MIS Quarterly

RESEARCH NOTE

INFORMATION TECHNOLOGY AND FIRM PROFITABILITY: MECHANISMS AND EMPIRICAL EVIDENCE

Sunil Mithas
Robert H. Smith School of Business, University of Maryland, Van Munching Hall,
College Park, MD 20742 U.S.A. {smithas@rhsmith.umd.edu}

Ali Tafti
College of Business, University of Illinois at Urbana–Champaign,
Champaign, IL 61820 U.S.A. {atafti@illinois.edu}

Indranil Bardhan
Naveen Jindal School of Management, University of Texas at Dallas, 800 West Campbell Road,
Richardson, TX 75080 U.S.A. {bardhan@utdallas.edu}

Jie Mein Goh
IE Business School, Maria de Molina, 12 - 5,
28006 Madrid SPAIN {jm.goh@ie.edu}

Appendix

Additional Analyses and Robustness Checks

This appendix provides some additional discussion and analysis that complement the discussion and findings of the paper.

Table A1 shows year-wise summary statistics for the firms in the full sample and those in the balanced panel. The means of the two samples are broadly similar, suggesting that the firms in the unbalanced and balanced panel are similar and attrition of firms is unlikely to bias our key results.

Table A2 shows the results of the Nijman-Verbeek test for sample selection in panel models. This test examines the possibility of selection bias in unbalanced panel data. We construct two indicator variables. First, the lagged selection indicator "inlastyr" indicates that a firm present in year t of the sample period is also present in year t – 1. Second, the forward selection indicator "innextyr" indicates that a firm present in year t of the sample period is also present in year t + 1. If profitability is biased by the number of times a firm is present in the sample, these selection indicators will be significant when included in the main panel regression models. The forward selection indicator is particularly useful to test the existence of bias due to attrition, while the lagged selection indicator is useful to test the existence of bias due to the possibility of systematic differences among firms that appear in the data set for the first time. The results of the Nijman-Verbeek test show no evidence for selection bias due to the structure of the unbalanced panel, as is evident in the nonsignificant coefficient estimates of the lagged and forward selection indicators. Columns 1 and 3 show fixed and random estimations, respectively, when we include the lagged selection indicator "inlastyr" in the model. This suggests that inclusion of the firm in the previous period has no significant effect on profitability, suggesting that selection bias in the unbalanced panel is not a problem. Columns 2 and 4 use a lead of the selection indicator "innextyr." Nonsignificance of coefficient estimates of the lead select indicator suggests that attrition is not a source of bias in the estimates.

Table A3 shows random effects panel regressions using the balanced panel subset of data. These coefficient estimates are consistent in direction and significance with the main results in Table 5 of the paper, suggesting that the estimates are fairly robust.

Table A4 shows random effects panel regression results in tests of endogeneity, in which IT investment has its one-year lag value as an excluded instrument. The results show the effect of the residuals and fitted values of IT investment. In columns 2 and 3, the residuals of IT investment are included along with the actual IT investment. The insignificance of the residuals of IT suggests that any potential endogeneity in IT is not of serious concern in this study. This is further supported by the results in columns 4 and 5, which include the fitted values of IT investment. The significance of fitted values of IT suggests that IT investment has a significant effect on profitability, even after the potentially endogenous components of IT investment have been filtered out.

Table A1. Year-Wise Summary Statistics

		All Firms			Firms in Balanced Panel Only		
	Variable	Observations	Mean	Standard Deviation	Observations	Mean	Standard Deviation
1998	Profitability	407	0.020	0.052	206	0.023	0.068
	OPEX	407	0.041	0.053	206	0.045	0.051
	SALES	407	0.338	0.526	206	0.342	0.627
	IT	407	0.010	0.032	206	0.012	0.044
	ADV	96	0.009	0.019	56	0.012	0.024
	RD	213	0.010	0.020	115	0.014	0.023
1999	Profitability	281	0.023	0.072	206	0.022	0.069
	OPEX	281	0.041	0.047	206	0.044	0.048
	SALES	281	0.367	0.652	206	0.342	0.641
	IT	281	0.013	0.042	206	0.014	0.048
	ADV	78	0.010	0.020	60	0.011	0.022
	RD	139	0.013	0.022	115	0.014	0.024
2000	Profitability	245	0.025	0.070	206	0.026	0.075
	OPEX	245	0.046	0.052	206	0.046	0.052
	SALES	245	0.379	0.689	206	0.361	0.715
	IT	245	0.016	0.052	206	0.016	0.057
	ADV	75	0.012	0.021	65	0.012	0.022
	RD	132	0.014	0.023	114	0.014	0.024
2001	Profitability	229	0.025	0.079	206	0.025	0.083
	OPEX	229	0.053	0.058	206	0.052	0.057
	SALES	229	0.427	0.836	206	0.414	0.864
	IT	229	0.017	0.057	206	0.016	0.060
	ADV	75	0.010	0.019	70	0.010	0.020
	RD	127	0.017	0.027	115	0.016	0.026
2002	Profitability	209	0.020	0.098	189	0.022	0.100
	OPEX	209	0.048	0.049	189	0.048	0.048
	SALES	209	0.397	0.830	189	0.382	0.856
	IT	209	0.016	0.062	189	0.016	0.065
	ADV	72	0.009	0.018	67	0.009	0.018
	RD	115	0.016	0.037	106	0.015	0.037
2003	Profitability	161	0.014	0.090	143	0.018	0.088
	OPEX	161	0.052	0.055	143	0.053	0.056
	SALES	161	0.412	0.883	143	0.394	0.917
	IT	161	0.018	0.063	143	0.018	0.066
	ADV	53	0.010	0.019	50	0.010	0.019
	RD	85	0.016	0.025	79	0.016	0.024

Table A2. Nijman Verbeek Test for Sample Selection in Panel Models

	(1)	(2)	(3)	(4)
	FE lnPriorYr	**FE lnNextYear**	**RE lnPriorYr**	**RE lnNextYear**
inlastyr	0.005 (0.009)		–0.002 (0.008)	
innextyr		–0.011 (0.012)		–0.013 (0.010)
IT	10.681*** (1.517)	10.698*** (1.498)	12.275*** (1.052)	12.263*** (1.040)
Observations	1532	1532	1532	1532
Number of firms	452	452	452	452
R-square	0.38	0.38		

Robust standard errors in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%. Models include constant term, dummy variables for firm size, and industry controls of capital intensity, Herfindahl index, and industry sector (trade, manufacturing, financial, and professional services).

Table A3. Random Effects Panel Regressions Using the Balanced Panel Subset of Data

	(1)	(2)	(3)	(4)
	SALES	**OPEX**	**PROFITABILITY**	**PROFITABILITY**
IT	11.149*** (1.033)	0.043 (0.054)	1.210*** (0.133)	0.732*** (0.171)
OPEX				0.122 (0.102)
SALES				0.040*** (0.013)
Constant	0.275*** (0.092)	–0.003 (0.012)	0.014* (0.008)	0.001 (0.009)
Observations	858	858	858	858
Number of firms	143	143	143	143

Robust standard errors in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%.
[a]Random effect models include an intercept, industry capital intensity, industry Tobin's Q, broad industry classifications based on the primary NAICS code, and dummy variables for firm size and year.

Table A4. Random Effects Panel Regression Results, with Endogeneity Tests

	(1)	(2)	(3)	(4)	(5)
	IT	**PROFITABILITY**	**PROFITABILITY**	**PROFITABILITY**	**PROFITABILITY**
IT		1.227***	1.003***		
		(0.102)	(0.166)		
IT_{t-1}	1.027***				
	(0.012)				
OPEX			0.083		0.073
			(0.064)		(0.065)
SALES			0.018*		0.034***
			(0.010)		(0.011)
Residuals of IT		0.081	0.128		
		(0.168)	(0.170)		
Fitted values of IT				1.173***	0.759***
				(0.159)	(0.209)
Constant	0.000	0.017***	0.010*	0.017***	0.006
	(0.001)	(0.005)	(0.006)	(0.005)	(0.006)
Observations	1208	1208	1208	1208	1208
R-square	0.98	0.77	0.77	0.75	0.76
Number of firms	308	308	308	308	308
Wald chi-square		405.68***	433.80***	245.05***	296.97***
F statistic	5135.16***				

Models involve two stages of estimation. The results of the first-stage regression are shown in column (1). An OLS regression of IT investment is done on lagged value of IT investment, as well as dummy variables for year and firm size, and industry controls of industry capital intensity, Herfindahl index, industry Tobin's q, and industry segment (Trade, Financial, Professional Services, and Manufacturing).
Columns (2)–(5) show the second stage regressions using the common panel random effects estimator. The same control variables are used as in the first-stage estimator.