe of small- and medium-cap stocks, i.e., we exclude the 20% largest stocks in each cross-section. "Enhanced" means that we avoid constrained winners, i.e., winners that are in the top 30% of short-interest and bottom 30% of institutional ownership. The "difference" rows display statistics of a hypothetical strategy going long the enhanced and short the regular strategy. Newey and West (1987) t-statistics are shown in parentheses.

Portfolio	Style	Sharpe Ratio	Excess Return	CAPM-α	FF3-α
WML	Regular	0.78	1.21 (3.74)	1.46 (5.11)	1.52 (5.36)
	Enhanced	0.86	1.33 (4.08)	1.59 (5.57)	1.65 (5.80)
	Difference	1.27	0.12 (6.73)	0.14 (6.83)	0.13 (7.56)
Winners	Regular	0.76	1.31 (3.97)	0.59 (2.31)	0.58 (4.20)
	Enhanced	0.85	1.43 (4.36)	0.73 (2.84)	0.71 (5.03)
	Difference	1.27	0.12 (6.73)	0.14 (6.83)	0.13 (7.56)

E Robustness Checks

E.I Sort on Past-Return and SIRIO

Figure E.1: Annual four-factor alphas of constrained buy-and-hold portfolios. See caption to Figure 1. The only difference here is that we use one sort on SIRIO (ratio of short interest to institutional ownership) instead of the double sort on SIR and IOR to identify constrained stocks. We define constrained stocks as those with a SIRIO above the 95th percentile in a particular month, following Drechsler and Drechsler (2016).

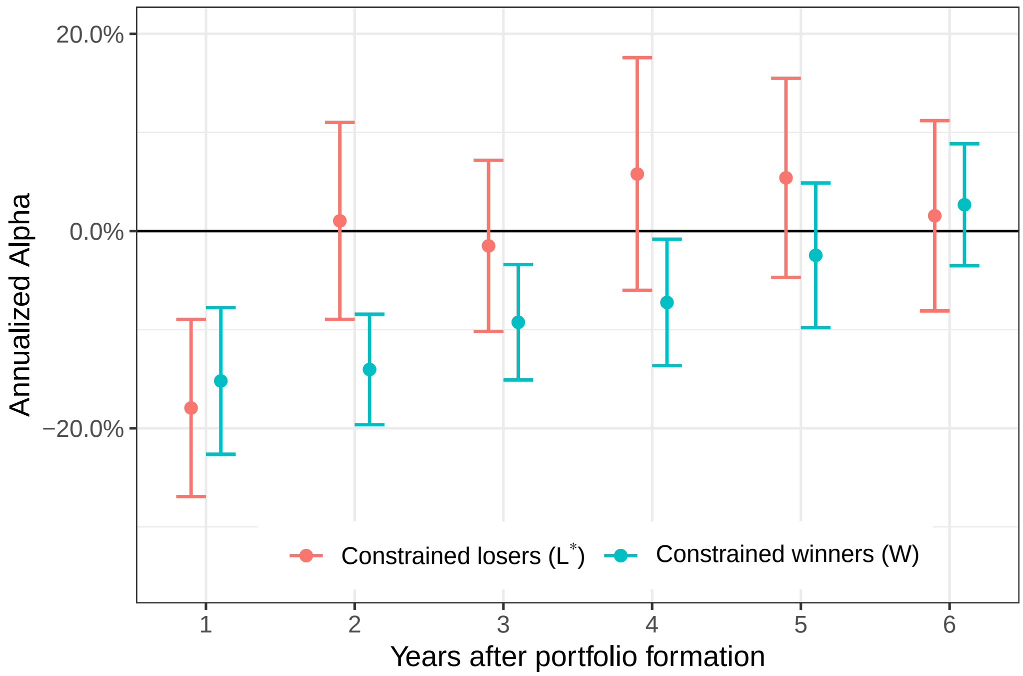

Table E.1: Calendar-time portfolio returns of stocks that were constrained within months $t-12$ to $t-1$ prior to formation.
See caption to Table 3. The only difference here is that we use one sort on SIRIO (ratio of short interest to institutional ownership) instead of the double sort on SIR and IOR to identify constrained stocks. We define constrained stocks as those with a SIRIO above the 95th percentile in a particular month, following Drechsler and Drechsler (2016).

	L^*	L^W	L^W-L^*	L	$M2$	$M3$	$M4$	W	W-L	W-L^*
Panel A: Raw excess returns										
Average	-0.81	-0.93	-0.11	-0.84	-0.06	-0.11	-0.22	-0.28	0.56	0.53
	(-1.30)	(-1.40)	(-0.32)	(-1.34)	(-0.13)	(-0.28)	(-0.55)	(-0.54)	(1.28)	(1.13)
No. of months	295	295	295	295	295	295	295	295	295	295
AvgN	141	130		267	198	152	146	183		
SR	-0.2536	-0.2955	-0.0548	-0.2727	-0.0252	-0.0514	-0.0960	-0.0998	0.2666	0.2162
Panel B: CAPM regressions										
Intercept	-1.94	-2.04	-0.10	-1.98	-0.96	-0.92	-1.12	-1.36	0.62	0.58
	(-4.09)	(-3.97)	(-0.24)	(-4.99)	(-3.28)	(-2.98)	(-3.56)	(-3.53)	(1.45)	(1.30)
MktRF	1.74	1.73	-0.01	1.77	1.39	1.24	1.39	1.67	-0.10	-0.07
	(15.79)	(12.83)	(-0.12)	(16.78)	(21.85)	(16.43)	(17.44)	(10.11)	(-0.56)	(-0.38)
R^2	0.4566	0.4713	0.0001	0.5122	0.5713	0.5116	0.5497	0.5426	0.0034	0.0013
IR	-0.8200	-0.8967	-0.0503	-0.9226	-0.6380	-0.6051	-0.7168	-0.7131	0.2975	0.2353
Panel C: Four-factor regressions										
Intercept	-1.49	-1.62	-0.13	-1.56	-0.78	-0.90	-1.06	-1.27	0.29	0.23
	(-3.91)	(-4.56)	(-0.34)	(-4.38)	(-3.29)	(-4.54)	(-4.21)	(-4.01)	(0.70)	(0.52)
MktRF	1.30	1.27	-0.03	1.32	1.10	1.03	1.16	1.44	0.12	0.14
	(13.37)	(14.03)	(-0.24)	(16.02)	(21.35)	(18.83)	(16.96)	(13.50)	(0.98)	(1.11)
HML	-0.03	-0.70	-0.67	-0.29	-0.15	0.06	-0.15	-0.55	-0.26	-0.51
	(-0.13)	(-5.57)	(-3.55)	(-1.44)	(-1.48)	(0.54)	(-1.53)	(-5.20)	(-1.10)	(-1.78)
SMB	1.34	1.43	0.10	1.40	1.14	1.20	1.12	1.05	-0.36	-0.29
	(5.86)	(8.75)	(0.87)	(6.64)	(9.69)	(7.89)	(7.28)	(6.71)	(-1.33)	(-1.04)
MOM	-0.69	-0.45	0.25	-0.58	-0.24	-0.06	-0.06	0.02	0.59	0.71
	(-4.82)	(-4.86)	(2.65)	(-4.92)	(-3.66)	(-0.99)	(-0.90)	(0.28)	(5.42)	(5.56)
R^2	0.6613	0.7251	0.1438	0.7383	0.7988	0.7668	0.7605	0.7204	0.1890	0.2192
IR	-0.7998	-0.9858	-0.0663	-0.9906	-0.7608	-0.8573	-0.9273	-0.8481	0.1556	0.1050

Table E.2: Calendar-time portfolio returns of stocks that were constrained within months $t-60$ to $t-13$ prior to formation.
See caption to Table 3. The only difference here is that we use one sort on SIRIO (ratio of short interest to institutional ownership) instead of the double sort on SIR and IOR to identify constrained stocks. We define constrained stocks as those with a SIRIO above the 95th percentile in a particular month, following Drechsler and Drechsler (2016).

	L^*	L^W	L^W-L^*	L	$M2$	$M3$	$M4$	W	W-L	W-L^*
Panel A: Raw excess returns										
Average	0.93	0.30	-0.63	0.73	0.36	0.40	0.46	0.08	-0.66	-0.86
	(1.55)	(0.50)	(-1.58)	(1.29)	(0.76)	(0.91)	(1.09)	(0.15)	(-2.37)	(-2.87)
No. of months	247	247	247	247	247	247	247	247	247	247
AvgN	278	228		468	414	355	345	417		
SR	0.3526	0.1094	-0.3301	0.2900	0.1743	0.2099	0.2289	0.0349	-0.5756	-0.5936
Panel B: CAPM regressions										
Intercept	0.19	-0.43	-0.62	-0.00	-0.29	-0.19	-0.16	-0.58	-0.58	-0.77
	(0.50)	(-1.03)	(-1.51)	(-0.00)	(-1.16)	(-1.01)	(-0.67)	(-2.17)	(-2.04)	(-2.26)
MktRF	1.57	1.55	-0.02	1.55	1.37	1.25	1.30	1.39	-0.16	-0.18
	(14.57)	(16.71)	(-0.21)	(17.21)	(24.15)	(29.57)	(21.26)	(17.50)	(-2.40)	(-2.05)
R^2	0.5882	0.5271	0.0002	0.6285	0.7443	0.7238	0.7057	0.6840	0.0318	0.0260
IR	0.1119	-0.2274	-0.3246	-0.0005	-0.2800	-0.1934	-0.1450	-0.4765	-0.5186	-0.5416
Panel C: Four-factor regressions										
Intercept	0.29	-0.48	-0.77	0.04	-0.38	-0.29	-0.24	-0.55	-0.59	-0.84
	(0.80)	(-1.70)	(-2.16)	(0.11)	(-1.88)	(-2.14)	(-1.63)	(-2.80)	(-2.06)	(-2.62)
MktRF	1.27	1.18	-0.09	1.26	1.22	1.08	1.13	1.15	-0.11	-0.12
	(13.05)	(17.04)	(-0.91)	(16.05)	(24.17)	(31.33)	(21.27)	(21.46)	(-1.79)	(-1.35)
HML	-0.08	-0.49	-0.41	-0.28	-0.05	0.02	-0.11	-0.45	-0.17	-0.37
	(-0.54)	(-4.58)	(-2.88)	(-2.52)	(-0.59)	(0.50)	(-1.81)	(-6.07)	(-1.68)	(-3.44)
SMB	0.82	1.40	0.58	0.93	0.73	0.82	0.80	0.77	-0.16	-0.05
	(5.13)	(16.73)	(3.57)	(7.51)	(12.57)	(15.91)	(17.25)	(11.13)	(-1.44)	(-0.37)
MOM	-0.37	-0.14	0.23	-0.22	0.00	-0.03	-0.02	-0.14	0.08	0.23
	(-3.20)	(-2.34)	(1.82)	(-2.97)	(0.01)	(-0.67)	(-0.42)	(-2.50)	(1.48)	(2.71)
R^2	0.6934	0.8046	0.2198	0.7671	0.8610	0.8853	0.8565	0.8472	0.0723	0.1622
IR	0.1995	-0.3930	-0.4563	0.0288	-0.4968	-0.4473	-0.3134	-0.6489	-0.5343	-0.6380

E.II Jegadeesh-Titman Calendar-Time Portfolios

Table E.3: Constrained 12-month Jegadeesh-Titman calendar-time portfolios. See caption to Table 3. The only difference here is that, to get the calendar-time portfolio return, each month, the portfolios formed in in each of the last 12 months are held with equal weight (following Jegadeesh and Titman, 1993), while within portfolios, stocks are still value-weighted.

	L^*	L^W	L^W-L^*	L	M	W	W-L	W-L^*
Panel A: Raw excess returns								
Average	-0.71	-0.55	0.16	-0.60	0.05	-0.29	0.31	0.42
	(-1.17)	(-1.00)	(0.40)	(-1.12)	(0.12)	(-0.67)	(0.83)	(0.98)
No. of months	295	295	295	295	295	295	295	295
AvgN	103	120		219	167	172		
SR	-0.2220	-0.2054	0.0797	-0.2202	0.0239	-0.1224	0.2002	0.1943
Panel B: CAPM regressions								
Intercept	-1.86	-1.51	0.35	-1.66	-0.78	-1.25	0.41	0.61
	(-4.61)	(-3.65)	(0.92)	(-4.60)	(-3.18)	(-4.20)	(1.08)	(1.48)
MktRF	1.77	1.49	-0.29	1.63	1.28	1.48	-0.15	-0.29
	(11.80)	(19.55)	(-2.63)	(16.11)	(20.70)	(14.57)	(-1.05)	(-1.49)
R^2	0.4783	0.4850	0.0304	0.5549	0.6805	0.5990	0.0150	0.0290
IR	-0.8046	-0.7901	0.1729	-0.9098	-0.7155	-0.8278	0.2657	0.2868
Panel C: Four-factor regressions								
Intercept	-1.31	-1.16	0.15	-1.25	-0.67	-1.21	0.04	0.11
	(-3.60)	(-3.65)	(0.37)	(-4.33)	(-3.22)	(-4.32)	(0.12)	(0.26)
MktRF	1.29	1.11	-0.19	1.22	1.09	1.28	0.06	-0.01
	(15.27)	(14.29)	(-2.40)	(16.11)	(18.71)	(20.27)	(0.69)	(-0.09)
HML	-0.25	-0.42	-0.18	-0.29	0.07	-0.23	0.06	0.02
	(-1.51)	(-3.98)	(-0.81)	(-2.15)	(0.65)	(-1.76)	(0.41)	(0.08)
SMB	1.27	1.23	-0.04	1.22	0.76	1.01	-0.21	-0.26
	(7.94)	(10.20)	(-0.31)	(10.21)	(13.99)	(10.10)	(-1.52)	(-1.41)
MOM	-0.77	-0.42	0.36	-0.55	-0.20	-0.00	0.55	0.77
	(-7.14)	(-5.17)	(2.61)	(-6.47)	(-4.53)	(-0.01)	(6.01)	(5.16)
R^2	0.6940	0.7212	0.1026	0.7842	0.8173	0.7767	0.2495	0.2693
IR	-0.7433	-0.8257	0.0791	-0.9828	-0.8105	-1.0731	0.0282	0.0574

Table E.4: Constrained 48-month (skipping 12) Jegadeesh-Titman calendar-time portfolios.

See caption to Table 4. The only difference here is that, to get the calendar-time portfolio return, each month, the portfolios formed in in each of the last 12 months are held with equal weight (following Jegadeesh and Titman, 1993), while within portfolios, stocks are still value-weighted.

	L^*	L^W	L^W-L^*	L	M	W	W-L	W-L^*
Panel A: Raw excess returns								
Average	0.85	0.23	-0.62	0.54	0.28	0.06	-0.48	-0.79
	(1.68)	(0.41)	(-2.76)	(1.04)	(0.64)	(0.12)	(-2.92)	(-3.66)
No. of months	247	247	247	247	247	247	247	247
AvgN	210	201		381	333	369		
SR	0.3776	0.0931	-0.4602	0.2412	0.1478	0.0274	-0.6075	-0.7500
Panel B: CAPM regressions								
Intercept	0.18	-0.46	-0.64	-0.14	-0.31	-0.62	-0.48	-0.80
	(0.60)	(-1.30)	(-2.19)	(-0.51)	(-1.41)	(-2.83)	(-2.84)	(-3.88)
MktRF	1.42	1.46	0.04	1.45	1.25	1.44	-0.01	0.01
	(19.77)	(18.25)	(0.56)	(24.55)	(25.03)	(24.94)	(-0.17)	(0.18)
R^2	0.6659	0.5869	0.0015	0.6977	0.7276	0.7762	0.0003	0.0003
IR	0.1363	-0.2916	-0.4746	-0.1176	-0.3152	-0.6241	-0.6017	-0.7562
Panel C: Four-factor regressions								
Intercept	0.18	-0.47	-0.65	-0.16	-0.39	-0.63	-0.47	-0.81
	(0.76)	(-1.96)	(-2.45)	(-0.83)	(-2.41)	(-4.85)	(-2.87)	(-3.41)
MktRF	1.18	1.15	-0.03	1.20	1.08	1.24	0.04	0.05
	(19.01)	(16.68)	(-0.36)	(23.43)	(21.95)	(29.31)	(0.70)	(0.89)
HML	-0.07	-0.50	-0.42	-0.26	-0.03	-0.15	0.11	-0.08
	(-0.90)	(-5.45)	(-3.65)	(-3.42)	(-0.62)	(-2.95)	(1.94)	(-0.94)
SMB	0.84	1.10	0.26	0.91	0.79	0.72	-0.19	-0.12
	(11.12)	(12.32)	(2.80)	(13.67)	(15.06)	(9.12)	(-2.64)	(-1.58)
MOM	-0.20	-0.14	0.06	-0.14	-0.05	-0.13	0.01	0.06
	(-2.79)	(-2.39)	(0.88)	(-2.40)	(-1.32)	(-2.70)	(0.06)	(0.68)
R^2	0.7917	0.8166	0.1583	0.8639	0.8824	0.8864	0.0809	0.0203
IR	0.1771	-0.4446	-0.5266	-0.1903	-0.5924	-0.8808	-0.6157	-0.7716

E.III Simple Value-Weighted Portfolios

Table E.5: Simple VW portfolios of stocks that were constrained within months $t-12$ to $t-1$ prior to formation.
See caption to Table 3. Here, we just include any stock, that falls into portfolio p at any point in time during the formation period (months $t-12$ to $t-1$ here) with the market equity at the end of the formation period $t-1$ as the weight. The main difference to the buy-and-hold approach is that a stock that fell into a portfolio more than once is only considered once.

	L^*	L^W	L^W-L^*	L	M	W	W-L	W-L^*
Panel A: Raw excess returns								
Average	-0.67	-0.60	-0.07	-0.63	-0.09	-0.21	0.42	0.46
	(-0.97)	(-1.11)	(-0.18)	(-1.07)	(-0.21)	(-0.46)	(1.17)	(1.04)
No. of months	295	295	295	295	295	295	295	295
AvgN	103	120		219	167	172		
SR	-0.2187	-0.2318	-0.0334	-0.2354	-0.0411	-0.0941	0.2772	0.2308
Panel B: CAPM regressions								
Intercept	-1.82	-1.60	-0.22	-1.71	-0.97	-1.15	0.56	0.67
	(-4.58)	(-4.54)	(-0.61)	(-5.31)	(-3.60)	(-4.40)	(1.63)	(1.67)
MktRF	1.78	1.54	0.24	1.67	1.37	1.45	-0.22	-0.33
	(11.54)	(17.29)	(2.36)	(12.91)	(18.23)	(21.74)	(-1.70)	(-2.17)
R^2	0.5305	0.5490	0.0231	0.5939	0.6434	0.6565	0.0311	0.0438
IR	-0.8711	-0.9182	-0.1137	-0.9974	-0.7663	-0.8784	0.3746	0.3472
Panel C: Four-factor regressions								
Intercept	-1.35	-1.31	-0.04	-1.32	-0.84	-1.11	0.21	0.23
	(-3.57)	(-4.24)	(-0.10)	(-4.12)	(-4.10)	(-4.14)	(0.68)	(0.65)
MktRF	1.38	1.20	0.17	1.29	1.15	1.29	-0.00	-0.09
	(12.42)	(13.30)	(1.61)	(13.01)	(21.50)	(25.50)	(-0.03)	(-0.83)
HML	-0.28	-0.22	-0.06	-0.26	0.01	-0.21	0.05	0.07
	(-1.18)	(-1.62)	(-0.25)	(-1.30)	(0.09)	(-1.63)	(0.29)	(0.36)
SMB	1.03	1.14	-0.11	1.06	0.90	0.82	-0.25	-0.22
	(7.98)	(11.87)	(-0.90)	(9.06)	(13.18)	(7.82)	(-2.03)	(-1.66)
MOM	-0.65	-0.39	-0.26	-0.54	-0.23	0.01	0.54	0.66
	(-6.26)	(-4.25)	(-2.55)	(-6.52)	(-4.95)	(0.08)	(7.24)	(6.27)
R^2	0.6959	0.7465	0.0602	0.7844	0.8019	0.7936	0.2670	0.2450
IR	-0.8007	-1.0030	-0.0191	-1.0545	-0.8839	-1.0998	0.1565	0.1352

Table E.6: Simple VW portfolios of stocks that were constrained within months $t-60$ to $t-13$ prior to formation.
See caption to Table 4. Here, we just include any stock, that falls into portfolio p at any point in time during the formation period (months $t-60$ to $t-13$ here) with the market equity at the end of the formation period $t-1$ as the weight. The main difference to the buy-and-hold approach is that a stock that fell into a portfolio more than once is only considered once.

	L^*	L^W	L^W-L^*	L	M	W	W-L	W-L^*
Panel A: Raw excess returns								
Average	0.70	0.12	0.59	0.47	0.29	-0.04	-0.51	-0.74
	(1.40)	(0.20)	(2.31)	(0.92)	(0.57)	(-0.08)	(-2.28)	(-3.08)
No. of months	247	247	247	247	247	247	247	247
AvgN	186	182		343	314	350		
SR	0.3304	0.0507	0.5267	0.2238	0.1328	-0.0192	-0.5029	-0.6484
Panel B: CAPM regressions								
Intercept	0.07	-0.56	0.63	-0.17	-0.38	-0.65	-0.48	-0.72
	(0.27)	(-1.83)	(2.59)	(-0.69)	(-1.43)	(-4.34)	(-2.21)	(-3.08)
MktRF	1.34	1.43	-0.09	1.37	1.42	1.31	-0.06	-0.04
	(23.98)	(20.66)	(-1.12)	(27.44)	(17.02)	(19.73)	(-0.83)	(-0.43)
R^2	0.6626	0.6566	0.0108	0.6974	0.7021	0.7974	0.0061	0.0019
IR	0.0556	-0.4198	0.5679	-0.1491	-0.3188	-0.7692	-0.4756	-0.6332
Panel C: Four-factor regressions								
Intercept	0.01	-0.60	0.60	-0.22	-0.46	-0.73	-0.51	-0.73
	(0.02)	(-2.83)	(2.62)	(-1.22)	(-2.33)	(-4.71)	(-2.59)	(-3.03)
MktRF	1.15	1.19	-0.04	1.15	1.28	1.24	0.09	0.09
	(17.17)	(21.38)	(-0.57)	(23.42)	(17.44)	(23.26)	(1.39)	(1.05)
HML	-0.01	-0.37	0.36	-0.15	-0.23	-0.07	0.08	-0.06
	(-0.15)	(-3.91)	(4.11)	(-1.98)	(-2.25)	(-1.15)	(1.08)	(-0.64)
SMB	0.85	0.94	-0.08	0.88	0.67	0.40	-0.48	-0.45
	(7.26)	(9.70)	(-1.18)	(10.21)	(10.21)	(6.66)	(-4.65)	(-3.42)
MOM	-0.08	-0.07	-0.01	-0.09	0.03	0.06	0.15	0.14
	(-1.47)	(-1.20)	(-0.19)	(-1.84)	(0.50)	(1.17)	(2.17)	(1.82)
R^2	0.7998	0.8458	0.1147	0.8597	0.8106	0.8490	0.2226	0.1432
IR	0.0054	-0.6663	0.5738	-0.2776	-0.4799	-0.9925	-0.5692	-0.6937

Table E.7: Simple VW portfolios of stocks that were constrained within months $t-60$ to $t-1$ prior to formation.
See caption to Table D.4. Here, we just include any stock, that falls into portfolio p at any point in time during the formation period (months $t-60$ to $t-1$ here) with the market equity at the end of the formation period $t-1$ as the weight. The main difference to the buy-and-hold approach is that a stock that fell into a portfolio more than once is only considered once.

	L^*	L^W	L^W-L^*	L	M	W	W-L	W-L^*
Panel A: Raw excess returns								
Average	0.41	-0.09	0.50	0.22	0.20	-0.06	-0.28	-0.47
	(0.75)	(-0.17)	(2.12)	(0.41)	(0.39)	(-0.15)	(-1.19)	(-1.89)
No. of months	247	247	247	247	247	247	247	247
AvgN	243	223		427	381	424		
SR	0.1830	-0.0407	0.4752	0.0978	0.0927	-0.0324	-0.2620	-0.3957
Panel B: CAPM regressions								
Intercept	-0.26	-0.80	0.53	-0.46	-0.47	-0.69	-0.23	-0.43
	(-0.99)	(-2.60)	(2.37)	(-1.80)	(-1.64)	(-4.10)	(-1.02)	(-1.72)
MktRF	1.41	1.48	-0.07	1.43	1.41	1.33	-0.09	-0.08
	(18.77)	(24.76)	(-0.88)	(22.15)	(15.09)	(21.83)	(-1.06)	(-0.77)
R^2	0.6768	0.6743	0.0066	0.7031	0.7034	0.8019	0.0130	0.0081
IR	-0.2080	-0.5982	0.5067	-0.3840	-0.3936	-0.8096	-0.2216	-0.3643
Panel C: Four-factor regressions								
Intercept	-0.25	-0.81	0.56	-0.45	-0.52	-0.78	-0.33	-0.53
	(-0.99)	(-3.64)	(2.37)	(-1.98)	(-2.54)	(-4.78)	(-1.46)	(-2.05)
MktRF	1.17	1.21	-0.04	1.16	1.25	1.27	0.10	0.10
	(14.61)	(20.00)	(-0.58)	(17.37)	(14.24)	(25.94)	(1.26)	(1.06)
HML	-0.07	-0.29	0.22	-0.18	-0.17	-0.10	0.08	-0.03
	(-0.52)	(-2.65)	(2.00)	(-1.52)	(-1.23)	(-1.55)	(0.90)	(-0.24)
SMB	0.84	0.98	-0.14	0.89	0.72	0.41	-0.47	-0.42
	(6.52)	(9.77)	(-1.64)	(7.93)	(12.66)	(7.01)	(-3.65)	(-2.93)
MOM	-0.21	-0.15	-0.06	-0.20	-0.03	0.08	0.28	0.29
	(-3.40)	(-2.18)	(-1.07)	(-3.51)	(-0.40)	(1.69)	(4.51)	(4.45)
R^2	0.8059	0.8524	0.0883	0.8588	0.8130	0.8600	0.2776	0.2014
IR	-0.2553	-0.8993	0.5511	-0.5390	-0.5560	-1.0796	-0.3683	-0.4971