

Cash Flow Volatility and Corporate Investment

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Submitted in partial fulfillment of the  
requirements for the degree of  
Doctor of Philosophy  
under the Executive Committee  
of the Graduate School of Arts and Sciences

COLUMBIA UNIVERSITY

2014

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## **ABSTRACT**

### Cash Flow Volatility and Corporate Investment

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I examine the effect of cash holdings on the relationship between cash flow volatility and corporate investment. My results call into question the long-assumed negative association between cash flow volatility and corporate investment. Using an expanded dataset of U.S. domestic firms, I show that firms with high cash holdings increase investment in the face of increasing cash flow volatility, whereas firms with low cash holdings lower their investment expenditure. In doing so, I provide empirical evidence in support of recent theoretical models predicting that the sensitivity of investment to cash flow volatility is dependent on the level of balance sheet cash holdings. My results are robust to a number of model specifications.















































































































































**TABLE 22: Using an alternative measure for cash flow volatility (full sample period)**

Dependent Variable: $INV_{NEW}$		
	Low cash holdings	High cash holdings
<i>Intercept</i>	0.028*** [5.23]	0.023*** [4.24]
<i>CFV<sub>CF</sub></i>	<b>-0.099***</b> <b>[-3.44]</b>	<b>0.183***</b> <b>[5.61]</b>
<i>Q</i>	0.030*** [11.07]	0.018*** [12.47]
<i>SALESGWTH</i>	0.044*** [5.65]	0.034*** [3.78]
<i>CASH</i>	0.340*** [7.28]	0.000 [0.03]
<i>DEBT</i>	-0.068*** [-8.59]	0.049*** [3.72]
Fixed effects	Industry and Year	Industry and Year
N	9,727	7,948
Adj. R <sup>2</sup>	0.157	0.179

**Table 22** presents regression results analyzing the relationship between cash flow volatility and investment for the full sample period while partitioning on the level of balance sheet cash holdings. **Panel A** reports results for low cash holding firms (firms in the bottom quartile of cash holdings by industry-year) and **Panel B** reports results for high cash holding firms (firms in the top quartile of cash holdings by industry-year). Variable definitions are as follows:  $INV_{NEW}$  represents new aggregate firm level investment in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ , where new aggregate investment is equal to the sum of capital expenditure, research & development and acquisitions minus the sale of PPE and depreciation & amortization. *CASH* is cash and short-term investments in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ . *CF* is cash from operations plus R&D minus depreciation & amortization all scaled by the book value of total assets at the beginning of period  $t$ .  $CFV_{CF}$  is the standard deviation of *CF* over the preceding ten years. *DEBT* is total debt in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ , where total debt is equal to interest bearing long-term debt plus interest bearing short-term debt. *Q* is a proxy for Tobin's Q, calculated as the market value of assets in period  $t-1$  divided by the book value of total assets in period  $t-1$ , where market value of assets is equal to the market value of equity plus the book value of assets minus the book value of equity. *SALESGWTH* is the log change in net sales between period  $t-1$  and  $t-2$ . All regressions include industry-year fixed effects. Robust t-statistics based on standard errors clustered by industry and year are presented in parentheses under the parameter estimates. Statistical significance is indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.10$  (two sided).

**TABLE 23: Using an alternative measure for cash flow volatility (pre- and post-1995 period)**

Panel A: Pre-1995 sample			Panel B: Post-1995 sample		
Dependent Variable: $INV_{NEW}$			Dependent Variable: $INV_{NEW}$		
	Low cash holdings	High cash holdings		Low cash holdings	High cash holdings
<i>Intercept</i>	0.036*** [4.17]	0.022** [2.13]	<i>Intercept</i>	0.025*** [3.66]	0.024*** [3.66]
<i>CFV<sub>CF</sub></i>	<b>-0.095**</b> [-2.28]	<b>0.186***</b> [3.59]	<i>CFV<sub>CF</sub></i>	<b>-0.098**</b> [-2.48]	<b>0.185***</b> [4.45]
<i>Q</i>	0.026*** [5.75]	0.017*** [4.69]	<i>Q</i>	0.032*** [9.51]	0.018*** [12.09]
<i>SALESGWTH</i>	0.053*** [4.45]	0.062*** [3.57]	<i>SALESGWTH</i>	0.040*** [4.04]	0.024** [2.31]
<i>CASH</i>	0.347*** [4.58]	-0.002 [-0.15]	<i>CASH</i>	0.336*** [5.84]	0.002 [0.16]
<i>DEBT</i>	-0.072*** [-4.39]	-0.003 [-0.19]	<i>DEBT</i>	-0.066*** [-7.20]	0.074*** [4.25]
Fixed effects	Industry and Year	Industry and Year	Fixed effects	Industry and Year	Industry and Year
N	3,082	2,479	N	6,645	5,469
Adj. R <sup>2</sup>	0.171	0.178	Adj. R <sup>2</sup>	0.152	0.179

**Table 23** presents regression results analyzing the relationship between cash flow volatility and investment while partitioning on the level of balance sheet cash holdings. **Panel A** reports results for the pre-1995 period and **Panel B** reports results for the post-1995 period. Firms are classified as high (low) cash holding firms if they fall in the top (bottom) quartile of firm cash holdings for their respective 2-digit SIC industry classification during a given year. Variable definitions are as follows:  $INV_{NEW}$  represents new aggregate firm level investment in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ , where new aggregate investment is equal to the sum of capital expenditure, research & development and acquisitions minus the sale of PPE and depreciation & amortization. *CASH* is cash and short-term investments in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ . *CF* is cash from operations plus R&D minus depreciation & amortization all scaled by the book value of total assets at the beginning of period  $t$ .  $CFV_{CF}$  is the standard deviation of *CF* over the preceding ten years. *DEBT* is total debt in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ , where total debt is equal to interest bearing long-term debt plus interest bearing short-term debt. *Q* is a proxy for Tobin's Q, calculated as the market value of assets in period  $t-1$  divided by the book value of total assets in period  $t-1$ , where market value of assets is equal to the market value of equity plus the book value of assets minus the book value of equity. *SALESGWTH* is the log change in net sales between period  $t-1$  and  $t-2$ . All regressions include industry-year fixed effects. Robust t-statistics based on standard errors clustered by industry and year are presented in parentheses under the parameter estimates. Statistical significance is indicated by \*\*\*p<0.01, \*\*p<0.05, \*p<0.10 (two sided).

**TABLE 24: Using an alternative measure of cash to partition sample (full sample period)**

Panel A: Low cash holdings			Panel B: High cash holdings		
Dependent Variable: $INV_{NEW}$			Dependent Variable: $INV_{NEW}$		
Column:	I	II	Column:	I	II
<i>Intercept</i>	0.014*** [3.81]	0.032*** [6.96]	Intercept	0.044*** [14.03]	0.039*** [8.20]
<i>CFV<sub>CF</sub></i>	<b>-0.069***</b> [-2.98]	<b>-0.097***</b> [-4.25]	<i>CFV<sub>CF</sub></i>	<b>0.116***</b> [4.70]	<b>0.113***</b> [4.65]
<i>Q</i>	0.032*** [14.00]	0.027*** [11.88]	<i>Q</i>	0.018*** [14.31]	0.018*** [14.33]
<i>SALESGWTH</i>	0.031*** [5.40]	0.040*** [6.47]	<i>SALESGWTH</i>	0.038*** [5.23]	0.033*** [4.60]
<i>CASH</i>		0.286*** [7.20]	<i>CASH</i>		0.001 [0.11]
<i>DEBT</i>		-0.064*** [-9.58]	<i>DEBT</i>		0.038*** [3.37]
Fixed effects	Industry and Year	Industry and Year	Fixed effects	Industry and Year	Industry and Year
N	12,841	12,841	N	10,600	10,600
Adj. R <sup>2</sup>	0.109	0.143	Adj. R <sup>2</sup>	0.183	0.185

**Table 24** presents regression results analyzing the relationship between cash flow volatility and investment for the full sample period while partitioning on an alternative measure for balance sheet cash holdings, calculated as cash holdings in period  $t$  scaled by total assets net of cash holdings at the beginning of period  $t$ . **Panel A** reports results for low cash holding firms (firms in the bottom quartile of cash holdings by industry-year) and **Panel B** reports results for high cash holding firms (firms in the top quartile of cash holdings by industry-year). Variable definitions are as follows:  $INV_{NEW}$  represents new aggregate firm level investment in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ ; where new aggregate investment is equal to the sum of capital expenditure, research & development and acquisitions minus the sale of PPE and depreciation & amortization. *CASH* is cash and short-term investments in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ . *OCF* is cash from operations in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ . *CF* is cash from operations plus R&D minus depreciation & amortization all scaled by the book value of total assets at the beginning of period  $t$ . *CFV<sub>CF</sub>* is the standard deviation of *CF* over the preceding five years. *DEBT* is total debt in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ , where total debt is equal to interest bearing long-term debt plus interest bearing short-term debt. *Q* is a proxy for Tobin's Q, calculated as the market value of assets in period  $t-1$  divided by the book value of total assets in period  $t-1$ , where market value of assets is equal to the market value of equity plus the book value of assets minus the book value of equity. *SALESGWTH* is the log change in net sales between period  $t-1$  and  $t-2$ . All regressions include industry-year fixed effects. Robust t-statistics based on standard errors clustered by industry and year are presented in parentheses under the parameter estimates. Statistical significance is indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.10$  (two sided).

**TABLE 25: Using an alternative measure of cash to partition sample (pre- and post-1995 period)**

Panel A: Pre-1995 sample			Panel B: Post-1995 sample		
Dependent Variable: $INV_{NEW}$			Dependent Variable: $INV_{NEW}$		
	Low cash holdings	High cash holdings		Low cash holdings	High cash holdings
<i>Intercept</i>	0.042*** [6.54]	0.027*** [3.51]	<i>Intercept</i>	0.027*** [4.22]	0.045*** [7.49]
<i>CFV<sub>CF</sub></i>	<b>-0.115***</b> [-3.76]	<b>0.109***</b> [3.30]	<i>CFV<sub>CF</sub></i>	<b>-0.075**</b> [-2.17]	<b>0.113***</b> [3.33]
<i>Q</i>	0.024*** [6.48]	0.021*** [7.46]	<i>Q</i>	0.028*** [9.95]	0.017*** [12.51]
<i>SALESGWTH</i>	0.047*** [5.16]	0.061*** [5.10]	<i>SALESGWTH</i>	0.035*** [4.33]	0.019** [2.18]
<i>CASH</i>	0.249*** [4.54]	0.007 [0.49]	<i>CASH</i>	0.301*** [5.68]	-0.001 [-0.07]
<i>DEBT</i>	-0.073*** [-6.68]	-0.002 [-0.16]	<i>DEBT</i>	-0.059*** [-6.95]	0.063*** [3.99]
Fixed effects	Industry and Year	Industry and Year	Fixed effects	Industry and Year	Industry and Year
N	4,834	3,930	N	8,007	6,670
Adj. R <sup>2</sup>	0.134	0.195	Adj. R <sup>2</sup>	0.145	0.181

**Table 25** presents regression results analyzing the relationship between cash flow volatility and investment while partitioning on an alternative measure for balance sheet cash holdings, calculated as cash holdings in period  $t$  scaled by total assets net of cash holdings at the beginning of period  $t$ . **Panel A** reports results for the pre-1995 period and **Panel B** reports results for the post-1995 period. Firms are classified as high (low) cash holding firms if they fall in the top (bottom) quartile of firm cash holdings for their respective 2-digit SIC industry classification during a given year. Variable definitions are as follows:  $INV_{NEW}$  represents new aggregate firm level investment in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ ; where new aggregate investment is equal to the sum of capital expenditure, research & development and acquisitions minus the sale of PPE and depreciation & amortization.  $CASH$  is cash and short-term investments in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ .  $CF$  is cash from operations plus R&D minus depreciation & amortization all scaled by the book value of total assets at the beginning of period  $t$ .  $CFV_{CF}$  is the standard deviation of  $CF$  over the preceding five years.  $DEBT$  is total debt in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ , where total debt is equal to interest bearing long-term debt plus interest bearing short-term debt.  $Q$  is a proxy for Tobin's Q, calculated as the market value of assets in period  $t-1$  divided by the book value of total assets in period  $t-1$ , where market value of assets is equal to the market value of equity plus the book value of assets minus the book value of equity.  $SALESGWTH$  is the log change in net sales between period  $t-1$  and  $t-2$ . All regressions include industry-year fixed effects. Robust t-statistics based on standard errors clustered by industry and year are presented in parentheses under the parameter estimates. Statistical significance is indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.10$  (two sided).

**Table 26: Implications of dividend and stock repurchase policies**

Panel A: Dividend paying firms (only)			Panel B: Stock repurchasing firms (only)			Panel C: Both dividend paying and stock repurchasing firms			Panel D: Neither dividend paying nor stock repurchasing firms								
Dependent Variable: $INV_{NEW}$			Dependent Variable: $INV_{NEW}$			Dependent Variable: $INV_{NEW}$			Dependent Variable: $INV_{NEW}$								
Low cash holdings			Low cash holdings			Low cash holdings			Low cash holdings								
High cash holdings			High cash holdings			High cash holdings			High cash holdings								
<i>Intercept</i>	0.012 [0.89]	0.025** [2.16]	0.035*** [2.97]	0.042*** [3.90]	0.017 [1.44]	0.017** [2.43]	0.039*** [5.55]	0.052*** [6.32]	<i>Intercept</i>	0.012 [0.89]	0.025** [2.16]	0.035*** [2.97]	0.042*** [3.90]	0.017 [1.44]	0.017** [2.43]	0.039*** [5.55]	0.052*** [6.32]
<i>CFV<sub>EBD</sub></i>	-0.083 [-0.84]	0.128 [1.43]	-0.033 [-0.42]	0.129*** [2.04]	-0.088 [-1.00]	0.105 [1.19]	-0.183*** [-5.26]	0.158*** [4.02]	<i>CFV<sub>EBD</sub></i>	-0.083 [-0.84]	0.128 [1.43]	-0.033 [-0.42]	0.129*** [2.04]	-0.088 [-1.00]	0.105 [1.19]	-0.183*** [-5.26]	0.158*** [4.02]
<i>Q</i>	0.038*** [4.86]	0.013*** [3.91]	0.016*** [2.64]	0.020*** [6.75]	0.029*** [6.62]	0.013*** [5.79]	0.028*** [6.88]	0.019*** [9.08]	<i>Q</i>	0.038*** [4.86]	0.013*** [3.91]	0.016*** [2.64]	0.020*** [6.75]	0.029*** [6.62]	0.013*** [5.79]	0.028*** [6.88]	0.019*** [9.08]
<i>SALESGWTH</i>	0.049** [1.98]	0.048* [1.86]	0.021 [1.15]	0.021 [1.24]	0.005 [0.24]	0.077*** [3.68]	0.042*** [4.75]	0.030*** [2.61]	<i>SALESGWTH</i>	0.049** [1.98]	0.048* [1.86]	0.021 [1.15]	0.021 [1.24]	0.005 [0.24]	0.077*** [3.68]	0.042*** [4.75]	0.030*** [2.61]
<i>CASH</i>	0.245* [1.74]	0.021 [0.86]	0.293*** [4.16]	0.000 [0.01]	0.321*** [3.68]	-0.002 [-0.12]	0.306*** [6.03]	-0.002 [-0.15]	<i>CASH</i>	0.245* [1.74]	0.021 [0.86]	0.293*** [4.16]	0.000 [0.01]	0.321*** [3.68]	-0.002 [-0.12]	0.306*** [6.03]	-0.002 [-0.15]
<i>DEBT</i>	-0.041** [-2.05]	0.029 [0.80]	-0.052** [-2.43]	-0.045* [-1.72]	-0.048** [-2.12]	0.041* [1.95]	-0.081*** [-6.87]	0.027 [1.31]	<i>DEBT</i>	-0.041** [-2.05]	0.029 [0.80]	-0.052** [-2.43]	-0.045* [-1.72]	-0.048** [-2.12]	0.041* [1.95]	-0.081*** [-6.87]	0.027 [1.31]
Fixed effects	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Fixed effects	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year
N	2,675	2,589	2,655	2,379	2,940	2,963	5,510	4,300	N	2,675	2,589	2,655	2,379	2,940	2,963	5,510	4,300
Adj. R <sup>2</sup>	0.129	0.115	0.150	0.230	0.151	0.157	0.163	0.180	Adj. R <sup>2</sup>	0.129	0.115	0.150	0.230	0.151	0.157	0.163	0.180

**Table 26** presents regression results analyzing the relationship between cash flow volatility and investment for the full sample period while partitioning on the level of balance sheet cash holdings. **Panel A** reports results for dividend paying firms only. **Panel B** reports results for stock repurchasing firms only. **Panel C** reports results for firms that do not engage in either dividend payout or stock repurchasing. Firms are classified as high (low) cash holding firms if they fall in the top (bottom) quartile of firm cash holdings for their respective 2-digit SIC industry classification during a given year. Variable definitions are as follows:  $INV_{NEW}$  represents new aggregate firm level investment in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ ; where new aggregate investment is equal to the sum of capital expenditure, research & development and acquisitions minus the sale of PPE and depreciation & amortization. *CASH* is cash and short-term investments in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ . *EBD* is earnings before depreciation in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ . *CFV<sub>EBD</sub>* is the standard deviation of *EBD* over the preceding five years. *DEBT* is total debt in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ , where total debt is equal to interest bearing long-term debt plus interest bearing short-term debt. *Q* is a proxy for Tobin's Q, calculated as the market value of assets in period  $t-1$  divided by the book value of total assets in period  $t-1$ , where market value of assets is equal to the market value of equity plus the book value of assets minus the book value of equity. *SALESGWTH* is the log change in net sales between period  $t-1$  and  $t-2$ . All regressions include industry-year fixed effects. Robust t-statistics based on standard errors clustered by industry and year are presented in parentheses under the parameter estimates. Statistical significance is indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.10$  (two sided).

**TABLE 27: Cash flow volatility and corporate investment during the financial crisis period**

Dependent Variable: $INV_{NEW}$			
Column:	I	II	III
<i>Intercept</i>	0.061*** [22.38]	0.026*** [6.42]	0.030*** [5.65]
<i>CFV</i>	<b>0.211***</b> <b>[4.92]</b>	<b>0.157***</b> <b>[3.84]</b>	<b>0.120***</b> <b>[3.04]</b>
<i>Q</i>		0.022*** [13.02]	0.019*** [10.66]
<i>SALESGWTH</i>		0.020** [2.13]	0.024*** [2.65]
<i>CASH</i>			0.035*** [3.23]
<i>OCF</i>			0.014 [0.62]
<i>DEBT</i>			-0.030*** [-3.21]
Fixed effects	Industry and Year	Industry and Year	Industry and Year
N	6,810	6,733	6,733
Adj. R <sup>2</sup>	0.102	0.138	0.143

**Table 27** presents regression results analyzing the relationship between cash flow volatility and investment during the financial crisis period (2008-2012). Results are reported using an OLS estimate of Eq.(1) for the full sample period. Variable definitions are as follows:  $INV_{NEW}$  represents new aggregate firm level investment in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ , where new aggregate investment is equal to the sum of capital expenditure, research & development and acquisitions minus the sale of PPE and depreciation & amortization. *CASH* is cash and short-term investments in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ . *OCF* is cash from operations in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ . *CF* is cash from operations plus R&D minus depreciation & amortization all scaled by the book value of total assets at the beginning of period  $t$ . *CFV* is the standard deviation of *CF* over the preceding five years. *DEBT* is total debt in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ , where total debt is equal to interest bearing long-term debt plus interest bearing short-term debt. *Q* is a proxy for Tobin's Q, calculated as the market value of assets in period  $t-1$  divided by the book value of total assets in period  $t-1$ , where market value of assets is equal to the market value of equity plus the book value of assets minus the book value of equity. *SALESGWTH* is the log change in net sales between period  $t-1$  and  $t-2$ . All regressions include industry-year fixed effects. Robust t-statistics based on standard errors clustered by industry and year are presented in parentheses under the parameter estimates. Statistical significance is indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.10$  (two sided).



**TABLE 28: Using the financial crisis period to address endogeneity concerns**

Dependent Variable: $INV_{NEW}$		
	Low cash holdings	High cash holdings
<i>Intercept</i>	0.012 [0.96]	0.027** [2.35]
$CFV_{CF}$	<b>-0.167**</b> <b>[-2.02]</b>	<b>0.202**</b> <b>[2.40]</b>
$Q$	0.034*** [5.18]	0.015*** [6.03]
<i>SALESGWTH</i>	0.022 [1.21]	-0.006 [-0.38]
<i>CASH</i>	0.301*** [4.26]	0.026 [1.02]
<i>DEBT</i>	-0.056*** [-3.56]	0.082** [2.53]
Fixed effects	Industry and Year	Industry and Year
N	1,785	1,655
Adj. $R^2$	0.155	0.143

**Table 28** presents regression results analyzing the relationship between cash flow volatility and investment during the financial crisis period (2008-2012) while partitioning on the level of balance sheet cash holdings. **Panel A** reports results for low cash holding firms (firms in the bottom quartile of cash holdings by industry-year) and **Panel B** reports results for high cash holding firms (firms in the top quartile of cash holdings by industry-year). Variable definitions are as follows:  $INV_{NEW}$  represents new aggregate firm level investment in period  $t$  scaled by the book value of total assets at the beginning of period  $t$ ; where new aggregate investment is equal to the sum of capital expenditure, research & development and acquisitions minus the sale of PPE and depreciation & amortization. *CASH* is cash and short-term investments in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ . *CF* is cash from operations plus R&D minus depreciation & amortization all scaled by the book value of total assets at the beginning of period  $t$ .  $CFV_{CF}$  is the standard deviation of *CF* over the preceding five years. *DEBT* is total debt in period  $t-1$  scaled by the book value of total assets at the beginning of period  $t-1$ , where total debt is equal to interest bearing long-term debt plus interest bearing short-term debt.  $Q$  is a proxy for Tobin's  $Q$ , calculated as the market value of assets in period  $t-1$  divided by the book value of total assets in period  $t-1$ , where market value of assets is equal to the market value of equity plus the book value of assets minus the book value of equity. *SALESGWTH* is the log change in net sales between period  $t-1$  and  $t-2$ . All regressions include industry-year fixed effects. Robust t-statistics based on standard errors clustered by industry and year are presented in parentheses under the parameter estimates. Statistical significance is indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.10$  (two sided).

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