

Corporate finance's assignement

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Threshold Events and Identification: A Study of Cash Shortfalls
Tor-Erik Bakke and Toni M. Whited [1]

Introduction

This paper explains how threshold events should be used to identify causal relationships under endogeneity. Rauh (2006) used threshold events to analyse Funding of Corporate Pension Plans. In theory, when firms have no finance constraints, internal cash shortfalls doesn't affect the funding for profitable investments because the firms can have access to financial markets. Rauh's puzzling result states that firms cut their capital expenditures 70 cents per dollar of mandatory contributions to pension funds. This paper aims to show why it is wrong to infer this result using RDD and go further by showing empirically how do firms respond to cash shortfalls.

Rauh's idea was to use discontinuity in mandatory pension contributions as generator of exogenous variation in cash flows which will be used to solve the endogeneity issue. The threshold event (contributions must be made) happens when liabilities exceed assets. He used this regression model :

$$\frac{I_{i,t}}{A_{i,t-1}} = a_i + a_t + b_1 Q_{i,t-1} + b_2 \frac{CF_{i,t}}{A_{i,t-1}} + b_3 \frac{FS_{i,t}}{A_{i,t-1}} + b_4 \frac{MC_{i,t}}{A_{i,t-1}} + u_{i,t}$$

such that $FS = \text{pension assets} - \text{pension liabilities}$. Rauh's main finding is that firms lower investment because of paying mandatory pension contribution. Bakke and Whited (2012) criticize Rauh's approach and the identification strategy used. The problem is that Rauh's finding were basically influenced by the presence of underfunded firms which corresponds to a small proportion of the sample. First let see the regression discontinuity design (RDD) to understand when we can use threshold events for identification.

1 Regression Discontinuity Design (RDD)

Threshold events are discrete event that occurs when an observable continuous variable passes a known threshold. In our case events are jumps in mandatory pension contributions when the level of pension plan funding passes a certain threshold. Near the threshold, we assume that there is uncertainty and firms can be thought of as close-to-randomly assigned to a treatment (a pension funding violation). To capture the causal effect, we will compare average of investment between treatment and non-treatment

group i.e just before and just after threshold. The RDD is known for resolving endogeneity problem only for observations close to the threshold. So the method is not strongly valid for firms not close to the threshold. In this paper, they showed that the puzzling result in Rauh’s paper (strong sensitivity of investment to mandatory pension contributions) stems from heavily underfunded firms that constitute a small fraction of the sample and which are systematically different from the rest of the sample with respect to firm characteristics that are related to financial distress and financing constraints.

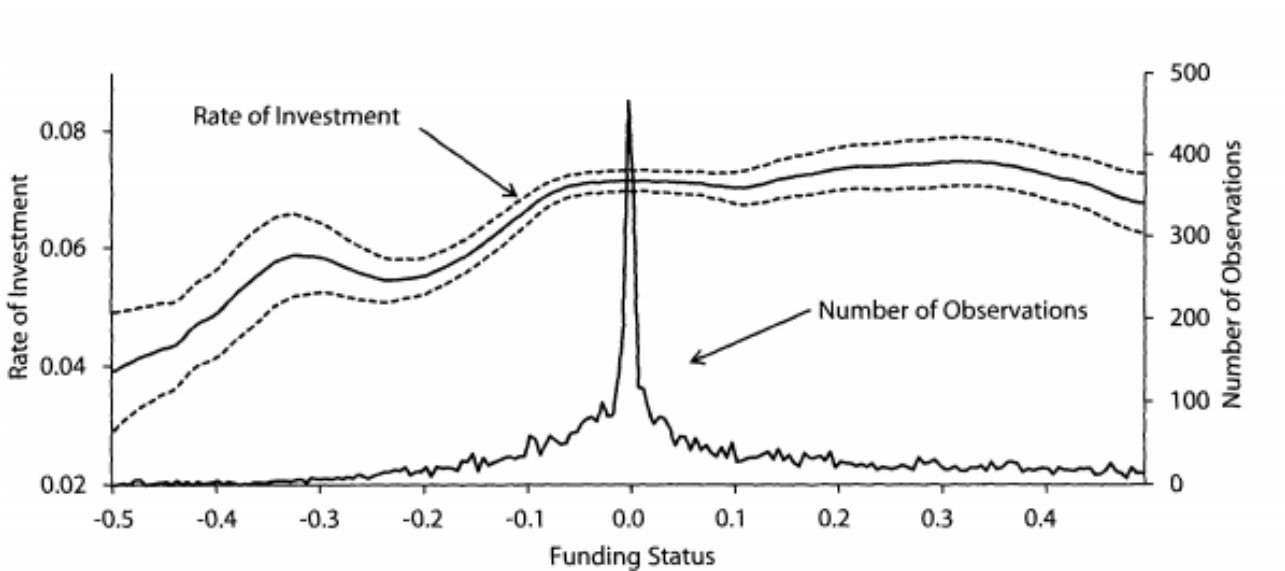
2 Findings of the paper

Replicating what Rauh did, leads to :

Market-to-Book	0.019	0.019	0.019	0.019	0.019	0.019
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Nonpension	0.113	0.113	0.112	0.111	0.111	0.112
Cash Flow	(0.011)	(0.011)	(0.008)	(0.008)	(0.009)	(0.011)
MPCs	-0.638	-0.624				
	(0.267)	(0.268)				
Funding	0.024					
Status	(0.011)					
Funding		0.038	0.048			
Gap		(0.020)	(0.020)			

Figure 1: Investment regression

For both measures of distance (funding status and funding gap), the coefficient on mandatory contributions is negative and significant (identical to Rauh’s finding).



This figure show that this funding may be because of of a small group of underfunded

firms. To prove this, the authors consider four thresholds and therefore four sub-sample regressions. They found that Rauh's finding are driving by the observations that are 80% to 90% funded; and this can be seen by observing how significance of the coefficient of MPC (see figure below) evolves when we drops parts of the global sample (firms that are less than 90% funded and then less than 80% funded) :

	Full Sample	At Least 90% Funded	At Least 80% Funded	>90% or <80% Funded	Underfunded	Less than 90% Funded	Less than 80% Funded	Between 80% and 90% Funded
Market-to-Book	0.019 (0.002)	0.019 (0.002)	0.019 (0.002)	0.019 (0.002)	0.019 (0.003)	0.004 (0.004)	-0.011 (0.007)	0.009 (0.005)
Nonpension Cash Flow	0.113 (0.011)	0.113 (0.013)	0.120 (0.011)	0.117 (0.012)	0.099 (0.013)	0.079 (0.019)	0.095 (0.041)	0.090 (0.026)
MPCs	-0.624 (0.268)	-0.586 (0.434)	-0.746 (0.317)	-0.498 (0.317)	-0.566 (0.511)	-0.152 (0.451)	-0.242 (1.025)	0.071 (0.551)
Funding Gap	0.038 (0.020)	0.034 (0.021)	0.037 (0.020)	0.036 (0.021)	0.051 (0.080)	-0.087 (0.110)	-0.290 (0.272)	-0.170 (0.253)
R^2 (within)	0.101	0.106	0.105	0.100	0.100	0.061	0.069	0.145
R^2	0.684	0.693	0.690	0.686	0.712	0.759	0.717	0.862
Sample size	7889	6932	7461	7360	2769	975	428	529

Note that dropping 12% of sample that is less than 90% funded leads to lose all significance, but dropping 6% of the sample that is less than 80% funded allows to recover significance again. So Identification seems to come from the 80%-90% funded firms. Next, they show that this part of sample is different then global sample :

	Full Sample	In Violation	Not in Violation	<90% Funded	<80% Funded
Total assets	3,418	3,435	3,409	2,362	2,152
Average Funding Status Indicator	0.218	0.622	0.000	0.951	0.970
Plan Violation Indicator	0.351	1.000	0.000	1.000	1.000
Average Funding Status	0.036	0.005	0.052	-0.020	-0.025
Funding Gap	0.015	-0.012	0.030	-0.025	-0.031
Total Contributions	0.003	0.005	0.002	0.008	0.008
Pension Assets	0.143	0.143	0.143	0.115	0.090
Pension Liabilities	0.106	0.138	0.089	0.137	0.125
Mandatory Contributions	0.001	0.003	0.000	0.005	0.006
Investment	0.069	0.066	0.071	0.057	0.055
Cash Flow	0.096	0.089	0.100	0.068	0.057
Nonpension Cash Flow	0.100	0.095	0.102	0.077	0.067
Market-to-Book	1.481	1.460	1.493	1.363	1.346
R&D	0.017	0.018	0.016	0.016	0.016
Advertising	0.012	0.013	0.012	0.010	0.009
Debt-to-Assets	0.249	0.263	0.241	0.280	0.284
Bond Rating	0.411	0.400	0.417	0.271	0.193
Short Term Debt Issuance	0.005	0.004	0.006	0.005	-0.001
Long Term Debt Issuance	0.021	0.022	0.021	0.021	0.027
Saving	0.004	0.004	0.004	0.003	0.003
Cash	0.070	0.065	0.073	0.072	0.076
Dividends	0.019	0.015	0.021	0.010	0.011
Common Dividends per Share	0.615	0.482	0.688	0.296	0.292
Equity Issuance	0.012	0.013	0.012	0.015	0.016
Equity Repurchases	0.012	0.012	0.012	0.007	0.007
Employment % Change	0.808	0.520	0.965	-1.691	-2.853
Earnings	0.042	0.034	0.046	0.014	0.006
Z-Score	2.780	2.280	3.052	1.667	1.599

Compare coefficients of first and fourth columns. Conclusion : it is hard to infer that the correlation between mandatory contributions and investment is causal. By

examining local responses of different variables (including investment) using RDD, they found :

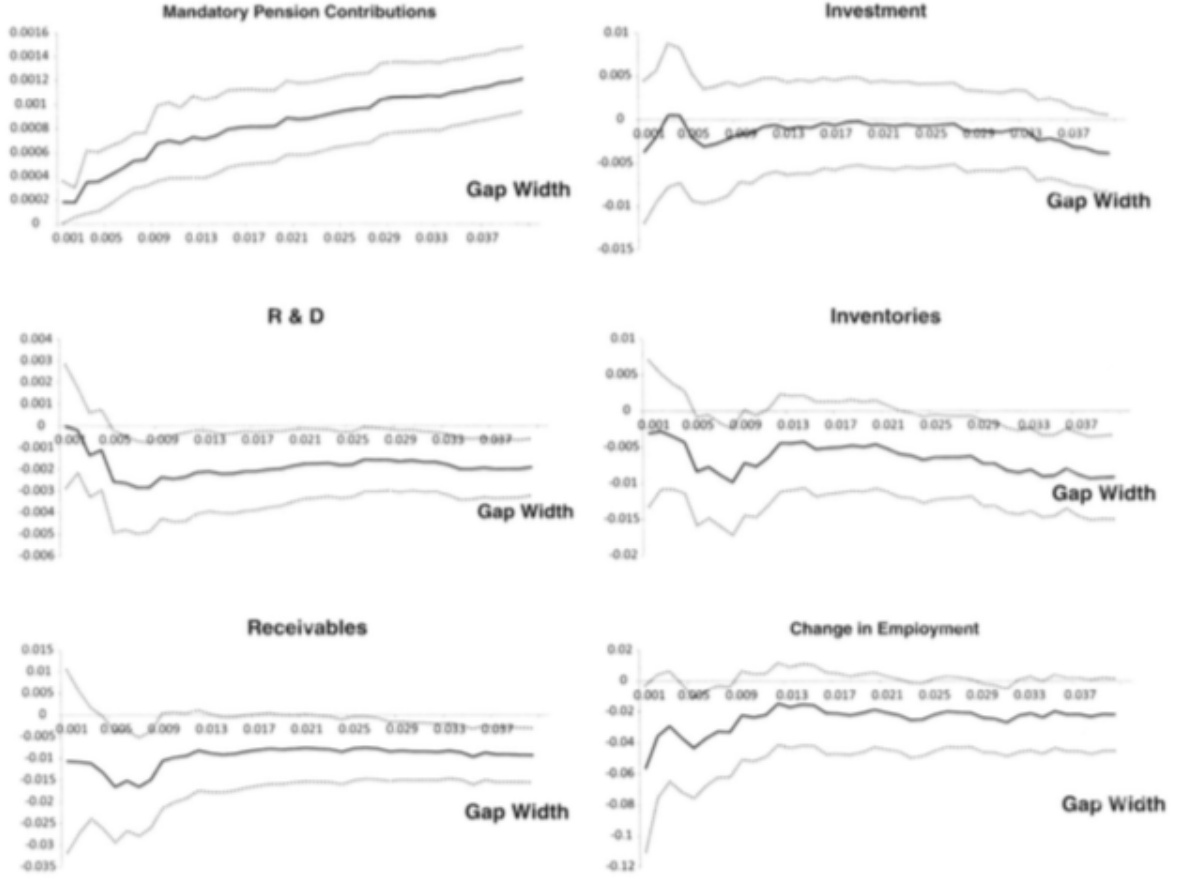


Figure 5. Local responses to funding violations. Calculations are based on a sample of firms

This means that impact on investment is not significantly different from zero (the impact is not clear) and we have significant negative treatment effects for R&D, inventories, receivables and changes in employees. So by a proper use of regression discontinuity, we found that we have little evidence of the impact on investment and local evidence of a causal impact on receivables and hiring.

To replicate some of the results of this paper, we will use data from Department of Labor (DOL) and consider a sample from a period different then 1990-1998 and we will use a regression discontinuity design to figure out if the answer to the question how do firms react to exogenous cash shortfalls remains the same using a more up-to-date data.

References

- [1] Tor-Erik Bakke and Toni M. Whited J. *Threshold Events and Identification: A Study of Cash Shortfalls*. Journal of Finance, 2012.