Payout Flexibility and Firm Innovation

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This paper investigates how flexibility in payout decisions affects firm innovation. Firms that make payout mainly in the form of share repurchase have greater flexibility in making payouts compared to firms that make payout mainly in the form of dividends. Using a sample of 45,644 firm-year observations of 7,888 U.S. firms for the period 1987-2010, I show that firms with greater payout flexibility have higher levels of innovation and have better quality innovations. Using a Granger-Causality framework, I show that firm innovation has no significant effect on payout flexibility while payout flexibility results in firm innovation. Results show that firms that make payout in the form of repurchase only, on an average, have 4.4% more patents granted compared to firms that make payout in the form of dividend only. The results are robust to whether I use the entire sample or a sub-sample of observations of firms with at least one patent granted during the sample period.

Keywords: innovation, payout, repurchase, dividend

INTRODUCTION

It is well known in corporate finance that firms tend to maintain a stable level of dividends over time and increase the level of dividends only when managers view that the increased level of dividends can be sustained in the future. Hence, dividend paying firms have little flexibility in their policies regarding dividend payouts. Any unexpected dividend cut is likely to cause negative reaction from investors and consequent drop in stock price. On the other hand, investors do not expect the level of share repurchase to remain stable over time. Managers are not expected to smooth the level of repurchases the way they smooth dividend payouts. Hence, firms that make most of their payouts in the form of share repurchase are under lower pressure to keep steady level of payouts compared to firms that make most of their payouts in the form of dividends. In other words, firms with a greater fraction of repurchase (out of total payout) have greater flexibility in their payout decisions. Such flexibility in payout decisions can provide a cushion to those firms in their financing decisions resulting in added financial flexibility. Bonaime, Hankins and Harford (2014) show that flexibility in payout decisions can act as substitute for financial hedging used in risk management. If payout flexibility leads to financial flexibility, it is worthwhile to investigate the impact of payout flexibility on firm innovation.

Recent studies in finance and economics show that firm innovation is affected by the development of financial markets, financing constraints and credit supply. Some papers argue that development of stock market positively affects firm innovation while development of credit market negatively affects innovation (Brown, Martinsson, and Petersen, 2013; Hsu, Tian, and Xu, 2014). On the other hand, several papers show that credit supply and banking development positively affects firm innovation (Amore, Schneider, and

Zaldokas, 2013; Chava, Oettl, Subramanian, and Subramanian, 2013). Overall, the papers indicate that capital markets and financial intermediaries play an important role in determining firm innovation. However, to the best of my knowledge, no paper has linked the financial flexibility channeled through payout policy in determining firm level innovation. In this paper, I investigate how payout policies can influence firm innovation. I hypothesize financial flexibility derived from payout flexibility can lead to greater innovation in terms of quantity and quality.

In this paper, I show that firms with greater payout flexibility innovate more and have better quality innovations. Following Bonaime, Hankins and Harford (2014), I estimate payout flexibility by measuring the ratio of repurchases to total payout. I use three patent-based measures of firm level innovation from Kogan, Papanikolaou, Seru, and Stoffman (2017). Using a sample of 45,644 firm-year observations of 7,888 U.S. firms for the period 1987-2010, I show that firms with greater payout flexibility innovate more in terms of number of patents granted and have better quality innovations in terms of citation counts of patents and in terms of economic value of patents. Results show that firms that make payout in the form of repurchase only, on an average, have 4.4% more patents granted compared to firms that make payout in the form of dividend only. The results are robust to whether I use the entire sample or a sub-sample of observations of firms with at least one patent granted during the sample period.

The goal of this paper is to examine how payout decisions (choice of dividends versus repurchases) affect firm innovation. This paper adds to the growing literature on financial flexibility and firm innovation. To the best of my knowledge, this is the first paper to link payout flexibility (choice of dividend versus repurchase) with firm innovation. The rest of the paper proceeds as follows. Section II presents literature review and develops testable hypotheses. Section III details the research methodology and also presents the data. Section IV tabulates and analyze the results. Section V concludes the paper.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

It is well documented in corporate finance that managers desire to keep a steady level of dividend and would increase dividend only if the increased level of dividends can be sustained in the future (Lintner, 1956). Survey findings of Brav et al. (2005) indicate that managers have a strong desire to avoid dividend cuts and are willing to forego some positive net present value (NPV) investment projects before cutting dividends. There is a strong negative market response to any dividend cut and such control mechanism by the market reinforces the commitment nature of dividends (John and Knyazeva, 2006). Hence, a history of dividend payments acts as a constraint to managers and can reduce financial flexibility of firms (Bonaime, Hankins and Harford, 2014). On the other hand, repurchases are viewed as the residual cash flows after investment decisions are made (Brav et al. 2005). Hence, investors do not view repurchases as recurring and any reduction in repurchase is generally not met with strong negative market reaction. DeAngelo, DeAngelo and Skinner (2008) argue that one of the advantages of stock repurchase over dividend is the financial flexibility associated with repurchases, as repurchases have no implied promise to continue payouts of equal or greater dollar amounts. Bonaime, Hankins and Harford (2014) argue that the form of payout influences financial flexibility – more repurchase relative to dividend increase financial flexibility. They define "payout flexibility" as the ratio of repurchases to total payout and show that payout flexibility offers operational hedging benefits.

If dividend act as a financial constraint, payout policy can significantly affect a firm's innovative activities. Investments in innovative projects can be risky and the outcome can be highly uncertain. Several papers show that financial constraints negatively affect growth and R&D investments (Carpenter and Petersen, 2002; Brown, Martinsson, and Petersen, 2012). The general notion is that firms facing financing constraints will have to forego investments in innovative projects. Firms with greater payout flexibility (more repurchase relative to dividend) face lower financial constraints and hence have greater financial flexibility. Such financial flexibility can provide a cushion for investments in innovative projects and subsequent innovation. When faced with favorable innovative investment opportunities, firms with greater payout flexibility will find it relatively less costly to decrease payout in order to finance the innovative projects. It can be argued that firms can raise debt or equity to finance innovative projects and hence payout

policy is not relevant in financing innovation. However, pecking order theory of Myers and Majluf (1984) suggests that innovative firms should finance risky investments (high information asymmetry) with internal cash as issuing debt or equity to finance such projects would be costly. Firms with greater payout flexibility can reduce the payout level before raising debt or equity in order to finance the innovative projects. Dividend-paying firms with lower payout flexibility will find it costly to reduce payout and issuing debt or equity to finance risky innovative projects can still be costly due to high information asymmetry of such projects resulting in sub-optimal levels of investments in innovative projects for such firms.

Motivating innovation requires substantial tolerance for failure and job security (Manso, 2011). Mangers of firms with lower payout flexibility will be less motivated to finance innovation as financing such innovation will require additional debt or equity and failure is unlikely to be tolerated by investors. The distribution of return from the innovation process is highly skewed and success requires investments in several projects (Scherer and Harhoff, 2000). Firms with lower payout flexibility are less likely to be able to finance several risky projects resulting in lower levels of innovation. Higher quality innovation usually requires more experimentation and the outcome is more uncertain (Azoulay, Zivin, and Manso, 2011; Atanassov, 2016). If firms with lower payout flexibility forego innovative investment opportunities, they are more likely to forego opportunities where the outcome is more uncertain. Hence, firms with lower payout flexibility are also expected to have lower quality innovations.

H1: *Firms with greater payout flexibility (ratio of repurchases to total payout) innovate more.*

H2: *Firms with greater payout flexibility (ratio of repurchases to total payout) have better quality innovations.*

METHODOLOGY AND DATA

Methodology

The main objective of this paper is to examine how flexibility in payout decisions can influence firm innovation. Firms with greater payout flexibility are expected to have greater financial flexibility. Following Bonaime, Hankins and Harford (2014), I define payout flexibility for firm *i* in year *t* as the ratio of repurchases to total payout:

$$Payout\ Flexibility_{i,t} = Repurchases_{i,t} / Total\ Payout_{i,t} \quad (1)$$

Payout flexibility takes a value of zero if the entire payout is in the form of dividends and takes a value of one if the entire payout is in the form of repurchases. Following Azim Khan (2023), I use three patent-based metrics to measure firm level innovation output. The three measures are the natural logarithm of one plus the number of patents granted (*Patent_number*), the natural logarithm of one plus the citation-weighted value of patents *(Patent_ citation)* and the natural logarithm of one plus the economic value of patents *(Patent_ value)*. Patent counts and citation counts are commonly used in the literature as proxies for firm innovation. While patent count measures the volume of firm level innovation, citation count measures the quality of innovation. However, citation count mainly reflects the scientific importance of patent but not the economic importance. In this regard, Kogan, Papanikolaou, Seru, and Stoffman (2017) estimate a measure of firm innovation by estimating the economic value of patents using stock price movements when the market learns that a patent application is successful. In this paper, I refer to this third measure of firm innovation as the economic value of patents.

Data and Summary Statistics

Share repurchase mainly evolved during the mid-1980s (DeAngelo, DeAngelo and Skinner, 2008). In order to have enough repurchasing firms in my sample, I start the sample period from 1987. Data on firm level innovation is taken from Noah Stoffman's website. The data was originally collected for the paper Kogan, Papanikolaou, Seru, and Stoffman (2017) and provides three measures (as discussed in

methodology subsection) of firm level innovation for the period 1926-2010. Hence, the sample period for this study is from 1987-2010.

I start with all available U.S. firms from the annual Compustat files. I exclude financial firms and regulated utilities from the sample and require firms to have positive values for total assets. The variables are winsorized at the 1st and 99th percentiles. I exclude industries (based on three-digit SIC codes) with nil patent during the sample period. However, I include all firms that are in industries with at least one patent during the sample period. Following the innovation literature, patent-based metrics of firm-year observations with nil patent are set to zero which mitigates sample selection problems (Atanassov, 2016; Acharya and Xu, 2017). Lastly, I exclude observations with nil payout. Final sample consists of 45,644 firm-year observations of 7,888 US firms from the period 1987-2010 and this sample is the baseline sample for this paper.

TABLE 1
SUMMARY STATISTICS AND CORRELATION

Panel A: Summary Statistics of Variables

	N	Mean	St. Dev.	Median	Minimum	Maximum
log (Patent_number)	45644	0.641	1.251	0.000	0.000	5.521
log (Patent_citation)	45644	0.819	1.523	0.000	0.000	6.300
log (Patent_value)	45644	0.941	1.959	0.000	0.000	8.477
log (R&D)	45644	1.209	1.803	0.000	0.000	7.154
Flexibility	45644	0.549	0.448	0.675	0.000	1.000
Leverage	45644	0.192	0.188	0.157	0.000	0.829
Deficit	45644	0.460	0.498	0.000	0.000	1.000
log (Age)	45644	2.739	0.819	2.833	0.693	4.060
ROA	45644	0.017	0.176	0.048	-1.083	0.289
MB	45644	1.795	1.304	1.386	0.560	8.814
log (Assets)	45644	5.712	2.104	5.670	0.920	10.649
PPE	45644	0.298	0.225	0.242	0.006	0.900

Panel B: Payout Flexibility by Year

Year	N	Mean	Std Dev	Minimum	Maximum
1987	2126	0.493	0.440	0.000	1.000
1988	1989	0.455	0.444	0.000	1.000
1989	1821	0.408	0.438	0.000	1.000
1990	1822	0.449	0.436	0.000	1.000
1991	1725	0.377	0.442	0.000	1.000
1992	1751	0.364	0.439	0.000	1.000
1993	1815	0.372	0.443	0.000	1.000
1994	1885	0.424	0.449	0.000	1.000
1995	2000	0.455	0.447	0.000	1.000
1996	2139	0.498	0.448	0.000	1.000
1997	2199	0.571	0.439	0.000	1.000
1998	2460	0.668	0.415	0.000	1.000
1999	2341	0.699	0.403	0.000	1.000
2000	2089	0.703	0.397	0.000	1.000
2001	1970	0.674	0.427	0.000	1.000
2002	1819	0.654	0.439	0.000	1.000
2003	1705	0.604	0.445	0.000	1.000
2004	1609	0.555	0.446	0.000	1.000
2005	1699	0.587	0.434	0.000	1.000
2006	1749	0.611	0.427	0.000	1.000
2007	1771	0.645	0.420	0.000	1.000
2008	1892	0.664	0.415	0.000	1.000
2009	1638	0.561	0.459	0.000	1.000
2010	1630	0.594	0.439	0.000	1.000

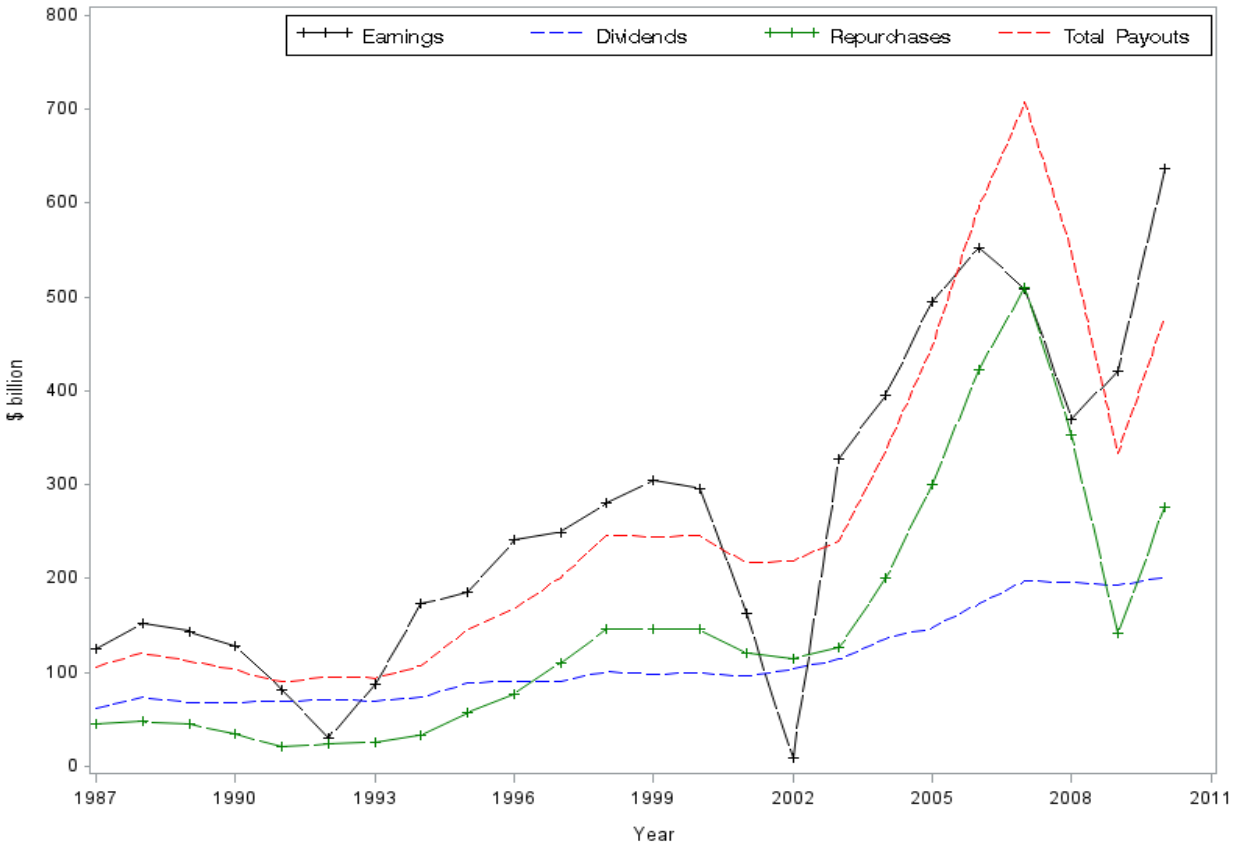
Panel C: Pearson Correlation Coefficients

	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)	log (R&D)	Leverage	log (Age)	ROA	MB	log (Assets)	PPE
log (Patent_number)	1.000									
log (Patent_citation)	0.987	1.000								
log (Patent_value)	0.947	0.935	1.000							
log (R&D)	0.754	0.749	0.752	1.000						
Leverage	-0.044	-0.057	-0.028	-0.113	1.000					
log (Age)	0.318	0.298	0.327	0.226	0.006	1.000				
ROA	0.074	0.069	0.094	0.023	-0.087	0.182	1.000			
MB	0.076	0.087	0.125	0.141	-0.164	-0.163	-0.058	1.000		
log (Assets)	0.443	0.425	0.522	0.405	0.250	0.417	0.245	-0.073	1.000	
PPE	-0.064	-0.079	-0.051	-0.198	0.328	0.052	0.065	-0.143	0.174	1.000

Table 1 reports the summary statistics of the variables of the firms studied in panel A, payout flexibility by year in panel B and correlation coefficients between variables in panel C. Summary statistics indicate that the median firm-year observation (based on payout flexibility) makes 67.5% of its total payout in the form of repurchases. Out of the total 45,644 firm-year observations, 18,840 (41.3%) observations have a flexibility of one (100% repurchase) and 13,127 (28.8%) observations have nil flexibility (100% dividend). Panel C shows that the three measures of firm level innovation are highly correlated. The innovation measures are positively correlated with R&D expense, firm age, profitability, growth opportunities (MB), firm size and negatively correlated with leverage and tangibility (PPE). The firm characteristics used in regressions as control variables are not highly correlated.

Figure 1 reports the aggregate Dividends, Repurchases, Total Payouts and Earnings of Compustat firms by year for the period 1987-2010. Aggregate repurchases in recent years have been greater than aggregate dividends. Aggregate repurchases show greater volatility and follow the aggregate earnings more closely compared to aggregate dividends. It appears from the figure that aggregate dividends grow in a relatively stable manner and do not necessarily track payer earnings but total payouts closely track the earnings and this is achieved through repurchases.

FIGURE 1
AGGREGATE DIVIDENDS, REPURCHASES, TOTAL PAYOUTS AND EARNINGS



EMPIRICAL RESULTS

Payout Flexibility and Firm Innovation

First, I examine how flexibility in payout decisions can influence firm level innovation using the model:

$$Innovation_{j,i,t} = \beta_0 + \beta_1 Flexibility_{i,t} + \beta_X X_{i,t} + \mu_{s,t} + \varepsilon_{i,t} \quad (2)$$

where $Innovation_{j,i,t}$ is one of the three measures of firm level innovation j for firm i in year t. The independent variable of interest, $Flexibility_{i,t}$, is the ratio of repurchases to total payout for firm *i* in year *t*. The control variables, $X_{i,t}$, are - the natural logarithm of one plus the R&D expense in millions of dollars, a dummy variable 'deficit' which is equal to one if the financing deficit is positive in year t and zero otherwise, long-term book leverage, the natural logarithm of number of years (age) in Compustat, return on assets (ROA), the market-to-book (MB) ratio, the natural logarithm of total book assets in millions of dollars and the fraction of total assets in property, plant, and equipment (PPE). $\mu_{s,t}$ is the industry-year fixed effect (FE) which controls for unobserved heterogeneity across industries (three-digit SIC) over time.

The first three specifications of table 2 indicate that firms with greater flexibility in payout decisions have higher levels of innovation in terms of number of patents (specification 1), citation measure of patents (specification 2) and economic value of patents (specification 3). The coefficient of *Flexibility* is both statistically and economically significant in all three specifications 1-3. As per specification 1, firms with flexibility of one (repurchase only), on an average, have 4.4% more patents granted compared to firms with nil flexibility (dividend only). Specifications 2 and 3 indicate that the patents of firms with greater payout flexibility are of better quality than the patents of firms with above-target debt. The findings are intuitive in the sense that, on an average, managers of firms with greater payout flexibility have the added financial flexibility to finance and support innovation opportunities while firms with lower payout flexibility may have to forego some good innovation opportunities. Results of specifications 1-3 also show that firm level innovation is positively related to R&D expense, firm age, growth opportunities (MB ratio), firm size and tangibility (PPE). Results also indicate that innovative firms tend to have lower leverage and lower profit margins.

TABLE 2
REGRESSION FOR PAYOUT FLEXIBILITY AND FIRM INNOVATION

Dependent Variable:	(1) log (Patent_ number)	(2) log (Patent_ citation)	(3) log (Patent_ value)	(4) log (Patent_ number)	(5) log (Patent_ citation)	(6) log (Patent_ value)
Flexibility	0.044**	0.078***	0.140***	0.134***	0.203***	0.280***
	(2.21)	(3.25)	(4.73)	(3.25)	(4.11)	(5.02)
Leverage	-0.131***	-0.204***	-0.239***	-0.302***	-0.414***	-0.613***
	(-2.95)	(-3.77)	(-3.30)	(-3.12)	(-3.53)	(-4.25)
log (R&D)	0.466***	0.556***	0.700***	0.431***	0.509***	0.579***
	(29.25)	(30.81)	(30.80)	(23.10)	(23.15)	(21.01)
Deficit	-0.016	-0.018	-0.031**	-0.027	-0.022	-0.038*
	(-1.56)	(-1.45)	(-2.09)	(-1.68)	(-1.06)	(-1.86)
log (Age)	0.159***	0.173***	0.236***	0.214***	0.200***	0.278***
	(11.12)	(10.09)	(10.04)	(7.26)	(5.43)	(7.37)
ROA	-0.109***	-0.122***	-0.019	-0.409***	-0.565***	-0.228**
	(-3.44)	(-3.28)	(-0.40)	(-5.88)	(-6.29)	(-2.35)
MB	0.036***	0.051***	0.137***	0.047***	0.072***	0.235***
	(4.95)	(5.86)	(9.93)	(3.64)	(4.68)	(11.29)
log (Assets)	0.096***	0.119***	0.229***	0.209***	0.239***	0.531***
	(12.33)	(12.40)	(13.15)	(11.61)	(10.97)	(16.35)

Dependent Variable:	(1) log (Patent_ number)	(2) log (Patent_ citation)	(3) log (Patent_ value)	(4) log (Patent_ number)	(5) log (Patent_ citation)	(6) log (Patent_ value)
PPE	0.160***	0.165**	0.112	0.253*	0.184	0.068
	(2.83)	(2.36)	(1.24)	(1.79)	(1.08)	(0.33)
Industry-year FE	x	x	x	x	x	x
Observations	45,104	45,104	45,104	21,569	21,569	21,569
Adjusted R^2	0.664	0.651	0.683	0.665	0.636	0.737

Robust t-statistics are in parentheses.
***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

In specifications 1-3, sample consists of firm-year observations of both patenting and non-patenting US firms from the period 1987–2010. In specifications 4-6, sample consists of firm-year observations of patenting firms only – firms with at least one patent during the sample period. The results are economically stronger for patenting firms. As per specification 4, firms with flexibility of one (repurchase only), on an average, have 13.4% more patents granted compared to firms with nil flexibility (dividend only). In all the specifications, I include industry-year fixed effects and cluster the standard errors two-way by firm and year.

Future Innovation

So far, I have shown that firms with greater payout flexibility innovate more in that year compared to firms with lower payout flexibility. However, any financial flexibility from payout choice is more likely to affect innovation in the upcoming years rather than innovation in current year as it takes time to convert investments in innovative projects into final innovation. In this section, I examine whether firms with greater payout flexibility innovate more than firms with lower payout flexibility in the next one to five years. The model is:

$$Innovation_{j,i,t+k} = \beta_0 + \beta_1 Flexibility_{i,t} + \beta_X X_{i,t} + \mu_{s,t} + \varepsilon_{i,t} \quad (3)$$

where $Innovation_{j,i,t+k}$ is one of the three measures of firm level innovation *j* for firm *i* in year $t+k$ instead of year *t*. All other variables in equation (3) are the same as those in equation (2). In panel A of table 3, the dependent variable is innovation measure at year $t+1$, that is *k* equals one. Results indicate that firms with greater payout flexibility innovate more in year $t+1$ in terms of number of patents (specifications 1 & 4), in terms of quality of patents (specifications 2 & 5) and in terms of economic value of patents (specifications 3 & 6). In specifications 1-3, sample consists of firm-year observations of both patenting and non-patenting US firms and in specifications 4-6, sample consists of patenting firms only. I repeat the above analysis of panel A using innovation measures for year $t+3$ in panel B and innovation measures for year $t+5$ in panel C and I get similar results. The sample size decreases from panel A to panel B and decreases further in panel C as many firms have fewer than six years of continuous data in Compustat.

TABLE 3
FUTURE INNOVATION

Panel A: Innovation variables lead by 1 year

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)
Flexibility	0.066***	0.103***	0.169***	0.144***	0.211***	0.283***
	(2.99)	(3.93)	(5.03)	(3.39)	(4.16)	(4.72)
Additional controls	x	x	x	x	x	x
Industry-year FE	x	x	x	x	x	x
Observations	37,168	37,168	37,168	19,020	19,020	19,020
Adjusted R^2	0.683	0.669	0.698	0.679	0.653	0.741

Panel B: Innovation variables lead by 3 years

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)
Flexibility	0.093***	0.129***	0.219***	0.169***	0.218***	0.339***
	(3.52)	(4.12)	(5.36)	(3.54)	(3.88)	(5.00)
Additional controls	x	x	x	x	x	x
Industry-year FE	x	x	x	x	x	x
Observations	26,872	26,872	26,872	14,854	14,854	14,854
Adjusted R^2	0.707	0.692	0.713	0.699	0.675	0.741

Panel C: Innovation variables lead by 5 years

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)
Flexibility	0.118***	0.146***	0.251***	0.181***	0.208***	0.353***
	(3.65)	(3.77)	(4.95)	(3.29)	(3.15)	(4.41)
Additional controls	x	x	x	x	x	x
Industry-year FE	x	x	x	x	x	x
Observations	19,971	19,971	19,971	11,610	11,610	11,610
Adjusted R^2	0.720	0.705	0.721	0.710	0.688	0.740

Robust t-statistics are in parentheses.
***Significant at the 1% level.

Causality

The main hypothesis of this paper is that firms with greater payout flexibility (repurchasing firms) innovate more compared to firms with lower payout flexibility (dividend payers). A limitation of this study is that it is hard to disentangle whether firms with greater payout flexibility innovate more because they

have greater financial flexibility resulting from payout choice or because innovative firms tend to choose to keep their dividend at a low level in anticipation of future innovative opportunities.

TABLE 4
GRANGER-CAUSALITY TESTS

Dependent Variable:	(1) log (Patent_ number)	(2) log (Patent_ citation)	(3) log (Patent_ value)	(4) Flexibility	(5) Flexibility	(6) Flexibility
Flexibility_lag_1	0.016***	0.024***	0.029**	0.674***	0.674***	0.674***
	(2.88)	(3.18)	(2.68)	(61.50)	(61.43)	(61.67)
log (Patent_ number)_lag_1	0.850***			0.002		
	(113.73)			(0.94)		
log (Patent_ citation)_lag_1		0.804***			0.003	
		(81.59)			(1.67)	
log (Patent_ value)_lag_1			0.840***			0.003*
			(82.54)			(2.02)
Additional controls	x	x	x	x	x	x
Industry-year FE	x	x	x	x	x	x
Observations	37,175	37,175	37,175	37,175	37,175	37,175
Adjusted R^2	0.910	0.882	0.910	0.669	0.669	0.669

Robust t-statistics are in parentheses.
***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

Since many innovative firms are young and growing firms, these firms may simply choose to make most of their payouts in the form of repurchases. I mitigate this potential problem by using Granger-Causality tests in table 4. In specifications 1-3, the dependent variable is one of the three innovation measures and independent variables include lagged measures of both *Flexibility* and *Innovation* as below:

$$Innovation_{j,i,t} = \beta_0 + \beta_1 Flexibility_{i,t-1} + \beta_2 Innovation_{j,i,t-1} + \beta_X X_{i,t} + \mu_{s,t} + \varepsilon_{i,t} \quad (4)$$

In specifications 4-6, the dependent variable is *Flexibility* and independent variables include lagged measures of both *Flexibility* and *Innovation* as below:

$$Flexibility_{i,t} = \beta_0 + \beta_1 Flexibility_{i,t-1} + \beta_2 Innovation_{j,i,t-1} + \beta_X X_{i,t} + \mu_{s,t} + \varepsilon_{i,t} \quad (5)$$

The results indicate that lagged *Flexibility* is a significant determinant of Innovation but lagged *Innovation* is not a significant determinant of Flexibility. In other words, results of table 4 suggest that payout flexibility causes innovation but innovation does not cause payout flexibility. All the specifications include additional control variables (as in table 2), industry-year fixed effects and the standard errors are clustered two-way by firm and year.

Robustness

For robustness, I repeat the tests of table 2 with two alternative measures of payout flexibility. Firstly, I measure two-year payout flexibility for firm *i* in year *t* as the ratio of cumulative repurchases in years *t* and *t-1* to cumulative total payout in years *t* and *t-1* as below:

$$\textit{Two-year Payout Flexibility}_{i,t} = (\textit{Repurchases}_{i,t} + \textit{Repurchases}_{i,t-1}) / (\textit{Total Payout}_{i,t} + \textit{Total Payout}_{i,t-1}) \quad (6)$$

Next, I measure three-year payout flexibility for firm *i* in year *t* as the ratio of cumulative repurchases in years *t, t-1* and *t-2* to cumulative total payout in years *t, t-1* and *t-2* as below:

$$\textit{Three-year Payout Flexibility}_{i,t} = (\textit{Repurchases}_{i,t} + \textit{Repurchases}_{i,t-1} + \textit{Repurchases}_{i,t-2})/(\textit{Total Payout}_{i,t} + \textit{Total Payout}_{i,t-1} + \textit{Total Payout}_{i,t-2}) \quad (7)$$

Regression results with two-year payout flexibility are reported in panel A of table 5 and results with three-year payout flexibility are reported in panel B of table 5. The coefficient of flexibility continues to be positive and both statistically and economically significant in both panels of table 5 indicating that the results are robust to the two alternative measures of payout flexibility.

TABLE 5
ALTERNATE MEASURES OF PAYOUT FLEXIBILITY

Panel A: Payout flexibility measured by two years of repurchases and total payout

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)
Flexibility	0.043**	0.080***	0.132***	0.132***	0.206***	0.269***
	(2.07)	(3.23)	(4.23)	(3.08)	(4.08)	(4.63)
Additional controls	x	x	x	x	x	x
Industry-year FE	x	x	x	x	x	x
Observations	44,966	44,966	44,966	21,553	21,553	21,553
Adjusted R^2	0.664	0.651	0.683	0.665	0.636	0.736

Panel B: Payout flexibility measured by three years of repurchases and total payout

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)	log (Patent_ number)	log (Patent_ citation)	log (Patent_ value)
Flexibility	0.047**	0.085***	0.136***	0.138***	0.215***	0.285***
	(2.11)	(3.21)	(4.06)	(2.99)	(3.91)	(4.50)
Additional controls	x	x	x	x	x	x
Industry-year FE	x	x	x	x	x	x
Observations	42,158	42,158	42,158	20,455	20,455	20,455
Adjusted R^2	0.665	0.652	0.684	0.664	0.636	0.735

Robust t-statistics are in parentheses.
***Significant at the 1% level.

CONCLUSION

Prior studies have documented that financial flexibility plays an important role in firm innovation. One of the important channels of financial flexibility comes from the choice of payout. I extend the literature on firm innovation by linking payout policies with firm innovation. Literature on payout policies indicate that firms that make most of their payouts in the form of repurchase have greater flexibility in payout decisions compared to those firms that make most of their payouts in the form of dividends. Using a sample of 45,644 firm-year observations of 7,888 U.S. firms for the period 1987-2010, I show that firms with greater payout flexibility innovate more in terms of number of patents granted and have better quality innovations in terms of citation counts of patents and in terms of economic value of patents. Using a Granger-Causality framework, I also show that firm innovation has no significant effect on payout flexibility while payout flexibility results in firm innovation. Findings of this paper indicate that the choice of payout plays an important role in firm innovation.

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