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Hiring, investments, and financial distress: evidence from a Panel VAR analysis of Japanese firms

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Abstract

We analyse the dynamic interactions among investment, hiring, and financial distress using a panel vector auto-regression approach to identify the effect of one shock while other shocks remain constant. The results indicate that adjustments in capital and labour significantly interact with each other and that financial distress critically influences these two components. We conclude that firm's dynamic optimization problem should be understood by accounting for these three factors simultaneously.

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1. Introduction

Investment and hiring are the two most important company decisions, though these issues are usually discussed separately (Yashiv, 2011). After Letterie et al.'s (2004) investigation into the dynamic interactions between investment and hiring in the context of lumpy adjustments, some research structurally estimates these two-factor adjustments simultaneously (e.g. Merz and Yashiv, 2007; Bloom, 2009; Lapatinas, 2012; Belo et al., 2014; Asphjell et al., 2014).

In addition to these real economic activities, financial activities which determine the ratio between internal and external finance have also become important where asymmetric information exists. While many economists agree with the idea that these economic activities are essential for a firm's decision-making, there are few attempts to clarify the dynamic interrelations among these three components (Christiano et al., 2011). One reason for this slow progress is that a structural estimation such as a simulated method of moments takes too long when state variables increase (Cooper et al., 2010).

This study overcomes these limitations using a panel vector auto-regression approach (PVAR). Although the results do not have a structural interpretation, they can answer whether hiring, investment, and financing constraints should be analysed within one framework. Focusing on the orthogonalized impulse-response functions, this study demonstrates that it is best to consider firms' dynamic optimization problem by simultaneously accounting for these three components. Our main contribution is that we point out the importance of considering both real and financial economic variables in one theoretical model.

2. Methodology

To analyse the dynamic interrelations among firms' investment, hiring, and financial decisions, we use a PVAR approach (Holtz-Eakin et al., 1988). We adopt this econometric method as it allows us to consider firms' real and financial decisions at the base level, treating these as endogenous variables.

We consider the following first-order PVAR system:

$$Z_{it} = \Gamma_0 + \Gamma_1 Z_{it-1} + f_i + d_t + \epsilon_{it}, \quad (1)$$

where Z is a three-variable vector (IK, HN, DEB/CF): IK, the investment to capital ratio; HN, the hiring to employees ratio; and DEB (debt to asset ratio) or CF (cash flow to capital ratio) as proxies for firms' financial distress, as these are often used to measure a firm's financing constraints (Hubbard, 1997). The subscripts i and t denote the firm and year, respectively. The variable f is an unobserved heterogeneity, d is a time dummy, and ϵ is an error term. We chose the lag structure in (1) by minimizing the moment model selection criteria developed by Andrews and Lu (2001).

Since the fixed effects in (1) are correlated with the lagged dependent variables, the mean-differencing approach commonly used leads to a biased estimator. To avoid this problem, we use forward-mean differencing (Arellano and Bover, 1995) to preserve the orthogonality between the transformed variables and lagged regressors, allowing us

Table1. Descriptive Statistics for key variables

	Full sample		Manufacturer		Non-manufacturer	
	mean	s.d.	mean	s.d.	mean	s.d.
IK	0.103	0.127	0.104	0.113	0.102	0.145
HN	—0.006	0.091	−0.008	0.083	−0.002	0.101
DEB	0.225	0.172	0.212	0.157	0.244	0.191
CF	0.147	0.164	0.141	0.148	0.155	0.184
No. of firms	2016		1053		963	
No. of samples	35849		21596		14253	
Inaction(IK)	26		10		16	
Inaction(HN)	589		345		244	

***Source*.** DBJ Database
Note: Inaction (IK) or Inaction (HN) indicate zero investment or zero employment, respectively. Other variables are defined on page 3.

to use these as instruments. Our model also allows for time dummies, which we eliminate by subtracting the means of each variable calculated for each year.

Since (1) is a reduced form, we identify the shocks by imposing the following recursive order: IK → HN → DEB/CF. First, comparing IK with HN, we assume that the former is more exogenous, because the adjustment for labour is more flexible than that of capital. Second, the proxy variables DEB or CF are assumed to be the most endogenous variables. This is because there is an information asymmetry between lenders and borrowers wherein lenders can only access the most recent borrower information so the debt ratio can affect corporate factor adjustments only with a lag. Second, for cash flow, we assume a cash-in-advance constraint for firms to invest in new capital goods or hire new employees (Love and Zicchino, 2006). In order to check the robustness of this recursive order, we consider all other possible orderings (a total of 5). We present the results in Section 5.

3. Data

The panel data are sourced from Development Bank of Japan database. There are a total of 2,016 belonging to manufacturing or non-manufacturing groups, with the sample chosen based on the criterion that there is neither a change in the term for settlements of accounts nor large mergers and acquisitions. The sample period ranges from 1981 to 2010. However, the panel is unbalanced as it includes entry and exits. The price index used to deflate the variables is taken from the Bank of Japan survey. Table 1 reports the descriptive statistics for the key variables.

Our panel data has several features. First, it is unique in that it provides long-term information on each company's financial statements, making it suitable for the PVAR

Table2. Main PVAR results

Panel A: Three Variables: IK, HN, DEB			
Response to:	IK(t-1)	HN(t-1)	DEB(t-1)
Response of:			
IK(t)	0.180**	0.059**	−0.093**
	(0.009)	(0.012)	(0.019)
HN(t)	0.033**	0.162**	−0.117**
	(0.005)	(0.012)	(0.014)
DEB(t)	0.026**	−0.006	0.824**
	(0.003)	(0.005)	(0.008)

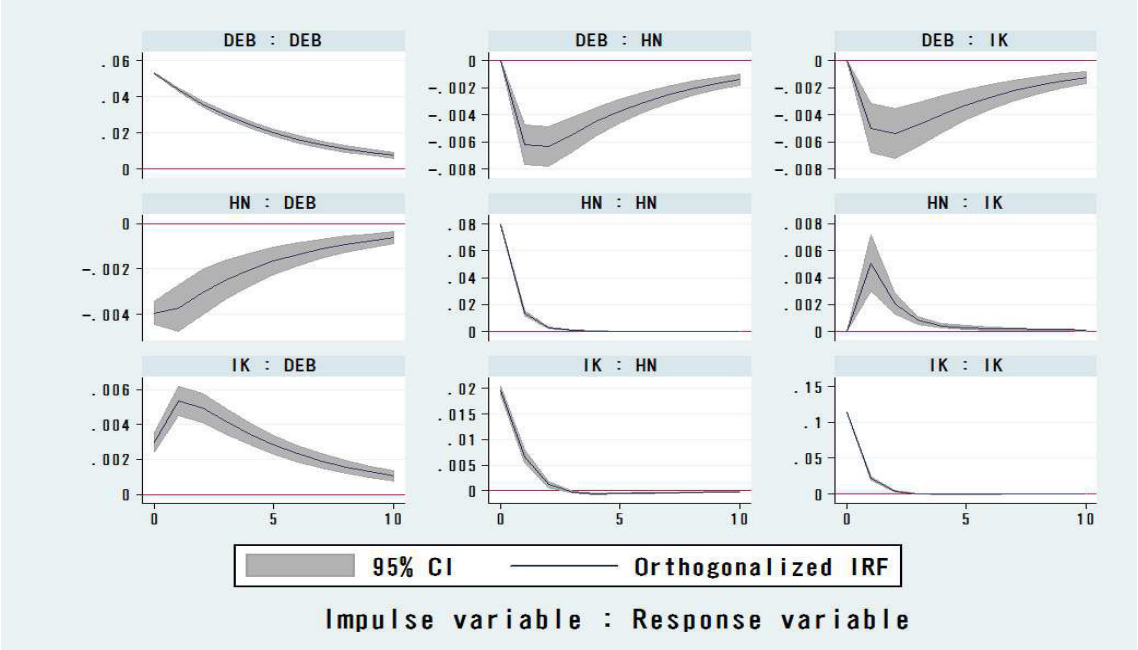
Panel B: Three Variables: IK, HN, CF			
Response to:	IK(t-1)	HN(t-1)	CF(t-1)
Response of:			
IK(t)	0.154**	0.039**	0.123**
	(0.009)	(0.011)	(0.010)
HN(t)	0.016**	0.156**	0.093**
	(0.005)	(0.012)	(0.014)
CF(t)	−0.034**	0.010	0.489**
	(0.009)	(0.011)	(0.016)

Note: The PVAR system is estimated by GMM with time and fixed removed prior to estimation. In GMM, the first and second lagged dependent variables are used as instruments. Panel A uses the three-variable vector IK, HN, DEB, and Panel B uses the three-variable vector IK, HN, CF. Heteroskedasticity adjusted standard errors are in parenthesis. ** indicates significance at the 1% level.

econometric method. Second, the data contains few inactive firms, such as those with zero investment or zero hiring (zero investment is less than 0.1 % of the sample, and zero hiring is less than 2 %). This phenomenon occurs since the plant-level inaction does not necessarily create inaction at the firm level (Eberly et al., 2012).

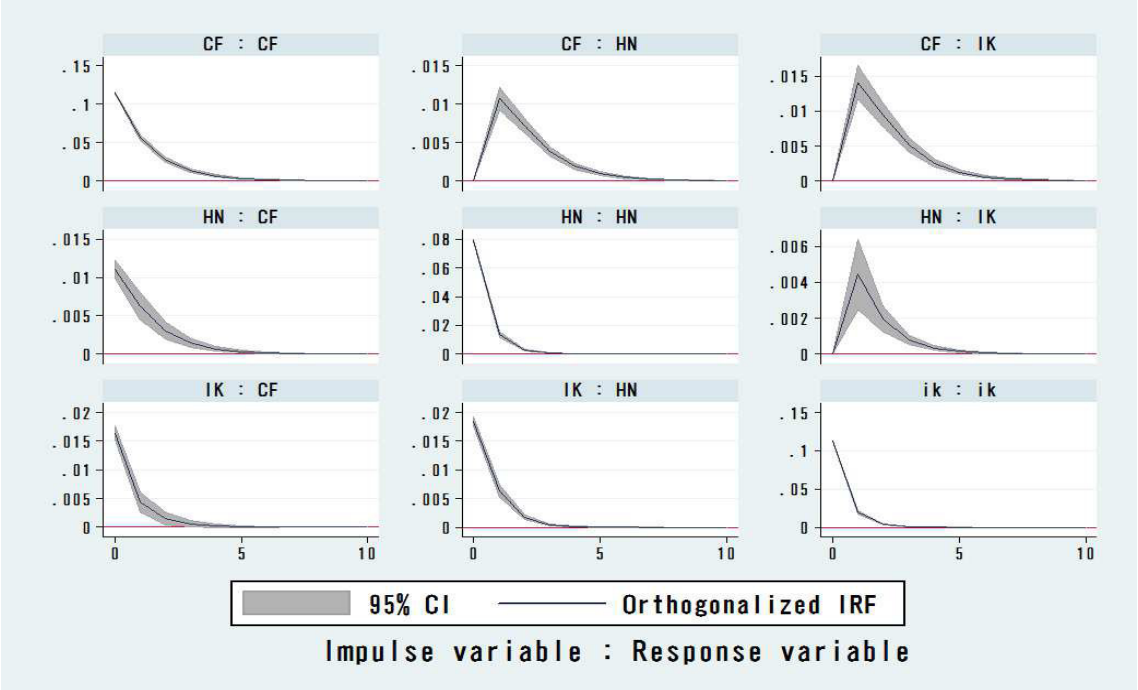
To construct the investment to capital ratio (IK) variable, we create a series of depreciable capital stock, using the perpetual inventory method with the benchmark capital value from fiscal year 1970. For companies founded after 1971, we apply this method from year the company appears in the database. Next, to construct the hiring to employees ratio (HN), we create a series of hiring flows. Since our database does not include employee departures, we define hiring flows as net employment changes. Third, we construct DEB by dividing the sum of short-term loans payable and long-term loans payable and corporate bonds issued by total assets. Finally, for CF, we first define the cash flow as after-tax profit + depreciation, then divide this index by capital stock.

Figure1. IRFs for the IK, HN, DEB three-variable vector auto-regression



***Note*.** Errors are 5% on each side generated by Monte-Carlo with 200 reps.

Figure2. IRFs for the IK, HN, CF three-variable vector auto-regression



***Note*.** Errors are 5% on each side generated by Monte-Carlo with 200 reps.

4. Results

Table 2 reports the PVAR estimates. Based on the recursive ordering suggested in Section 2, we can derive the orthogonalized impulse-response functions (IRFs). Figure 1 illustrates the IRFs with the three-variable vector IK, HN, DEB, and Figure 2 illustrates the IRFs with the three-variable vector IK, HN, CF.

An analysis of Table 2 reveals that: (i) in both panels, IK affects HN at a 1% significance level, and vice versa; (ii) DEB significantly and negatively affects both investment and hiring decisions; (iii) CF significantly and positively affects both investment and hiring decisions.

The panels in Figures 1 and 2 allow us to evaluate the above phenomena quantitatively. From Figure 1, a one standard deviation shock in DEB clearly shows a negative impact on the levels of investment and hiring. The largest negative impact on investing is about 0.5% points and that on hiring is about 0.6% points after two periods. Similarly, from Figure 2, a one standard deviation shock in CF brings about a 1.5% positive effect on investment and a 1% positive effect on hiring with a one-period lag. Finally, from Figures 1 and 2, a one standard deviation shock in the hiring rate creates a 0.5% positive effect on investment with a one-period lag, and that in the investment rate gives a 2% positive effect on hiring in the same period.

5. Robustness

To check robustness, we first changed the lag structure in Equation (1) from the first to the second. Second, we changed the estimation method from a forward-mean difference to a first difference approach. Finally, we altered the Cholesky ordering. We consider all other possible orderings (a total of 5). Through these trials, we confirm that our main results remain largely unchanged. We omit these results for conciseness, though they are available upon request. Finally, Table 3 and Figure 3 present the results from a larger PVAR system consisting of the four-variable vector IK, HN, DEB, CF. This figure confirms that our results remain essentially the same. Furthermore, we added further economic variables such as the sales to capital ratio, but the coefficients on these economic variables are not significantly estimated.

6. Conclusion

In this study, we investigate the dynamic interrelationships among investment, hiring, and financial distress using firm-level data from Japanese industrial companies. We find that these three components interact significantly. Although the results presented here do not have a structural interpretation, they indicate that a model of firms' dynamic optimization problem should consider the simultaneous interrelations among these three variables. Our study also evaluates the degree of the interactions among these variables, demonstrating that a one standard deviation shock in the debt ratio has a negative impact on the levels of investment and hiring, and this negative impact is about 0.5% points and about 0.6% points, respectively. Similarly, a one standard deviation shock in the rate of cash flow has a positive effect of about 1.5% and 1% on investment and hiring, respectively.

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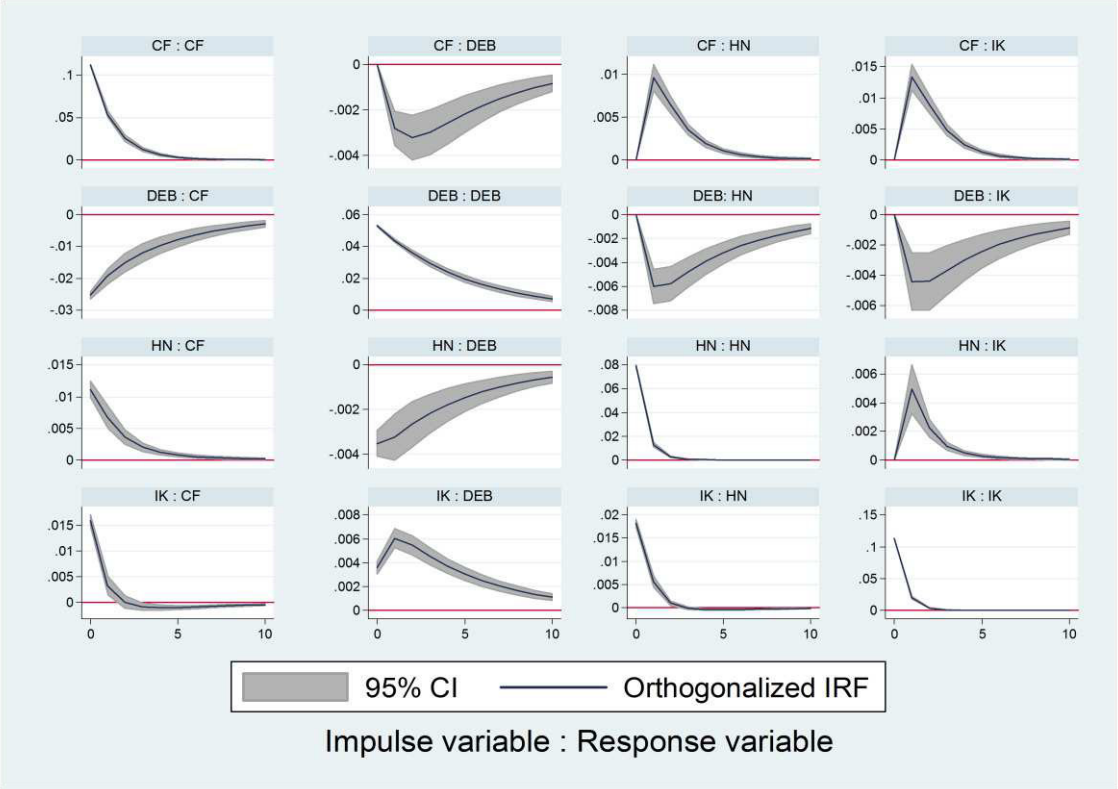
Table3. Four-variable (IK, HN, DEB, CF) PVAR results

Four Variables: IK, HN, DEB, CF				
Response to:	IK(t-1)	HN(t-1)	DEB(t-1)	CF(t-1)
Response of:				
IK(t)	0.154**	0.044**	−0.026	0.119**
	(0.009)	(0.011)	(0.018)	(0.010)
HN(t)	0.015**	0.150**	−0.072**	0.085**
	(0.005)	(0.012)	(0.014)	(0.007)
DEB(t)	0.031**	−0.001	0.812**	−0.025**
	(0.003)	(0.005)	(0.008)	(0.003)
CF(t)	−0.036**	0.012	−0.135**	0.478**
	(0.008)	(0.011)	(0.019)	(0.016)

Note: The PVAR system is estimated by GMM with time and fixed removed prior to estimation. In GMM, the first and second lagged dependent variables are used as instruments. Four-variable vector IK, HN, DEB, CF is used in estimation. Heteroskedasticity adjusted standard errors are in parenthesis. ** indicates significance at the 1% level.

Figure3. IRFs for the four-variable vector auto-regression



Note. Errors are 5% on each side generated by Monte-Carlo with 200 reps.

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