Internal Cash Flows, Firm Valuation, and the Simultaneity of Corporate Policies*

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ABSTRACT

We outline a simple model in which optimizing firms choose corporate investment, external financing, and cash holding decisions simultaneously. The model generates predictions for the responsiveness of the above three corporate financial decisions to cash flow shocks and firm misvaluation, as well as new predictions for the cross-effects of misvaluation on the cash flow sensitivities of these corporate policy variables. We test all these predictions based on a large sample of public firms in the U.S. and find consistent evidence. Overall, by confirming the model's predictions for the signs of cash flow sensitivities, misvaluation sensitivities and cross-sensitivities for a number of different misvaluation measures, our model provides strong support for the notion that the wedge between the cost of external and internal finance affects corporate policies. Our estimation method follows Gatchev, Pulvino, and Tarhan (2010) in that we employ a dynamic simultaneous-equation model which is subject to the constraint that sources must equal uses of cash. However, contrary to Gatchev, Pulvino, and Tarhan's (2010) claims, we empirically show that this approach does not outperform the unconstrained static single-equation model as long as all corporate policy variables are defined consistently using the flow-of-fund data and all explanatory variables are either exogenous or predetermined.

***JEL classification*:** G21, G31, G32

***Keywords*:** Cash Flow, Mispricing, Financial Constraints, Investment, Cash Holdings, Simultaneity, Interdependence.

I. Introduction

The fact that in the presence of financial market imperfections, the cost of external finance can diverge from that of internally available funds has stimulated a substantial amount of research in the last two decades. One strand of literature examines how firms' financial policies, such as investment, cash holding and external financing decisions, are affected when the availability of internal funds changes.[1] A second strand of literature examines how some of these same corporate policies are affected when the firm's securities become misvalued, and in the process the cost of external finance changes.[2] In this paper, we argue that examining the cash-flow response of investment, cash holding, and external financing decisions when security misvaluation varies both in the time-series and in the cross-section is a useful way to understand how financial constraints, or the wedge between the cost of external and internal finance, affect corporate financial policies.

Specifically, we make the following contributions. First, unlike existing literature that treats these financial policies in isolation, we set up a simple model in which firms choose these policies simultaneously subject to the cash flow identity, namely, that the use of cash in the form of investment, dividend payout, increase in cash holding and reduction of external finance should equal internal cash flow. The

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[1] Among others, Fazzari, Hubbard, and Petersen (1988) document that corporate investment generally increases with internally generated cash flows, suggesting a positive investment-cash flow sensitivity. Almeida, Campello, and Weisbach (2004) show that firms increase cash holdings as cash flows increase, implying a positive cash-cash flow sensitivity. Almeida and Campello (2008) find that the use of external finance decreases with internal cash flows, indicating a negative external finance-cash flow sensitivity. These studies also document that the abovementioned cash flow sensitivities are more pronounced for financially constrained firms.

[2] Among others, Baker, Stein, and Wurgler (2003), Barro (1990), Chirinko and Schaller (2001), Gilchrist, Himmelberg, and Huberman (2005), Polk and Sapienza (2009), and Stein (1996) document that stock overvaluation is positively associated with corporate investment, suggesting a positive investment-mispricing sensitivity. Baker, Stein, and Wurgler (2003), Baker and Wurgler (2002), Graham and Harvey (2001), Hovakimian, Opler, and Titman (2001), Loughran, and Ritter (1995) and Jung, Kim, and Stulz (1996) find that stock overvaluation is positively related to the use of external finance, implying a positive external finance-mispricing sensitivity. Baker, Ruback, and Wurgler (2007) provide a comprehensive survey on how market misvaluation affects corporate policies.

model has an intertemporal element since we need to derive firm's cash holding decision, which is affected by anticipated future cash flow and investment policy. We derive how firms' financial decisions respond to cash flow shocks as well as changes in security misvaluation. More importantly, and possibly most unique to this analysis, we derive implications for how security misvaluation affects the so-called cash-flow sensitivities of investment, cash holdings, and external finance. We then test all the implications of the model concerning the cash flow sensitivities, misvaluation sensitivities, and cross-sensitivities of corporate policies, using several different measures of security misvaluation, and find very consistent results. To the best of our knowledge, ours is the only paper that derives all these implications from one framework and tests these on a large sample of firms.

One of the problems afflicting the financial constraint literature is the difficulty of obtaining unambiguous predictions regarding how a change in the degree of financial constraint affects the cash flow sensitivities of corporate policy variables. While a convex cost function for the deadweight cost of external finance implies a positive response of investment to cash flow shocks, the empirical literature, recognizing that cash flow could proxy for Tobin's Q in the investment equation, has focused attention on testing the prediction that the cash flow sensitivity of investment should be higher for financially more constrained firms. However, Kaplan and Zingales (2000) show that the effect of a change in the financial constraint parameter on the cash flow sensitivity of investment depends crucially on how the curvature of the cost function for external finance is affected by the change in financial constraints (which is unclear *a priori*) and third derivatives of the production and cost functions. As a consequence, it is not possible to reject the financial constraint hypothesis (i.e., the cost function for external finance is convex)[3] on the basis of how the cash flow sensitivity of investment differs (if at all) for financially constrained and unconstrained firms.[4]

In contrast, in our model, it is much easier to reject the financial constraint hypothesis. A change in the extent of security misvaluation affects the wedge between the cost of external and internal finance, and in this respect is similar to a change in the degree of financial constraint faced by the firm. However, an interesting feature of our model is that a change in misvaluation affects only the level, but not the slope, of the net marginal cost curve for external finance.[5] In other words, the curvature of the cost function for external finance is unaffected by firm misvaluation. We show that for fairly general specifications of the production function and the cost function for external finance, this feature allows us to obtain predictions regarding the sensitivity of financial policy variables to cash flow and misvaluation measures and, more importantly, for the cross-effects, that hold only if the financial constraint hypothesis is valid. We test these predictions empirically and find evidence strongly in support of the financial constraint hypothesis.

Our empirical strategy respects the simultaneous nature of the corporate decisions. Similar to Gatchev, Pulvino, and Tarhan (2010) (GPT hereafter), we test our models by both imposing the restriction that the cash-flow sensitivity coefficients across the various uses of cash flow should add up to unity, and without. Unlike GPT, however, we find that imposing the constraint makes no difference to our results. The

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[3] If the cost function of external finance is $C(e)$ and $C'(0) = 1$ (i.e., the marginal cost of external finance is equal to that of internal finance when no external finance is raised), convexity of $C(e)$ implies that there is a wedge between the cost of internal and external finance at any positive level of external finance.

[4] For example, if the cost function for external finance is of the form $C(E)=kE+E^2$, where k is a financial constraint parameter and E is external finance, it follows from equation (2) of KZ (2000) that cash flow sensitivity is invariant with respect to k; yet, $C''(E)>0$.

[5] The net cost of external finance is the gross (deadweight) cost due to information asymmetry minus the gain from security mispricing.

reason is simple: when variables are consistently defined and satisfy the cash-flow identity, imposing the constraint is redundant. Unlike GPT, we use data from Compustat Industrial Annual Files at any point between 1971 and 2008 and define uses and sources of cash using the cash flow statement (flow-of-funds) data. We find that it is crucial to solely rely on cash flow statements when defining financial policy variables. By doing so, the cash flow identity that sources of cash equal uses of cash automatically holds in our data. In contrast, GPT define different corporate policy variables using data from different sources, including balance sheet, income statement, and the cash flow statement. As a result, their sources-equal-uses identity is severely violated in the data.[6]

The predictions of our model for the effect of security misvaluation on cash flow sensitivities are novel and find strong support in our empirical tests. For example, the model predicts that firms exhibit a weaker negative relation between cash flow and external funds as its securities become more undervalued. In other words, if securities become more undervalued, firms will allocate a smaller fraction of available cash flow to retire (reduce) external capital. This may appear counter-intuitive: if we consider the external financing decision in isolation, it might seem that when external capital is undervalued, the net marginal cost of external finance is higher, and a firm should have a stronger incentive to reduce its dependence on the latter, leading to a stronger substitution (negative relation) between internal and external funds. However, a greater degree of undervaluation, in equilibrium, reduces

[6] GPT also replace missing values of the financial policy variables by zeros. This unusual treatment of missing values further worsens the cash-flow inequality since not all components in cash flow identity have missing values at the same time in a given firm-year. Further, GPT also argue that it is indispensible to take into account the intertemporal dependencies within and across corporate decision variables by including lagged corporate policy variables in the simultaneous-equation framework. However, our empirical analysis reveals that the inclusion of lagged dependent variables has no material impact on the coefficient estimates of key explanatory variables (e.g., cash flow and firm valuation), suggesting that the importance of the intertemporal nature of financial decisions is exaggerated by their unbalanced cash-flow identity and inconsistently defined variables.

investment and cash holding and thus the return from allocating cash to these uses increases. When cash flows increase, more is allocated to these uses and less is left for the reduction of external finance, leading to a weaker (less negative) cash flow sensitivity of external finance. This result highlights the importance of recognizing the interdependence and simultaneity of corporate financial decisions.

The rest of this paper is organized as follows. Section II outlines a simple model concerning the independent and joint impacts of cash flow and firm valuation on corporate policies. Our sample and data are described in Section III. Empirical results are reported Section IV. Robustness checks are performed in Section V. Section VI concludes the paper.

II. Model

The model we outline below is similar to the ‘reduced form” models of Froot, Scharfstein and Stein (1993) and Kaplan and Zingales (1997, 2000), and borrows some features of a model due to Polk and Sapienza (2009). We assume that a firm needs to optimally allocate cash flow to three uses: investment, addition to cash holdings and reduction of external finance. The gross cost of external finance is convex in the amount of external finance raised.[7] We initially assume that both the cost function for external finance and the production function can be approximated by linear-quadratic functions, and derive comparative static results that form the basis of our empirical analysis. Specifically, we derive the response of investment, cash holding and external financing to changes in cash flow, changes in security misvaluation, and the cross-effects (i.e., how the response of the investment, cash

[7] Froot, Scharfstein, and Stein (1992) show that such an external finance cost function can be derived from a version of the costly state verification (CSV) model.

holding and external financing to cash flow change with the level of misvaluation). We then show that for a more general class of production and cost functions, our comparative statics results are valid only if the cost function is sufficiently convex. As a result, these comparative static results can be a basis for the rejection of the null hypothesis of no financial constraint even under a general class of production and cost functions. [8] Finally, we present an alternative interpretation of our model in which the focus is on equity issuance (and repurchase) activity in response to shocks to the market value of equity. In this model, when equity becomes overvalued (undervalued), there are costs (benefits) to equity issuance associated with movements further away (closer) to a target capital structure. We show that if firms choose the optimal amount of issuance by trading off the benefit (cost) of issuing overvalued (undervalued) equity and the costs (benefits) of deviation (conformity) to target behavior, we get qualitatively very similar results to the main model.

A. Structure

A firm is endowed with assets in place which generate the net-of-dividend cash flows c_0 and c_t at time 0 and t, respectively, where $t \geq 1$.[9] We denote A as the value of the assets in place. The firm has access to two investment opportunities at time 0 and t. It can choose the level of investment I_i at time $i = \{0,t\}$ and generate an expected value of $f_i(I_i)$.[10] The function f_i follows the standard properties: it is

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[8] As explained below, our tests on the cross-effects err on the side of incorrectly rejecting the financial constraint hypothesis (convexity of the cost function) even when it is true (i.e., type II error), but not on the side of incorrectly rejecting the null of no financial constraints. (i.e., type I error).

[9] Since the optimality of a dividend payout policy is a complex issue, we ignore dividend payouts. In unreported tests, we do not find dividends to be very sensitive to cash flows or our misvaluation measures.

[10] We assume that the net working capital investment is proportional to the capital investment. Let K and x be the capital investment and the proportion of the net working capital investment to the capital investment, respectively. The total investment is $I=(1+x)K$. Moreover, without loss of generality and for notational simplicity, we assume the risk adjusted discount rate to be equal to zero, so that f_i represents the present value of the project.

increasing, concave and continuously differentiable for all $I_i \in R^+$. The true value of the firm is thus $V = A + \sum_{i=\{0.t\}} f_i(I_i)$. The market value of the firm at time *u* is

$$V_u = (1+\theta_u)\left(A + \sum_{i=\{0,t\}} f_i(I_i)\right),$$

where θ_u represents the per dollar unit of mispricing at time *u*, which is greater (less) than zero when the firm is over (under) valued. Below, we argue that this set-up is much more general than it may appear, since for *t=1* we can essentially treat $f_1(.)$ as a function representing the present value of cash flows at *t=1*, or a value function.

The firm can raise external financing by issuing securities in the financial market at time 0, and can also reduce external financing by repurchasing securities. The dollar amount of the external funds raised or reduced at time 0 is denoted by X, where X>0 (X<0) denotes external financing raised (reduced). Raising (reducing) external financing imposes (alleviates) incremental deadweight costs. Here, we focus on agency costs of debt and equity, since deadweight costs associated with mispricing are subsumed in the misvaluation parameter. [11] We assume that the incremental effects of external financing on the deadweight costs is represented by a function *h(X)*, where *h(.)* is increasing and convex, and *h(0)=0*. We assume that *h(X)>0* for *X>0*, i.e., *h(.)* represents a deadweight cost when the firm issues securities. On the other hand, *h(X)<0* for *X<0*, that is, the firm reduces deadweight costs by retiring securities. For brevity, here we do not distinguish between debt and equity financing. In Section II.F, we recognize the difference between debt and equity financing and discuss the implications of the distinction for our results.

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[11] See among others, Jensen and Meckling (1976), Jensen (1986), Greenwald, Stiglitz and Weiss (1984), Townsend (1979), and Gale and Hellwig (1985).

We denote $\hat{\theta}$ as the per dollar unit of mispricing at time 0 – positive (negative) values of $\hat{\theta}$ correspond to overvaluation (undervaluation). Following Stein (1996), we assume that the firm can gain from mispricing by raising (retiring) external capital at time 0 when it is overvalued (undervalued). However, a firm with good projects but not enough cash may issue securities even when it is undervalued, just as a firm with high deadweight cost may decide to retire overvalued external capital in the absence of good projects. The impact of market timing is equal to $\hat{\theta}X$.[12] Undoubtedly, the issuance or retirement of external funds can lead to the price-pressure effect. In particular, the price-pressure effect is greater for larger transactions. Stein (1996) argues that the price-pressure effect does not necessarily eliminate the market-timing gain on average, we thus assume a linear price-pressure function, ξX , which describes the impact of external financing on firm value and has $\xi \geq 0$ (<0) for $X \geq 0\ (<0)$.

Since shareholders may have short horizons, the firm may try to boost its short-run value by catering its investment to market sentiment (Polk and Sapienza (2009)). Following Polk and Sapienza (2009), we assume that the arrival of shareholders' liquidity needs follow an exponential process with the mean arrival rate being $\lambda \in [0, \infty)$ and that firm misvaluation disappears over time at the rate q (i.e. $\theta_u = \theta e^{-qu}$, where $\theta = \hat{\theta} - \xi$ is the net-of-price-pressure mispricing at the issuing date and θ_u represents the per dollar unit of mispricing at time u). While these

[12] Since we do not distinguish equity financing from debt financing, we essentially assume that both equity and debt can be subject to mispricing. There is extensive literature on equity misvaluation, but the research on debt timing is more limited. Previous studies (e.g., Flannery (1986), Wittenberg-Moerman (2008)) have suggested that long-term debt is subject to information asymmetry, which leaves the possibility that debt can be mispriced. However, it can be argued that debt is less likely to be mispriced than equity, because debt is generally easier to price than equity (i.e., the main uncertainty regarding the future cash-flows is the probability of default) and because participants in the debt markets are usually sophisticated institutional investors. Consistent with this prediction, Chang, Chen, and Hilary (2010) find that the benefits of timing equity issuance are more pronounced than the benefits of timing debt issuance.

assumptions on the time path of the misvaluation parameter and the arrival rates of shareholder liquidity needs follow the literature, all our results go through if we assume that the misvaluation is instantaneous and disappears immediately after security issuance and repurchase at time 0.

In this section, we restrict attention to $f(I)$ and $h(X)$ that are linear-quadratic, so that $f^{(n)}(I)=0$ and $h^{(n)}(E)=0$ for all $n \geq 3$. In section II.D, we relax this assumption and consider a wider class of functions.

B. Analysis

We now consider how firm misvaluation influences financial decisions. At time 0, an owner manager who may have liquidity needs, chooses the level of investment I_0, the amount of external financing X and the cash balance C to carry forward from time 0 until time t in order to finance investment I_t at time t. The owner manager makes optimal investment and financing decisions $\left(I_0, X, C, I_t\right)$ that maximize her expected profits at time 0:

$$\begin{aligned} \max_{I_0,C} \int_0^\infty \left(1+\theta e^{-qu}\right)\lambda e^{-\lambda u} f_0\left(I_0\right) du + \theta X - h\left(X\right) - I_0 \\ + \int_0^\infty \left(1+\theta e^{-qu}\right)\lambda e^{-\lambda u} f_t\left(I_t\right) du - I_t \end{aligned} \tag{1a}$$

$$\text{s.t.} \quad I_0 + C = c_0 + X\,, \tag{1b}$$

$$\text{and } I_t = c_t + C\,. \tag{1c}$$

The first order conditions (*FOCs*) of problem (1) are:

$$\left(1+a\theta\right) f_0'\left(I_0\right) + \left(\theta - h'\left(X\right)\right) = 1\,, \tag{2}$$

$$\left(1+a\theta\right) f_t'\left(I_t\right) + \left(\theta - h'\left(X\right)\right) = 1\,, \tag{3}$$

where $a = \dfrac{\lambda}{q+\lambda}$.

Notice from equation (1b) that a one dollar increase in c_0 can be used to increase either current investment or cash carried over to the next period, or reduce external finance. The first term in the left-hand-side of equations (2) and (3), respectively, indicates the marginal benefit from a one dollar increase in current investment, and cash carried over (the latter is evident from equation (1c)). The marginal benefit from each of these uses is equated to $1+h'(X)-\theta$, which for $X>0$ is the net marginal cost of external finance, or the marginal benefit of reducing external financing by one dollar. For $X<0$, we have analogous interpretations, with $1+h'(X)-\theta$ representing the marginal benefit of security repurchase (recall that $h'(X)$ now denotes the marginal reduction in deadweight cost) and $f'(I)$ representing marginal profits foregone. To facilitate discussion of subsequent results, we focus on the case of $X>0$, but analogous arguments apply for $X<0$.

Using equation (2), equation (3) can be rewritten as

$$f_0'\left(c_0+X-C\right)=f_t'\left(c_t+C\right). \tag{4}$$

Equation (4) indicates that the firm allocates funds across time by choosing the optimal level of cash holdings C, which equates the marginal cost of cash savings at time 0 with the expected marginal benefit at time t. The optimal corporate policies (I_0, X, C, I_t) can be solved simultaneously using equations (1b), (1c), (2) and (4).

The model setup considered here may appear restrictive since we are limiting investment to two periods only, period 0 and a later period, say period 1. However, rewrite (1a)-(1c) as

$$\max_{I_0,C}\int_0^\infty\left(1+\theta e^{-qu}\right)\lambda e^{-\lambda u}f_0\left(I_0\right)du+\theta X-h\left(X\right)-I_0$$
$$+\int_0^\infty\left(1+\theta e^{-qu}\right)\lambda e^{-\lambda u}f_1\left(C+c_1\right)du-C-c_1$$

s.t $I_0+C=c_0+X$.

Suppose $f_1(y)$-y represents the net present value of additional cash flows that can be generated if the firm has y dollars of liquidity at $t=1$ and follows its optimal strategy (which might involve investment and new financing at $t=1$ and any subsequent period). In other words, $f_1(y)$-can be thought of as a value function of a dynamic maximization problem under this more general interpretation. If this value function is increasing and concave, our analysis remains unchanged.

C. Misvaluation, Corporate Policies, and Cash Flow Sensitivities

We now derive the propositions regarding independent effects of cash flow and firm valuation on various corporate policies, followed by the proposition describing how cash flow and firm valuation jointly influence corporate policies. It is worth highlighting that all propositions are derived under the constraint that sources of cash equal uses of cash (constraints 1b and 1c), and that all corporate policies (I_0, X, C, I_t) are determined simultaneously.

By differentiating equations (2) and (4) with respect to c_0 and rearranging terms, we have Proposition 1 which outlines the independent effect of cash flow innovations on corporate policies.

Proposition 1. *In response to a cash flow innovation, the optimal corporate policies have the following properties:* $(a)\, dI_0 / dc_0 > 0$, $(b)\, dC / dc_0 > 0$, and $(c)\, dX / dc_0 < 0$.

Proof: see Appendix A1.

These results are standard and follow immediately from the fact that the firm optimally allocates cash flow across its different uses to equate the marginal returns.

By differentiating equation (2) with respect to θ and rearranging terms, we have

$$\frac{dI_0}{d\theta} = \frac{1 + af_0'}{h'' - (1 + a\theta) f_0''} - \frac{h''}{h'' - (1 + a\theta) f_0''} \frac{dC}{d\theta}. \tag{5}$$

Equation (5) concerns the impact of the change in firm misvaluation on current investment. Since current investment and cash holdings are two competing uses of funds, the impact of mispricing on investment hinges on how cash holdings react to mispricing, which is captured by the second term of equation (5).

Differentiating (4) with respect to θ and rearranging terms yield

$$\frac{dC}{d\theta} = \frac{f_0''}{f_t'' + f_0''} \frac{dX}{d\theta}. \tag{6}$$

Equation (6) indicates that the impact of mispricing on cash holdings depends on how external financing responds to mispricing. Collectively, equations (5) and (6) suggest that the effects of mispricing on various corporate policies are interrelated. The following proposition summarizes the impact of mispricing on corporate policies.

Proposition 2. *The impact of mispricing on corporate policies has the following properties:* (*a*) $dI_0 / d\theta > 0$, (*b*) $dX / d\theta > 0$, and (*c*) $dC / d\theta > 0$.

Proof: see Appendix A2.

Propositions 2(a) and 2(b) state that firms should invest more and raise more external capital as they become more overvalued. In addition, after taking into account the impact of mispricing on investment and external finance, our model (Proposition 2(c)) implies that firms will hold more cash as they become more overpriced.

We next derive results concerning how the cash flow sensitivities of corporate policies (investment, cash holding, and external financing) are affected as the extent of misvaluation changes. The following proposition describes the joint impact of cash flow and firm valuation on corporate policies.

Proposition 3. *The impact of mispricing on the cash flow sensitivities have the following properties:* $(a)\ \frac{d}{d\theta}\left(\frac{dI_0}{dc_0}\right) < 0$, $(b)\ \frac{d}{d\theta}\left(\frac{dX}{dc_0}\right) < 0$, and $(c)\ \frac{d}{d\theta}\left(\frac{dC}{dc_0}\right) < 0$.

Proof: see Appendix A3.

Propositions 3(a) and 3(c) suggest that when firms become more undervalued (overvalued), they will rely more (less) on internal cash flow to finance their investment and cash holdings. If the extent of financial constraints increases as the wedge between the costs of external and internal funds widens, firms should be more (less) financially constrained when they are undervalued (overvalued). Thus, Propositions 3(a) and 3(c) essentially predict that a lower firm valuation aggravates the extent of financial constraints, resulting in higher investment-cash flow and cash-cash flow sensitivities.

Proposition 3(b) indicates that the substitution between internal and external funds becomes weaker (stronger) as firm valuation decreases (increases). Intuition suggests that a decrease in firm valuation will increase the cost of external capital, thus firms should use more internal cash flows to retire external capital, leading to a stronger substitution between internal and external funds (i.e., the negative relation between internal and external funds should become more negative). In contrast, Proposition 3(b) suggests the opposite. This is because as firms become more undervalued, the net marginal cost of external finance increases, leading to lower external financing, lower investment and lower cash holding (and future investment). Thus, the marginal return from investment and holding cash is higher. After allocating additional cash to these uses, less cash is left for the reduction of external finance.[13] This result highlights the importance of recognizing the simultaneity of corporate financial decisions.

From a different perspective, Proposition 3 can also be interpreted as predictions concerning the impact of cash flow on the sensitivities of corporate policy variables to mispricing. Specifically, Proposition 3 predicts that the investment-mispricing, the external finance-mispricing, and the cash-mispricing sensitivities all decrease with internally generated cash flows, indicating that firms are less likely to take advantage of mispricing when their internal cash flows are high.

D. Summary of Empirical Implications and a General Class of Production and Cost Functions

While the results stated in Proposition 1 are the ones most directly related to the financial constraint hypothesis that $h''>0$, it has long been recognized that since cash flows are likely to proxy for investment opportunities, failure to find adequate proxies for the latter can bias the cash flow coefficients. Thus, it is difficult to reject the null hypothesis of no financial constraints based on tests of Proposition 1.

On the other hand, the results in Proposition 2, though implied by our model, are not directly related to the financial constraint hypothesis. Our model assumes that opportunities exist in the market for the firm's existing shareholders to benefit from misvaluation, and that the firm's managers recognize and exploit such misvaluation. The literature suggests several proxies for misvaluation. These proxies indicate when misvaluation is likely to exist. If these proxies were not related to misvaluation and

[13] Almeida and Campello (2008) find that the negative relation between internal and external funds is weaker for firms that are more financially constrained. They argue that it is because constrained firms mainly allocate internal funds to investment and cash holdings, rather than the reduction of external capital.

managers did not respond to actual or perceived misvaluation, there would be no reason for corporate policy to be affected by these proxies in a manner consistent with Proposition 2. Thus, our tests can reject the hypothesis that managers do not respond to actual or perceived misvaluation.

Consequently, the key tests of the financial constraint hypothesis come from Proposition 3. To arrive at Proposition 3, however, we imposed the rather stringent requirement that the production function and the deadweight cost function are in linear-quadratic form. However, Kaplan and Zingales (1997, 2000) point out that the cross-effects (i.e., the effect of financial constraint on cash flow sensitivities) are often ambiguous if the third-order derivatives cannot be signed. In the reduced-form model studied by Kaplan and Zingales (1997, 2000), since there are no clear predictions regarding the cross-partials when the deadweight cost function is not convex, the hypothesis of no financial constraints cannot be rejected based on tests that compare cash flow sensitivities across financially constrained and unconstrained firms.

We now show that in our framework, for a wide class of functions, the tests implied by Proposition 3 can reject the hypothesis of no financial constraints.

Proposition 4. *Suppose that the production function f(I) is Cobb-Douglas, i.e.* $f(I) = \frac{f}{\rho} I^{\rho}$ *where f>0 and ρ<1, and the deadweight cost function h(X) is a Power function of the form* $h(X) = \frac{h}{\beta} X^{\beta}$*, where h>0 and β>0. Then if h'''>0, a necessary condition for the results in Proposition 3 to hold is that h''>0.*

Proof: A proof is available from the authors on request.

Note that with the Power function, *h'''>0* except for *1<β<2*. However, if *1<β<2*, the cost function is convex, i.e. the financial constraint hypothesis holds, although the comparative static results of Proposition 3 need not hold in this case. Thus, if our empirical tests are not consistent with Proposition 3, we may be incorrectly rejecting the hypothesis of financial constraints (type II error). However, since the Proposition 3 results are only possible when the financial constraint hypothesis is valid (h''>0), we will not be incorrectly rejecting the null hypothesis of no financial constraints (type I error).

E. An Alternative Interpretation of Deadweight Costs

In this section, we provide an alternative interpretation of the deadweight costs *h(X)* that is motivated by the costs of deviation from a target capital structure. Here, we assume that equity is the only security that can be subject to mispricing.[14] Suppose at time 0, a firm that is at its target *market value* debt to equity ratio experiences a misvaluation shock θ. If θ>0, the equity is overvalued, and the firm now has a debt-equity ratio below target, whereas if θ<0, the firm has a debt-equity ratio above target. Notice that the firm that experiences a positive misvaluation shock has an incentive to time the market and issue equity; however, in the process it will move farther away from the target. We assume that if the firm deviates farther away from the target, it incurs a deadweight cost of *h(X),* which, as above, is assumed to be increasing and convex. In contrast, the firm with a negative misvaluation shock will make a loss if it issues equity but will reduce deadweight costs by *g(X)* – a benefit of equity issuance as it moves closer to the target. The function *g(X)* is assumed to be increasing and concave. Analogous arguments apply if a firm receiving a positive misvaluation shock repurchases equity (it incurs a loss on the repurchase but benefits from moving closer to target) or a firm experiencing a negative misvaluation shock repurchases equity (it

[14] The next subsection explores this case in more detail.

experiences a gain on the repurchase but moves further from the target). Since *g(X)* is concave and is a benefit function, it enters the firm's objective function with a positive sign whereas the convex cost function *h(X)* enters with a negative sign. Consequently, the analysis in this case is identical to the one considered above, with the magnitude of the cash flows and investment opportunities determining whether firms issue or repurchase equity.

F. Separating Debt and Equity Financing

So far, we have ignored the difference between debt and equity as external capital and assumed that both debt and equity can be mispriced. We now distinguish between debt and equity and assume that while there is no mispricing of debt, equity can be misvalued. Firms are assumed to pay off debt outstanding at time *t* if they borrow at time 0. However, we allow firms to default on debt obligations if they are insolvent.

Denote the amount of debt financing by *D* and let $g\left(D, c_0\right)$ be the cost of debt financing. Following the cost function *h*, we assume that *g* is an increasing and convex function of *D* and that the third order derivatives of *g* with respect to *D* is zero (i.e. $g_1 > 0$, $g_{11} > 0$ and $g_{111} = 0$). In addition, we assume that *g* depends also on the initial liquidity c_0. The idea is that c_0 affects the probability of default and the moral hazard costs associated with debt, hence it affects the cost of debt financing. Since an increase in initial liquidity reduces the probability of default and the moral hazard costs associated with debt, we assume that $g_2 < 0$, $g_{12} < 0$ and $g_{112} < 0$.[15] Under

[15] Essentially we assume that other things being equal, a firm with higher initial liquidity will have a lower and 'flatter' cost function of debt financing. As an example, it is easy to show that a quadratic cost of debt financing function $g(D, c_0) = (D/c_0)^2$ satisfies all the assumptions on *g*.

these assumptions, one can show that the signs of $\frac{dD}{dc_0}$ and $\frac{dD}{d\theta}$ become undetermined. In addition, if $\frac{dD}{d\theta} > 0$, it is even possible for $\frac{d^2E}{dc_0 d\theta} < 0$ but $\frac{d^2D}{dc_0 d\theta} > 0$. Thus, while the cash flow sensitivity of mispriced equity becomes more negative when equity is more overvalued, that for debt can become more positive. Appendix A4 provides the first-order conditions for a model that accommodates debt financing and detailed derivations.

III. Data and Variables

A. Data

Our sample selection is similar to that of Cleary (1999), Baker, Stein, and Wurgler (2003), and Almeida and Campello (2008). The sample consists of firms listed in the Compustat Industrial Annual Files at any point between 1971 and 2008. Our empirical analysis mainly uses the flow-of-funds data to define the cash-flow identity, we thus set the starting point of our sample at 1971, the year from which the flow-of-funds data are extensively reported in Compustat. Data on stock prices and returns are retrieved from the Center for Research on Security Prices (CRSP) Files.

Following common practice in the literature, we discard observations from financial institutions (SICs 6000-6999), utilities (SICs 4900-4999), not-for-profit organizations, and government enterprises (SICs greater than 8000).[16] We require firms to provide valid information on their total assets, sales growth, market capitalization, the change in cash holdings, investment, cash dividend, cash flows, and external financing. Following Almeida, Campello, and Weisbach (2004) and

[16] Utility firms, not-for-profit organizations, and government enterprises are excluded because they are heavily regulated. We discard financial firms since their financing decisions are likely affected by different factors (e.g., capital adequacy regulations) than nonfinancial firms.

Almeida and Campello (2008), we exclude firm-years for which the market value of assets is less than $1 million, those displaying asset growth exceeding 100%, and those with annual sales lower than $1 million in order to minimize the sampling of financially distressed firms.[17] These screens leave us with an unbalanced sample panel which consists of 64,021 firm-year observations (10,993 firms).

B. Variables concerning the sources and uses of funds

Our empirical analysis critically hinges upon the following cash flow identity defined using the flow-of-funds (cash-flow statement) data of Compustat:

$$\Delta Cash_t + Div_t + Inv_t - \Delta X_t = CF_t, \qquad (7)$$

where the uses of funds include investment (*Inv*), the change in cash holdings ($\Delta Cash$), and cash dividend (*Div*). The sources of funds comprise the internally generated cash flows (*CF*) and external finance (ΔX). External finance (ΔX) can be further decomposed into the net debt issuance (ΔD) and the net equity issuance (ΔE).

$$\Delta X_t = \Delta D_t + \Delta E_t$$

According to Compustat data manuals, it is important to consider the format code (*scf*) when defining variables using the flow of funds data. Effective for fiscal years ending July 15, 1988 the SFAS #95 requires U.S. companies to report the Statement of Cash Flows (format code = 7). Prior to adoption of SFAS #95, companies may have reported one of the following statements: Working Capital Statement (format code = 1), Cash Statement by Source and Use of Funds (format code = 2) and Cash Statement by Activity (format code = 3). Thus the variable

[17] Very small firms (market value of assets less than $1 million) are removed because they have severely limited access to public markets. Our results are essentially unchanged if we increase cutoff for defining very small firms from $1 million to $5 million. Firms experiencing extremely high growth are eliminated since they are typically involved in major corporate events, such as mergers and acquisitions.

definitions vary depending on which format code a firm follows in reporting the flow-of-funds data. Table 1 details the construction of variables in equation (7).

[Insert Table 1 here]

It is worth noting that, following recent studies on cash flow sensitivities (e.g., Bushman, Smith, and Zhang (2008), GPT, and Dasgupta, Noe, and Wang (2010)), we define cash flows (*CF*) as the operating cash flows, net of the change in working capital.[18] Bushman, Smith, and Zhang (2008) suggest that the cash flow measure used almost universally in the investment-cash flow literature is actually earnings before depreciation, which contains a true cash component (operating cash flows) and a non-cash component in the form of working capital accruals. They find that the investment-cash flow sensitivity documented in previous studies is mainly due to the naturally positive correlation between investment and working capital accruals.[19] By removing the effect of the change in working capital and focusing on cash flows from operations, we mitigate the concern that our results are driven by the correlations between the uses of funds (investment in particular) and working capital accruals. Following GPT, we assume cash flows (*CF*) to be exogenous and to be determined by the past investment and the current behavior of consumers and supplies' behavior.

C. Comparisons between our variables and sample and those of GPT

GPT examine intertemporal effects of financial decisions on investment-cash flow sensitivities using Compustat firms over the period 1952 to 2007. After

[18] For instance, for firms with format code = 7, *CF* is defined as income before extra items + extra items & discontinued operation + depreciation & amortization + deferred taxes + equity in net loss + gains in sale of PPE & investment + other funds from operation + exchange rate effect - the change in working capital (ΔWC). The definitions of *CF* for firms with other format codes are detailed in Table 1.

[19] Since the fixed assets investment normally gives rise to an increase in the scale of the firm, it is natural to expect corresponding increases in non-cash working capital items such as accounts receivables and inventories. However, as pointed out by Bushman, Smith, and Zhang (2008), this relation has little to do with financing constraints caused by capital market imperfections but rather is a manifestation of increasing scale.

removing financial and utilities firms, their empirical analysis is based on 237,412 firm-years, a sample much larger than ours. In addition, compared with our equation (7), their sources-equal-uses identity contains more variables as follows.

$$\Delta Cash_t + Div_t + CAPX_t + ACQUIS_t - ASALES_t - (EQISSU - RP)_t - (\Delta LTD + \Delta STD)_t = CF_t, \quad (8)$$

where *CAPX* is net capital expenditures, *ACQUIS* is acquisitions, *ASALES* is sale of assets and investment, *EQISSU* stands for equity issuances, *RP* represents equity repurchases, and *ΔLTD* and *ΔSTD* are net long-term debt issuances and net short-term debt issuances, respectively.

Our cash-flow identity (equation (7)) is less detailed than that of GPT (equation (8)) because several variables in equation (7) consolidate some of the items in equation (8). In particular, our measure of investment (*Inv*) aggregates capital expenditure (*CAPX*), acquisition (*ACQUIS*), and the sales of investment (*ASALES*). Our measure of net debt issuance (*ΔD*) captures funds from both short-term (*ΔSTD*) and long-term debt (*ΔLTD*) financing. In addition, *ΔE* is equal to the difference between two items in equation (8), *EQISSU* and *RP*. The purpose of consolidation is to simplify the empirical analysis and to ease exposition. Robustness checks (untabulated) indicate that our results remain qualitatively the same if we use equation (8) instead of equation (7), so long as all items are defined properly using cash flow statements.

Although the length of the cash-flow identity is unimportant, the definitions of variables in the identity do matter. To ensure that equation (7) holds in the data for each firm each year, we solely rely on cash flow statements (the flow-of-funds data) in defining variables. In contrast, GPT define variables in equation (8) using data from different sources. To be more specific, they use balance-sheet data to define

$\Delta Cash$, the change in net working capital, and long- and short-term debt issuances, use income-statement data to define cash flows (*CF*), and rely on cash-flow statement data to define equity issuances and repurchases, investment items and cash dividend (*Div*).[20] As a result, their sources-equal-uses identity generally does not hold in the data.

The disturbance to equality (8) is further magnified by GPT's treatment of missing values in defining variables. They replace missing values of the variables in equation (8) by zeros.[21] Due to this practice, their sample (237,412 firm-years) is much larger than ours (64,021 firm-years). This unusual treatment of missing values worsens the cash-flow inequality since not all components in equation (8) have missing values at the same time in a given firm-year.

Panel A of Table 2 reports summary statistics for cash-flow statement variables in equation (7) for our sample that has excluded observations with missing Compustat variables. All variables are deflated by the beginning-of-period total assets and have been winsorized at the top and bottom 1% of their distributions.[22] This approach reduces the impact of extreme observations by assigning the cutoff value to values beyond the cutoff point. Our results (not tabulated) are qualitatively very similar when we truncate the distribution instead of winsorizing it.

[Insert Table 2 here]

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[20] Variable definitions of GPT can be found in their Table III (page 737).

[21] For instance, without setting missing values to zero, their measure of cash flow (*CF*) can only be computed for 124,406 firm-years for 1952-2007 in Compustat because of missing values in operating income, interest expenses, taxes, or the change in net working capital. In addition, they define a few variables, such as *EQISSU* and *RP*, over the 1952-2007 period using cash-flow statement data, however, Compustat cash-flow-statement data is only available from 1971 onwards. Thus they set all missing values between 1952 and 1970 to zeros. In footnote 9 of their paper, GPT suggest that their results are not qualitatively affected if they drop observations with missing Compustat variables, instead of setting missing values to zeros. This is not surprising given that the identity is still violated because the variables are defined using data from different sources.

[22] This treatment of outliers actually leads to a mild violation of the cash flow identity because not all flow-of-funds variables are winsorized at the same time in a given firm-year. This explains why in Table 2 we observe a small fraction of firms having a slightly unbalanced cash flow identity.

On average our sample firms invest (*Inv*) 9.9%, increase cash holdings (Δ*Cash*) by 1%, and pay out as dividend (*Div*) 1% of the beginning-of-period assets. To finance these uses of funds, an average firm in our sample taps external capital markets by issuing debt and equity that amounts to 2.1% and 3.1% of the beginning-of-period assets, respectively. The gap between the uses of funds and external financing is met by internally generated cash flows (*CF*), which accounts for 6.8% of the beginning-of-period assets. Except for dividend (*Div*), all flow-of-funds variables exhibit significant variation, ranging from large negative to large positive values.[23]

To examine whether the cash-flow identity holds in our data, we define $DIF^{Equation\ 7}$ as the difference between the left-hand side and the right-hand side of equation (7). The mean, median, and standard deviation of $DIF^{Equation\ 7}$ are 0.001, 0, and 0.004, respectively, suggesting that our cash flow identity (equation (7)) holds up well in the data.[24]

To contrast our sample with that of GPT, we define variables in equation (8) by closely following their variable definitions and using data from different sources, i.e., income statement, balance sheet, and cash-flow statement. By following their sampling process and setting missing values of variables in equation (8) to zero, we end up with 221,119 firm-years, similar to the size of their sample (237,412 firm-years). Panel B of Table 2 reports the summary statistics of variables in this sample, which are comparable to those reported in Table IV of GPT.[25] We also tabulate the statistics of $DIF^{Equation\ 8}$ defined as the difference between the left-hand side and the

[23] Our sampling approach and variable definitions closely follow the literature, thus the figures reported in Table 1 resemble those in previous studies, including Frank and Goyal (2003) and Almeida and Campello (2008).
[24] However, we do have around 1% of observations with $DIF^{Equation\ 7}$ greater than 0.01. The largest value of $DIF^{Equation\ 7}$ is 0.089 in our sample. These non-zero values are mainly due to rounding errors, misrecorded data, or the winsorizations.
[25] The figures reported in Panel B are not identical to those in Table IV of GPT partly due to the difference in sample size, the way of handling extreme observations (winsorization), and the variable used deflate variables in equation (8) (the beginning-of-period total assets or the end-of-period total assets).

right-hand side of equation (8). The results reveal that, although the mean and median values of $DIF^{Equation\ 8}$ are close to zero (0.013 and 0.001, respectively), its distribution is dispersed with standard deviation equal to 0.396. Additional statistics (untabulated) indicate that the sample contains roughly 76% (25%) of observations with the absolute value of $DIF^{Equation\ 8}$ larger than 1% (10%) of total assets, confirming our conjecture that the cash flow identity (equation (8)) generally does not hold in the data of GPT.

D. Measures of stock valuation

A challenging part of our analysis is to find a good proxy for stock valuation, especially the mispricing component or the nonfundamental component of stock prices. Following Baker, Stein, and Wurgler (2003), we start by using *Q* to capture mispricing. We measure *Q* using the market-to-book assets ratio (*MB*) defined as

$$MB = \frac{E^m - E^b + A^b}{A^b},$$

where *E*, and *A* stand for equity and assets, respectively, and superscripts *b* and *m* denote book and market values.

As pointed out by Baker, Stein and Wurgler (2003), *Q* (or *MB*) potentially contains three sources of variation: (1) mispricing; (2) information about the profitability of investment; (3) measurement error arising from accounting discrepancies between book capital and economic replacement costs. Our main focus is on the first of these components, but the other two can color our inferences.

To get around the abovementioned problems, we again follow Baker, Stein, and Wurgler (2003) and use future realized stock returns (*FRet*), defined as stock returns over the next three years multiplied by (-1), as an alternative proxy for stock misvaluation, The motivation behind the use of this measure is that future realized returns, as noisy estimates of future expected returns, should be at least partly determined by the extent to which stock prices currently deviate from the intrinsic stock values. We multiply the return by (-1) to ease the interpretation.[26] Thus, the high (low) value of *FRet* suggests a stock is currently overvalued (undervalued), similar to the market-to-book ratio (*MB*).

In Section 5, as a robustness check, we test the hypotheses derived from our model by extracting the nonfundamental component from Tobin's *Q* following two empirical methodologies developed by Rhodes-Kropf, Robinson, and Viswanathan (RKRV hereafter) (2005) and Dong et al. (2006).

E. Control variables

We also incorporate the following control variables in regressions. We include the log of the book value of assets, *Ln*(*Assets*), as a proxy for firm size. The sales growth (*SalesG*) is included to capture a firm's growth prospects. Companies having more tangible assets are expected to invest more in fixed assets and support more debt as these assets can be pledged as collateral. The net PPE-to-asset ratio (*Tangibility*) is used to measure the tangibility of the firm's assets. We also include the leverage ratio (*Leverage*) - defined as total debt (the sum of short-term and long-term debt) divided by total assets. The importance of controlling for firm leverage is suggested by Lang, Ofek, and Stulz (1996), who find that investment is negatively related to leverage, particularly for highly leveraged firms and firms with low Tobin's *Q*. Panel C of Table 2 reports the descriptive statistics for these control variables and proxies for stock valuation. Dollar values are adjusted to the 2000 dollar value using a GDP deflator.

[26] Since this measure requires firms to have stock return data in the next three years, it can only be computed for 43,496 firm years.

[Insert Table 2 here]

Table 3 reports the correlation coefficients between key variables of our interest. Univariate correlations indicate that investment is positively correlated with cash flows (*CF*) and external financing (*ΔD* and *ΔE*). In addition, Table 2 indicates a significant positive correlation between our two main proxies for stock valuation, *MB* and *FRet* (the correlation coefficient = 0.11). Both proxies are positively correlated with the uses of fund (*Inv*, *ΔCash,* and *Div*) and the amount of external financing (*ΔX*), and negatively related to internal cash flows (*CF*).

[Insert Table 3 here]

IV. Empirical results

A. Non-parametric analysis

Table 4 reveals how stock valuation and cash flows jointly affect corporate policies. In Panel A, firms are sorted into 5 groups according to the market to book ratio (*MB*) and cash flows (*CF*), respectively (independent sorts). Average values of variables are reported for each *MB-CF* group. In Panel B, firms are sorted into 5 groups according to *FRet* and *CF*, respectively (independent sorts). Average values of variables are reported for each *FRet-CF* group.[27]

[Insert Table 4 here]

Table 4 suggests that investment and cash holdings increase with both stock valuation and cash flows, whereas external financing increases with stock valuation and decreases as cash flows increase. These findings are consistent with the first-order effects implied by our model (Propositions 1 and 2). More importantly, we find that the impact of cash flows on investment (external financing) is more (less) pronounced

[27] We obtain similar findings using other misvaluation proxies defined in Section 5 to sort firms. The results are not tabulated but available upon request.

for firms with low equity valuation.[28] These findings are consistent with Proposition 3 which predicts that firms rely more on their internal cash flows to finance investment and the substitution between internal fund and external financing is weaker for firms with low equity valuation. However, the impact of cash flows on cash holding does not display a stark difference between firms with low and high equity valuation in this nonparametric analysis.[29]

B. Static stand-alone equations versus static simultaneous equations

Table 5 estimates our baseline empirical models in which we regress different corporate policies (e.g., investment, the change in cash holdings, cash dividend, and external financing) on cash flows (*CF*), market to book ratio (*MB*) using a proxy for stock valuation, and other control variables (*Y*). We also include firm dummies (f) to control for unobserved heterogeneity and year dummies (*y*) to control for time effects. The regression equations are written as follows.

$$Inv_{it} = \alpha^{Inv} CF_{it} + \beta^{Inv} MB_{it-1} + \gamma^{Inv} Y_{it-1} + f_i + y_t + \varepsilon_{it}^{Inv} \tag{9}$$

$$\Delta Cash_{it} = \alpha^{\Delta Cash} CF_{it} + \beta^{\Delta Cash} MB_{it-1} + \gamma^{\Delta Cash} Y_{it-1} + f_i + y_t + \varepsilon_{it}^{\Delta Cash} \tag{10}$$

$$Div_{it} = \alpha^{Div} CF_{it} + \beta^{Div} MB_{it-1} + \gamma^{Div} Y_{it-1} + f_i + y_t + \varepsilon_{it}^{Div} \tag{11}$$

$$\Delta X_{it} = \alpha^{\Delta X} CF_{it} + \beta^{\Delta X} MB_{it-1} + \gamma^{\Delta X} Y_{it-1} + f_i + y_t + \varepsilon_{it}^{\Delta X}, \tag{12}$$

where the superscripts of coefficients (α, β, and γ) denote different equations.

We also decompose external finance (ΔX) into ΔD *and* ΔE and estimate the impact of cash flows and stock valuation on net debt and equity issued separately.

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[28] Investment experiences 13-fold increase (from 1% to 13% of the beginning-of-period assets) when we move from the lowest *CF* group to the highest *CF* group when stock valuation is low (*MB* group = 1), while the increase is less than 100% when stock valuation is high (*MB* group = 5). External financing decreases 9% of the beginning-of-period assets when we move from the lowest *CF* group to the highest *CF* group when stock valuation is low, while the decrease is 30% when stock valuation is high.

[29] For both low and high equity valuation firms, the cash holdings increases 9% of the beginning-of-period assets when we move from the lowest *CF* group to the highest *CF* group.

$$\Delta D_{it} = \alpha^{\Delta D} CF_{it} + \beta^{\Delta D} MB_{it-1} + \gamma^{\Delta D} Y_{it-1} + f_i + y_t + \varepsilon_{it}^{\Delta D} \quad (13)$$

$$\Delta E_{it} = \alpha^{\Delta E} CF_{it} + \beta^{\Delta E} MB_{it-1} + \gamma^{\Delta E} Y_{it-1} + f_i + y_t + \varepsilon_{it}^{\Delta E}, \quad (14)$$

Panel A of Table 5 reports results obtained by estimating equations (9)-(14) as stand-alone equations. To estimate regressions with firm fixed effects, we demean dependent and independent variables in equations (9)-(14).[30] The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic-consistent errors.

Consistent with our Propositions 1 and 2 and previous studies, Panel A reveals that investment and cash holding increase with both stock valuation and cash flows, whereas external financing increases with stock valuation and decreases with cash flows.[31] By comparing the estimated coefficients of *MB*, $\beta^{\Delta D}$ and $\beta^{\Delta E}$ in columns (5) and (6) (0.01 vs. 0.03), we find that the impact of stock valuation (*MB*) on debt financing is less pronounced than that on equity financing. This result is consistent with the idea that debt is generally less informationally sensitive and therefore less likely to be mispriced than equity. Thus, firms are more likely to issue equity as opposed to debt in response to high stock valuations. Moreover, we document that dividend (*Div*) is not highly responsive to all explanatory variables in column (3). The absolute values of coefficients on explanatory variables in column (3) all do not exceed 1%, consistent with the dividend-smoothing practice and the general perception that corporate dividend is sticky.

[Insert Table 5 here]

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[30] Alternatively, we also estimate regressions by including firm dummies. Not surprisingly, the resulting coefficients and *t*-statistics are identical to those obtained by demeaning variables. However, the estimation with firm dummies generally has a higher R-squared than the demean approach since the former explains the level of the dependent variable, while the latter explains the deviation of the dependent variable from the firm-specific mean.

[31] These results are documented in, among others, Fazzari, Hubbard, and Petersen (1988), Almeida, Campello, and Weisbach (2004), and Almeida and Campello (2008), Baker, Stein, and Wurgler (2003), Polk and Sapienza (2009) .

Importantly for our purpose, we find that in Panel A, $\alpha^{Inv} + \alpha^{\Delta Cash} + \alpha^{Div} - \alpha^{\Delta X} = 1$. For other explanatory variables, we have $\beta^{Inv} + \beta^{\Delta Cash} + \beta^{Div} - \beta^{\Delta X} = 0$, and $\gamma^{Inv} + \gamma^{\Delta Cash} + \gamma^{Div} - \gamma^{\Delta X} = 0$. In addition, for all independent variables, the coefficients in columns (5) and (6) add up to the coefficient in column (4), namely, $\alpha^{\Delta D} + \alpha^{\Delta E} = \alpha^{\Delta X}$, $\beta^{\Delta D} + \beta^{\Delta E} = \beta^{\Delta X}$, and $\gamma^{\Delta D} + \gamma^{\Delta E} = \gamma^{\Delta X}$. It is important to highlight that we obtain these results *without* simultaneously estimating equations (9)-(14) and *without* imposing any linear constraints on the estimation. However, this result is natural, rather than surprising, since they are implied by the underlying cash flow identity (equation (7)) which holds by definition in the data (Dasgupta, Noe, and Wang (2010)).

GPT argue that examining corporate decisions in isolation using the static single-equation framework may lead to inefficient coefficient estimates. To incorporate the interrelated corporate decisions into the empirical analysis, they propose that it is crucial to impose the following linear constraints and estimate all equations simultaneously.

$$\alpha^{Inv} + \alpha^{\Delta Cash} + \alpha^{Div} - \alpha^{\Delta X} = 1 \tag{15}$$

$$\beta^{Inv} + \beta^{\Delta Cash} + \beta^{Div} - \beta^{\Delta X} = 0 \tag{16}$$

$$\gamma^{Inv} + \gamma^{\Delta Cash} + \gamma^{Div} - \gamma^{\Delta X} = 0 \tag{17}$$

$$\alpha^{\Delta D} + \alpha^{\Delta E} = \alpha^{\Delta X} \tag{18}$$

$$\beta^{\Delta D} + \beta^{\Delta E} = \beta^{\Delta X} \tag{19}$$

$$\gamma^{\Delta D} + \gamma^{\Delta E} = \gamma^{\Delta X} \tag{20}$$

Constraint (15) reflects the accounting identity that sources of cash equal uses of cash. In other words, a one dollar increase in internal cash flows needs to be used to increase investment, increase cash holdings, pay cash dividends, or repurchase outstanding debt or equity. Constraints (16) and (17) stipulate that the total response across different sources and uses of cash must sum up to zero if the shock stems from an exogenous or predetermined variable that represents neither a source nor a use of funds in the current period.[32] Constraints (18)-(20) are trivial given that $\Delta X = \Delta D + \Delta E$. Using our data, we then estimate the simultaneous equations (9)-(14) with the linear constraints (15)-(20) and report the results in Panel B of Table 5. Perhaps the most striking result is that the estimated coefficients (α, β, and γ) and R-squared in Panel B are almost identical to those in Panel A.[33] Our findings in Table 5 clearly suggest that it is unnecessary to impose linear constraints on the estimation of static simultaneous equations so long as the cash-flow identity holds in the data. In addition, stand-alone equations are not any worse than simultaneous equations when one estimating *static* models which include no lagged dependent variables as explanatory variables.

C. Dynamic stand-alone equations verus dynamic simultaneous equations

If simultaneous equations do not outperform single equations in estimating static models, do dynamic model estimations make simultaneous equation a better choice in capturing the impact of cash flows and firm valuation on corporate decisions? GPT argue that it is indispensible to take into account the intertemporal dependencies within and across corporate decision variables. For example, apart from commonly used determinants of investment (for instance, *CF*, *Q*, and leverage ratio), the current investment of a company may be affected by the investment made last year, and the change in cash holdings, and debt or equity issued last year. Without incorporating

[32] For instance, suppose the coefficient of *MB* is 0.1 in equation (9), suggesting that investment increases by 10% of total assets if *MB* increases by one. Since investment is a use of funds and total uses of funds must be equal to total sources of funds, the net effect of the increase of *MB* on other use and source variables must sum to -10% of total assets.

[33] Note that the *t*-statistics in Panel B are much larger than those in Panel A of Table 5 because we adjust standard errors for heteroskedasticity in Panel A, while the same adjustment cannot be done in the framework of simultaneous equations. We have tried to estimate regressions in Panel A without adjusting standard errors for heteroskedasticity and obtained *t*-statistics very similar to those reported in Panel B.

lagged dependent variables into equations (9)-(14), the estimation of simultaneous equation may suffer from model misspecification and omitted variable biases.

Thus, to account for the interdependent nature of corporate policies, we include lagged dependent variables ($Inv_{t\text{-}1}$, $\Delta Cash_{t\text{-}1}$, $Div_{t\text{-}1}$, $\Delta D_{t\text{-}1}$, and $\Delta E_{t\text{-}1}$) in equations (9)-(14).[34] We estimate five equations as stand-alone equations in Panel A of Table 6. Panel B of Table 6 reports the results obtained by estimating the system of five equations, which is subject to the constraint that cash flow coefficients (α) add up to one across equations, and coefficients of other explanatory variables, including five lagged dependent variables, sum to zero across equations.

[Insert Table 6 here]

Because both panels of Table 6 consider the interdependencies of corporate policies by including lagged dependent variables, and because they include the same set of explanatory variables, the differences in coefficients between two panels can only be attributed to the difference between unconstrained dynamic stand-alone equations and constrained dynamic simultaneous equations. However, we find that the coefficients in Panel A and Panel B are almost identical. This result not only confirms our earlier inference that linear constraints are redundant if the cash-flow identity holds in the data, but also reveals that simultaneous equations estimates and single-equation estimates are almost identical even for dynamic models if the right-hand-side variables in all equations are either exogenous (for example, *CF*) or pre-determined (for example, *MB* and lagged dependent variables).

Most coefficients of lagged dependent variables are statistically significant in Table 6, consistent with the intertemproral nature of financial decisions and the interdependence among corporate policies. However, by comparing the coefficients

[34] Note that we do not include $\Delta X_{t\text{-}1}$ in equations as it would give rise to multicollinearity in the presence of $\Delta D_{t\text{-}1}$ and $\Delta E_{t\text{-}1}$.

in Table 6 with those in Table 5 where lagged dependent variables are not included, we find the inclusion of lagged dependent variables has no material impact on the coefficient estimates of key explanatory variables, such as *CF* and *MB*.[35] This result indicates that omitted variable biases, which are caused by excluding lagged dependent variables from all equations, are almost negligible and not as significant as proposed by GPT.

We also use the variables and the sample summarized in Panel B of Table 2, which closely follow GPT, to repeat the same analysis as in Section IV. B and IV.C. The results (untabulated) reveal that, although we fail to obtain identical coefficient estimates due to the difference in sample size, we indeed document drastic changes in coefficients of explanatory variables when we move from static unconstrained single-equation models to dynamic constrained simultaneous-equation models. However, our findings in Section IV.B and IV.C suggest that we should interpret the results of GPT with great caution because the importance of linear constraints and the intertemproal and interdependent natures of financial decisions are hugely exaggerated by their use of a severely unbalanced cash-flow identity in the data.

Consistent with our Proposition 1, we document in Tables 6 positive investment-cash flow and cash-cash flow sensitivities and a negative external finance-cash flow sensitivity. More specifically, a one-dollar increase in cash flow increases investment by 17 cents, increases cash holdings by 23 cents, increases dividends by less than 1 cent, reduces the use of debt by 27 cents, and lowers the use of equity by 33 cents. To sum up, in response to a one-dollar increase in cash flow, firms on average increase the uses of cash by roughly 40 cents and reduce the reliance on external finance by roughly 60 cents.

[35] The slight differences between the coefficients in Table 5 and those in Table 6 are mainly driven by the inclusion of lagged dependent variable in Table 6.

Consistent with our Proposition 2, we find in Table 6 that all uses and sources of cash are positively related to stock valuation. In other words, in response to an increase in stock valuation, firms on average increase investment, cash holdings, dividend, and the uses of debt and equity.

D. The joints impact of cash flow and stock valuation on corporate policies

In this section we empirically test Proposition 3 developed in Section II, which concerns the joint impact of cash flow and stock valuation on various corporate policies. To this end, we first interact internal cash flows (*CF*) with our first proxy for stock valuation, the market-to-book ratio (*MB*) and add this interaction term to equations (9)-(14). As in Table 6, we estimate both the unconstrained dynamic single-equation model and the constrained dynamic simultaneous-equation model and find two models generate almost identical results. Thus for brevity, we only report in Table 7 the results obtained using the constrained dynamic simultaneous-equation model.

[Insert Table 7 here]

Consistent with Proposition 3 developed in Section II, we find that the coefficient of $CF \times MB$ is negative and significant in the investment equation (column (1)), suggesting that the investment-cash flow sensitivity decreases with stock valuation, or equivalently that the positive relation between investment and stock valuation becomes less pronounced as internal cash flows increase. This result confirms our conjectures that when stock valuation becomes higher (lower), firms tend to rely less (more) on internal funds to finance their investment, and that firms with ample internal cash flows are less likely to increase investment in response to an increase in stock price. The negative coefficient of $CF \times MB$ in column (2) reveals that the when stock valuation becomes lower (higher), firms save more (less) cash out of internal cash flows. The negative coefficients of $CF \times MB$ in columns (1) and (2) are consistent with Fazzari, Hubbard, and Petersen (1988) and Almeida, Campello, and Weisbach (2004) who, respectively, document that the investment-cash flow and the cash-cash flow sensitivities are stronger (weaker) for financially constrained (unconstrained) firms. To the extent that financial constraints are positively associated with the wedge between the costs of external and internal funds, firms are more financially constrained when stock valuation is lower. Thus, our results indicate that undervaluation aggravates the impact of financial constraints, resulting in higher investment- and cash-cash flow sensitivities.

In addition, we document in column (4) that the substitution between internal fund and external financing becomes weaker (stronger) as stock valuation decreases (increases). Intuitively, a decrease in stock valuation makes external financing more costly, and thus should strengthen firms' incentive to substitute internal funds for external finance. In other words, the negative relation between internal funds and external finance should be more pronounced as stock valuation decreases. However, the results in column (4) suggest that if various financial decisions are allowed to be determined simultaneously, internal funds and external finance may display a weaker negative relation as stock valuation decreases. This is because, when external finance becomes more costly, firms would use more internal funds to finance investment and increase cash holdings. As a result, less internal funds are available to reduce the use of external finance, leading to a weaker degree of substitution between internal and external funds.

When we break up external finance into net debt issues and net equity issues in columns (5) and (6), an interesting result emerges. The coefficient of *CF* (-0.35) is negative and significant, while the coefficient of $CF \times MB$ (0.03) is positive and statistically significant for debt financing, implying that firms substitute internal funds for debt financing when stock valuation is low, and issue debt when stock valuation and cash flows are high. In contrast, firms are found to substitute internal funds for equity financing mainly when stock valuation is high.

To address the concern that *MB* is a noisy measure of stock misvaluation, we employ a direct proxy for stock mispricing, namely, future stock returns (*FRet*). Table 8 examines the joint impact of cash flows and future stock returns on corporate policies.[36] Note that apart from *FRet*, we also control for *MB* as an additional proxy for stock valuation in all regression equations.[37] To the extent that *MB* contains a component of misvaluation, this design works against us finding any independent effect of *FRet* on corporate financial decisions.

[Insert Table 8 here]

The results in Table 8 are generally consistent with those in Table 7. The cash flow sensitivities of investment, cash, and external finance decrease with the extent of stock valuation. In other words, in response to a decrease in stock valuation, firms rely more on internal cash flows to finance their investment and cash holdings, so that the substitution between internal fund and external finance becomes weaker.

Polk and Sapienza (2009) use discretionary accruals as a proxy for stock mispricing in examining the catering channel through which stock mispricing affects investment.[38] As a robustness check, we define discretionary accruals based on the

[36] The number of observations is reduced to 43,496 since this test requires firms to have non-missing stock returns for the next three years.
[37] As a robustness check, we also tried to include $CF \times MB$ in all regression equations reported in Table 8 and found that the coefficients of *FRet* and $CF \times FRet$ are essentially unaffected by the inclusion of $CF \times MB$.
[38] Accruals are defined as the difference between a firm's accounting earnings and its underlying cash flows. Discretionary accruals capture the unusual part of accruals given the underlying timing of cash flows, and so are deemed to be under managerial discretions. A large body of empirical evidence (e.g., Teoh, Welch, and Wong (1998) and Chan et al. (2006)) documents a negative relationship between

methodology used by Polk and Sapienza (2009) and use it to replace *FRet* in the regressions reported in Table 8. Untabulated results indicate that coefficients of discretionary accruals and its interaction with cash flow are generally consistent with what Proposition 2 and 3 predict.

V. Robustness Checks

Our analysis critically hinges upon identifying situations where firms are mispriced. Baker, Stein, and Wurgler (2003) suggest that *Q* (*MB*) contains both a nonfundamental component and a fundamental component. Our interest is the former, but the latter can create problems for our inferences. In this section, we perform a more focused test of the hypotheses derived from our model by extracting the nonfundamental component from Tobin's *Q* following two empirical methodologies developed by Rhodes-Kropf, Robinson, and Viswanathan (RKRV) (2005) and Dong et al. (2006). Generally, the market-to-book ratio can be decomposed as follows.

$$\begin{aligned} MB &= \frac{E^m - E^b + A^b}{A^b} = \frac{(E^m - v) + (v - E^b + A^b)}{A^b} = \frac{(E^m - v)}{A^b} + \frac{(v - E^b + A^b)}{A^b} \\ &= MP + VA, \end{aligned}$$

where *v* stands for the fundamental value of equity, *E* and *A* stand for equity and assets, respectively, and superscripts *b* and *m* denote book and market values. $MP = \frac{(E^m - v)}{A^b}$ stands for the firm-level equity mispricing deflated by book value of total assets. $VA = \frac{(v - E^b + A^b)}{A^b}$ denotes the fundamental-value-to-assets ratio, which can be viewed as a proxy for investment opportunities.

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discretionary accruals and subsequent stock returns, suggesting that firms with high discretionary accruals are overpriced relative to otherwise similar firms.

To obtain the fundamental value of equity (*v*), we first follow the methodology proposed by RKRV (2005) and regress the logarithm of the market value of equity on the logarithm of the book value of equity, the absolute value of net income, an indicator function for negative net income observations, and the book leverage ratio. We group the firms according to the 12 Fama and French industries and run annual cross-sectional regressions for each industry in question. The fundamental value of equity (*v*) is then the exponential of the fitted value from the regression equation. The resulting measures of the equity mispricing (*MP*) and the fundamental-value-to-assets ratio (*VA*) are denoted as MP_{RKRV} and VA_{RKRV}. Appendix B describes RKRV's (2005) decomposition in greater details.

Alternatively, we use the Residual Income Model (RIM) as in Dong et al. (2006) to compute the fundamental value of equity (*v*). In particular, we employ Edwards-Bell-Ohlson (EBO) valuation model which calculates the fundamental value of the equity by anchoring its price at the current book value of equity and adding a premium to book value based on future residual earnings.[39] Penman and Sougiannis (1998) show that the valuation error using RIM is lower than both the Discounted Cash Flow and Dividend Discount Model (DDM) methods during both the forecast period and beyond the forecast horizon. Appendix C details the Residual Income Model that we use. The resulting measures of the equity mispricing (*MP*) and the fundamental-value-to-assets ratio (*VA*) obtained using RIM are denoted as MP_{RIM} and VA_{RIM}. The following identity holds according to the two ways of decomposition described above.

[39] Frankel and Lee (1998) attribute the term Edwards-Bell-Ohlson to Bernard (1994). This technique has been used extensively to calculate fundamental value in previous studies, for example, Frankel and Lee (1998), Lee, Myers and Swaminathan (1999) and Ritter and Warr (2002). In addition, Feltham and Ohlson (1995) show that the model is equivalent to the theoretically sound dividend discount model (DDM) under clean surplus accounting, which describes the situation where the change in book value is equal simply to earnings minus dividends for the given period.

$$MB = MP_{RKRV} + VA_{RKRV} = MP_{RIM} + VA_{RIM}$$

Panel A of Table 9 presents the results obtained using the decomposition proposed by RKRV (2005). In Panel B of Table 9, we consider the measures constructed based on the methodology used by Dong et al. (2006). In both panels, apart from key explanatory variables reported in the table, we have also included in all regressions the same control variables as those reported in Tables 7. However, for brevity, the coefficients of control variables are not tabulated since they are very similar to those reported in Table 7.

[Insert Table 9 here]

We find that the fundamental-value-to-assets ratios (VA_{RKRV} and VA_{RIM}) are positive and statistically significant in all regressions, suggesting that external finance and various uses of cash are positively associated with companies' investment opportunities. Consistent with Proposition 2, two proxies for stock misvaluation, MP_{RKRV} and MP_{RIM} are found to be positively related to investment, the change in cash holdings, and net debt and equity issuances. The signs of coefficients on the interaction terms between cash flow (*CF*) and mispricing proxies are in line with the predictions of Proposition 3. Our results indicate that overvaluation mitigates the impact of financial constraints, resulting in lower investment-cash flow and cash-cash flow sensitivities. In addition, the negative relation between the internal funds and external finance is weaker for firms that are more likely to be undervalued.

VI. Conclusions

We examine the interaction of mispricing, cash flows and corporate policies. Our analysis is carried out to explicitly account for the interdependence between corporate policies. Our theoretical findings highlight the importance of modeling the choices of corporate policies interdependently since it provides different predictions from those derived from examining corporate policies in isolation. However, the empirical examination of the theoretical hypotheses using either single-equation or simultaneous equations framework will not provide significantly different results as long as the sources and uses of cash are internally balanced in the data and all explanatory variables are either exogenous or predetermined. This finding stands in sharp contrast to those in GPT who claim that the use of single-equation models may lead to severe biases.

This paper contributes to the literature by investigating the mix of conditioning forces that cash flow and firm valuation jointly might bring to bear on the cash flow sensitivities. By doing so, this paper provides new evidence on how firms simultaneously adjust their uses and sources of financing in response to financial market inefficiencies. In addition, our analysis also provides evidence on how firms with different cash flow status adjust their corporate policies in response to firm misvaluation. Our results are robust to several alternative specifications, as well as to corrections for measurement error in Tobin's *Q*, our proxy for investment opportunities. Our findings complement the previous studies, offer important insights into different strands of literatures, and represent a synergistic bridging of complementary ideas.

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Appendix A

A1: Proof of Proposition 1

Differentiating equation (2) with respect to c_0 and rearranging yields,

$$\frac{dI_0}{dc_0}=\frac{h''}{h''-(1+a\theta)f_0''}\left(1-\frac{dC}{dc_0}\right). \tag{A1}$$

Differentiating equation (4) with respect to c_0 and rearranging yields,

$$\frac{dC}{dc_0}=\frac{f_0''}{f_0''+f_t''}\left(1+\frac{dX}{dc_0}\right). \tag{A2}$$

Substituting $I_0=c_0+X-C$ into equation (2) and differentiating it with respect to c_0 and rearranging yields,

$$\frac{dX}{dc_0}=\frac{(1+a\theta)\,f_0''}{h''-(1+a\theta)\,f_0''}\left(1-\frac{dC}{dc_0}\right). \tag{A3}$$

Substituting equation (A2) into (A3) and simplifying yields,

$$\frac{dX}{dc_0}=\frac{(1+a\theta)\,f_0''f_t''}{h''\left(f_0''+f_t''\right)-(1+a\theta)\,f_0''f_t''}<0\,. \tag{A4}$$

Substituting equation (A4) into (A2) and simplifying yields,

$$\frac{dC}{dc_0}=\frac{h''f_0''}{h''\left(f_0''+f_t''\right)-(1+a\theta)f_0''f_t''}>0\,. \tag{A5}$$

Substituting equation (A5) into (A1) and simplifying yields,

$$\frac{dI_0}{dc_0}=\frac{h''f_t''}{h''\left(f_0''+f_t''\right)-(1+a\theta)f_0''f_t''}>0\,. \tag{A6}$$

Q.E.D.

***A2: Proof of Proposition* 2**

Substituting $I_0=c_0+X-C$ into equation (2) and differentiating it with respect to θ and rearranging yields,

$$\frac{dC}{d\theta}=-\frac{1}{(1+a\theta)\,f_0''}\left(\frac{dX}{d\theta}\left(h''-(1+a\theta)\,f_0''\right)-1-af_0'\right). \tag{A7}$$

Substituting equation (A7) into equation (6) and rearranging yields,

$$\frac{dX}{d\theta}=\frac{\left(1+af_0'\right)\left(f_t''+f_0''\right)}{h''\left(f_t''+f_0''\right)-(1+a\theta)\,f_0''f_t''}>0\,. \tag{A8}$$

By equation (6), equation (A8) implies that $\dfrac{dC}{d\theta}>0$.

Substituting equations (A8) and (6) into (5) and simplifying yields,

$$\frac{dI_0}{d\theta} = \frac{\left(1+af_0'\right)f_t''}{h''\left(f_t''+f_0''\right)-\left(1+a\theta\right)f_0''f_t''} > 0\,. \qquad \text{(A9)}$$

Q.E.D.

A3: Proof of Proposition 3

Differentiating (A4) – (A6) with respect to θ and simplifying yields,

$$\frac{d}{d\theta}\left(\frac{dX}{dc_0}\right) = \frac{af_0''f_t''h''\left(f_0''+f_t''\right)}{\left(h''\left(f_0''+f_t''\right)-\left(1+a\theta\right)f_0''f_t''\right)^2} < 0\,, \qquad \text{(A10)}$$

$$\frac{d}{d\theta}\left(\frac{dI_0}{dc_0}\right) = \frac{ah''f_0''f_t''^2}{\left(h''\left(f_0''+f_t''\right)-\left(1+a\theta\right)f_0''f_t''\right)^2} < 0\,, \qquad \text{(A11)}$$

and $$\frac{d}{d\theta}\left(\frac{dC}{dc_0}\right) = \frac{ah''f_0''^2 f_t''}{\left(h''\left(f_0''+f_t''\right)-\left(1+a\theta\right)f_0''f_t''\right)^2} < 0\,. \qquad \text{(A12)}$$

Q.E.D.

A4: The impact of cash flow and firm valuation on debt financing

As there is no mispricing of debt, the objective function can be written as

$$\int_0^\infty \left(1+\theta e^{-qu}\right)\lambda e^{-\lambda u}\left(f_0\left(I_0\right)+f_t\left(c_t+C\right)\right)du+\theta E-h\left(E\right)-I_0-c_t-C-g(D,c_0).$$

The optimal level of D is then given by

$$g_1\left(D,c_0\right)=h'\left(E\right)-\theta. \qquad \text{(A13)}$$

The right hand side of equation (A13) is the effective marginal cost of equity. The left hand side of equation (A13) is the marginal cost of debt. The rest of the first-order-conditions remain unchanged. Using equation (A13), one can show that

$$\frac{dF}{dc_0} = \frac{h''}{g_{11}}\frac{dE}{dc_0}-\frac{g_{12}}{g_{11}},$$

$$\frac{d^2F}{dc_0 d\theta} = \frac{h''}{g_{11}}\frac{d^2E}{dc_0 d\theta}-\frac{g_{112}}{g_{11}}\frac{dF}{d\theta}, \qquad \text{(A14)}$$

and

$$\frac{dF}{d\theta} = \frac{1}{g_{11}}\left(h''\frac{dE}{d\theta}-1\right).$$

Since $g_{112} < 0$, if $dF/d\theta > 0$, it can be seen from (A14) that is possible for $\frac{d^2E}{dc_0 d\theta} < 0$ but $\frac{d^2F}{dc_0 d\theta} > 0$.

Appendix B: Decompositions of the market-to-book ratio.

Specifically, Rhodes-Kropf, Robinson, and Viswanathan (2005) decompose the logarithm of the market-to-book *equity* ratio (E^m/E^b) as follows.

$$
\begin{aligned}
Ln(E^m / E^B)_{it} &= Ln(E^m_{it}) - Ln(E^b_{it}) \\
&= \underbrace{Ln(E^m_{it}) - v(\theta_{it}, \alpha_{jt})}_{FSE} + \underbrace{v(\theta_{it}, \alpha_{jt}) - v(\theta_{it}, \alpha_{j})}_{TSE} + \underbrace{v(\theta_{it}, \alpha_{j}) - Ln(E^b_{it})}_{LRV}
\end{aligned}
\qquad \text{(B1)}
$$

where *Ln* stands for the natural logarithm function. The first term, firm-specific error (*FSE*), is the difference between the market value and fundamental value as implied by its accounting multiples θ_{jt} and its sector *j* multiple α_{jt} measured at the valuation year *t*. If the market is overheated at time t, this will show up in α_{jt} and therefore $v(\theta_{jt}, \alpha_{jt})$. Similarly, if industry *j* is overvalued relative to other industries at time *t*, this, too, will appear in α_{jt}. Thus *FSE* captures purely firm-specific deviations from fundamental value, because the *v* term captures all deviation common to a sector at a point in time. The second term, time-series sector error (*TSE*), measures the difference between the firm's fundamental value conditional on contemporaneous accounting principles and its value implied by its accounting information and long-run multiples. This term captures the misvaluation of the whole sector at time *t* since $v(\theta_{jt}, \alpha_j)$ measures sector-specific valuation that does not vary over time. The third term, *LRV*, concerns the difference between the firm's valuation based on long-run multiples and its book value. This term captures the firm's set of investment prospect at time *t*.

To obtain $v(\theta_{jt}, \alpha_{jt})$ and $v(\theta_{jt}, \alpha_j)$, RKRV estimate the following model.

$$Ln(E^m_{it}) = \alpha_{0jt} + \alpha_{1jt} Ln(E^b_{it}) + \alpha_{2jt} Ln(NI)^+ + \alpha_{3jt} I_{(<0)} Ln(NI)^+_{it} + \alpha_{4jt} (D/A)_{it} + \varepsilon_{it},$$

where NI^+ stands for the absolute value of net income and $I_{(<0)}Ln(NI^+)$ is an indicator function for negative operating income observations. Because the equation is estimated in logs, and operating income can be negative, this specification allows for operating income to enter into the estimation without discarding all the firms with negative operating income at a point in time. Leverage ratio, *D/A*, is included to allow for the fact that firms with higher or lower than industry average leverage have a different value of a multiple. Firms are grouped according to the 12 Fama and French industries. We then run annual, cross-sectional regressions for each industry in question. $v(\theta_{jt}, \alpha_{jt})$ is the fitted value from the regression equation, which proxies for the fundamental value for a firm *i*, in a sector *j*, and at time *t*. The fundamental value of equity in equation (B1) is then equal to the exponential value of $v(\theta_{jt}, \alpha_{jt})$. Since our focus is on the firm-level equity mispricing only, we do not decompose $v(\theta_{jt}, \alpha_{jt})$ - $Ln(E^b_{it})$ further into *TSE* and *LRV* in this paper.

Appendix C: Mechanics of the Residual Income Model

Residual earnings are essentially earnings in excess of what would be generated if book equity was to earn the investors' required rate of return. This paper follows the method used by Frankel and Lee (1998) whereby the fundament value (v) is calculated by estimating a two-period version of the Residual Income Model as follows:

$$v = BPS_t + \frac{FROE_t - r_e}{1 + r_e} BPS_t + \frac{FROE_{t+1} - r_e}{(1 + r_e)^2} BPS_{t+1} + \frac{FROE_{t+2} - r_e}{(1 + r_e)^2 r_e} BPS_{t+2} \qquad \text{(C1)}$$

BPS_{t+i} is the book value per share for fiscal year end $t+i$. $FROE_{t+i}$ is the forecast return on equity for year $t+i$ and r_e is the firm's estimated cost of equity, the difference between these two measures being the firm's forecast residual earnings.[40] All residual earnings from $t+2$ onwards are assumed to be constant in perpetuity and are captured in the final term of model (C1).[41] $FROE_{t+2}$ for this terminal value is estimated using I/B/E/S consensus long-term growth forecasts (*Ltg*), while $FROE_t$ and $FROE_{t+1}$ utilise I/B/E/S consensus earnings per share (EPS) forecasts over one and two-year forecast horizons respectively. For missing observations of *Ltg*, $FROE_{t+2}$ is replaced with $FROE_{t+1}$. Book values of equity per share (BPS_{t-1} and BPS_{t-2}) are calculated using the most recent book value of common equity from COMPUSTAT prior to the announcement month and adjusting for the number of shares outstanding. Future fiscal-year-end Book Values (BPS_{t+i}) are calculated by applying clean surplus accounting to the previous year's *BPS*. This is done by deflating future earnings by dividends paid using an estimate of the dividend payout ratio (k).

The cost of equity, r_e is measured using the Fama and French three-factor model. This model segregates firms into 48 industry classifications and creates replicating portfolios based on size and book-to-market characteristics. Explicitly, the risk premiums reported for each industry on a monthly basis are combined with the effective annual risk-free rate, based on the current monthly risk-free rate, to generate an industry cost of equity for that given month.[42]

The payout ratio, k, is calculated using Compustat items as dividends divided by net income (*NI*). For negative observations of *NI*, k is approximated as Dividends divided by 6% of total assets. Thus we can calculate *FROE* and future values of *BPS* as follows:

$$FROE_t = \frac{2 \times EPS_{t+1}}{BPS_{t-1} + BPS_{t-2}}$$

$$BPS_t = BPS_{t-1}.[1 + FROE_t(1\text{-}k)]$$

$$FROE_{t+1} = \frac{2 \times EPS_{t+2}}{BPS_t + BPS_{t-1}}$$

$$BPS_{t+1} = BPS_t.[1 + FROE_{t+1}(1\text{-}k)]$$

$$FROE_{t+2} = \frac{2 \times EPS_{t+2} \times (1 + LTG)}{BPS_{t+1} + BPS_t}$$

$$BPS_{t+2} = BPS_{t+1}.[1 + FROE_{t+2}(1\text{-}k)]$$

[40] The present value of future residual earnings is the difference between the true value of a firm's equity and its book value.

[41] Although this assumption is unrealistic, EPS forecasts are likely to become less accurate as the time horizon increases, making the use of a two period model less worrisome.

[42] Cost of equity = (Fama-French risk premium + 12*monthly risk-free rate) /100.

Table 1: Variables defined using the flow-of-funds data

According to the Compustat data manual, it is important to consider the format code (*scf*) when using the flow of funds data. Effective for fiscal years ending July 15, 1988 the SFAS #95 requires U. S. companies to report the Statement of Cash Flows (*scf* = 7). Prior to adoption of SFAS #95, companies may have reported one of the following statements: Working Capital Statement (*scf* = 1), Cash Statement by Source and Use of Funds (*scf* = 2) and Cash Statement by Activity (*scf* = 3). Thus the variable definitions vary depending on which format code (*scf*) a firm follows in reporting the flow-of-funds data. We include in parentheses the Compustat XPF variable names in italics.

Variables	*scf* = 1	*scf* = 2	*scf* = 3	*scf* = 7
Inv	capital expenditure (*capx*) + increase in investment(*ivch*) + acquisition(*aqc*) + other uses of funds(*fuseo*) - sale of PPE(*sppe*) - sale of investment(*siv*)	same as *scf* = 1	same as *scf* = 1	capital expenditure (*capx*) + increase in investment(*ivch*) + acquisition(*aqc*) - sale of PPE(*sppe*) - sale of investment(*siv*) - change in short-term investment(*ivstch*) - other investing activities(*ivaco*)
$\Delta Cash$	cash and cash equivalents increase/decrease (*chech*)	same as *scf* = 1	same as *scf* = 1	same as *scf* = 1
Div	cash dividends (*dv*)	same as *scf* = 1	same as *scf* =1	same as *scf* = 1
ΔD	long-term debt issuance(*dltis*) - long-term debt reduction(*dltr*) - changes in current debt(*dlcch*)	long-term debt issuance(*dltis*) - long-term debt reduction(*dltr*) + changes in current debt(*dlcch*)	same as *scf* = 2	same as *scf* = 2
ΔE	sale of common and preferred stock (*sstk*) - purchase of common and preferred stock(*prstkc*)	same as *scf* = 1	same as *scf* = 1	same as *scf* = 1
ΔWC	change in working capital(*wcapc*)	- change in working capital(*wcapc*)	same as *scf* = 2	-change in account receivable(*recch*) - change in inventory(*invch*) - change in account payable(*apalch*) - accrued income taxes(*txach*) - other changes in assets and liabilities (*aoloch*) - other financing activities(*fiao*)
CF	income before extra items(*ibc*) + extra items & discontinued operation(*xidoc*) + depreciation & amortization(*dpc*) + deferred taxes(*txdc*) + equity in net loss(*esubc*) + gains in sale of PPE & investment(*sppiv*) + other funds from operation(*fopo*) + other sources of funds(*fsrco*) - ΔWC	same as *scf* = 1	same as *scf* = 1	income before extra items(*ibc*) + extra items & discontinued operation(*xidoc*) + depreciation & amortization(*dpc*) + deferred taxes(*txdc*) + equity in net loss(*esubc*) + gains in sale of PPE & investment(*sppiv*) + other funds from operation(*fopo*) + exchange rate effect(*exre*) - ΔWC

Table 2 Summary statistics

The data for Panel A and C are retrieved from Compustat and CRSP for the 1971- 2008 period. Excluded are firms without valid information on total assets (*Assets*), sales growth (*SaleG*), market capitalization, the change in cash holdings ($\Delta Cash$), investment (*Inv*), cash dividend (*Div*), cash flows (*CF*), and external financing (ΔX) which equals to sum of net debt issued (ΔD) and net equity issued (ΔE). $DIF^{Equation\ 7}$ is the difference between the left-hand side and the right-hand side of equation (7). We also discard firm-years for which the market value of assets is less than $1 million, those displaying asset growth exceeding 100%, and those with annual sales lower than $1 million. Panel B contains firms in GPT's sample. Variables in Panel B are defined following Table III of GPT. $DIF^{Equation\ 8}$ is the difference between the left-hand side and the right-hand side of equation (8). SD, Q1 and Q3 stand for the standard deviation, the 25th percentile, and the 75th percentile of the distribution. In Panel A and B, all variables are deflated by the beginning-of-period total assets, and winsorized at the top and bottom 1% of their distributions. In Panel C, *MB* is defined as the market value of assets divided by the book value of assets. Future realized stock returns (*FRet*), defined as returns over the next three years multiplied by (-1). *Tangibility* is the net PPE over total assets. *Sales Growth* is the change in net sales scaled by the lagged net sales. *Leverage* is defined as total debt (the sum of short-term and long-term debt) divided by total assets. *Ln*(*Assets*) is the natural log of total book value of assets. Dollar values are adjusted to the 2000 dollar value using GDP deflator.

Variables	N	Mean	SD	Min	Q1	Median	Q3	Max
Panel A: Cash-flow statement variables in equation (7) for 1971-2008								
Inv	64,021	0.099	0.159	-0.360	0.023	0.066	0.137	2.066
$\Delta Cash$	64,021	0.010	0.120	-0.466	-0.021	0.001	0.028	2.122
Div	64,021	0.010	0.017	0	0	0	0.014	0.092
ΔX	64,021	0.052	0.211	-0.275	-0.026	0.002	0.057	3.881
ΔD	64,021	0.021	0.122	-0.400	-0.020	0	0.033	1.260
ΔE	64,021	0.031	0.173	-0.145	0	0	0.008	3.765
CF	64,021	0.068	0.159	-2.234	0.014	0.082	0.146	0.655
$DIF^{Equation\ 7}$	64,021	0.001	0.004	0	0.000	0.000	0.000	0.089
Panel B: Gatchev, Pulvino, and Tarhan's (2010) *variables in equation (8) for 1952-2007*								
CAPX	221,119	0.093	0.139	0	0.020	0.050	0.105	0.913
ACQUIS	221,119	0.024	0.092	-0.004	0	0	0	0.698
ASALES	221,119	0.006	0.024	0	0	0	0.002	0.198
$\Delta Cash$	221,119	0.069	0.382	-0.457	-0.023	0.000	0.041	2.636
Div	221,119	0.008	0.021	0	0	0	0.007	0.173
ΔLTD	221,119	0.033	0.183	-0.442	-0.015	0	0.034	1.104
ΔSTD	221,119	0.012	0.124	-0.445	-0.007	0	0.018	0.725
EQISSU	221,119	0.182	0.711	0	0	0.001	0.020	5.461
RP	221,119	0.008	0.028	0	0	0	0	0.198
CF	221,119	-0.045	0.473	-3.269	-0.039	0.052	0.126	0.585
$DIF^{Equation\ 8}$	221,119	0.013	0.396	-7.620	-0.031	0.001	0.035	7.517
Panel C: Key explanatory variables for 1971-2008								
MB	64,021	1.764	1.590	0.516	1.016	1.322	1.922	27.209
FRet	43,496	-0.497	1.278	-6.785	-0.845	-0.196	0.295	0.951
Ln(*Assets*)	64,021	5.104	2.195	-1.482	3.501	4.972	6.552	10.83
SaleG	64,021	0.092	0.247	-0.934	-0.028	0.079	0.201	1
Leverage	64,021	0.218	0.198	0	0.032	0.190	0.342	0.884
Tangibility	64,021	0.302	0.227	0	0.120	0.245	0.432	0.936

Table 3 Correlation coefficients among key variables

The data are retrieved from Compustat and CRSP for the 1971- 2008 period. Excluded are observations from financial institutions, utilities, and not-for-profit organizations and government enterprises. Also excluded are firms without valid information on total assets (*Assets*), sales growth (*SaleG*), market capitalization, the change in cash holdings (Δ*Cash*), investment (*Inv*), cash dividend (*Div*), cash flows (*CF*), and external financing (Δ*X*) which equals to sum of net debt issued (Δ*D*) and net equity issued (Δ*E*). We also discard firm-years for which the market value of assets is less than $1 million, those displaying asset growth exceeding 100%, and those with annual sales lower than $1 million. *MB* is defined as the market value of assets divided by the book value of assets. Future realized stock returns (*FRet*), defined as stock returns over the next three years multiplied by (-1). *Tangibility* is the net PPE over total assets. *Sales Growth* is the change in net sales scaled by the lagged net sales. *Leverage* is defined as total debt (the sum of short-term and long-term debt) divided by total assets. *Ln*(*Assets*) is the natural log of total book value of assets. The pairwise Pearson correlation coefficients among variables are reported. Correlation coefficients that are significant at the 1% level are marked with [a] in superscripts.

	Inv	Δ*Cash*	*Div*	Δ*X*	Δ*D*	Δ*E*	*CF*	*MB*	*FRet*	*Ln*(*Assets*)	*SaleG*	*Leverage*
Δ*Cash*	-0.02[a]											
Div	0.03[a]	-0.01										
Δ*X*	0.57[a]	0.41[a]	-0.08[a]									
Δ*D*	0.49[a]	0.06[a]	0.00	0.57[a]								
Δ*E*	0.35[a]	0.47[a]	-0.09[a]	0.82[a]	0.00							
CF	0.23[a]	0.18[a]	0.24[a]	-0.46[a]	-0.23[a]	-0.4[a]						
MB	0.12[a]	0.12[a]	0.03[a]	0.23[a]	0.02[a]	0.27[a]	-0.09[a]					
FRet	0.06[a]	0.02[a]	0.01	0.09[a]	0.07[a]	0.06[a]	-0.05[a]	0.11[a]				
Ln(*Assets*)	0.31[a]	0.12[a]	0.00	0.20[a]	0.17[a]	0.13[a]	0.12[a]	0.17[a]	0.04[a]			
SaleG	0.06[a]	-0.06[a]	-0.10[a]	0.08[a]	0.25[a]	-0.08[a]	-0.10[a]	-0.19[a]	-0.01	-0.04[a]		
Leverage	0.20[a]	-0.07[a]	0.14[a]	-0.04[a]	0.04[a]	-0.08[a]	0.22[a]	-0.13[a]	-0.02[a]	0.00	0.30[a]	
Tangibility	0.10[a]	0.02[a]	0.30[a]	-0.10[a]	0.03[a]	-0.15[a]	0.28[a]	-0.11[a]	0.01	0.07[a]	0.15[a]	0.23[a]

Table 4: Stock valuation, cash flows and corporate policies

The data are retrieved from Compustat and CRSP for the 1971- 2008 period. In Panel A, firms are sorted into 5 groups according to the market to book ratio (*MB*) and *CF*, respectively (independent sorts). Average values of variables are reported for each *MB*-*CF* group. In Panel B, firms are sorted into 5 groups according to *FRet* and *CF*, respectively (independent sorts). Average values of variables are reported for each *FRet*-*CF* group. Future realized stock returns (*FRet*), defined as returns over the next three years multiplied by (-1).

	MB groups	Panel A: *MB*-*CF* grouping Cash flow groups					*FRet* groups	Panel B: *FRet*-*CF* grouping Cash flow groups				
		1(undervalued)	2	3	4	5(overvalued)		1(undervalued)	2	3	4	5(overvalued)
Inv	1(low)	0.01	0.04	0.06	0.08	0.13	1(low)	0.04	0.06	0.08	0.11	0.19
	2	0.03	0.05	0.07	0.10	0.16	2	0.06	0.06	0.08	0.11	0.18
	3	0.04	0.07	0.08	0.11	0.19	3	0.05	0.06	0.08	0.11	0.19
	4	0.06	0.08	0.10	0.12	0.20	4	0.07	0.07	0.09	0.12	0.20
	5(high)	0.10	0.12	0.13	0.14	0.21	5(high)	0.08	0.09	0.12	0.15	0.23
Δ*Cash*	1(low)	-0.04	-0.01	0.00	0.02	0.05	1(low)	-0.02	0.00	0.01	0.02	0.06
	2	-0.03	-0.01	0.00	0.01	0.05	2	-0.02	0.00	0.01	0.01	0.05
	3	-0.03	-0.01	0.00	0.01	0.04	3	-0.03	0.00	0.00	0.01	0.05
	4	-0.04	0.00	0.00	0.01	0.05	4	-0.02	0.00	0.01	0.02	0.06
	5(high)	-0.01	0.01	0.02	0.03	0.08	5(high)	-0.01	0.00	0.01	0.03	0.09
Div	1(low)	0.00	0.00	0.01	0.01	0.01	1(low)	0.00	0.01	0.01	0.01	0.02
	2	0.00	0.01	0.01	0.01	0.01	2	0.00	0.01	0.02	0.02	0.02
	3	0.00	0.01	0.01	0.02	0.01	3	0.00	0.01	0.01	0.02	0.02
	4	0.00	0.01	0.01	0.02	0.02	4	0.00	0.01	0.01	0.02	0.02
	5(high)	0.00	0.00	0.01	0.02	0.02	5(high)	0.00	0.00	0.01	0.01	0.01
Δ*X*	1(low)	0.06	0.01	-0.01	-0.02	-0.03	1(low)	0.12	0.02	0.00	0.00	0.01
	2	0.09	0.02	0.00	-0.00	-0.01	2	0.13	0.03	0.01	0.00	0.01
	3	0.12	0.04	0.02	0.01	0.02	3	0.12	0.03	0.01	0.01	0.02
	4	0.17	0.06	0.03	0.02	0.03	4	0.16	0.03	0.02	0.02	0.03
	5(high)	0.35	0.10	0.07	0.05	0.05	5(high)	0.22	0.06	0.05	0.05	0.07
Δ*D*	1(low)	0.04	0.00	-0.01	-0.02	-0.04	1(low)	0.05	0.01	0.00	0.00	0.00
	2	0.07	0.01	0.00	0.00	-0.02	2	0.06	0.02	0.01	0.00	0.00
	3	0.07	0.02	0.01	0.01	0.01	3	0.06	0.02	0.01	0.01	0.01
	4	0.08	0.03	0.02	0.02	0.02	4	0.07	0.02	0.01	0.01	0.01
	5(high)	0.07	0.04	0.02	0.02	0.01	5(high)	0.07	0.03	0.02	0.01	0.01
Δ*E*	1(low)	0.02	0.00	0.00	0.00	0.00	1(low)	0.07	0.01	0.01	0.00	0.02
	2	0.03	0.01	0.00	0.00	0.01	2	0.07	0.01	0.00	0.00	0.01
	3	0.05	0.01	0.00	0.00	0.01	3	0.06	0.01	0.00	0.00	0.01
	4	0.09	0.02	0.01	0.00	0.01	4	0.09	0.01	0.01	0.01	0.02
	5(high)	0.27	0.07	0.05	0.03	0.03	5(high)	0.15	0.03	0.03	0.03	0.05

Table 5: The impact of cash flows and equity valuation on corporate policies (baseline model)

The data are retrieved from Compustat and CRSP for the 1971- 2008 period. Dependent variables are defined in Table 1. The regression equation is estimated with fixed *firm* and *year* effects. The estimation corrects for heteroskedasticity and clustering using the White-Huber estimator. The constant term and year dummies are included but not reported. *Tangibility* is the net PPE over total assets. *SalesG* is the change in net sales scaled by the lagged net sales. *Leverage* is defined as total debt (the sum of short-term and long-term debt) divided by total assets. *Ln*(*Assets*) is the natural log of total book value of assets. Coefficients significant at the 10%, 5% and 1% level are indicated by *, ** and *** respectively. *t*-statistics are presented in parentheses. Both panels are estimated with firm fixed effects. Panel A estimates equations separately without linear constraints. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors. Panel B reports results obtained using simultaneous equations with linear constraints that sources equal uses of cash.

	Panel A: Standalone equations without constraints						Panel B: Simultaneous equations with linear constraints					
Dependent Variables	(1) Inv_t	(2) $\Delta Cash_t$	(3) Div_t	(4) ΔX_t	(5) ΔD_t	(6) ΔE_t	(7) Inv_t	(8) $\Delta Cash_t$	(9) Div_t	(10) ΔX_t	(11) ΔD_t	(12) ΔE_t
CF_t	0.18***	0.22***	0.01***	-0.59***	-0.26***	-0.33***	0.18***	0.22***	0.01***	-0.59***	-0.26***	-0.33***
	(17.7)	(21.1)	(15.0)	(-36.9)	(-31.9)	(-18.5)	(40.1)	(57.9)	(19.3)	(-106.5)	(-71.1)	(-70.6)
MB_{t-1}	0.03***	0.01***	0.00***	0.04***	0.01***	0.03***	0.03***	0.01***	0.00***	0.04***	0.01***	0.03***
	(23.9)	(9.8)	(15.4)	(23.9)	(9.1)	(19.9)	(45.6)	(22.5)	(18.7)	(54.5)	(13.4)	(53.9)
$SaleG_{t-1}$	0.02***	0.01**	-0.00***	0.02***	0.01***	0.01***	0.02***	0.00**	-0.00***	0.02***	0.01***	0.01***
	(8.3)	(2.2)	(-7.8)	(7.0)	(6.5)	(4.0)	(14.7)	(2.2)	(-6.0)	(13.4)	(9.8)	(8.2)
$Ln(Assets)_{t-1}$	-0.02***	-0.03***	0.00***	-0.05***	-0.01***	-0.05***	-0.03***	-0.02***	0.00**	-0.05***	-0.01***	-0.04***
	(-16.6)	(-21.8)	(6.4)	(-27.2)	(-6.7)	(-25.8)	(-30.0)	(-29.8)	(2.4)	(-45.4)	(-11.4)	(-44.8)
$Leverage_{t-1}$	-0.16***	0.02***	-0.01***	-0.16***	-0.25***	0.10***	-0.16***	0.02***	-0.01***	-0.15***	-0.25***	0.09***
	(-25.2)	(3.8)	(-33.4)	(-18.8)	(-41.2)	(13.7)	(-32.9)	(5.1)	(-43.6)	(-26.1)	(-64.5)	(19.1)
$Tangibility_{t-1}$	0.03**	0.12***	0.00	0.15***	0.08***	0.07***	0.03***	0.11***	0.00***	0.14***	0.08***	0.06***
	(2.6)	(16.4)	(1.2)	(12.4)	(10.1)	(6.9)	(4.9)	(18.6)	(5.0)	(17.3)	(14.4)	(9.3)
N	64,021	64,021	64,021	64,021	64,021	64,021	64,021	64,021	64,021	64,021	64,021	64,021
R-squared	0.11	0.08	0.06	0.24	0.15	0.15	0.11	0.08	0.06	0.24	0.15	0.15

Table 6: Simultaneous equations with linear constraints and lagged dependent variables

The data are retrieved from Compustat and CRSP for the 1971- 2008 period. Dependent variables are defined in Table 1. The regression equation is estimated with fixed *firm* and *year* effects. The estimation corrects for heteroskedasticity and clustering using the White-Huber estimator. All control variables are lagged one period. Coefficients significant at the 10%, 5% and 1% level are indicated by *, ** and *** respectively. *t*-statistics are presented in parentheses. Panel A estimates equations separately without linear constraints. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors. Panel B reports results obtained using simultaneous equations with linear constraints that sources equal uses of cash.

	Panel A: Standalone equations without constraints						**Panel B: Simultaneous equations with linear constraints**					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Inv_t	$\Delta Cash_t$	Div_t	ΔX_t	ΔD_t	ΔE_t	Inv_t	$\Delta Cash_t$	Div_t	ΔX_t	ΔD_t	ΔE_t
CF_t	0.17***	0.23***	0.00***	-0.60***	-0.27***	-0.33***	0.17***	0.23***	0.00***	-0.60***	-0.26***	-0.33***
	(16.7)	(21.8)	(11.7)	(-37.7)	(-32.3)	(-18.7)	(37.5)	(59.9)	(15.9)	(-107.0)	(-72.3)	(-70.1)
MB_{t-1}	0.03***	0.02***	0.00***	0.04***	0.01***	0.04***	0.03***	0.02***	0.00***	0.04***	0.01***	0.04***
	(22.0)	(13.2)	(11.4)	(24.3)	(8.7)	(20.5)	(42.7)	(30.4)	(12.9)	(56.7)	(12.8)	(56.9)
$SaleG_{t-1}$	0.02***	0.01***	-0.00***	0.03***	0.01***	0.02***	0.02***	0.01***	-0.00***	0.03***	0.01***	0.02***
	(6.7)	(5.4)	(-4.4)	(8.3)	(5.9)	(5.6)	(11.8)	(9.9)	(-3.7)	(16.3)	(8.8)	(12.4)
$Ln(Assets)_{t-1}$	-0.03***	-0.03***	0.00***	-0.05***	-0.01***	-0.05***	-0.03***	-0.02***	0.00***	-0.05***	-0.01***	-0.04***
	(-17.9)	(-20.5)	(5.9)	(-27.0)	(-7.2)	(-25.3)	(-31.6)	(-29.2)	(2.7)	(-45.9)	(-12.0)	(-44.8)
$Leverage_{t-1}$	-0.17***	0.02***	-0.01***	-0.16***	-0.25***	0.09***	-0.16***	0.02***	-0.01***	-0.16***	-0.24***	0.08***
	(-25.4)	(3.1)	(-27.8)	(-18.9)	(-39.4)	(11.7)	(-31.6)	(4.2)	(-36.5)	(-25.1)	(-58.8)	(15.9)
$Tangibility_{t-1}$	0.05***	0.08***	0.00	0.12***	0.07***	0.05***	0.05***	0.07***	0.00***	0.12***	0.07***	0.05***
	(4.7)	(10.8)	(1.0)	(10.5)	(9.1)	(5.4)	(7.8)	(11.7)	(4.3)	(14.6)	(12.7)	(7.4)
Inv_{t-1}	0.04***	-0.01**	0.00*	0.03***	0.05***	-0.02*	0.04***	-0.02***	0.00***	0.03***	0.05***	-0.02***
	(5.7)	(-2.1)	(1.7)	(3.0)	(9.0)	(-1.9)	(10.5)	(-4.8)	(3.4)	(5.6)	(14.4)	(-4.5)
$\Delta Cash_{t-1}$	0.12***	-0.15***	0.00**	-0.03**	0.01	-0.03***	0.12***	-0.15***	0.00***	-0.03***	0.01**	-0.03***
	(15.9)	(-17.4)	(2.5)	(-2.5)	(1.5)	(-3.2)	(28.5)	(-42.8)	(4.2)	(-5.3)	(2.1)	(-7.8)
Div_{t-1}	0.05	-0.22***	0.26***	0.12**	0.12***	0.01	0.07**	-0.23***	0.25***	0.09**	0.10***	-0.00
	(1.0)	(-5.2)	(28.8)	(2.2)	(3.9)	(0.1)	(2.1)	(-8.0)	(116.6)	(2.2)	(3.5)	(-0.1)
ΔD_{t-1}	-0.02**	0.00	-0.00	-0.01	-0.04***	0.02**	-0.02***	0.00	-0.00	-0.01**	-0.04***	0.02***
	(-2.1)	(0.6)	(-1.4)	(-1.2)	(-5.7)	(2.3)	(-3.2)	(0.9)	(-1.4)	(-2.1)	(-9.1)	(4.6)
ΔE_{t-1}	-0.06***	0.02***	-0.00***	-0.04***	-0.03***	-0.01*	-0.06***	0.02***	-0.00***	-0.04***	-0.03***	-0.01***
	(-10.2)	(3.2)	(-9.4)	(-5.3)	(-6.7)	(-1.8)	(-17.9)	(7.1)	(-13.9)	(-10.7)	(-10.5)	(-4.5)
Observations	64,021	64,021	64,021	64,021	64,021	64,021	64,021	64,021	64,021	64,021	64,021	64,021
R-squared	0.13	0.13	0.24	0.24	0.15	0.16	0.12	0.13	0.23	0.24	0.15	0.16

Table 7: The joint impact of cash flow and stock valuation (*MB*) on corporate policies

The data are retrieved from Compustat and CRSP for the 1971- 2008 period. Dependent variables are defined in Table 1. *Tangibility* is the net PPE over total assets. *SalesG* is the change in net sales scaled by the lagged net sales. *Leverage* is defined as total debt (the sum of short-term and long-term debt) divided by total assets. *Ln*(*Assets*) is the natural log of total book value of assets. The regression equation is estimated with fixed *firm* and *year* effects. All control variables are lagged one period. Coefficients significant at the 10%, 5% and 1% level are indicated by *, ** and *** respectively. *t*-statistics are presented in parentheses. All equations are estimated using simultaneous equations with linear constraints that sources equal uses of cash.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Inv_t	$\Delta Cash_t$	Div_t	ΔX_t	ΔD_t	ΔE_t
CF_t	0.28***	0.35***	0.01***	-0.37***	-0.35***	-0.02**
	(40.3)	(61.2)	(15.1)	(-44.3)	(-64.3)	(-2.2)
MB_{t-1}	0.03***	0.02***	0.00***	0.04***	0.01***	0.04***
	(43.5)	(31.6)	(13.1)	(58.5)	(12.2)	(60.5)
$CF_t \times MB_{t-1}$	-0.04***	-0.04***	-0.00***	-0.08***	0.03***	-0.11***
	(-20.4)	(-28.2)	(-6.0)	(-36.6)	(21.5)	(-60.9)
$SaleG_{t-1}$	0.02***	0.01***	-0.00***	0.03***	0.01***	0.02***
	(11.6)	(9.7)	(-3.7)	(16.1)	(9.1)	(12.1)
$Ln(Assets)_{t-1}$	-0.03***	-0.02***	0.00***	-0.05***	-0.01***	-0.04***
	(-31.0)	(-28.5)	(2.9)	(-45.2)	(-12.7)	(-44.1)
$Leverage_{t-1}$	-0.16***	0.02***	-0.01***	-0.16***	-0.24***	0.08***
	(-32.1)	(3.7)	(-36.6)	(-26.1)	(-58.6)	(15.3)
$Tangibility_{t-1}$	0.05***	0.06***	0.00***	0.11***	0.07***	0.04***
	(7.3)	(10.9)	(4.1)	(13.8)	(13.3)	(5.9)
Inv_{t-1}	0.05***	-0.01***	0.00***	0.04***	0.04***	-0.00
	(12.0)	(-2.8)	(3.8)	(8.3)	(12.8)	(-0.3)
$\Delta Cash_{t-1}$	0.13***	-0.14***	0.00***	-0.01***	0.00	-0.02***
	(29.8)	(-41.1)	(4.6)	(-2.9)	(0.7)	(-4.1)
Div_{t-1}	0.10***	-0.20***	0.25***	0.14***	0.08***	0.06*
	(2.8)	(-7.1)	(116.8)	(3.4)	(2.8)	(1.8)
ΔD_{t-1}	-0.02***	-0.00	-0.00*	-0.03***	-0.03***	0.01
	(-4.3)	(-0.6)	(-1.7)	(-4.1)	(-7.9)	(1.3)
ΔE_{t-1}	-0.06***	0.01***	-0.00***	-0.05***	-0.02***	-0.03***
	(-19.6)	(4.8)	(-14.4)	(-13.8)	(-8.7)	(-9.7)
Observations	64,021	64,021	64,021	64,021	64,021	64,021
R-squared	0.13	0.14	0.23	0.26	0.16	0.21

Table 8: The joint impact of cash flow and future stock returns (*FRet*) on corporate policies

The data are retrieved from Compustat and CRSP for the 1971- 2008 period. Dependent variables are defined in Table 1. *Tangibility* is the net PPE over total assets. *SalesG* is the change in net sales scaled by the lagged net sales. *Leverage* is defined as total debt (the sum of short-term and long-term debt) divided by total assets. *Ln*(*Assets*) is the natural log of total book value of assets. Future realized stock returns (*FRet*), defined as stock returns over the next three years multiplied by (-1). The regression equation is estimated with fixed *firm* and *year* effects. All control variables are lagged one period. Coefficients significant at the 10%, 5% and 1% level are indicated by *, ** and *** respectively. *t*-statistics are presented in parentheses. All equations are estimated using simultaneous equations with linear constraints that sources equal uses of cash.

VARIABLES	(1) Inv_t	(2) $\Delta Cash_t$	(3) Div_t	(4) ΔX_t	(5) ΔD_t	(6) ΔE_t
CF_t	0.17***	0.24***	0.00***	-0.59***	-0.26***	-0.32***
	(29.2)	(48.1)	(13.7)	(-81.9)	(-57.5)	(-52.7)
MB_{t-1}	0.03***	0.01***	0.00***	0.04***	0.01***	0.04***
	(33.0)	(22.9)	(10.9)	(43.5)	(9.2)	(44.1)
$FRet_t$	0.01***	0.01***	0.00***	0.02***	0.00***	0.01***
	(16.2)	(12.4)	(5.9)	(22.2)	(9.2)	(19.1)
$CF_t \times FRet_t$	-0.03***	-0.02***	0.00	-0.05***	0.00	-0.05***
	(-6.9)	(-8.3)	(1.0)	(-11.3)	(1.0)	(-14.1)
$SaleG_{t-1}$	0.02***	0.01***	-0.00***	0.03***	0.01***	0.02***
	(8.9)	(7.8)	(-3.5)	(12.5)	(7.1)	(9.3)
$Ln(Assets)_{t-1}$	-0.04***	-0.03***	0.00*	-0.06***	-0.01***	-0.05***
	(-30.5)	(-26.7)	(1.7)	(-43.4)	(-12.1)	(-41.8)
$Leverage_{t-1}$	-0.17***	0.03***	-0.01***	-0.15***	-0.26***	0.10***
	(-25.9)	(4.7)	(-33.3)	(-19.8)	(-51.1)	(15.3)
$Tangibility_{t-1}$	0.05***	0.07***	0.00***	0.12***	0.07***	0.06***
	(6.5)	(9.7)	(3.2)	(12.2)	(10.1)	(6.7)
Inv_{t-1}	0.05***	-0.02***	0.00***	0.03***	0.05***	-0.02***
	(10.1)	(-5.1)	(3.6)	(5.0)	(12.0)	(-3.1)
$\Delta Cash_{t-1}$	0.12***	-0.14***	0.00***	-0.02***	0.01***	-0.03***
	(23.8)	(-33.4)	(3.2)	(-3.0)	(2.9)	(-5.7)
Div_{t-1}	0.05	-0.28***	0.24***	0.02	0.06*	-0.05
	(1.2)	(-7.9)	(96.7)	(0.3)	(1.9)	(-1.1)
ΔD_{t-1}	-0.01**	0.01*	-0.00	-0.00	-0.02***	0.02***
	(-2.0)	(1.7)	(-1.5)	(-0.6)	(-4.6)	(2.8)
ΔE_{t-1}	-0.06***	0.02***	-0.00***	-0.05***	-0.03***	-0.02***
	(-15.2)	(5.4)	(-12.0)	(-9.5)	(-8.8)	(-4.6)
Observations	43,496	43,496	43,496	43,496	43,496	43,496
R-squared	0.14	0.13	0.25	0.23	0.16	0.16

Table 9: The decomposition of the market-to-book assets ratio and the joint impact of cash flow and stock misvaluation on corporate policies

The data are retrieved from Compustat and CRSP for the 1971- 2008 period. Dependent variables are defined in Table 1. In Panel A, we use the methodology proposed by Rhodes-Kropf, Robinson, and Viswanathan (RKRV) (2005) to decompose the market-to-book assets ratio. The resulting measures of the equity mispricing (*MP*) and the fundamental-value-to-assets ratio (*VA*) are denoted as MP_{RKRV} and VA_{RKRV}, respectively. Appendix B describes RKRV's (2005) decomposition in greater details. In Panel B, we use the Residual Income Model (RIM) as in Dong et al. (2006) to compute the fundamental value of equity. The resulting measures of the equity mispricing (*MP*) and the fundamental-value-to-assets ratio (*VA*) obtained using RIM are denoted as MP_{RIM} and VA_{RIM}. Appendix C describes the Residual Income Model that we use in greater details. Apart from key explanatory variables reported in the table, we also include in all regressions the same control variables as those reported in Table 7. For brevity, the coefficients of control variables are not tabulated. The regression equation is estimated with fixed *firm* and *year* effects. All control variables are lagged one period. Coefficients significant at the 10%, 5% and 1% level are indicated by *, ** and *** respectively. *t*-statistics are presented in parentheses. All equations are estimated using simultaneous equations with linear constraints that sources equal uses of cash.

VARIABLES	(1) Inv_t	(2) $\Delta Cash_t$	(3) Div_t	(4) ΔX_t	(5) ΔD_t	(6) ΔE_t
	Panel A: MP_{RKRV} as the proxy for stock misvaluation					
CF_t	0.21***	0.27***	0.01***	-0.51***	-0.28***	-0.23***
	(41.6)	(66.3)	(16.7)	(-84.3)	(-70.2)	(-45.4)
VA_{RKRV}	0.04***	0.02***	0.00***	0.06***	0.01***	0.05***
	(25.3)	(16.2)	(11.8)	(32.9)	(9.8)	(31.7)
MP_{RKRV}	0.03***	0.02***	0.00***	0.04***	0.01***	0.04***
	(38.7)	(28.5)	(9.3)	(52.5)	(9.4)	(55.7)
$CF \times MP_{RKRV}$	-0.03***	-0.04***	-0.00***	-0.07***	0.02***	-0.09***
	(-15.1)	(-23.5)	(-4.4)	(-29.0)	(12.5)	(-44.8)
Observations	62237	62237	62237	62237	62237	62237
R-squared	0.13	0.14	0.23	0.24	0.15	0.18
	Panel B: MP_{RIM} as the proxy for equity misvaluation					
CF	0.25***	0.28***	0.01***	-0.47***	-0.26***	-0.20***
	(31.5)	(45.1)	(11.6)	(-50.0)	(-43.1)	(-26.6)
VA_{RIM}	0.03***	0.01***	0.00***	0.04***	0.01***	0.03***
	(24.2)	(16.0)	(10.0)	(31.6)	(10.7)	(30.1)
MP_{RIM}	0.03***	0.01***	0.00***	0.04***	0.00***	0.04***
	(24.8)	(17.5)	(6.3)	(33.0)	(4.8)	(36.5)
$CF \times MP_{RIM}$	-0.02***	-0.03***	-0.00***	-0.05***	0.01***	-0.07***
	(-8.0)	(-13.2)	(-3.7)	(-15.6)	(4.8)	(-23.0)
Observations	33449	33449	33449	33449	33449	33449
R-squared	0.15	0.14	0.22	0.18	0.14	0.13