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Accounts Payable and Natural Hedge:

Evidence from Manufacturing Industry

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Contents

[Abstract]
In this paper, I examine the relation between accounts payable and natural hedge. Prior literature has argued that firms with high natural hedge (proximity to the median industry capital-labor ratio) tend to have less financial leverage. Firms with less leverage may suffer from liquidity constraints and asymmetric information. Theories of accounts payable suggest that accounts payable can substitute for institutional finance. I discovered that natural hedge is positively related to the level of accounts payable in which high natural hedge holds low institutional loans. Based on previous studies of accounts payable and natural hedge, this paper demonstrates that after controlling for firm- and industry-level factors, a firm's choice of accounts payable is associated with its natural hedge.

1. Introduction

This paper investigates the association between accounts payable and natural hedge during the period 2002 to 2018 in Japanese listed companies. Natural hedge indicates that the proximity to the industry median of capital-labor ratio. Prior researches find that firms with natural hedge close to one have less cash flow risk and use less financial leverage whereas firms with natural hedge near zero hold high cash flow volatility, and are highly leveraged. In other words, firms with natural hedge which equals to zero whose technology departs from the industry norm adopt more financial leverage to manage its unique business operations (Maksimovic and Zechner, 1991). Natural hedge is negatively related to financial leverage, this is empirically supported by MacKay and Phillips (2005).[1)] Meanwhile, firms using less financial leverage under the high level of natural hedge are likely to seek alternative sources of institutional financing. Accounts payable is widely used as a substitute for institutional finance (Atanasova, 2007). Accounts payable is created over the course of business transactions. When suppliers allow their buyers to delay payment of the purchase, the buyers hold accounts payable. Offered accounts payable terms give liquidity

Key words：Accounts payable, Natural hedge, Manufacturing industry, Fixed effects model

to the buyers for a short-term. Given that firms with low level of financial leverage might suffer from a lack of liquidity and asymmetric information, less leveraged firms are likely to adopt accounts payable as an alternative financing source.

I test whether the natural hedge is negatively correlated with firms' institutional finance, but also find the association between accounts payable and natural hedge. To estimate the results, I compute the natural hedge in Japanese manufacturing industry during the period 2002 to 2018. The findings obtained from mean/median difference tests suggest that firms with high natural hedge hold less bank loans and more accounts payable. Results from the firm-fixed effects model attenuating the potential endogeneity problems show that the natural hedge is positively related to accounts payable.

This paper contributes by providing the evidence suggesting that the positive relation exists between accounts payable and natural hedge based on the theories and empirical studies finding that accounts payable can substitute for institutional finance, and the importance of industry-level factors to firm's decisions of financial structure.

The remainder of this paper is organized as follows. Section 2 describes previous studies and hypothesis. Section 3 introduces the empirical methodology and data. Section 4 shows main empirical results. Finally, Section 5 offers a summary and the conclusion.

2. Hypothesis

Natural hedge denotes the proximity to the median industry capital-labor ratio. High natural hedge indicates that firm is located at the technological core of the industry. Maksimovic and Zechner (1991) postulate that firms can choose natural hedge, and firms with a safe technology (near to the core of industry capital-labor ratio) have a certain marginal cost whereas firms with a risky technology (at the fringe of industry capital-labor ratio) hold an uncertain cost. Maksimovic and Zechner (1991) argue that the natural hedge as an industry-level factor affects not only firms' cost structure but also financial decisions. MacKay and Phillips (2005) compute natural hedge based on the U.S. manufacturing companies during the period 1981 to 2000, find that natural hedge of industry factor affects firms' financial structure. MacKay and Phillips (2005) point out that firms with a natural hedge value of near one, benefit from risky minimizing, adopt less financial leverage.

The level of financial leverage might affect information asymmetry, and choice of non-institutional financing. Jensen (1986) argues that low leverage induces free cash flow problems, and using institutional financing reduces information asymmetry due to the role in the monitoring. Generally, accounts payable in working capital is widely used as an alternative measure of institutional financing, has a function of information production.[2)] Previous studies investigating accounts payable focus on a close monitoring provided by suppliers to mitigate information asymmetry, moreover, find whether or not accounts payable substitutes for institutional financing during liquidity shocks. Biais and Gollier (1997) and Petersen and Rajan (1997) show that suppliers can closely monitor buyers using

accounts payable, which substantially alleviates information asymmetry. As for the role of substitute for institutional financing, Choi and Kim (2005) find that the use of accounts payable increases during tighter monetary policy. They suggest that given that government's monetary tightening policy increases the premium for external financing, firms are more likely to adopt interfirm liquidity market. Atanasova (2007) examines that accounts payable is used as an alternative financing source of institutional finance (such as bank loans) during periods of tight money. Furthermore, Nam and Uchida (2019) show the empirical evidence across 40 countries that accounts payable is positively associated with firm value (Tobin's Q) during the global financial crisis.

Natural hedge has an effect on the financial structure, particularly, high natural hedge depends less on financial leverage. I assume that the firms with less leverage rely less on institutional finance. Using low level of institutional finance suggests that firms are likely to secure liquidity through alternative channels. These alternative channels should probably be accompanied by the monitoring effect to mitigate information asymmetry, which financial institutions commonly offer. Accounts payable can substitute institutional finance, has the function of information production. Overall, given that firms with high natural hedge use less institutional finance, I examine the association between accounts payable and natural hedge with the hypothesis below.

Hypothesis 1.

Natural hedge is positively related to accounts payable.

3. Methodology and data

I examine the association between accounts payable and natural hedge. The dependent variable is ACCPAY computed by accounts payable over total assets (Petersen and Rajan, 1997). For the computation of natural hedge as the key independent variable to test the hypothesis, I borrow a part of the equation from MacKay and Phillips (2005). Natural hedge indicates the proximity to the median industry capital-labor ratio. In the equation (1), i stands for firm, ind for industry, and t for fiscal year. The term K denotes firm's capital defined property, plant and equipment. The term Lrepresents the labor, I use the number of employees at the end of each fiscal year.

$$Natural\ hedge_{i,ind,t} = 1 - \frac{\left| \left(\frac{K}{L}\right)_{i,ind,t} - median_{ind,t}\left(\frac{K}{L}\right) \right|}{range\left\{ \left| \left(\frac{K}{L}\right)_{i,ind,t} - median_{ind,t}\left(\frac{K}{L}\right) \right| \forall i \in_{ind,t} \right\}} \qquad (1)$$

The numerator in the right side of the equation (1) is the absolute value of the difference between the firm's capital-labor ratio and the industry-year median. The denominator is computed by the industry-year range between the maximum value and the minimum value of the firm-year numerator. The value of calculated fraction is subtracted from one so that

firms with capital-labor ratios close to the industry median hold high level of natural hedge.[3)]

I presume that firms with high natural hedge hold less financial leverage, use more accounts payable that substitutes for institutional loans and reduces information asymmetry. Therefore, I expect that the positive relation exists between accounts payable and natural hedge. To test this idea, the following analyses adopt one-year lagged natural hedge to estimate less biased results (such as a reverse causality). Moreover, to mitigate the endogeneity issues caused by time-unvarying omitted variables, this paper uses the firm-fixed effects model.[4)] Thus I estimate the following equation.

$$ACCPAY_{i,t} = \alpha + \beta_1 Natural\ hedge_{i,t-1} + \boldsymbol{X_{i,t-1}}\phi + \mu_i + \delta_t + \varepsilon_{i,t} \qquad (2)$$

For the vector of control variables (**X**) in the equation (2), I include the sum of short-term and long-term loans scaled by total assets (BANKLOAN). According to the prior studies, firms with the lack of institutional loans are likely to adopt more accounts payable. I predict the negative coefficient on BANKLOAN, based on the views that accounts payable substitutes for institutional loans. The level of accounts payable is determined by industry trends (Ng et al., 1999). To address the industry effect, I add the IND(ACCPAY) computed by industry-year level average of ACCPAY, and anticipate the positive coefficient on IND(ACCPAY). Firms with potential growth prospects are more likely to adopt accounts payable. For the operating performance control, I adopt ROA (earnings before interest and tax scaled by assets) and SGR (sales growth rate). I predict both control variables are positively associated with accounts payable. Wilner (2000) argues that firm's bargaining power is related to the use of accounts payable. Firms with strong bargaining power utilize accounts payable with favorable contract in the maturity and discount rate. BARGAINING is defined as the firm's sales over the sum of sales in industry-year level. Commonly, small-medium size firms tend to use the accounts payable as an alternative financing source (Choi and Kim, 2005). The natural logarithm of total assets is included to control size effect. I expect the negative relation between SIZE and ACCPAY. One-year lagged data are adopted for all variables (**X**) to reduce the reverse causality problem. All controls variables are winsorized at the top and bottom one percent levels.

I collected the sample companies from the QUICK Astra Manager database. This paper focuses on the manufacturing industry since prior researches point out that accounts payable is widely adopted in the manufacturers' transactions (Petersen and Rajan, 1997; Ng et al., 1999). All manufacturing companies are listed in Tokyo Stock Exchange during the sample period from 2002 to 2018. Companies were deleted from the analysis when the aforementioned financial data were not available. Based on the TOPIX 33-sectors classification (index code), I include Foods (3050), Textiles and Apparels (3100), Pulp and Paper (3150), Chemicals (3200), Pharmaceutical (3250), Oil and Coal Products (3300), Rubber Products (3350), Glass and Ceramics Products (3400), Iron and Steel (3450), Nonferrous Metals (3500), Metal Products (3550), Machinery (3600), Electric Appliances (3650),

Transportation Equipment (3700), Precision Instruments (3750), and Other Products (3800) for the entire sample. As a result, the sample consists of 25,186 firm-year observations involving 1,955 companies.

Table 1

Summary statistics

This table presents summary statistics for sample from Japanese manufacturers companies during 2002 to 2018. Panel A shows the summary statistics for variables adopted in the analyses. See Appendix A and equation (1) for the computation of variables. Panel B shows the number of subsamples and the mean/median for the ACCPAY, Natural hedge, and BANKLOAN across the manufacturing industry identified by the TOPIX 33-sectors classification (index code 3050-3800).

Panel A

Variables	N	Mean	S.D.	Min.	25%	Med.	75%	Max.
ACCPAY	25,186	0.213	0.100	0.001	0.145	0.207	0.274	0.622
Natural hedge	25,186	0.932	0.122	0.004	0.930	0.977	0.992	1.000
Natural hedge change	25,186	0.002	0.062	-0.273	-0.005	0.000	0.007	0.308
BANKLOAN	25,186	0.162	0.156	0.000	0.021	0.122	0.260	0.676
IND(ACCPAY)	25,186	0.214	0.029	0.054	0.193	0.217	0.232	0.373
SGR	25,186	0.018	0.183	-0.639	-0.055	0.012	0.076	1.022
ROA	25,186	0.034	0.051	-0.187	0.010	0.031	0.057	0.229
BARGAINING	25,186	0.009	0.022	0.000	0.001	0.002	0.007	0.152
SIZE	25,186	10.511	1.461	6.932	9.484	10.326	11.362	14.746

Panel B

		ACCPAY		*Natural hedge*		*BANKLOAN*	
Industry sectors	N	Mean	Med.	Mean	Med.	Mean	Med.
Foods	2,195	0.176	0.171	0.956	0.976	0.166	0.118
Textiles and Apparels	1,096	0.171	0.166	0.949	0.982	0.185	0.149
Pulp and Paper	413	0.222	0.207	0.856	0.937	0.210	0.196
Chemicals	3,485	0.215	0.204	0.886	0.925	0.152	0.111
Pharmaceutical	801	0.172	0.169	0.816	0.862	0.086	0.025
Oil and Coal Products	178	0.213	0.188	0.743	0.826	0.189	0.154
Rubber Products	321	0.240	0.235	0.812	0.910	0.187	0.164
Glass and Ceramics Products	1,070	0.219	0.206	0.885	0.934	0.220	0.200
Iron and Steel	854	0.187	0.189	0.792	0.872	0.197	0.183
Nonferrous Metals	573	0.217	0.218	0.858	0.935	0.243	0.246
Metal Products	1,489	0.242	0.235	0.954	0.983	0.171	0.120
Machinery	3,937	0.239	0.226	0.957	0.978	0.149	0.104
Electric Appliances	4,555	0.226	0.226	0.978	0.992	0.142	0.095
Transportation Equipment	1,703	0.206	0.206	0.969	0.983	0.157	0.137
Precision Instruments	770	0.207	0.208	0.983	0.994	0.175	0.147
Other Products	1,746	0.198	0.204	0.965	0.984	0.166	0.127

Table 1 presents the summary statistics. Panel A includes the entire sample. During the sample period, the mean (median) of ACCPAY is 21.3% (20.7%). Natural hedge shows the 25th percentile value is over 0.9, most of the manufacturer companies in the entire sample are close to the industry median of capital-labor ratio. BANKLOAN indicates the use of institutional loans, and the mean (median) value is 16.2% (12.2%). Panel B depicts the industry-level (TOPIX 33-sectors classification) mean/median statistics for ACCPAY,

Natural hedge, and BANKLOAN. About 18.1% of the observations in the sample are Electric Appliances. Metal Products (Textiles and Apparels) industry adopts a large (less) accounts payable to the total assets. The mean of natural hedge for the Oil and Coal Products industry is the lowest (about 0.7) among all industries, implies that firms have the wide variation of capital-labor ratios across the Oil and Coal Products industry (untabulated value of its standard deviation is 0.258).

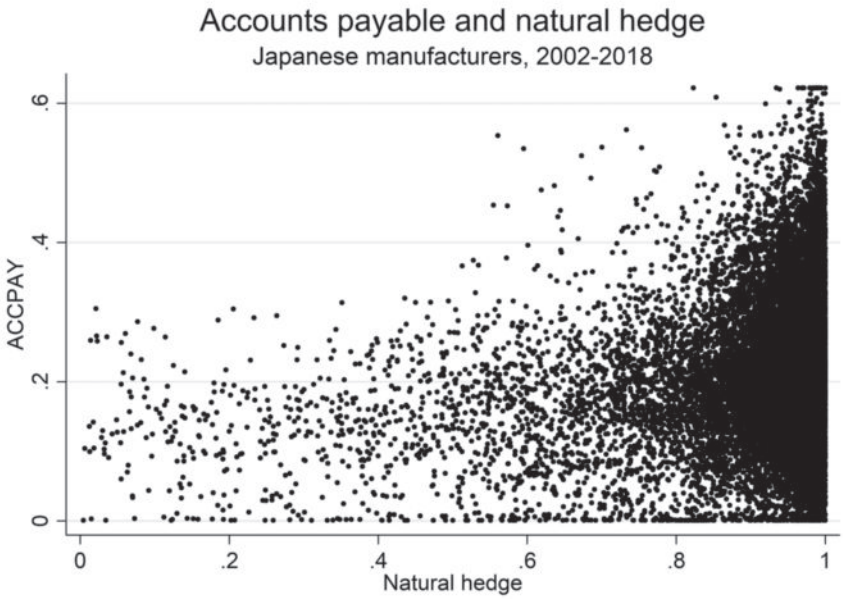

Fig. 1.

This figure presents the scatter plot between ACCPAY and Natural hedge. ACCPAY is computed by accounts payable over total asset, Natural hedge is computed by following MacKay and Phillips (2005) and equation (1) above.

This paper tests the hypothesis that natural hedge is positively related to accounts payable. The Fig. 1 plots the relation between accounts payable and natural hedge during the sample period. I find that the spread of accounts payable increases with the increase of natural hedge. This suggests that firms with high natural hedge might adopt more accounts payable to the total assets.

MacKay and Phillips (2005) point out that natural hedge is one of variables that supports the importance of industry-level characteristics. In a similar vein, Ng et al. (1999) argue that the use of accounts payable depends on industry-specific practice. Fig. 2 shows the scatter diagram and its fitted line between average value of accounts payable and average value of natural hedge, both are computed by industry-year average. I find that the plot depicts persistently positive relation.

Prior studies investigating the relation between natural hedge and capital structure argue that firm with high natural hedge use less financial leverage (Maksimovic and Zechner, 1991; MacKay and Phillips, 2005). Less leverage is primarily related to the less

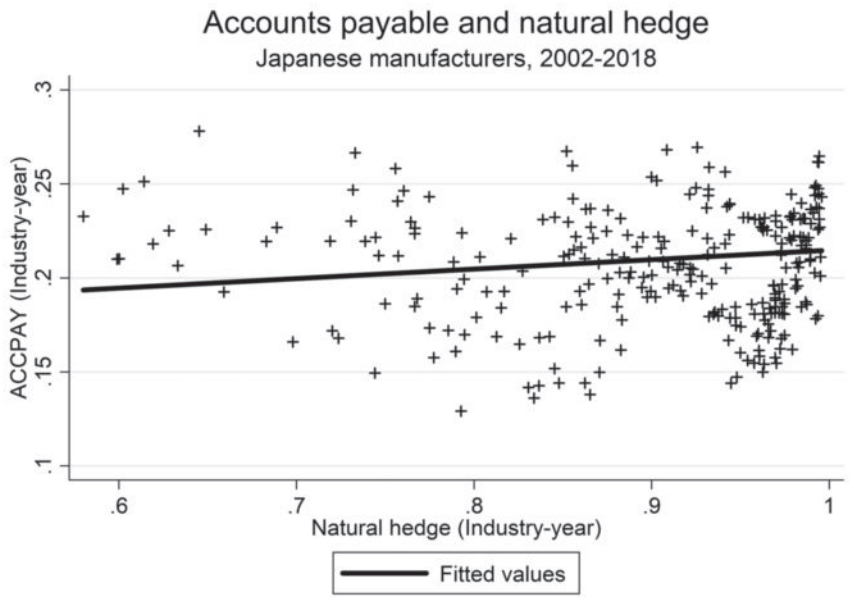

Fig. 2.

This figure shows the scatter plot and its fitted line obtained from industry-year level average value of ACCPAY and Natural hedge. ACCPAY is computed by accounts payable over total asset, Natural hedge is computed by following MacKay and Phillips (2005) and equation (1) above.

institutional loans. Given that theories and empirical studies in the accounts payable stress that accounts payable substitutes for institutional loans, firms with less leverage might depend on the accounts payable as an alternative financing source. To test this idea, I equally divide the sample into four groups upon the natural hedge. I presume that high natural hedge group (Top percentile) holds a large amount of accounts payable to total assets and less institutional loans whereas lowest group (Bottom percentile) might have less

Table 2

Mean/median difference tests

This table presents the number of subsamples and the mean/median ACCPAY and BANKLOAN across the Natural hedge groups. Natural hedge is equally divided into four groups. See Appendix A and equation (1) for the computation of Natural hedge, ACCPAY, and BANKLOAN. This table includes the results from the mean/median difference test in each variable between Top and Bottom of Natural hedge groups. Asterisks and p-values are for the null hypothesis that the mean/median value is identical between the subsamples (between Top and Bottom of Natural hedge groups).

		ACCPAY		*BANKLOAN*	
Natural hedge percentile	N	Mean	Med.	Mean	Med.
Top	6,296	0.230	0.226	0.151	0.115
75–50th	6,297	0.221	0.215	0.152	0.111
50–25th	6,296	0.213	0.206	0.158	0.113
Bottom	6,297	0.190	0.183	0.185	0.154
Difference test Top-Bottom		23.084***	23.749***	-12.071***	-10.872***
(p-value)		(0.000)	(0.000)	(0.000)	(0.000)

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

accounts payable and large institutional loans. Table 2 presents the mean/median for the ACCPAY and BANKLOAN by the natural hedge groups, includes the results from difference test. Consistent with the presumption the mean/median ACCPAY and BANKLOAN move in the opposite direction across the natural hedge groups. Top percentile group indicates large ACCPAY and less BANKLOAN suggesting that accounts payable substitutes for institutional loans. The results from difference test between Top and Bottom natural hedge groups are significant and persistent with the prediction.

Table 3 describes the pairwise correlation matrix for variables adopted in analyses, includes the Pearson's correlation coefficients (p-value in parentheses). BANKLOAN is negatively correlated with natural hedge at the 1% level of significance (coefficient is -0.111). This is consistent with the finding revealed in Table 2 that natural hedge is negatively correlated with institutional loans. Meanwhile, results present that ROA, BARGAINING, and SIZE are substantially associated with other control variables (significant at the 1% level), the potential multicollinearity might estimate a bias within the analyses. To address the potential multicollinearity problems, I add the regression analyses by omitting related control variables.

Table 3

Correlation matrix

This table presents the pairwise correlation matrix for the variables adopted in the analyses. Pearson's correlation coefficients and p-values (in parentheses) are included. See Appendix A and equation (1) for computation of variables.

	ACCPAY	*Natural hedge*	*Natural hedge change*	*BANKLOAN*	*IND (ACCPAY)*	*SGR*	*ROA*	*BARGAINING*
Natural hedge	0.187***							
	(0.000)							
Natural hedge change	0.006	-0.221***						
	(0.376)	(0.000)						
BANKLOAN	0.001	-0.111***	0.016**					
	(0.826)	(0.000)	(0.012)					
IND(ACCPAY)	0.252***	0.060***	-0.020***	-0.020***				
	(0.000)	(0.000)	(0.002)	(0.001)				
SGR	0.046***	0.011*	-0.004	-0.059***	0.061***			
	(0.000)	(0.079)	(0.584)	(0.000)	(0.000)			
ROA	0.035***	-0.009	-0.023***	-0.248***	0.042***	0.320***		
	(0.000)	(0.178)	(0.000)	(0.000)	(0.000)	(0.000)		
BARGAINING	-0.117***	-0.188***	-0.008	-0.000	-0.084***	0.015**	0.039***	
	(0.000)	(0.000)	(0.191)	(0.975)	(0.000)	(0.015)	(0.000)	
SIZE	-0.172***	-0.164***	-0.007	-0.096***	-0.049***	0.031***	0.099***	0.605***
	(0.000)	(0.000)	(0.297)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

4. Empirical results

Model (1) of Table 4 presents the results of regressions with firm-fixed effects for the

entire sample. Natural hedge has a positive and significant coefficient, suggesting that natural hedge is positively related to accounts payable. I interpret this finding is consistent with the prediction that firms with high level of natural hedge using less institutional loans adopt accounts payable, that supports the Hypothesis 1. To deal with the potential multicollinearity issue identified in Table 3, I implement analysis with restricted control variables. In model (2) of Table 4, the result from the regression analysis only adopting IND(ACCPAY) and SGR persistently shows that the finding supports the Hypothesis 1.

Prior studies examining the use of accounts payable argue that the level of accounts payable is generally determined by the industry-specific terms and practice. Indeed, Ng et al. (1999) point out accounts payable terms and policies are dependent on the industry practice. Models (3) and (4) of Table 4 add the industry-dummy to equation (2). Not surprisingly, the findings are qualitatively unchanged, support the Hypothesis 1.

With respect to the control variables, BANKLOAN has a negative and significant coefficient, suggesting that accounts payable substitutes for institutional finance, this result

Table 4

Regression results

This table presents results of regression with firm-fixed effects of ACCPAY. Models (1) and (2) include year-dummy, Models (3) and (4) include year- and industry-dummy variables. See Appendix A and equation (1) for the computation of variables. *t*-statistics computed by using robust standard errors are reported in parentheses.

	(1)	(2)	(3)	(4)
Dependent variable:	*ACCPAY*	*ACCPAY*	*ACCPAY*	*ACCPAY*
Natural hedge	0.039***	0.050***	0.039***	0.050***
	(4.997)	(6.061)	(4.963)	(6.046)
BANKLOAN	-0.041***		-0.041***	
	(-3.924)		(-3.905)	
IND(ACCPAY)	0.253***	0.277***	0.252***	0.279***
	(4.747)	(5.028)	(4.700)	(5.030)
SGR	0.023***	0.025***	0.023***	0.025***
	(9.347)	(10.837)	(9.347)	(10.827)
ROA	0.028		0.028*	
	(1.644)		(1.651)	
BARGAINING	0.901***		0.892***	
	(5.600)		(5.520)	
SIZE	-0.033***		-0.033***	
	(-6.819)		(-6.798)	
Constant	0.482***	0.120***	0.475***	0.140***
	(9.324)	(8.034)	(9.194)	(7.605)
Firm FE	YES	YES	YES	YES
Industry FE	—	—	YES	YES
Year FE	YES	YES	YES	YES
N	25,186	25,186	25,186	25,186
N of firms	1,955	1,955	1,955	1,955
Adj. R^2	0.129	0.099	0.129	0.100

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

is consistent with the prediction and previous literature. Not surprisingly, industry-level average accounts payable is positively associated with firm-level accounts payable. Accounting performance measured by SGR has a positive and significant coefficient. A possible interpretation of this result is that optimistic prospects of ongoing business give firms an incentive to adopt accounts payable. Meanwhile, ROA is only marginally correlated with accounts payable (at the 10% level of significance in Model (3) of Table 4). BARGAINING has a significantly positive coefficient, suggesting that firms enjoying favorable terms of accounts payable due to the sales power hold high level of accounts payable to the total assets. Lastly, SIZE has a negative and significant coefficient. As might be expected, small-medium sized firms tend to use accounts payable as an alternative financing source.

To avoid that the findings are biased by the potential endogeneity concerns arising from time-unvarying omitted variables related to natural hedge, I conduct additional regression analyses adopting alternative definition of natural hedge. Models (1) through (4) in Table 5 use natural hedge change instead of one-year lagged natural hedge. The tabulated results

Table 5

Regression results (*Natural hedge change*)
This table presents results of regression with firm-fixed effects of ACCPAY. Models (1) and (2) include year-dummy, Models (3) and (4) include year- and industry-dummy variables. See Appendix A and equation (1) for the computation of variables. *t*-statistics computed by using robust standard errors are reported in parentheses.

	(1)	(2)	(3)	(4)
Dependent variable:	*ACCPAY*	*ACCPAY*	*ACCPAY*	*ACCPAY*
Natural hedge change	0.017***	0.012***	0.017***	0.012***
	(3.964)	(2.749)	(3.915)	(2.709)
BANKLOAN	-0.043***		-0.042***	
	(-4.012)		(-3.992)	
IND(ACCPAY)	0.259***	0.284***	0.260***	0.288***
	(4.887)	(5.162)	(4.865)	(5.202)
SGR	0.023***	0.025***	0.023***	0.025***
	(9.407)	(10.910)	(9.401)	(10.896)
ROA	0.027		0.027	
	(1.582)		(1.597)	
BARGAINING	0.957***		0.947***	
	(5.712)		(5.630)	
SIZE	-0.034***		-0.034***	
	(-7.040)		(-7.023)	
Constant	0.529***	0.164***	0.507***	0.156***
	(10.531)	(12.789)	(9.935)	(9.686)
Firm FE	YES	YES	YES	YES
Industry FE	—	—	YES	YES
Year FE	YES	YES	YES	YES
N	25,186	25,186	25,186	25,186
N of firms	1,955	1,955	1,955	1,955
Adj. R^2	0.126	0.094	0.126	0.095

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

in Table 5 are qualitatively unchanged compared to the findings in Table 4. One caveat is that coefficients on the key independent variable and Adj. R-squared are substantially reduced in Table 5.

Overall, the Hypothesis 1 of this paper is generally supported by regression analyses with firm-fixed effects model (year- and industry-dummy variables are also considered) and additional regressions with alternative definition of key independent variable.

5. Conclusion

Natural hedge is the proximity to the median industry capital-labor ratio. Firms that close to the industry technology core hold near the value of one, these firms have less risky and certain cost structure. Prior literature points out that the natural hedge generated by the industry-specific characteristics explains the choice of financial structure. Maksimovic and Zechner (1991) and MacKay and Phillips (2005) argue that firms with high natural hedge choose low financial leverage. Given that accounts payable is used as an alternative financing source, firms having high natural hedge with low financial leverage might adopt accounts payable. Previous studies find that accounts payable reduces information asymmetry, can substitute for institutional finance (Biais and Gollier, 1997; Petersen and Rajan, 1997; Atanasova, 2007). This paper investigates the relation between accounts payable and natural hedge. Using data from Japanese listed companies, I show that firms with high natural hedge hold less institutional loans and high accounts payable. Furthermore, I find that with the firm-fixed effects model, the natural hedge is positively related to accounts payable. This paper exploring Japanese manufacturing industry provides empirical findings which are consistent with prior literature examined by using U.S. manufacturers that shows the natural hedge is correlated to financial structure. On a broader level, I contribute to researches finding the determinant of accounts payable by suggesting that accounts payable working as an information production channel and alternative financing source is associated with natural hedge defined by firm's industry position. Further studies are needed to reduce the potential endogeneity issues (e.g. by

Appendix A

Definition of variables

Variable	Definition
ACCPAY	Accounts payable scaled by total assets
Natural hedge	See equation (1) and Mackay and Phillips (2005) for the computation of natural hedge
Natural hedge change	The yearly change of natural hedge
BANKLOAN	Short-term and long-term loan scaled by total assets
IND(ACCPAY)	The industry-year level average ACCPAY
SGR	Sales growth rate
ROA	Earnings before interest and taxes scaled by total assets
BARGAINING	Sales over the sum of sales in industry-year level
SIZE	Natural logarithm of total assets

using the propensity score matching analysis) and consider the effect of market competition (i.e. market divided by Herfindahl-Hirschman Index).

〔Notes〕

[1] Using the sample of U.S. manufacturing companies during the period 1981 to 2000, MacKay and Phillips (2005) find the financial leverage depends on natural hedge.

[2] According to Nam and Uchida (2019), Japanese firms' average accounts payable to the total assets is 13.4% during the period 2004 to 2014. See Table 1 in Nam and Uchida (2019) to find average accounts payable over total assets across 40 countries.

[3] MacKay and Phillips (2005) use the industry-year median computed with a weighted value of each firm's market share of sales and excluded each firm value itself. I conduct additional analyses using the natural hedge computed by following MacKay and Phillips (2005), the unreported results are qualitatively identical to the tabulated findings.

[4] With respect to the fixed effect model, I implement the Hausman test to find the appropriate model. Untabulated result reveals that Hausman's Chi-squared value is 326.04 (at the 1% level of significance). Based on Hausman test result, fixed effects model is mainly adopted through analyses.

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