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Firm (re)valuation and payouts

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Abstract

We document an inverted-U pattern in the frequency and magnitude of share repurchases across firms arranged into $\frac{V}{P}$ deciles (value to price), and a symmetric opposite pattern in equity issuances. These patterns cannot be explained by the market timing theory, which predicts monotonically increasing share repurchases or decreasing equity issuances across $\frac{V}{P}$ deciles. Instead, these patterns can be explained by Chen and Lambrecht (2021) theory that "cash cow" firms with a target negative net debt ratio decrease payouts to shareholders (or raise equity) after a positive revaluation of their assets captured by high $\frac{V}{P}$ ratios. We demonstrate that the hump-shaped patterns are driven largely by such firms with negative net debt ratio and by "mature" firms with low asset growth consistent with corporate lifecycle theory.

JEL CLASSIFICATION
G10, G35

1 | INTRODUCTION

The market timing hypothesis has been an important part of the corporate finance literature for many years. According to this hypothesis, managers possess superior information about a firm's true value relative to outside investors. Further, assuming that managers' interests are more closely tied to the interests of existing or long-term shareholders than to the interests of new or short-term shareholders, firm managers will, according to the market timing hypothesis, repurchase equity when it is underpriced and issue equity when it is overpriced. Several studies, including Ikenberry et al. (1995), Dittmar (2000), Peyer and Vermaelen (2008), Ben-Rephael et al. (2014), Dittmar and Field (2015), Sloan and You (2015), and Ma (2019), find empirical evidence on share repurchases consistent with the market timing hypothesis. The evidence is usually based on the current valuation or the long-term returns of an aggregate sample of firms that carry out share repurchases. In contrast, we start our research by examining the frequency and magnitude of share repurchases across the aggregate sample of firm-quarters during 2004-2021 arranged by their degree of misvaluation. We use $\frac{V}{P}$ ratio as a measure of misvaluation, where V is the firm's fundamental value of shares calculated using the residual income model of Ohlson (1991, 1995) and P is the market price per share.

The market timing hypothesis would predict higher frequency and magnitude of share repurchases for high $\frac{V}{P}$ firms that are arguably undervalued relative to low $\frac{V}{P}$ firms that are overvalued. Instead, we find an inverted-U relation between the number of share repurchases and $\frac{V}{P}$ ratio. Repurchase activity starts from a low level in the first $\frac{V}{P}$ decile, increases steadily and attains a maximum value around the fifth and sixth deciles, and then declines over the remaining deciles. We expand our experiment by next examining equity issuance activity across the same $\frac{V}{P}$ deciles of firm-quarters. Equity issuances are the opposite of share repurchases but occur less frequently.[1] Interestingly, we find an opposite pattern in the frequency and magnitude of equity issuances that start from a high point in the first decile, decrease steadily until the sixth decile, and then increase over the remaining deciles. We believe that such nonlinear, non-monotonic, and symmetric opposite patterns in share repurchase and equity issuance activity across $\frac{V}{P}$ deciles have not been documented before in the finance literature.[2] These patterns cannot be explained by the market timing hypothesis and motivate our investigation into their likely reasons.

Further tests show that the inverted-U and direct-U patterns are driven in large part by the subset of firms with negative net debt ratio (where net debt is the total debt minus cash and equivalents, and it is scaled by the combined market value of equity and net debt to calculate the net debt ratio). These patterns point to the theory model of Lambrecht and Myers (2017) for a possible explanation. They analyze corporate policies of payouts, investments, and financing in a unified framework that starts with an intertemporal budget constraint based on the cash flow identity. The identity states that each year a firm's source of funds (operating income and change in debt) equals its uses of funds (interest payments, payouts, and investments). In this framework, Lambrecht and Myers (2017) show that a firm controlled by a group of managers with power utility (constant relative risk aversion) preferences has interdependent payout, investment, and borrowing decisions. The payouts, capital stock, and net debt level for this firm are proportional to its net worth, which results in a constant net debt ratio. Chen and Lambrecht (2021) consider a firm's net debt ratio as constant and known a priori. In their model, the firm's total value of risky assets can increase either by investment in productive assets or by a positive revaluation of existing assets. Although the revaluation of assets does not increase the cash flow of a firm, it can alter its net debt ratio. To maintain the constant net debt ratio for a given level of investment, the firm needs to change its payouts assuming no additional borrowing or debt redemption. As per Proposition I of their model, a firm with a positive net debt ratio increases its payouts whereas a firm with a negative net debt ratio decreases its payouts when either firm experiences a positive revaluation of its assets.

We argue that the ratio of fundamental value (V) to market price (P) of equity can also serve as a measure of a firm's revaluation of risky assets. The fundamental value of equity calculated using Ohlson (1991, 1995) model is a forward-looking measure of a firm's fundamental value based on the analysts' forecasts about the future earnings of a firm. It is possible that the analysts have developed expertise in valuing a firm. In addition, their broad perspective about the industry in which a given firm operates and overall economy allows them to better assess a firm's prospects vis-à-vis its industry peers and macroeconomy. Therefore, if a firm's fundamental value is higher than the market price, then the latter is likely to converge to the former, resulting in a positive revaluation of its assets.

We execute our research idea on 81,705 firm-quarter observations of around 4,100 U.S. industrial (nonfinance) firms for the period 2004-Q1 to 2021-Q4. Depending on the number of shares repurchased and the amount of

[1]Ritter (1991), Loughran and Ritter (1995), Dong et al. (2012), Sloan and You (2015), and many others find evidence of overvaluation in the aggregate sample of firms that accomplish equity issuances.

[2]These patterns are shown in Figure 1 and Figure 5.

equity raised, we assign a given observation to one of the four mutually exclusive categories: share repurchase, equity issuance, both share repurchase and equity issuance, and neither share repurchase nor equity issuance. As mentioned before, we observe that the number of share repurchases follow an inverted-U pattern with increasing $\frac{V}{P}$, whereas the number of equity issuances follow a direct-U pattern with increasing $\frac{V}{P}$. Our contribution lies in documenting and then analyzing the reasons behind these patterns in the numbers and magnitudes of share repurchases and equity issuances.

In analyzing these patterns, our covariates of interest are the firm revaluation $\frac{V}{P}$ in its quadratic form and its interaction with categorical variables that characterize a firm's debt policy or its life cycle. The first categorical variable is based on a firm's net debt ratio (NDR) to identify a "cash cow", and the second categorical variable is its past asset growth (AG) to identify a "mature" firm. The parameters are estimated using the multinomial logistic and the fractional response logistic models, and we control for the investments or capital expenditure of the firm. Since we use a nonlinear regression involving an interaction of a quadratic covariate with a categorical variable for a meaningful interpretation of estimated coefficients, we rely more on the plots of predicted values of either outcome variable (share repurchase or equity issuance) for different percentile values of firm revaluation $\frac{V}{P}$.[3] The main takeaway is that a cash cow firm or a mature firm reduces share repurchases or increases equity issuances in the event of a positive revaluation of its risky assets over certain ranges of $\frac{V}{P}$.

2 | HYPOTHESIS DEVELOPMENT

The three major corporate finance decisions of payouts, investments, and financing can be analyzed in a unified framework. The intertemporal budget constraint of a firm provides this unified framework. In each year, the firm must balance its cash flow identity, which requires that the sources of funds (operating income plus change in borrowing) equal the uses of funds (interest payment, payouts to shareholders, and investments).[4] We focus on how external valuation impacts a firm's decisions in this unified framework.

Bonaimé et al. (2014) study a firm's decision to repurchase its shares with twin objectives of achieving target capital structure and unlocking the value. They use relative valuation $\frac{V}{P}$ as a measure of misvaluation. Their hypothesis is that an underlevered firm maintaining a target capital structure gains maximum benefits of share repurchases when it is undervalued by the market. In support of their hypothesis, they find that the announcement period returns are maximum when an underlevered and undervalued firm announces that it will repurchase its shares. Ma (2019) analyzes a firm's decision to concurrently issue debt and retire equity, or vice versa, using the cross-market (debt and equity) valuations. She finds that the nonfinancial firms regularly act as "cross-market arbitrageurs." When the cost of debt is low, a firm issues additional debt and repurchases shares. When the cost of equity is low, the firm issues equity and retires debt. Further, she finds that cross-market arbitrage is more prevalent in large and financially unconstrained firms.

Chen and Lambrecht (2021) help provide a theoretical framework to connect firm valuation to its payouts, investments, and financing decisions. They suggest focusing on net debt (debt minus cash) instead of debt because a firm can use its cash reserves to retire the existing debt. Hence, the target net debt ratio is more relevant than the target debt ratio (i.e., leverage). In addition, a firm's risky assets can be changed by its investment in productive assets and by an exogenous shock to its existing risky assets-in-place. Their Proposition I (equation 14) suggests that, for a given investment level, the change in a firm's payout following a revaluation of its asset value equals its (target) net debt ratio multiplied by the change in asset value.

[3]We extensively refer to the STATA® (statistical software) manuals on -margins- command.

[4]While highlighting the overall decline in the published research on corporate finance, Denis (2024) recognizes the importance of understanding the interdependency of payouts, investments, and financing.

In the remainder of this section, we attempt to illustrate the above-mentioned work of Chen and Lambrecht (2021) using a hypothetical example and how it helps form the research idea. For exposition, we use a standard textbook approach of the investment process as shown in Jordan et al. (2015) while replacing the margin balance with the net debt ratio and an individual investor with a corporation.

Suppose that, at time t = 0, a typical corporation has only two items on the assets side of its balance sheet. These are cash of $20 and risky assets worth $100. The liability includes debt of $60 and the remaining is the equity of $60. The current NDR is 0.4, which is $\frac{(60-20)}{100}$. This ratio is also a target (constant) NDR that the firm would like to maintain in the short-term. Suppose that the risky assets experience a positive revaluation and their values increase by 20%. This increase in value reduces the NDR to 0.333. To maintain a constant NDR of 0.4, the firm needs to rebalance its capital structure. If the firm does not make any changes to the level of debt ($60), then it needs to reduce the cash reserves to $12. In other words, the firm can increase its payout by $8 (which equals its constant NDR of 0.4 multiplied by change in asset value of $20). This scenario indicates that a firm with a positive target NDR can increase its payout, due to a positive revaluation of its existing risky assets-in-place.

Next, we consider the case of a cash cow firm that holds a significant amount of cash on its balance sheet. Suppose that, at time t = 0, it holds $70 in cash and risky productive assets worth $100. The liability includes debt of $60 and the remaining amount is equity worth $110. The current net debt ratio is −0.1. Suppose that the risky assets experience a positive revaluation and their values increase by 20%. This revaluation increases the NDR to -0.0833. Therefore, to maintain the constant NDR of −0.1 and assuming the cash cow firm does not make any changes to the level of debt, then it needs to increase its level of cash by an additional $2. In other words, it needs to reduce its payouts by $2. Therefore, our hypothesis is the following:

Hypothesis H1. A firm with negative (positive) net debt ratio reduces (increases) payouts such as share repurchases when it experiences a positive revaluation of its assets.

The above discussion focuses on share repurchases, but it can be extended to [negative] payouts such as equity issuances, which are the opposite of share repurchases. Thus, a firm with negative (positive) net debt ratio may increase (decrease) equity issuances by the same dollar amount and adjust the cash holdings accordingly when it experiences a positive revaluation of its assets.

3 | SAMPLE SELECTION AND METHODS

3.1 | Data

We construct our sample using Compustat, CRSP (Center for Research in Security Prices), and IBES (Institutional Brokers' Estimate System) datasets. We begin with the CRSP-Compustat (CCM) merged dataset. Our sample period is from the first quarter of fiscal year 2004 to the fourth quarter of fiscal year 2021. Starting in 2004, Compustat quarterly dataset provides the total shares of a company's common stock repurchased within a quarter (item: CSHOPQ). From Compustat, we retain only US firms. We drop federal agencies and exclude financials and utility firms (SIC codes between 6000 and 6999 and SIC codes between 4900 and 4999).

We define the outcome variables 'RepShr' and 'EqiRsd'. The variable 'RepShr' is the fraction of shares repurchased by a firm in each quarter. It is the ratio of the number of shares repurchased during a quarter (Compustat item: CSHOPQ) to the number of shares outstanding (Compustat item: CSHOQ) at the beginning of that quarter. The variable 'EqiRsd' is the ratio of the amount of equity raised to the beginning period market value of equity. We compute the amount of equity raised in a quarter by taking the difference between the current period year-to-date sale of common and preferred stock (Compustat item: SSTKY) and its one-quarter lagged value if the current quarter is second, third, or fourth fiscal quarter, and is the same as SSTKY if the current quarter is the first fiscal quarter. The market value of equity is the product of share price (CRSP item: PRC) and number of shares outstanding (CRSP item: SHROUT). We include all firm-quarter observations with available values of outcome variables (RepShr and EqiRsd), covariates ($\frac{V}{P}$, net debt ratio, and past asset growth), and a control variable (CAPX/TA). We need this last variable since when studying the relation between asset revaluation and payouts, it is necessary to control for the firm's investments. The variable 'CAPX/TA' is defined as the ratio of capital expenditure (Compustat item: CAPXY minus its one-quarter lag value) to the beginning period total assets (Compustat item: ATQ).[5] The final sample consists of 81,705 firm-quarter observations for 4,118 different firms.

We assign each firm-quarter observation to one of the four mutually exclusive categories and define a categorical variable 'Outcome'. These categories are 1) share repurchase (category: RP), 2) equity issuance (category: EI), 3) both share repurchase and equity issuance (category: BT), and 4) neither share repurchase nor equity issuance (category: NT). The first category (RP) represents payouts through share repurchases and the second category (EI) represents equity issuances. Somewhat arbitrarily, we define a share repurchase as having occurred during a quarter when a firm repurchases at least 0.1% of its outstanding shares at the beginning of the quarter. Also, we define an equity issuance as having occurred during a quarter when a firm raises at least 1.0% of its outstanding market value of equity at the beginning of the quarter. Firm repurchases are typically small, amounting to an average 1.18% of outstanding shares in quarters when firms repurchase at least 0.1% of shares. In contrast, equity issues are large, amounting to an average 7.8% of outstanding equity in quarters when firms raise at least 1.0% of outstanding equity. Equity issuances by firms are larger because they incur substantial transaction costs associated with preparation of legal documents, registration with SEC, underwriters' spread, market reaction, etc., and some of these transaction costs are fixed regardless of issue size. In comparison, open-market share repurchases incur virtually no fixed transaction costs and only small variable costs such as bid-ask spreads; therefore, they can be done in smaller batches.[6] Using these criteria, we have 26,324 firm-quarter observations of share repurchases, 2,934 firm-quarter observations of equity issuances, 515 firm-quarter observations of both, and 51,932 firm-quarter observations of neither.

3.2 | Measure of firm revaluation $\left(\frac{V}{P}\right)$

Our covariate of interest measures the degree of a firm's revaluation of risky assets. For that, we use the ratio of a firm's fundamental value of equity (V) to its market price of equity (P). The residual income model of Ohlson (1991, 1995) helps compute a firm's fundamental value of equity. It is a forward-looking model based on the analysts' earnings forecasts. For calculating $\frac{V}{P}$, we follow Ma (2019), who in turn follows Dong et al. (2012).[7] Specifically, the fundamental value per share in quarter t is estimated as follows:

$$V_t = B_t + \frac{\left(f_{t+1}^{ROE} - R_{E,t}\right)B_t}{(1 + R_{E,t})^1} + \frac{\left(f_{t+2}^{ROE} - R_{E,t}\right)B_{t+1}}{(1 + R_{E,t})^2} + \frac{\left(f_{t+3}^{ROE} - R_{E,t}\right)B_{t+2}}{(1 + R_{E,t})^2 R_{E,t}}, \tag{1}$$

where B is the book value of equity per share, R_E is the cost of equity, f_{t+h}^{ROE} is the forecasted return on equity for period $t+h$ that is computed as $f_{t+h}^{ROE} = f_{t+h}^{EPS}/\bar{B}_{t+h-1}$ and $\bar{B}_{t+h-1} = \frac{(B_{t+h-1} + B_{t+h-2})}{2}$. We obtain data on forecasted

[5]We use the beginning period values of covariates that presumably enter the firm's decision to repurchase or issue equity in this period and therefore the current period's outcome variables and control variable (although each is scaled by the beginning period total shares or total assets). We describe computations of net debt ratio and past asset growth later in the paper.

[6]Not applying the 1.0% filter to equity issues would mean including a large number of firm-quarters with small equity issues. That is because the Compustat item SSTKY includes many items other than equity issues to public shareholders via a seasoned equity offering, such as exercise of executive stock options and convertible debt, equity grants to key executives, etc. We intend to exclude such equity issues that are unlikely to represent a firm's actions in response to asset revaluation.

[7]We thank Yueran Ma for providing the replication kit of her study at the publisher's website.

earnings per share (f_{t+h}^{EPS}) from IBES. We obtain book value of equity from Compustat.[8] We estimate future book values of equity by applying the current plowback ratio to future earnings. We compute the cost of equity using the traditional CAPM (capital asset pricing model). Following Ma (2019), we estimate stock beta using monthly stock and market returns over a five-year period ending before the current quarter, use the three-month Treasury bill rate from the FRED (Federal Reserve Economic Data) database as a proxy for the risk-free return, and the annualized average difference between the monthly market return and the risk-free return over the last 30 years as a proxy for equity risk premium. We proxy market return by the CRSP variable VWRETD (value-weighted return including dividends).

3.3 | Sample distribution and payouts incidence over $\frac{V}{P}$

Table 1 reports the frequency distribution of the sample based on the categorical variable 'Outcome.' Panel A shows the distribution across fiscal years. The lowest number of repurchases are recorded in 2009, perhaps showing the effects of the financial crisis of 2007-2008 when firms experienced liquidity constraints and decided to hold on to cash. Repurchases are also low in 2020, perhaps showing the effects of the Covid crisis. The maximum number of equity issuances is recorded in the expansion years of 2004-2006 and the Covid year of 2020. Interestingly, there are 515 firm-quarters where the firms engage in both share repurchases and equity issuances simultaneously within the same quarter. The reasons behind this anomaly are not entirely clear. It is unlikely that a firm is both overvalued and undervalued in the same quarter, so market timing cannot be a reason. It is also unlikely that firms would be adjusting payouts through share repurchases and equity issuances in the same quarter in response to firm revaluation. Bens et al. (2003) and Moore (2023) suggest that this seemingly anomalous pattern can be explained by firms trying to limit EPS (earnings-per-share) dilution, resulting from large employee stock option exercises that lead to issuance of new shares with simultaneous share repurchases. Finally, we also notice a steady decline in the number of all firm-quarters over time, consistent with a decrease in the number of publicly-traded firms in the United States in recent years (Blair, 2019).

Panel B of Table 1 shows the distribution of sample observations across industries. The industry classification is based on the Fama-French 12 industries as per the two-digit SIC codes. In our data, the maximum share repurchases are in the computer and software industry, and the maximum equity issuances are in the medical industry.

Figure 1 shows the percent frequencies of share repurchases in the upper panel and equity issuances in the lower panel across deciles of firm revaluation. On the *x*-axis, we show $\frac{V}{P}$ decile ranks, with each rank comprising 8,170 firm-quarter observations. Panel A of Appendix Table A1 shows the upper cutoff values of $\frac{V}{P}$ for each decile rank. For example, the first and lowest decile contains firm-quarter observations with $\frac{V}{P}$ values below 0.247 while the tenth and highest decile contains observations with $\frac{V}{P}$ values ranging from 1.680 to 3.276. Both the share repurchase and equity issuance frequencies in the top and bottom panels are reported as percent of all firm quarters and represented by a solid dot for each decile rank. The short vertical spike through each dot represents the 95% confidence level calculated using the multinomial proportion of the corresponding outcome. The STATA® commands used for different calculations are reported in notes to Figure 1 and all other figures that follow.

The top panel of Figure 1 shows that the frequency of share repurchases starts from the lowest value of 14.6% in the 1st decile and increases steadily until the 5th decile where it reaches a value of 37.9%. It increases marginally between the 5th and 6th deciles to attain a maximum value of 38.5%. Thereafter it declines over the remaining four deciles, gradually at first and sharply in the end, from a value of 35.9% in the 9th decile to 30.2% in the 10th decile. To understand confidence intervals, consider the 6th decile where share repurchases occur with an exact frequency of 38.52%. Using the STATA command for multinomial proportion confidence interval with the four possible

[8]The book value of equity is defined as book value of stockholders' equity (item: SEQQ) plus balance sheet deferred taxes (item: TXDBQ) plus investment tax credit (if available, item: TXDITCQ) minus book value of preferred stock (item: PSTKQ).

TABLE 1 Sample distribution.

Panel A: Year-wise distribution

Year	Repurchases (RP) N	Repurchases (RP) V/P	Equity issuances (EI) N	Equity issuances (EI) V/P	Both (BT) N	Both (BT) V/P	Neither (NT) N	Neither (NT) V/P	All N	All V/P
2004	947	0.935	285	0.798	40	0.935	3,957	0.881	5,229	0.887
2005	1,393	0.802	226	0.696	37	0.589	3,628	0.723	5,284	0.742
2006	1,557	0.663	234	0.543	77	0.566	3,426	0.593	5,294	0.611
2007	1,673	0.605	155	0.509	49	0.485	3,226	0.545	5,103	0.563
2008	1,669	0.926	90	0.890	24	0.848	3,237	0.935	5,020	0.931
2009	875	1.523	182	1.387	24	1.255	3,722	1.465	4,803	1.472
2010	1,246	1.341	164	1.145	47	1.142	3,358	1.148	4,815	1.198
2011	1,606	1.327	115	1.227	36	1.167	2,940	1.145	4,697	1.210
2012	1,619	1.185	109	1.173	29	1.274	2,801	1.051	4,558	1.103
2013	1,503	1.077	123	0.893	50	1.014	2,559	0.943	4,235	0.990
2014	1,756	0.840	113	0.673	17	0.955	2,481	0.750	4,367	0.785
2015	1,859	0.825	117	0.782	17	0.760	2,370	0.758	4,363	0.787
2016	1,714	0.922	131	0.771	14	0.837	2,511	0.814	4,370	0.855
2017	1,548	0.870	153	0.714	17	1.294	2,621	0.737	4,339	0.786
2018	1,690	0.734	144	0.720	11	0.861	2,255	0.720	4,100	0.726
2019	1,533	0.776	153	1.084	7	1.430	2,251	0.745	3,944	0.771
2020	920	0.782	246	1.054	8	0.892	2,361	0.834	3,535	0.836
2021	1,216	0.700	194	0.856	11	0.951	2,228	0.601	3,649	0.649
Total	26,324	0.919	2,934	0.873	515	0.894	51,932	0.870	81,705	0.886

Panel B: Industry-wise distribution

Industry	Repurchases (RP) N	Repurchases (RP) V/P	Equity issuances (EI) N	Equity issuances (EI) V/P	Both (BT) N	Both (BT) V/P	Neither (NT) N	Neither (NT) V/P	All N	All V/P
Consumer Nondurables	1,823	1.142	83	1.075	35	1.088	3,021	1.066	4,962	1.095
Consumer Durables	971	0.809	53	0.971	10	0.801	1,650	0.926	2,684	0.884
Manufacturing	3,775	0.823	216	0.928	57	0.851	6,767	0.863	10,815	0.850
Energy	827	1.017	193	1.015	20	1.171	2,545	1.029	3,585	1.026
Chemicals	1,238	0.952	60	1.130	12	0.889	1,694	0.975	3,004	0.968
Computer, Software, etc.	6,380	0.748	723	0.642	213	0.744	12,227	0.668	19,543	0.694
Telephone & TV	606	0.869	53	0.621	11	0.831	1,285	0.851	1,955	0.850
Shops	4,476	1.055	222	1.024	56	1.093	6,607	0.967	11,361	1.003
Medical	2,216	1.144	1,014	0.930	37	1.173	9,001	0.893	12,268	0.942

(Continues)

TABLE 1 (Continued)

Panel B: Industry-wise distribution

Industry	Repurchases (RP) N	Repurchases (RP) V/P	Equity issuances (EI) N	Equity issuances (EI) V/P	Both (BT) N	Both (BT) V/P	Neither (NT) N	Neither (NT) V/P	All N	All V/P
Other	4,012	0.909	317	0.914	64	0.928	7,135	0.934	11,528	0.925
Total	26,324	0.919	2,934	0.873	515	0.894	51,932	0.870	81,705	0.886

Note: Our sample includes all firm-quarters from fiscal 2004-Q1 to 2021-Q4 for which relevant data are available on CRSP, Compustat, and IBES databases to calculate 1. Shares repurchased, 2. Equity raised, 3. Value-to-price (V/P) ratio, 4. Net debt ratio, 5. Asset growth, and 6. Capital expenditure scaled by total assets. Panel A and Panel B document year-wise and industry-wise sample distribution based on four categories. The category 'Repurchases (RP)' ('Equity issuances (EI)') includes firm-quarter observations where a firm repurchases (sells) above 0.1% of outstanding shares (1% of market value of equity). The category 'Both (BT)' contains observations where a firm undertakes both a share repurchase and an equity issuance. The category 'Neither (NT)' is for the remaining firm-quarter observations where a firm neither repurchases shares nor issues additional equity. The industry categories in Panel B use Fama-French 12-industry definitions. N is the number of firm-quarter observations. In this table, we report the average value of V/P. The variable V/P is the ratio of a firm's fundamental value per share (V) to the market value per share (P). Our V/P measure is using the residual income model of Ohlson (1991, 1995).

outcomes of RP, EI, BT, and NT, we estimate the 95% confidence interval from 37.18% to 39.87% around the observed frequency.[9] That amounts to a vertical spike of 2.69%. The 95% confidence intervals for all other deciles with lower frequency of share repurchases will be smaller.

The lower panel of Figure 1 shows the percent frequency of equity issuances relative to all firm-quarters by $\frac{V}{P}$ decile rank. The pattern is strikingly opposite to that for share repurchases although the percent values shown on the *y*-axis are much smaller. Equity issuances start from the highest value of 7.1% in the 1st decile and decrease monotonically until the 6th decile, attaining the lowest value of 2.3%. Thereafter, the numbers of equity issuances increase over the remaining deciles, gradually at first and sharply in the end, from 2.9% in the 9th decile to 4.6% in the 10th decile. The vertical spikes through solid dots that represent 95% confidence intervals in the lower panel look taller than in the upper panel, but that appearance is deceptive due to different scales used for the *y*-axes of the two panels. The confidence intervals in the lower panel are in fact smaller due to lower proportions of equity issuances. For the highest frequency of equity issuances of 7.13% in the first $\frac{V}{P}$ decile, we estimate the 95% confidence interval from 6.46% to 7.88%, implying a vertical spike of 1.42%. This vertical spike is expectedly a bit shorter on the downside than on the upside relative to the observed frequency of 7.13%, due to less room below than above the observed frequency.

Finally, we find a high correlation of −0.976 between percent frequencies of share repurchases in the top panel and equity issuances in the bottom panel of Figure 1. These symmetric and opposite patterns suggest a common underlying reason, which we explore further in the sections below.

4 | RESULTS FOR THE LIKELIHOOD OF PAYOUTS

Our empirics involve analyzing the likelihood of payouts (both share repurchases and equity issuances) and the magnitude of actual payouts. In this section, we report the results of multinomial regressions estimating the likelihood of payouts. In the first part of this section, we fit the model using a quadratic term of $\frac{V}{P}$ and assess

[9]We use the STATA's user-written file 'mpci.ado' to simultaneously compute the multinomial proportion's confidence intervals. May and Johnson (1997) provide its equivalent SAS macro. The estimation method is based on Goodman (1965). For more details visit: https://www.statalist.org/forums/forum/general-stata-discussion/general/134445-how-to-compute-simultaneous-confidence-intervals-for-multinomial-proportions.

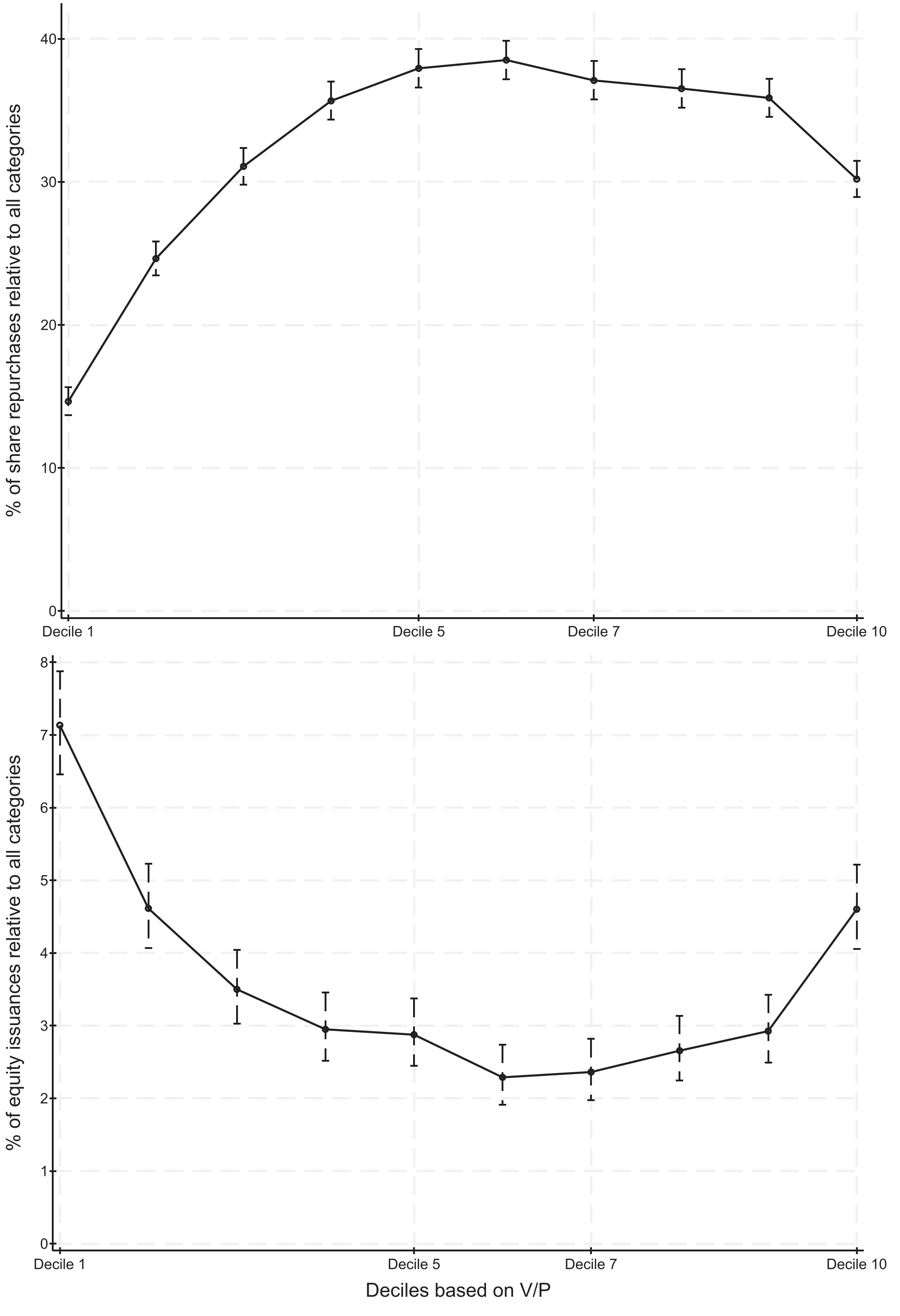

FIGURE 1 Firm revaluation (V/P) deciles and incidence of share repurchases and equity issuances. *Note*: This figure shows the proportion of share repurchases (upper panel) and equity issuances (lower panel) relative to all four category observations for a given V/P decile. The four categories and V/P are defined in notes to Table 1. The vertical spikes show a multinomial proportion confidence interval of 95%. We use STATA's user-written 'mpci.ado' file that is based on the equivalent SAS macro of May and Johnson (1997). This code simultaneously constructs confidence interval of multinomial proportions based on method of Goodman (1965).

whether we obtain the hump-shaped patterns of Figure 1 after controlling for the firm's investments (i.e., capital expenditure) and time and industry fixed effects. In the second part of this section, we test the hypothesis that a cash cow firm (as well a mature firm) helps explain the observed patterns of Figure 1.

4.1 | Firm revaluation and the probabilities of share repurchases and equity issuances

For our multinomial logistic regression model, the dependent variable is the categorical variable ‘Outcome’. It comprises four categories: share repurchases (RP), equity issuances (EI), both share repurchases and equity issuances (BT), and neither share repurchases nor equity issuances (NT). We select category NT as the base category. As an example, the full empirical specification for the choice between a share repurchase transaction and “neither” transaction is given as follows, where the log-odds of the outcomes are modeled as a linear combination of the independent variables[10]:

$$\log\left(\frac{\Pr(\mathrm{RP})}{\Pr(\mathrm{NT})}\right) = \beta_0 + \beta_1 \times \frac{\mathrm{V}}{\mathrm{P}} + \beta_2 \times \left(\frac{\mathrm{V}}{\mathrm{P}}\right)^2 + \beta_3 \times \mathrm{CAPX/TA} + \mathrm{I_j} + \mathrm{T_t}, \tag{2}$$

where $\frac{V}{P}$ is our proxy for the firm revaluation measured at the beginning of a given quarter t; control variable CAPX/TA is capital expenditure during the quarter scaled by beginning total assets; I_j are Fama-French 12-industry dummy variables; T_t are the year-quarter dummy variables; and Pr is the abbreviation for probability. The coefficients of interest are β_1 and β_2. Their respective positive and negative signs would indicate that an increase in firm revaluation increases the likelihood of a share repurchase with respect to the base category of undertaking neither share repurchase nor equity issuance. However, after some level of revaluation $\frac{V}{P}$, there is a decline in the likelihood of a share repurchase. We cluster the standard errors at the firm level to control for multiple transactions by a firm.

Table 2 reports the results. Model 1 is a linear model with $\frac{V}{P}$ as the covariate, Model 2 includes both the linear and quadratic terms of $\frac{V}{P}$, and Model 3 additionally controls for CAPX/TA. Model 1 and Model 2 test reduced forms of Equation (2) and are shown for full details. Within each model, we show results of share repurchases (RP) versus the base category neither (NT) and equity issuances (EI) versus the base category neither (NT). Separately, in Appendix Tables A2, A3, and A4, we also present results for both share repurchases and equity issuances (BT) versus the base category neither (NT) along with other results.

The linear Model 1 is not adequate as it shows that, at least in the ‘EI vs. NT’ test, the odds of equity issuance relative to the odds of neither action increases monotonically over the entire range of $\frac{V}{P}$, which is inconsistent with the pattern seen in Figure 1. The quadratic Model 2 captures the patterns in both share repurchases and equity issuances much better. Model 3, which further controls for firm's capital expenditure, shows that β_1 and β_2 coefficients from Model 2 are not much changed. For discussion and subsequent inference, we focus on Model 3.

For share repurchases, the coefficients of linear and quadratic terms of $\frac{V}{P}$ equal 1.343 and −0.367, both significant at 1% level, which imply an inverted-U pattern. Further, taking partial derivatives of Equation (2) with respect to $\frac{V}{P}$ and equating to zero, the ratio of the odds of share repurchase and the odds of neither action is maximized for a $\frac{V}{P}$ value of $\frac{\beta_2}{-2\beta_1} = \frac{1.343}{2 \times 0.367}$, or 1.83, which is in the last decile. The corresponding coefficients for equity issuances equal −0.148 and 0.047, significant at 5% and 1% levels, which imply a direct-U pattern. The ratio of the odds of equity issuance and the odds of neither action in this case is minimized for a $\frac{V}{P}$ value of $\frac{0.148}{2 \times 0.047}$, or 1.57, which is in the 9th decile. The coefficients of CAPX/TA are as expected, negative for share repurchases and positive for equity issuances, and significant at 1% level. As a firm's investment needs increase, it is less likely to

[10]For better exposition, see https://stats.oarc.ucla.edu/stata/dae/multinomiallogistic-regression/.

TABLE 2 Firm revaluation (V/P) and likelihood of share repurchases and equity issuances.

	Model 1		Model 2		Model 3	
	RP vs. NT	EI vs. NT	RP vs. NT	EI vs. NT	RP vs. NT	EI vs. NT
V/P	0.245***	0.085*	1.340***	−0.146**	1.343***	−0.148**
	(8.12)	(1.90)	(12.16)	(2.23)	(12.17)	(2.25)
V/P square			−0.365***	0.046***	−0.367***	0.047***
			(8.89)	(4.61)	(8.90)	(4.64)
CAPX/TA					−8.437***	5.090***
					(5.28)	(2.70)
Constant	−1.929***	−3.027***	−2.600***	−2.839***	−2.521***	−2.894***
	(14.15)	(15.96)	(17.79)	(14.73)	(17.19)	(14.87)
N	81,705		81,705		81,705	
Pseudo R2	0.047		0.056		0.057	

Note: This table reports the results of multinomial logistic regression for the outcome categories share repurchases (RP) and equity issuances (EI) relative to the category 'Neither (NT)'. For brevity, we report results of the category 'Both (BT)' relative to the category 'Neither (NT)' in Appendix Table A2. The categories are defined in notes to Table 1, and the variable definition of firm revaluation measure (V/P) and control variable capital expenditure scaled by total assets (CAPX/TA) are in notes to Appendix Table A1. Each model controls for time and industry fixed effects by including fiscal year-quarter dummies and Fama-French 12 industry dummies. Standard errors are clustered at the firm level and absolute value of z-statistics are reported in parentheses below the coefficients. N and R2 are abbreviations for the number of firm-quarter observations and R-squared, respectively. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

disburse cash through share repurchases and more likely to raise cash through equity issuances. Finally, Appendix Table A2 shows that the β_1, β_2, and β_3 coefficients for the BT versus NT choice have the same sign as for RP versus NT choice in Table 2, significant in every case.

The interpretation of coefficients of a multinomial logistic regression, as reported in Table 2, is not straightforward. The coefficients show the log-odds of the outcome variable for a given change in the value of a covariate. Often a researcher is interested in the effects of a change in covariate on the probability of an outcome event, not the log-odds. The problem becomes further complicated when we have quadratic terms of a covariate.

Figure 2 shows a plot of predicted probabilities of share repurchases (upper panel) and equity issuances (lower panel) for 2.5th to 97.5th (with an increment of five) percentile values of firm revaluation measure $\frac{V}{P}$. These predicted probabilities are based on Model 3 of Table 2. For plotting this figure, we carefully refer to STATA® -margins- command and Perraillon and Hedeker (forthcoming).[11] As shown in the upper panel of Figure 2, the predicted probability of a share repurchase increases with firm revaluation for most of the observations. However, for the last decile values, the probability of a repurchase shows a declining trend. As shown in the lower panel of Figure 2, the predicted probability of an equity issuance decreases with firm revaluation for most of the observations. For the last decile values of firm revaluation, the predicted probability of an equity issuance increases with the firm revaluation. Overall, these results support the patterns shown in Figure 1. A large positive revaluation of the risky assets can reduce share repurchases or increase equity issuances.

[11]We refer an interested reader to Chapter 6 titled "Marginal effects to interpret regression parameters."

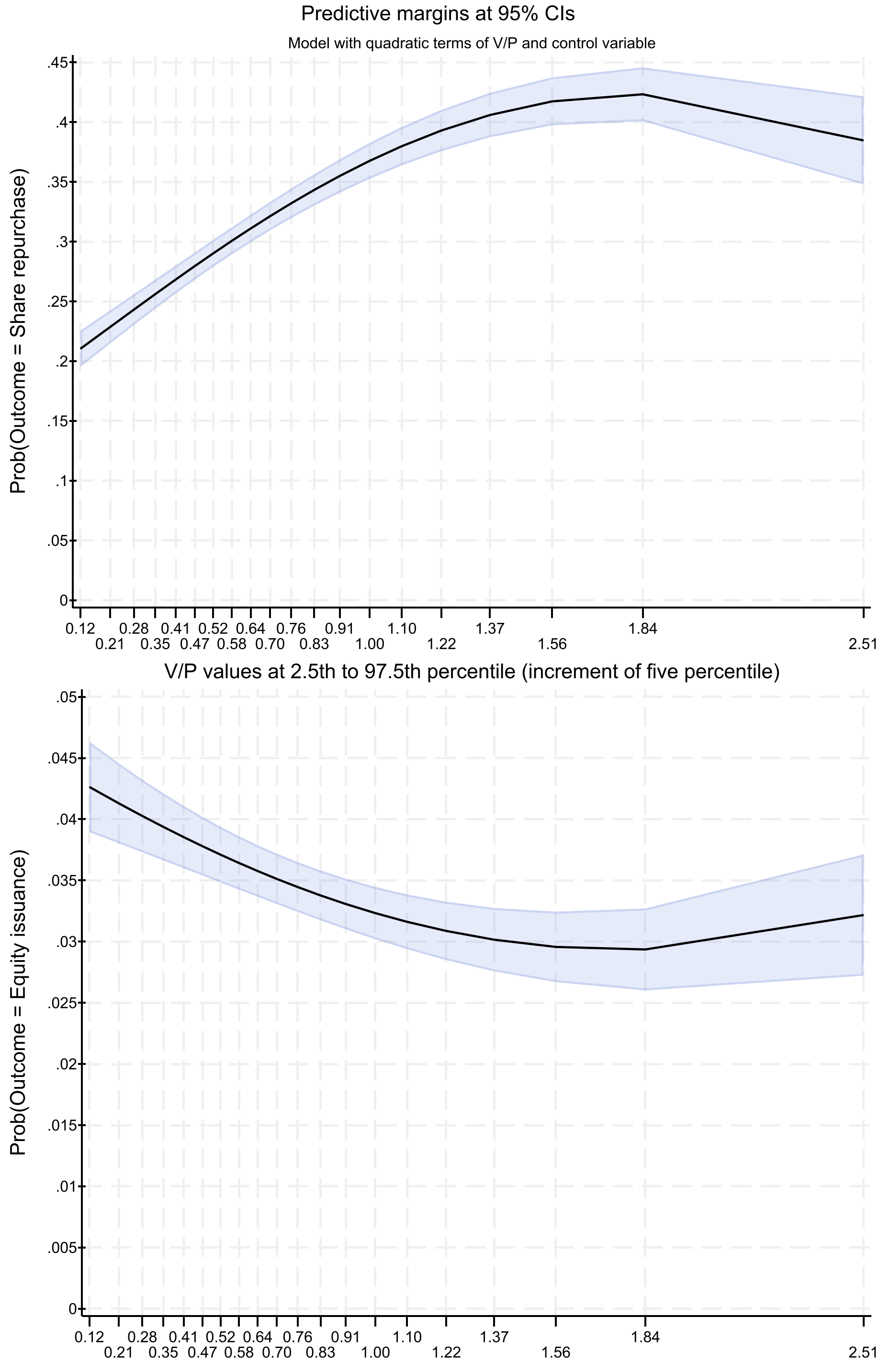

FIGURE 2 Firm revaluation (V/P) and probabilities of share repurchases and equity issuances. *Note*: This figure shows the predicted probabilities of share repurchases (upper panel) and equity issuances (lower panel) for 2.5th to 97.5th percentile with an increment of five percentile values of firm revaluation (V/P). These probabilities are based on a multinomial logistic regression of Model 3 of Table 2 that includes quadratic term of V/P, control variable CAPX/TA, and dummy variables for industry and time fixed effects. The CI is the abbreviation for the confidence interval. We use STATA's -margins- command. For predicted values of an outcome, we use the value of V/P at a given percentile and that of CAPX/TA at its mean value. [Color figure can be viewed at wileyonlinelibrary.com]

4.2 | Firm revaluation and likelihood of payouts in cash cow and mature firms

This subsection presents the results of the analyses on whether a cash cow firm or a mature firm helps explain the observed patterns of Figure 1. We use net debt ratio and life cycle characteristics, such as past asset growth, to identify a cash cow firm and a mature firm, respectively.

4.2.1 | Net debt ratio and the revaluation effects on the likelihood of payouts

The variable 'NDR' is the ratio of net debt to risky assets. The net debt is the total debt (long-term debt [Compustat item: DLTTQ] plus debt in current liability [Compustat item: DLCQ]) minus cash and equivalents (Compustat item: CHEQ). The risky assets are the sum of market value of equity and total debt minus cash and equivalents. In Panel B of Appendix Table 1, we report summary statistics of the beginning-period net debt ratio (NDR) for the overall sample of 81,705 firm-quarter observations. For empirics, we generate a dummy variable by forming two groups based on whether the beginning-period NDR is positive or negative. The variable 'Positive NDR' takes the value one if NDR is greater than or equal to zero and includes approximately 59% of all 81,705 observations. It takes the value zero in the remaining 41% cases with NDR less than zero. These latter cases are also referred to as 'Negative NDR' cases.

We are interested in analyzing the effects of risky asset revaluation on the likelihood of payout for positive and negative NDR groups. For that, we modify the empirical model as shown in Equation (2) and incorporate interactions of linear and quadratic terms of firm revaluation $\frac{V}{P}$ with dummy variable 'Positive NDR'. Specifically, we perform the following multinomial logistic regression for the choice between a share repurchase and category neither.

$$\log\left(\frac{\Pr(RP)}{\Pr(NT)}\right) = \beta_0 + \beta_1 \times \frac{V}{P} + \beta_2 \times \left(\frac{V}{P}\right)^2 + \beta_3 \times \text{Positive NDR} + \beta_4 \times \text{Positive NDR} \times \frac{V}{P} + \beta_5 \times \text{Positive NDR} \times \left(\frac{V}{P}\right)^2 + \beta_6 \times \text{CAPX/TA} + I_j + T_t, \tag{3}$$

where the omitted category is the Negative NDR group, and other notations are similar to those of Equation (2). We report the results obtained from the above specification in Model 1 of Appendix Table A3 for each of RP vs. NT, EI vs. NT, and BT vs. NT. For better interpretation of coefficients and exposition, we plot the graph of the above specification using the -margins- command of STATA®.

Figure 3 shows the predicted probabilities of share repurchases (upper panel) and equity issuances (lower panel) for 2.5th percentile to 97.5th percentile values of firm revaluation for the two groups of firms formed by Negative NDR (solid line) and Positive NDR (broken line) values. As shown in the upper panel for Negative NDR firms, the probability of a share repurchase increases with an increase in $\frac{V}{P}$ until its 82.5th percentile value (given by $\frac{V}{P}$ = 1.37) and then takes a sharp downward turn. In comparison, the probability of a share repurchase for Positive NDR firms increases with an increase in $\frac{V}{P}$ until its 92.5th percentile value (given by $\frac{V}{P}$ = 1.84) and then flattens or takes a slight downward turn. The curvature of predicted probabilities curve for share repurchases is clearly higher for Negative NDR firms than for Positive NDR firms. This finding suggests that the overall inverted-U pattern for share repurchases with firm revaluation $\frac{V}{P}$ in Figure 1 is driven largely by Negative NDR firms. The lower panel of Figure 3 shows that the results for equity issuances are the symmetric opposite of those for share repurchases. There also the direct-U pattern is much more visible for Negative NDR firms than for Positive NDR firms.

Overall, Figure 3 shows that the payout policy of firms with Negative NDR is quite different from that of firms with Positive NDR. The probability of a share repurchase decreases and that of an equity issuance increases with positive revaluation of risky assets for Negative NDR (cash cow) firms. This finding supports our hypothesis H1.

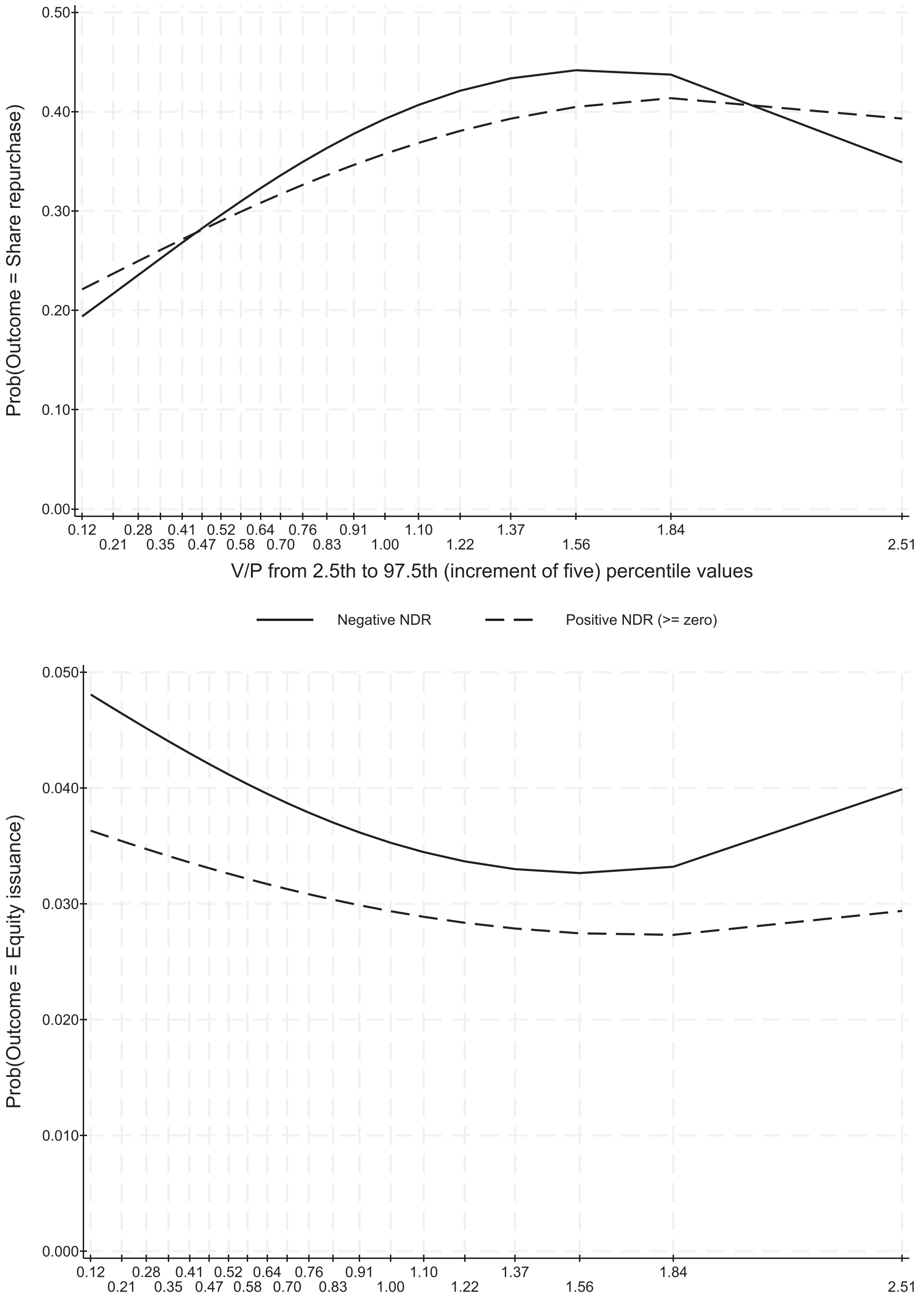

FIGURE 3 Net debt ratio and valuation effects on probability of share repurchase (equity issuance). *Note*: This figure shows the predicted probabilities of share repurchases (upper panel) and equity issuances (lower panel) for the 2.5th percentile to the 97.5th (increment of five) percentile values of firm revaluation (V/P) for two groups based on net debt ratio (NDR). The 'Positive NDR' group has an NDR value greater than or equal to zero. We have 58 (0.07%) observations with zero NDR values. The 'Negative NDR' group contains 33,198 (41%) firm-quarter observations. The variable NDR is defined in notes to Table A1. The predicted probabilities are computed based on Model 1 of Table A3. We use STATA's -margins- command. For predicted values of an outcome, we use the value of V/P at a given percentile and that of CAPX/TA at its mean value.

4.2.2 | Asset growth and revaluation effects on the likelihood of payouts

In the previous subsection, we show that firms with negative net debt ratio help explain the observed pattern of Figure 1. In this subsection, we attempt to explain that pattern drawing on the literature on corporate life cycle.[12] Following Grullon et al. (2002), we use past asset growth as a proxy for the firm life cycle. A firm with low asset growth is considered a mature firm.

We compute past assets growth (AG) as the log of the ratio of total assets (Compustat item: ATQ) during the current quarter (t) and that during four quarters before (t − 4). The summary statistics of the beginning-period asset growth (AG) for the overall sample of 81,705 firm-quarter observations are given in Panel B of Appendix Table A1. For each fiscal year-quarter, we assign a firm in one of the three groups based on the percentile values of past asset growth. The 'Low AG' group consists of firm-quarter observations with asset growth values below 30th percentile. The 'High AG' group has asset growth values above 70th percentile. The 'Medium AG' group contains the remaining observations. To analyze the effects of revaluation of risky assets $\frac{V}{P}$ on likelihood of payouts for the groups based on past asset growth, we perform the following multinomial logistic regression for the likelihood of share repurchases:

$$
\begin{aligned}
\log\left(\frac{\Pr(RP)}{\Pr(NT)}\right) = {} & \beta_0 + \beta_1 \times \frac{V}{P} + \beta_2 \times \left(\frac{V}{P}\right)^2 + \beta_3 \times \text{LowAG} + \beta_4 \times \text{HighAG} + \beta_5 \times \text{LowAG} \times \frac{V}{P} \\
& + \beta_6 \times \text{HighAG} \times \frac{V}{P} + \beta_7 \times \text{LowAG} \times \left(\frac{V}{P}\right)^2 + \beta_8 \times \text{HighAG} \times \left(\frac{V}{P}\right)^2 \\
& + \beta_9 \times \text{CAPX/TA} + I_j + T_t;
\end{aligned} \tag{4}
$$

the results of this analysis are reported in Model 1 of Appendix Table A4. For better understanding, we explain the results using a plot of the predicted probabilities.

Figure 4 shows the predicted probabilities of share repurchases (upper panel) and equity issuances (lower panel) for 2.5th to 97.5th (with an increment of five) percentile values of firm revaluation for three groups based on the past asset growth (AG). As shown in the upper panel of Figure 4, the probability of a share repurchase notably declines in the last decile of revaluation $\frac{V}{P}$ for Low AG firms relative to Medium AG and High AG firms. As shown in the lower panel, the probability of an equity issuance also increases more in the last decile of revaluation $\frac{V}{P}$ for Low AG firms relative to Medium AG and High AG firms.

Overall, the results, using the past asset growth as a measure of firm life cycle characteristics, demonstrate a similar pattern to the one obtained earlier using the net debt ratio. A mature firm with low past asset growth tends to reduce share repurchases and increase equity issuances if it experiences a positive revaluation of its risky assets.

5 | FIRM REVALUATION AND THE MAGNITUDE OF ACTUAL PAYOUTS

In the previous section, we analyze the likelihood of payouts in the event of positive revaluation of a firm's risky assets. For that, we use multinomial logistic regression framework because our focus is on the probability of a share repurchase and the probability of an equity issuance with respect to the probability of undertaking neither a share repurchase nor an equity issuance (category NT). In this section, we analyze the actual number of shares repurchased and the actual amount of equity raised by a firm. Specifically, our two outcome variables of interest are (1) fraction of shares repurchased (RepShr) and (2) the fraction of amount of equity raised (EqiRsd). Because

[12]For a survey on corporate life cycle literature, see Habib and Hasan (2019).

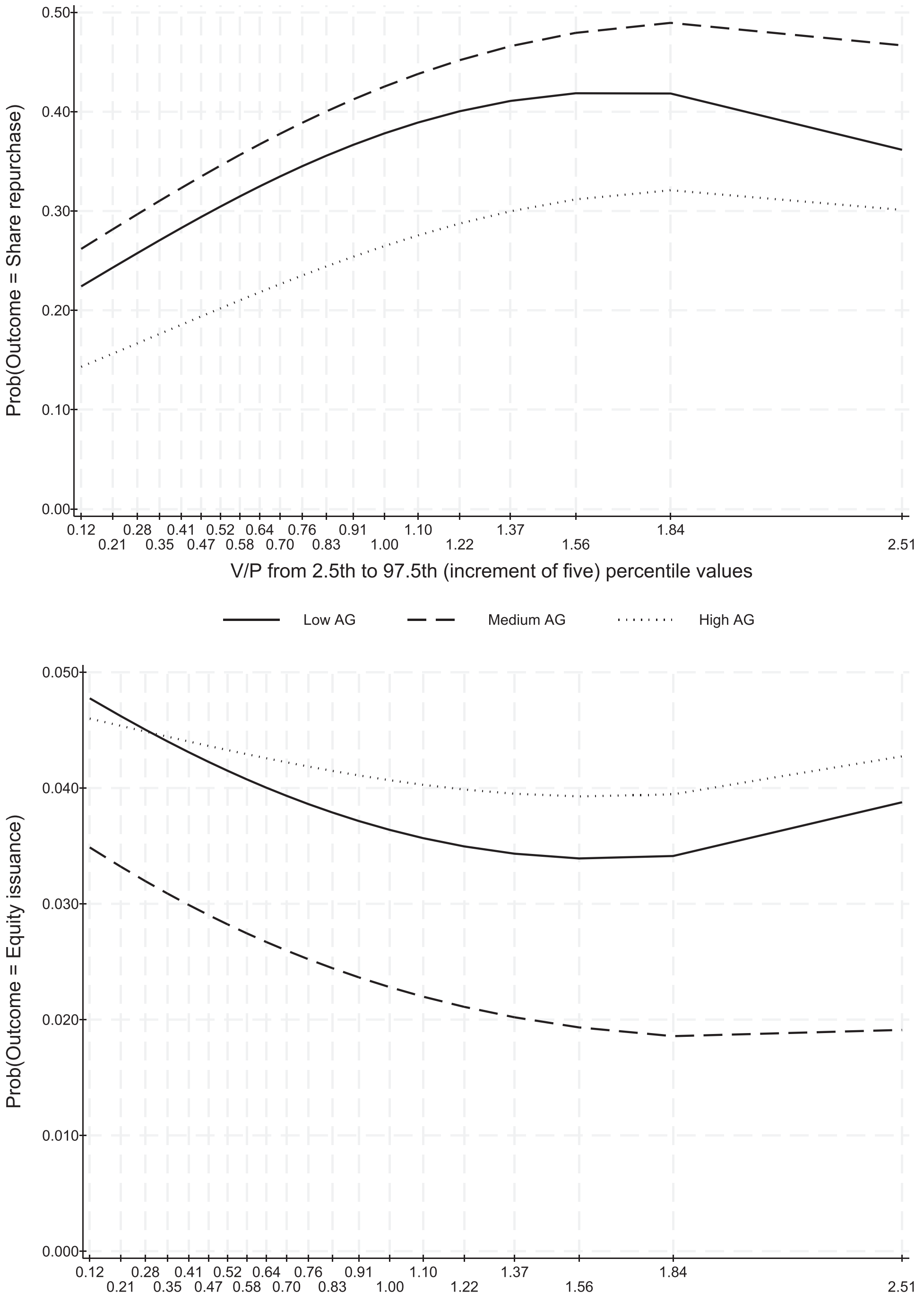

FIGURE 4 Asset growth and valuation effects on probability of share repurchase (equity issuance). *Note*: This figure shows the predicted probabilities of share repurchases (upper panel) and equity issuances (lower panel) for the 2.5th percentile to the 97.5th (increment of five) percentile values of valuation (V/P) for three groups based on asset growth (AG). The 'Low AG' ('High AG') group consists of firms with asset growth values below 30th (above 70th) percentile by each quarter. The 'Medium AG' group contains the remaining observations. The predicted probabilities are based on Model 1 of Table A4. We use STATA's -margins- command. For predicted values of an outcome, we use the value of V/P at a given percentile and that of CAPX/TA at its mean value.

the outcome variable is bounded between zero and one, we use the fractional response model of Papke and Wooldridge (1996, 2008).[13]

We begin this section by plotting the patterns of the fraction of shares repurchased and the fraction of equity raised for firm revaluation deciles, like the ones shown in Figure 1. Then, we perform econometric analysis to assess the effects of firm revaluation on the fractions of shares repurchased and equity raised on the full sample and the subsamples based on categories of net debt ratio and past asset growth. As in the previous section, for better exposition, we put greater emphasis on the graphs of the predicted values of outcome variables using -margins- command of STATA®.

Figure 5 shows the average value of fraction of shares repurchased (RepShr) expressed in percentages in the upper panel and the fraction of amount of equity raised (EqiRsd) expressed in percentages in the lower panel, both across deciles of our measure of a firm's revaluation of risky assets $\frac{V}{P}$. For computing the average value for a given decile, we take equally weighted average of all firm-quarter observations that also includes firm-quarters where a firm neither repurchases shares nor issues equity. The mean values of RepShr and EqiRsd are shown by solid dots and the confidence intervals are shown by vertical spikes through each dot.

As shown in Figure 5, the percentage of shares repurchased increases until the 6th decile of firm revaluation $\frac{V}{P}$. After that, it declines gradually until the 9th decile and a bit more in the last decile. Once again, the fraction of equity raised shows the opposite pattern. It declines until the 6th decile and then trends upward, gradually until the 9th decile and then quite steeply in the last decile. Overall, the patterns shown in Figure 5 look like the patterns shown earlier for the likelihood of payouts in Figure 1.

5.1 | Firm revaluation and the fractions of shares repurchased and equity raised

We estimate coefficients of the fractional response logit regression using the quasi-maximum likelihood estimation (Papke & Wooldridge, 1996, 2008).[14] The log-likelihood function for the fractional logit model has the following form:

$$\ln L = \sum_{i=1}^{N} y_i \ln\{G(.)\} + (1 - y_i)\ln\{1 - G(.)\}, \tag{5}$$

where $G(.)$ is the logit function and it is given as,

$$G(.) = \frac{\exp\left(\beta_0 + \beta_1 \times \frac{V}{P} + \beta_2 \times \left(\frac{V}{P}\right)^2 + \beta_3 \times \mathrm{CAPX/TA} + \mathrm{I_j} + \mathrm{T_t}\right)}{\left\{1 + \exp\left(\beta_0 + \beta_1 \times \frac{V}{P} + \beta_2 \times \left(\frac{V}{P}\right)^2 + \beta_3 \times \mathrm{CAPX/TA} + \mathrm{I_j} + \mathrm{T_t}\right)\right\}}$$

y is the dependent variable which can be either RepShr or EqiRsd, N is the sample size, I is vector of industry dummies, and T is the vector of time dummies.

Table 3 reports the results of fractional response logit regression. As shown in the Model 3 for the dependent variable RepShr, the coefficients on the quadratic terms of $\frac{V}{P}$ are positive and negative and the coefficient of CAPX/TA is negative, all significant at 1% level in the same direction as the multinomial logistic model for RP vs. NT

[13]Gallani and Krishnan (2017) show that in accounting research the fractional response model performs better than the linear OLS model or nonlinear approaches such as logit transformations and truncated or censored models such as Tobit, when the dependent variables are bounded from both above and below.

[14]Specifically, for this analysis, we use -fracreg- command of STATA®. For more on the fractional response regression and quasi-maximum likelihood estimation and their advantages over the other approaches, we refer an interested reader to pages 748 to 755 of Wooldridge (2010).

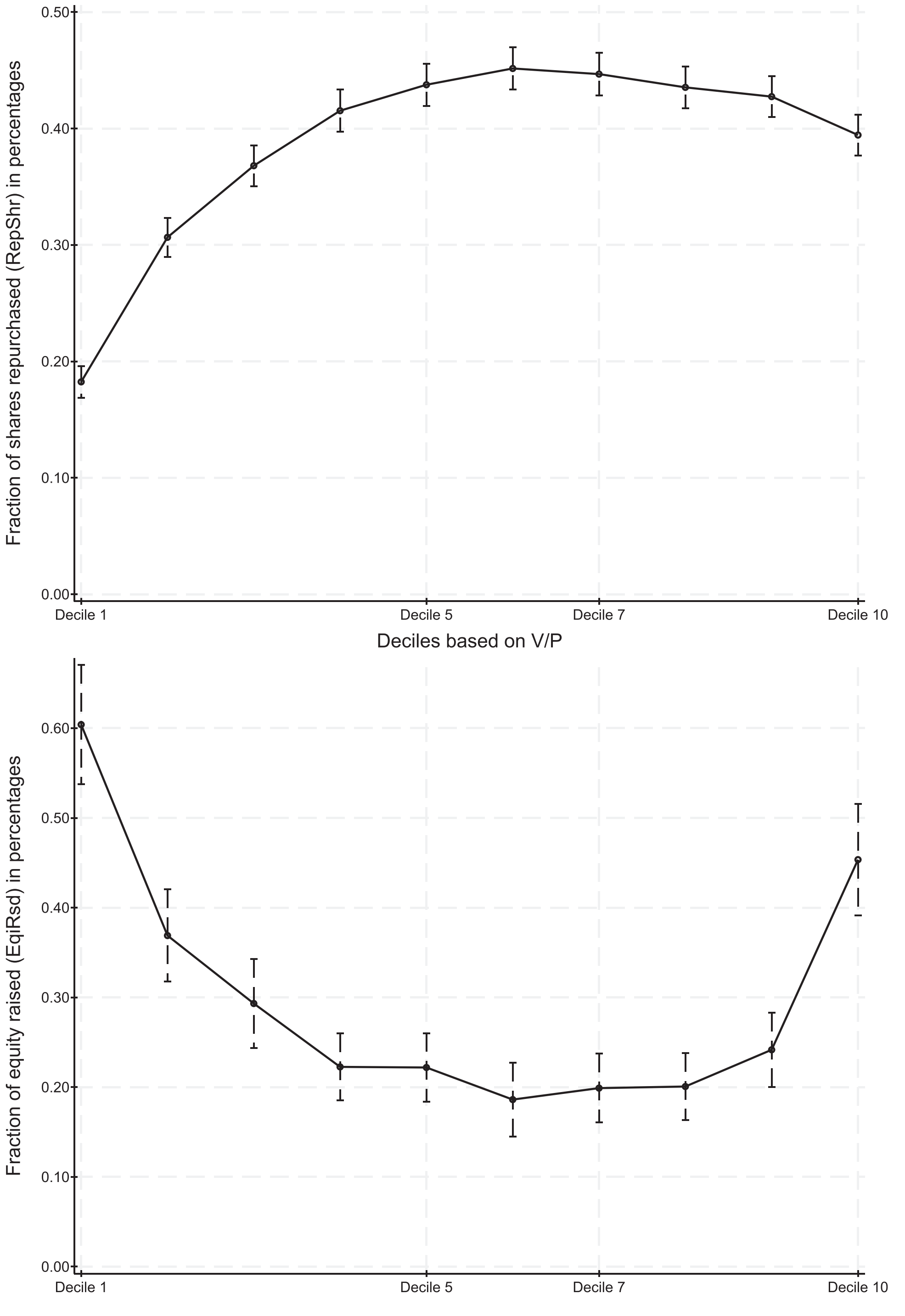

FIGURE 5 Firm revaluation (V/P) deciles and magnitude of share repurchases (equity issuances). *Note*: This figure shows the average value of the fractions of shares repurchased (upper panel) and the amount of equity raised (lower panel) in percentages across V/P deciles. The fraction of shares repurchased 'RepShr' (amount of equity raised 'EqiRsd') is relative to the beginning period number of outstanding shares (market value of equity). The average value for a given decile is the equally-weighted average of all observations including when a firm neither repurchases shares nor issues equity. The vertical spikes represent a confidence interval of mean at the 95% level. We use STATA's -collapse- command to compute mean and standard error. V/P is defined in notes to Table 1.

TABLE 3 Firm revaluation (V/P) and magnitude of share repurchases and equity issuances.

	RepShr			EqiRsd		
Dep. var.	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
V/P	0.188***	0.955***	0.954***	0.067	−0.134**	−0.133**
	(9.50)	(12.72)	(12.71)	(1.63)	(2.22)	(2.20)
V/P square		−0.252***	−0.252***		0.040***	0.040***
		(9.26)	(9.26)		(4.85)	(4.81)
CAPX/TA			−7.146***			6.582***
			(5.53)			(3.73)
Constant	−7.055***	−7.528***	−7.458***	−5.695***	−5.530***	−5.605***
	(63.81)	(64.12)	(63.34)	(35.60)	(33.63)	(33.58)
N	81,705	81,705	81,705	81,705	81,705	81,705
Pseudo R2	0.016	0.018	0.019	0.035	0.036	0.037

Note: This table reports the results of a fractional response logit regression for the bounded dependent variables that are the fraction of shares repurchased (RepShr) and the fraction of amount of equity raised (EqiRsd). The fraction of shares repurchased (amount of equity raised) is relative to the beginning period number of shares outstanding (market value of equity). The variable definitions are in the notes to Appendix Table A1. Each specification includes fiscal year-quarter dummies and Fama-French 12 industry dummies. Standard errors are clustered at the firm level, and absolute value of z-statistics are reported in parentheses below the coefficients. N and R2 are abbreviations for the number of firm-quarter observations and R-squared, respectively. ** and *** denote statistical significance at the 5% and 1% levels, respectively.

in Table 2. Their opposite signs indicate that, with the increase in firm revaluation $\frac{V}{P}$, the fraction of shares repurchased first increases and then, after some unique value of $\frac{V}{P}$, it starts decreasing. Similarly, the coefficients in Model 3 for the dependent variable EqiRsd show that the amount of equity raised first decreases and then increases with firm revaluation.

Overall, the baseline results of fractional response logit regression for number of shares repurchased and amount of equity raised confirm the earlier results of multinomial logistic regression regarding the likelihood of a share repurchase and an equity issuance.

5.2 | Firm revaluation and fractions of shares repurchased and equity raised for a cash cow and a mature firm

In this subsection, we analyze whether a cash cow or a mature firm (based on the net debt ratio and past asset growth) helps explain the patterns of the number of shares repurchased and the amount of equity raised as observed in Figure 5. For better exposition, we show the results using the graphs in the main part of the paper and relegate the tables to the Appendix A.

5.2.1 | Net debt ratio and the revaluation effects on the magnitude of payouts

In this subsection, we report the results of our analysis regarding the effects of firm revaluation $\frac{V}{P}$ on the fraction of shares repurchased and the fraction of equity raised for the two groups based on positive and negative net debt ratios. We modify the $G(.)$ logit function of the fractional response regression as shown in Equation (5) by

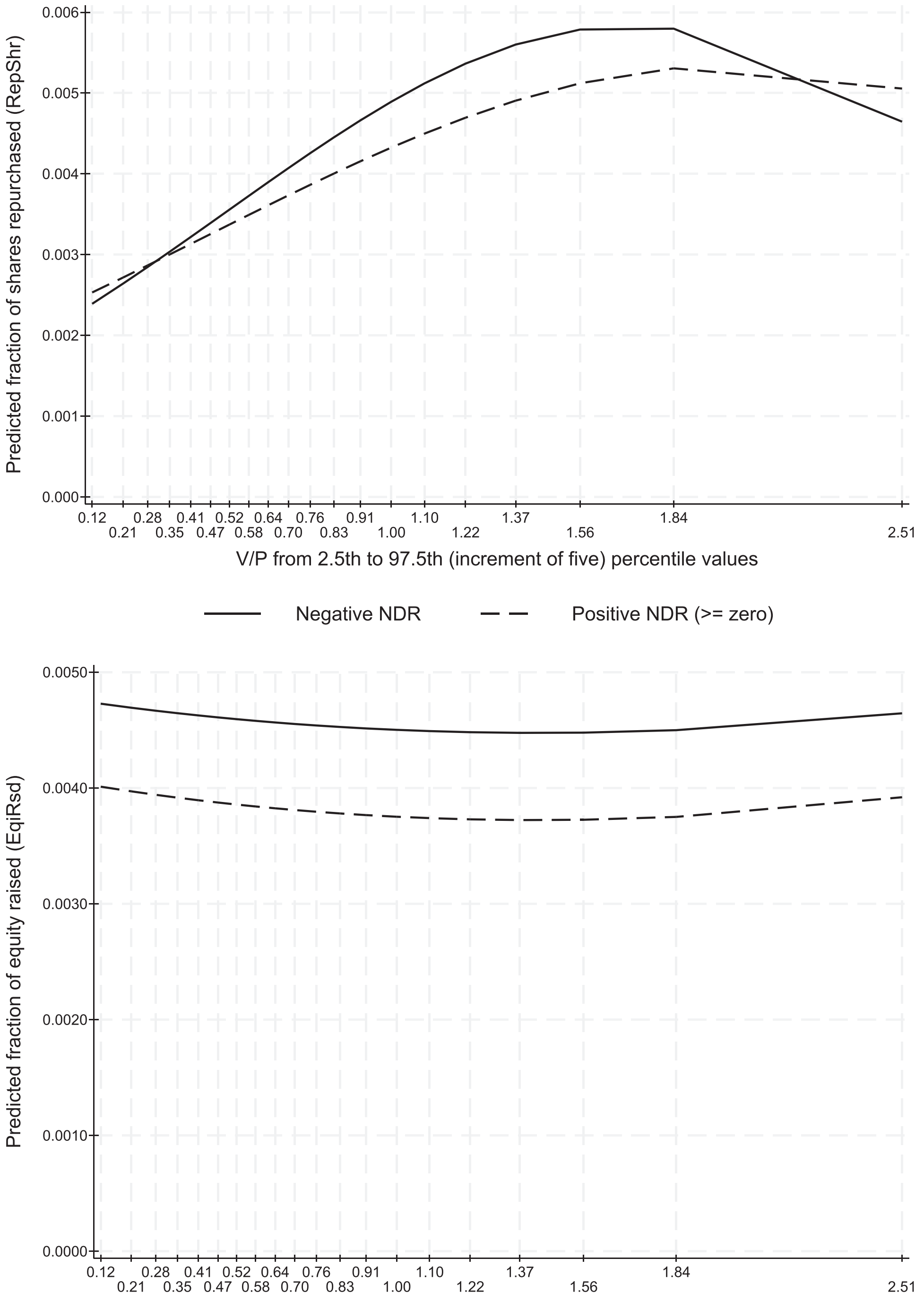

FIGURE 6 Net debt ratio and valuation effects on fractions of shares repurchased (equity raised). *Note*: This figure shows the predicted fraction of shares repurchased 'RepShr' (upper panel) and the fraction of equity amount raised 'EqiRsd' (lower panel) at every five percentile cut-off values starting at 2.5th percentile and ending at 97.5th percentile of firm revaluation (V/P) for two groups based on net debt ratio (NDR). The 'Positive NDR' group has an NDR value greater than or equal to zero. We have 58 (0.07%) observations with zero NDR values. The 'Negative NDR' group contains 33,198 (41%) firm-quarter observations. The predicted values are based on Models 2 and 3 of Table A3. We use STATA's -margins- command. For predicted values of an outcome, we use the value of V/P at a given percentile and that of CAPX/TA at its mean value. V/P is defined in notes to Table 1.

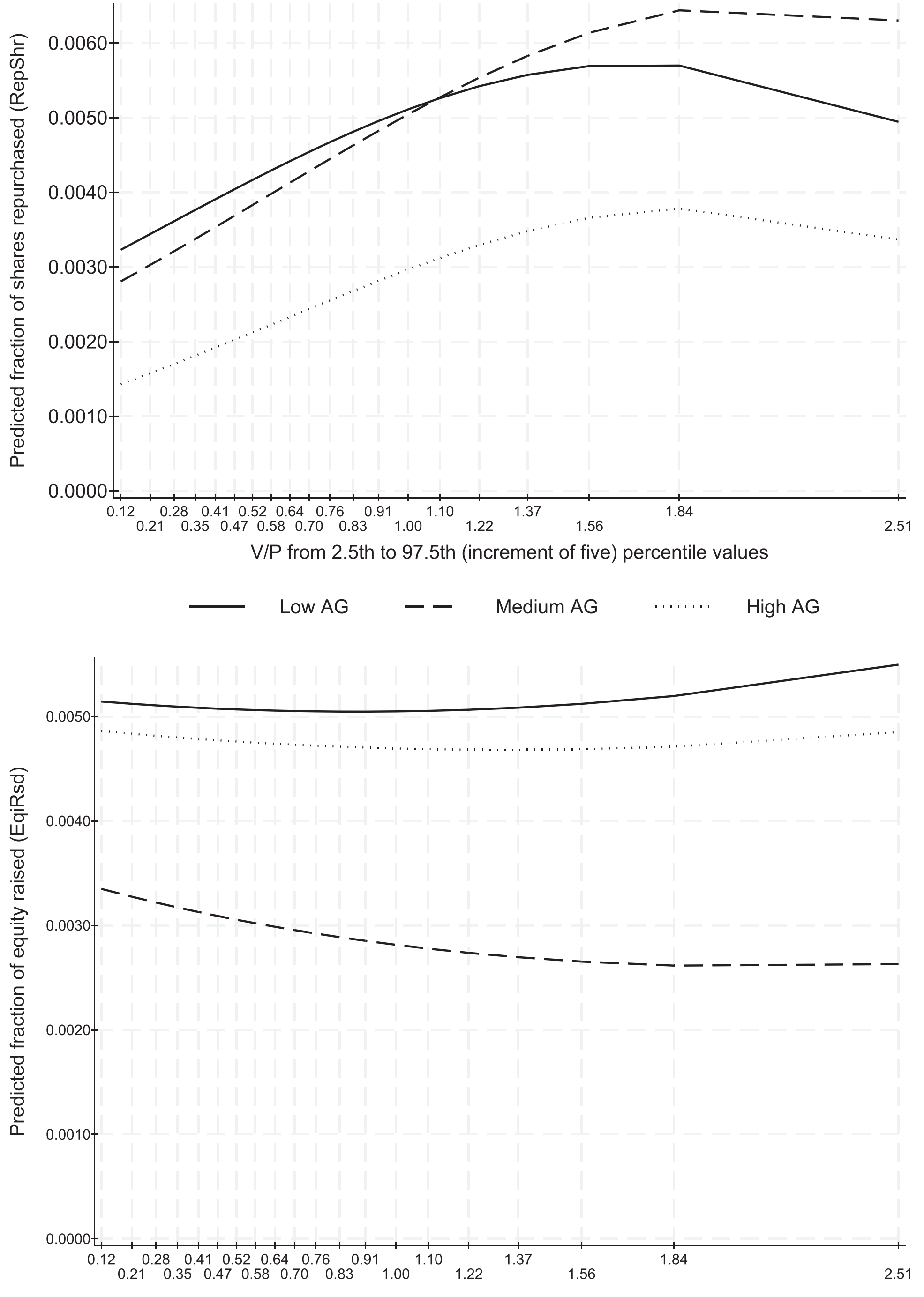

FIGURE 7 Asset growth and valuation effects on fractions of shares repurchased (equity raised). *Note*: This figure shows the predicted fraction of shares repurchased 'RepShr' (upper panel) and the fraction of equity amount raised 'EqiRsd' (lower panel) at every five percentile cut-off values starting at 2.5th percentile and ending at 97.5th percentile of firm revaluation (V/P) for the groups based on asset growth (AG). The Low AG, Medium AG, and High AG groups consists of firms with less than 30th percentile, between 30th to 70th percentile, and above 70th percentile values of asset growth by each quarter, respectively. The predicted values are based on Models 2 and 3 of Table A4. We use STATA's -margins- command. For predicted values of an outcome, we use the value of V/P at a given percentile and that of CAPX/TA at its mean value. V/P is defined in notes to Table 1.

incorporating an interaction term of dummy variable Positive NDR with the linear and quadratic terms of $\frac{V}{P}$. This exercise is like the one we performed earlier in subsection 4.2.1 for the likelihood of payouts. The results are shown in Model 2 and Model 3 of the Appendix Table A3.

As shown in the upper panel of Figure 6, the predicted value of the fraction of shares repurchased increases with $\frac{V}{P}$ till the 82.5th percentile value of $\frac{V}{P}$ for a cash cow firm (Negative NDR group). After that, a cash cow firm reduces its fraction of shares repurchased at an increasing rate for the last two deciles of $\frac{V}{P}$. In other words, in the event of experiencing a large positive revaluation of its risky assets, a cash cow firm reduces its cash distribution to shareholders by buying back fewer shares. This evidence again supports our hypothesis H1, which is based on the theoretical work of Chen and Lambrecht (2021). For equity raised, we find a rather flat pattern for both 'cash cow' and 'not cash cow' firms.

5.2.2 | Past asset growth and the revaluation effects on the magnitude of payouts

In the last part of our empirics, we use the past asset growth (AG) as a measure of a mature firm. Our analysis involves using the interaction of categorical variable of asset growth with the linear and quadratic terms of $\frac{V}{P}$. The dependent variables are the fraction of shares repurchased (RepShr) and the fraction of equity raised (EqiRsd). The results are reported in Model 2 and Model 3 of the Appendix Table A4. Here, we highlight the plots of the predicted values of the outcome variables at different percentile values of firm revaluation.

As shown in the upper panel of Figure 7, the fraction of shares repurchased for a group of firms with low past asset growth first increases till the 87.5th percentile value of firm revaluation $\frac{V}{P}$, after which it declines at an increasing rate. As shown in the lower panel of Figure 7, the mature firms with low asset growth raise an increasing amount of equity with an increase in revaluation of their assets, whereas the firms with medium asset growth decrease their equity financing with increase in firm revaluation $\frac{V}{P}$. In the case of firms with high asset growth, it seems that the equity issuance decision is unrelated to their asset revaluation $\frac{V}{P}$.

Overall, the analysis based on the fractional response logit regression for the subsamples based on past asset growth further helps explain the patterns observed in Figure 5. The payout policy of a mature firm with low asset growth is significantly different from that of a typical firm when it experiences positive revaluation of its risky assets.

6 | ROBUSTNESS CHECK WITH ALTERNATIVE CUT-OFF VALUES

We now test the robustness of our results to alternative cut-off values for defining when a firm carried out a share repurchase, an equity issuance, both, or neither. Specifically, we define a share repurchase as having occurred during a quarter when a firm repurchased at least 0.2% of its outstanding shares and an equity issuance as having occurred when a firm raised at least 2.0% of its outstanding equity. With these alternative cutoffs, we find 24,119 cases of share repurchase, 1,985 cases of equity issuance, 115 cases of both share repurchase and equity issuance, and 55,486 cases of neither action.

Appendix Figure A1 plots the frequencies of share repurchase and equity issuance across $\frac{V}{P}$ deciles using these new definitions. We notice a strong similarity between Appendix Figure A1 and earlier Figure 1. Share repurchases continue to follow an inverted-U pattern across $\frac{V}{P}$ deciles and equity issuances continue to follow a direct-U pattern. Due to higher cutoff criteria, the percent frequencies of these outcomes in Appendix Figure A1 are lower than in Figure 1. Although not shown in the paper for brevity, the results in the remaining tables and figures are also qualitatively similar to those documented earlier with cutoff values of 0.1% for share repurchase and 1.0% for equity issuance. Overall, we find that our results are robust to the alternative cutoff values considered in this section.

7 | CONCLUSION

We document an inverted U-shaped relationship between the occurrence of share repurchases and the fundamental asset value-to-price ratio, as well as a symmetric opposite U-shaped relationship between the occurrence of equity issuances and the same ratio. This finding cannot be explained by the traditional market timing theory of raising and retiring equity capital; rather, we argue that it aligns with the theoretical framework proposed by Chen and Lambrecht (2021). Their theory predicts that a cash cow firm with a negative net debt ratio (i.e., debt net of cash scaled by market assets) can reduce its payouts via share repurchases when it experiences a positive revaluation of its risky assets. Using higher value-to-price ratio as indicative of positive asset revaluation, we show that the inverted U-shaped relationship for share repurchases and the direct U-shaped relationship for equity issuances are both driven in large part by negative net debt ratio firms. Further, consistent with the corporate life cycle theory of payouts and financing, we find similar results that these hump-shaped relationships are driven to a greater extent by mature firms with low asset growth than by early-stage firms with high asset growth. All our results are robust to using magnitudes of share repurchases and equity issuances in place of their likelihood. In conclusion, we provide new empirical evidence consistent with some previously proposed but untested theories of corporate payouts.

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APPENDIX A

TABLE A1 Sample statistics.

Panel A: Cutoff values of firm revaluation (V/P) deciles	
	V/P
Decile 1	0.247
Decile 2	0.380
Decile 3	0.496
Decile 4	0.610
Decile 5	0.730
Decile 6	0.871
Decile 7	1.049
Decile 8	1.289
Decile 9	1.680
Decile 10	3.276

Panel B: Summary statistics								
Variables	**Mean**	**SD**	**Median**	**P10**	**P25**	**P75**	**P90**	**N**
RepShr (%)	0.390	0.805	0.000	0.000	0.000	0.400	1.400	81,705
EqiRsd (%)	0.420	2.180	0.059	0.000	0.003	0.198	0.482	81,705
V/P	0.886	0.671	0.730	0.247	0.440	1.159	1.680	81,705
V/P square	1.236	2.737	0.532	0.061	0.193	1.342	2.823	81,705
NDR	0.051	0.331	0.054	−0.254	−0.086	0.217	0.402	81,705
AG	0.116	0.247	0.072	−0.079	−0.000	0.176	0.360	81,705
CAPX/TA (%)	1.225	1.467	0.765	0.187	0.385	1.474	2.696	81,705

Note: Panel A reports cutoff values of deciles based on the beginning period firm revaluation (V/P). V/P is the ratio of a firm's fundamental value per share (V) to the market value per share (P). Our V/P measure is using the residual income model of Ohlson (1991, 1995). Panel B provides summary statistics. The variable 'RepShr' is the ratio of number of shares repurchased (Compustat item: 'CSHOPQ') to the beginning period number of shares outstanding (Compustat item: 'CSHOQ'), and it is expressed in percentage. The variable 'EqiRsd' is the percentage of the amount of equity raised (Compustat item: SSTKY minus its one-quarter lag value) with respect to the beginning period market value of equity. Net debt ratio (NDR) is the ratio of net debt to risky assets. The net debt is the total debt (long term debt (Compustat item: 'DLTTQ) and debt in current liability ('DLCQ)) minus cash and equivalents ('CHEQ'). The risky assets are the sum of market value of equity (product of market price (CRSP item: 'PRC') and share holdings (CRSP item: 'SHROUT')) and total debt minus cash and equivalents. Assets growth (AG) is the difference of natural logarithm of total assets (Compustat item: 'ATQ') of current quarter (t) and that of the fourth previous quarter (t − 4). The variable 'CAPX/TA' is the ratio of capital expenditure (Compustat item: CAPXY minus its one-quarter lag value) to the beginning period total assets. N is the number of firm-quarter observations. SD and P are the abbreviations for standard deviation and percentile, respectively.

TABLE A2 Firm revaluation (V/P) and likelihood of both share repurchases and equity issuances in the same quarter.

	Model 1	Model 2	Model 3
	BT vs. NT	BT vs. NT	BT vs. NT
V/P	0.257***	0.817***	0.822***
	(3.12)	(3.32)	(3.33)
V/P square		−0.179**	−0.181**
		(2.41)	(2.42)
CAPX/TA			−10.417**
			(2.18)
Constant	−5.184***	−5.528***	−5.433***
	(11.63)	(11.78)	(11.53)

Note: This appendix table reports the remaining results of multinomial logistic regressions of Table 2. It shows the results of the category 'Both (BT)' relative to the category 'Neither (NT)'. The categories 'BT' and 'NT' are defined in notes to Table 1, and the variable definition of firm revaluation measure V/P and control variable CAPX/TA are in notes to Table A1. The number of observations and pseudo R-squared values are in Table 2. Each model controls for time and industry fixed effects by including fiscal year-quarter dummies and Fama-French 12 industry dummies. The standard errors are clustered at the firm level, and the absolute values of z statistics are reported in parentheses below the coefficients. ** and *** denote statistical significance at the 5% and 1% levels, respectively.

TABLE A3 Net debt ratio and valuation effects on share repurchases and equity issuances.

	Model 1			Model 2	Model 3
	RP vs. NT	EI vs. NT	BT vs. NT	RepShr	EqiRsd
V/P	1.803***	−0.115	1.262***	1.213***	−0.092
	(10.92)	(1.22)	(3.61)	(9.90)	(1.18)
V/P square	−0.550***	0.046***	−0.310***	−0.355***	0.032***
	(8.20)	(2.63)	(2.68)	(7.06)	(2.99)
Positive NDR	0.236**	−0.273***	−0.038	0.099	−0.162*
	(2.21)	(2.69)	(0.13)	(1.15)	(1.76)
Positive NDR x V/P	−0.672***	0.028	−0.620	−0.367**	−0.034
	(3.45)	(0.23)	(1.42)	(2.56)	(0.33)
Positive NDR x V/P square	0.259***	−0.010	0.188	0.144**	0.012
	(3.38)	(0.49)	(1.34)	(2.56)	(0.85)
CAPX/TA	−8.636***	5.001***	−11.030**	−7.333***	6.520***
	(5.37)	(2.66)	(2.29)	(5.63)	(3.70)
Constant	−2.659***	−2.754***	−5.396***	−7.519***	−5.516***
	(16.74)	(13.79)	(11.15)	(59.11)	(32.86)
Number of observations	81,705			81,705	81,705
Pseudo R-squared	0.058			0.019	0.037

Note: This appendix table reports the results of a multinomial logistic regression (Model 1) and fractional response regression (Model 2 and Model 3) assessing firm revaluation (V/P) effects for groups based on net debt ratio (NDR). The outcome categories RP, EI, BT, and NT of Model 1 are defined in notes to Table 1. The dependent variables for Model 2 and Model 3 are the fraction of shares repurchased 'RepShr' and the fraction of equity raised 'EqiRsd', respectively. The variable V/P is the ratio of a firm's fundamental value per share (V) to the market value per share (P). The 'Positive NDR' is a dummy variable that takes on a value of one if the given firm-quarter observation has NDR value greater than or equal to zero. We have 58 observations with zero NDR. The variable NDR and the control variable CAPX/TA are defined in the notes to Table A1. Each regression specification includes fiscal year-quarter and Fama-French 12 industry dummies. The standard errors are clustered at the firm level, and the absolute values of z statistics are reported in parentheses below the coefficients. *, **, and *** denote at the 10%, 5%, and 1% statistical significance level.

TABLE A4 Asset growth and valuation effects on share repurchases and equity issuances.

	Model 1			Model 2	Model 3
	RP vs. NT	EI vs. NT	BT vs. NT	RepShr	EqiRsd
V/P	1.241***	−0.306***	1.527***	0.910***	−0.270***
	(9.14)	(2.88)	(3.35)	(9.91)	(2.93)
V/P square	−0.320***	0.065***	−0.448***	−0.217***	0.064***
	(6.22)	(4.18)	(2.74)	(6.39)	(6.00)
Low AG	−0.206**	0.276**	0.623*	0.157**	0.407***
	(2.49)	(2.52)	(1.93)	(2.33)	(3.96)
High AG	−0.780***	0.119	−0.287	−0.705***	0.351***
	(7.96)	(1.15)	(0.80)	(9.09)	(3.75)
Low AG x V/P	0.081	0.159	−1.295**	−0.132	0.212*
	(0.52)	(1.16)	(2.53)	(1.15)	(1.70)
High AG x V/P	0.032	0.301**	−0.485	0.264*	0.201*
	(0.17)	(2.40)	(0.83)	(1.91)	(1.82)
Low AG x V/P square	−0.069	−0.015	0.422**	−0.011	−0.031*
	(1.15)	(0.67)	(2.44)	(0.25)	(1.85)
High AG x V/P square	−0.004	−0.044**	0.238	−0.093*	−0.038***
	(0.06)	(2.18)	(1.17)	(1.73)	(2.62)
CAPX/TA	−6.688***	5.391***	−8.693*	−5.009***	6.987***
	(4.18)	(2.91)	(1.77)	(3.96)	(4.12)
Constant	−2.283***	−3.012***	−5.685***	−7.385***	−5.855***
	(14.98)	(14.71)	(10.48)	(60.98)	(32.57)
Number of observations	81,705			81,705	81,705
Pseudo R-squared	0.070			0.023	0.041

Note: This appendix table reports the results of a multinomial logistic regression (Model 1) and fractional response regression (Model 2 and Model 3) assessing firm revaluation effects for groups based on asset growth (AG). The outcome categories RP, EI, BT, and NT are defined in notes to Table 1. The variable V/P is the ratio of a firm's fundamental value per share (V) to the market value per share (P). We define Low AG, Medium AG, and High AG as a categorical variable for firms with asset growth values below 30th percentile, between 30th to 70th percentile, and above 70th percentile, respectively by each fiscal quarter. The control variable CAPX/TA is the ratio of capital expenditures to the beginning period total assets. Each regression specification includes fiscal year-quarter and Fama-French 12 industry dummies. The standard errors are clustered at the firm level, and the absolute values of z statistics are reported in parentheses below the coefficients. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

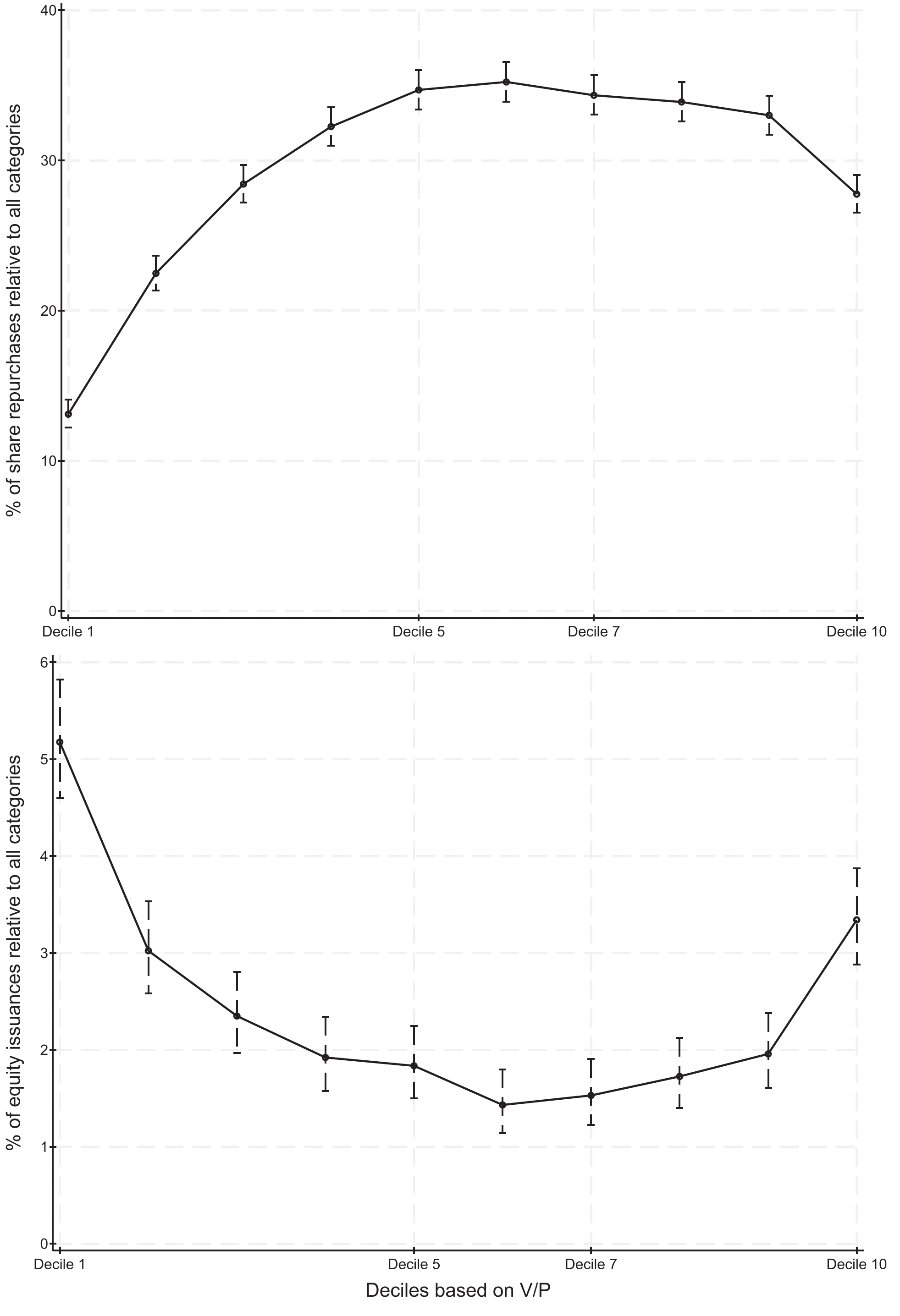

FIGURE A1 Firm revaluation (V/P) deciles and incidence of share repurchases and equity issuances with alternative cutoffs. *Note*: This figure is based on the alternative cutoffs for share repurchases and equity issuances. These cutoffs are 0.2% for share repurchases and 2% for equity issuances. With these alternative cutoffs, in our sample of 81,705 firm quarter observations, we have 24,119 share repurchases, 1,985 equity issuances, and 115 both share repurchases and equity issuances. The other details for this figure remain the same as written in the notes to Figure 1.