

INFORMATION TECHNOLOGY IMPACTS ON FIRM PERFORMANCE: AN EXTENSION OF KOHLI AND DEVARAJ (2003)

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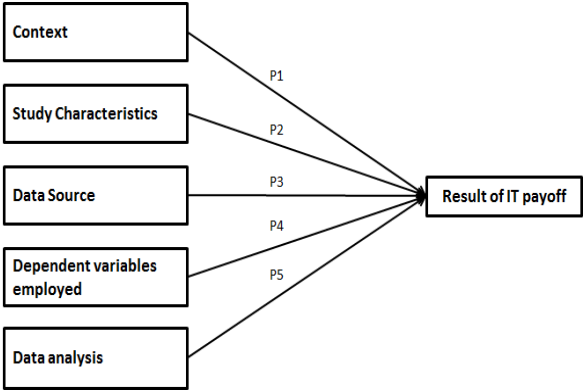
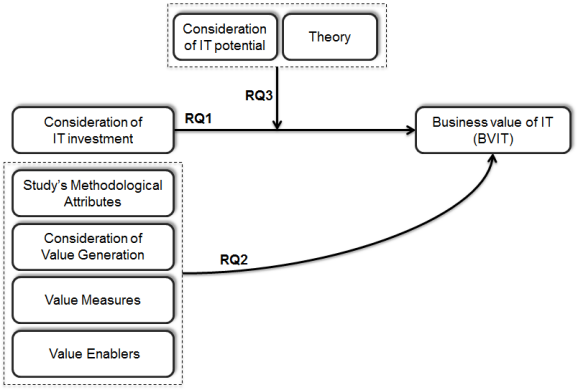
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Appendix A

Further Comparison of Kohli and Devaraj (2003) and the Present Study

	Kohli & Devaraj (2003)	The Present Study
Model	 <p>P1. Context represents manufacturing versus service sector P2. Study characteristics represents sample size P3. Data source represents primary versus secondary data P4. Dependent variables employed represents profitability versus productivity or both P5. Data analysis represents analytical approach (regression versus correlation analysis, as P5A), method (longitudinal versus cross-sectional, as P5B), and level of detail (IT assets and IT impacts, as P5C)</p>	 <p>RQ1: Consideration of IT investment represents whether the study measured IT investment RQ2: <i>Study's methodological attributes:</i> Sample size (P2 in K&D); Secondary versus primary data (P3 in K&D); Regression versus others (P5A in K&D); Number of IT-based antecedents; and Number of dependent variables. <i>Consideration of value generation:</i> IT assets (P5C in K&D); IT adoption or use; and IT infrastructure or capability <i>Value measures:</i> Profitability (P4 in K&D) and Productivity <i>Value enablers:</i> IT progress and Developing region RQ3: Moderating effects <i>Consideration of IT potential</i> represents: IT sophistication, IT alignment, and Interorganizational IT <i>Theory:</i> Technological, Organizational, or Environmental theories <i>Note:</i> P1 and P5B in K&D are excluded from this study.</p>
Studies	66	303 (generating 336 samples/findings)
Period	1990–2000	1990–2013

Appendix B

Dependent and IT-Related Independent Variables in the Meta-Analysis Sample

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
Floyd & Wooldridge (1990)		C-P	ROA	Product IT use, Process IT use	50.00
Venkatraman & Zaheer (1990)		L-P	Commissions, Effectiveness (# of premiums), Efficiency (# of policies), New Business Policies	IT integration	100.00
Weill (1990)		L-P	ROA, Labor productivity, Sales growth	Strategic IT investment	11.11
*Harris & Katz (1991)		L-S	Operating cost efficiency ratio	IT expense	100.00
*Weill (1992)		L-P	ROA, Labor, % change in labor, Sales growth	IT investment	0.00
*Ahituv & Giladi (1993)		L-S	Revenue per employee, Profits increase	IS budget, Staff budget, Training, Relative value of computers, PCs/employee	-10.00
Dos Santos et al. (1993)		L-S	CAR	IT investment	0.00
Mahmood (1993)		C-S	ROS, Sales/assets, Sales/employee, ROI, market value to book value, Dividend payout ratio, Total debt to equity, Working capital/net sales, Cash flow to investment, Growth in revenue	IT budget, IT budget (revenue), IT budget (training), IT budget (staff), IT value, IT value (% revenue), Total # of PCs and terminals, # of PCs and terminals (as % of total employees)	40.00
*Mahmood & Mann (1993)		C-S	ROS, ROI, Market to book value, Sales by assets, Sales by employee, Growth in revenue	IT budget (% revenue), IT value (% revenue), IT budget (staff), IT budget (training), PCs per employee	-6.67
*Markus & Soh (1993)	1	L-S	Profitability	IT expenditure, IT portfolio	-50.00
	2	L-S	Profitability	IT expenditure, IT portfolio	0.00
	3	L-S	Profitability	IT expenditure, IT portfolio	0.00
	4	L-S	Profitability	IT expenditure, IT portfolio	0.00
*McKeen & Smith (1993)		L-S	Revenue growth	IS dollars per employee, Production hours	50.00
Sethi et al. (1993)		L-S	ROE, ROS, Sales growth	IT adoption	75.00
Brynjolfsson et al. (1994)		L-S	Value added, Sales	IT investment	-60.00
*Kelley (1994)		C-P	Production hours per unit	Programmable versus Conventional machines	100.00
*Loveman (1994)		L-S	Output	IT capital	-100.00
*Strassman (1994)		L-S	Return on Management	IT expense / revenue ratio	-100.00

^aStudies included in Kohli and Devaraj (2003) are marked using an asterisk. The studies are sorted in the order of the year of publication, with studies published in the same year being listed in alphabetical order.

^b Glossary of acronyms available at the bottom of the table.

^c Where the same publication reported results for multiple samples, the results for each sample are shown in separate rows in this table, with the specific sample for each study identified in the "Sample" column.

^d L – Longitudinal data; C – Cross-sectional data; P – Primary data source; S – Secondary data source.

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
*Barua et al. (1995)		L-S	Inventory Turnover, Capacity utilization, New products, Relative quality	IT capital	75.00
Brown et al. (1995)		L-S	ROA, ROS, Asset turnover, Inventory turnover, A/R turnover, Sales/employee, Income/employee, % change in sales	Strategic IS use	21.15
*Kivijarvi & Saarinen (1995)		C-P	Profitability, Funding position, Growth	IS cost/net sales, IS cost/employee, IS cost/office worker	11.11
*Kwon & Stoneman (1995)		L-S	Output	Technology adoption	100.00
*Lichtenberg (1995)		L-S	Revenue	Computer capital stock, # of IS employees	100.00
*Lubbe et al. (1995)		L-P	Profitability	IT investment	100.00
Mukhopadhyay et al. (1995)		L-P	Inventory turnover	EDI %	100.00
Ramamurthy (1995)		C-P	Performance	AMT (for efficiency), AMT (for flexibility)	100.00
*Rao et al. (1995)		C-P	Performance	Implementation	0.00
*Brynjolfsson & Hitt (1996)		L-S	Sales	Computer capital, IS staff	100.00
*Chen (1996)		C-S	EPS, ROS, ROA, ROE, Labor productivity - sales, Labor productivity - profit, Profit growth, Sales growth	IT budget, IT personnel	-6.25
Dos Santos et al. (1996)		L-S	ROI	IT expenses, IT budget	37.50
*Hitt & Brynjolfsson (1996)		L-S	ROA, ROE, Total return, Value added	IT stock	25.00
*Mayberry-Stewart (1996)	1	L-S	\$ cost per patient discharge	IT investment intensity, IT automation intensity	-50.00
	2	L-S	\$ cost per patient discharge	IT investment intensity, IT automation intensity	0.00
Mitra & Chaya (1996)		L-S	COGS/Sales, SGA/Sales	IT budget/ sales	100.00
*Peffer & Dos Santos (1996)		L-S	Performance, Market share	Adoption	43.75
*Rai et al. (1996)		L-S	ROA, ROE, Asset turnover, Labor productivity, Sales, Market share	IS budget	50.00
Rogers et al. (1996)		C-P	Cycle time reduction, Productivity improvements, Reduced waste, Reduced costs, Reliability of service, Customer satisfaction, Quality improvements	IT use	42.86
*Stoneman & Kwon (1996)		L-S	Sales	Computer adoption	100.00
*Alshilash (1997)		C-P	Overall performance	Managers' IT knowledge, Subordinates' IT knowledge	100.00
Barua & Lee (1997)		L-S	Output	IT capital	100.00
*Byrd & Marshall (1997)		L-S	Sales/total assets, Sales/employee	IT budget (staff), IT budget (training), IT processor value (% of revenue), IT budget (% of revenue), # of PCs and terminals	-20.00
Chan et al. (1997)		C-P	Business performance	IT alignment	100.00

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
*Mahmood & Mann (1997)		L-S	Performance	IT budget (revenue), IT budget (training), IT budget (staff), Market value of IT (% of revenue), Proportion of PCs and terminals to employees	80.00
*Mukhopadhyay et al. (1997)	1	L-P	Labor hours	Simple transactions, Complex transactions	100.00
	2	L-P	Total sorting performed	Level of automation	100.00
Powell & Dent-Micallef (1997)		C-P	Profitability, Sales growth, IT performance, Overall performance	IT resources	25.00
*Prasad & Harker (1997)		L-S	ROA, ROE, Output (Loans + Deposits), Output (Revenues)	IT capital, IT labor	25.00
*Prattipati & Mensah (1997)		C-S	Management productivity	IS budget, % of budget on new development, % of budget on client server apps, % of budget spent outside IS department, IS employees, PCs, Network	0.00
*Rai et al. (1997)		C-S	ROA, ROE, Value, Labor productivity, Administrative productivity, Sales	IT capital, IT budget, IS staff	50.00
Shin (1997)		L-S	Value added, Coordination costs, Sales	IT budget	33.33
*Siegel (1997)		L-S	Productivity growth	Computer expenditure	100.00
*Wang (1997)		C-P	Revenue growth rate	IT spending, IT use	100.00
*Francalanci & Galal (1998)		L-S	Operating expense to premium income, Income per employee	IT expense	0.00
*Grover et al. (1998)		C-P	Productivity	IT diffusion	100.00
*Lehr & Lichtenberg (1998)		L-S	Growth rate of output	IT capital	100.00
Sakaguchi & Dibrell (1998)		C-P	Cycle time reduction	Degree of computerization (IT investment), GLITS	100.00
*Tam (1998a)	1	L-S	Output	Computer capital	0.00
	2	L-S	Output	Computer capital	100.00
	3	L-S	Output	Computer capital	0.00
*Tam (1998b)	1	L-S	ROE, ROA, ROS, Total shareholder return, Market value	Computer capital	0.00
	2	L-S	ROE, ROA, ROS, Total shareholder return, Market value	Computer capital	60.00
	3	L-S	ROE, ROA, ROS, Total shareholder return, Market value	Computer capital	40.00
	4	L-S	ROE, ROA, ROS, Total shareholder return, Market value	Computer capital	-20.00
*Teo & Wong (1998)		C-P	Organizational impact	Intensity of IT investment, Information quality	50.00
*Van Asseldonk et al. (1998)		L-S	Production (Milk), Production (Protein), Production (Fat), Calving Interval	ACF, MPM, AM	25.00
*Xia (1998)		C-P	Organizational performance	IT capability, IT alignment	100.00
*Bharadwaj et al. (1999)		L-S	Tobin's q	IT spending ratio	100.00
*Cline (1999)		L-P	Net income/employee, Net income/revenue mile	IT investment	100.00
Dasgupta et al. (1999)	1	C-S	Net income	IT budget, IT employees	-100.00
	2	C-S	Net income	IT budget, IT employees	-100.00
Johannessen et al. (1999)		C-P	Productivity	13 IT use variables	7.69

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
*Koski (1999)		L-P	Labor productivity, Total factor productivity, Revenues	Use of technology	0.00
*Lee & Barua (1999)		L-S	Productivity	IT capital	100.00
Lehr & Lichtenberg (1999)	1	L-S	Inventory/Sales, Sales	IT%	0.00
	2	L-S	Inventory/Sales, Sales	IT%	0.00
*Li & Ye (1999)		L-S	ROA, ROS	IT investment	0.00
Smith (1999)		C-P	Performance	IT use	100.00
*Barua et al. (2000)	1	C-S	Sales per employee, Sales	IT capital	100.00
	2	C-S	Sales per employee, Sales	IT capital	0.00
Bharadwaj (2000)		L-S	ROA, ROS, COGS/Sales, SGA/Sales, OI/Sales, OI/Assets, OI/Expenses, Op Exp/Sales	IT use	62.50
*Devaraj & Kohli (2000)		L-P	Net patient revenue per day, Net patient revenue per admission, Customer satisfaction	IT capital, IT labor, IT support	55.56
Droge & Germain (2000)		C-P	Performance, Inventory	EDI (% of sales, purchases)	100.00
*Haynes & Thompson (2000)		L-S	Labor productivity	ATM adoption	100.00
Krishnan & Sriram (2000)		C-S	Market value/ book value	Y2K cost	100.00
Lee & Menon (2000)		L-S	Adjusted patient days	IT labor, IT capital	0.00
*Lee & Perry (2000)		L-S	Output	IT stock	100.00
*Menon et al. (2000)		L-P	Adjusted patient days	IT capital, Medical IT capital	100.00
Palmer & Markus (2000)		L-P	Profitability, Stock turn, Sales per square foot, Sales per employee, Sales growth	QR adoption and use	80.00
Poston & Grabski (2000)		L-S	Residual Income, SGA/Revenues, COGS/Revenues, Number of employees/ Revenues	ERP implementation	-16.67
*Ragowsky et al. (2000)		C-P	Overall benefit	Avg # of purchase orders, Avg # of sales transactions	0.00
Schwager et al. (2000)		C-P	ROS	IT factors	100.00
Sircar et al. (2000)		L-S	Assets, Equity, Net income, Sales	IT staff, IT staff training, Computer capital, PCs per employee	75.00
Stratopoulos & Dehning (2000)		L-S	ROA, ROE, ROI, Operating profit margin, Net profit margin, Gross profit margin, Fixed asset turnover, Total asset turnover, Inventory turnover, Growth in sales	IT use	18.00
Tallon et al. (2000)		C-P	Process planning and support, supplier relations, production and operations, product and service enhancement, sales and marketing, customer relations	Strategic alignment	100.00
Andersen & Segars (2001)		L-P	Performance	IT use	0.00
Bergeron et al. (2001)		C-P	Performance	Strategic IS use	100.00
Chatterjee et al. (2001)		L-S	Cumulative abnormal return	CIO adoption	100.00
Croteau (2001)		C-P	Organizational performance	IT alignment	50.00
Duliba et al. (2001)		L-S	Load factor, Operating profit, Revenue per passenger mile	System locations	66.67
Gold et al. (2001)		C-P	Organizational effectiveness	KM capability	100.00

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
Hu & Plant (2001)	1	L-S	ROA, ROE, Operating cost, Productivity, Growth in sales	IT investment	-6.67
	2	L-S	ROA, ROE, Operating cost, Productivity, Growth in sales	IT investment	26.67
	3	L-S	ROA, ROE, Operating cost, Productivity, Growth in sales	IT investment	13.33
Im et al. (2001)		L-S	AS CAR	IT investment	0.00
Lesjak & Cohen (2001)		C-P	Financial performance	IT usage	100.00
Sabherwal & Chan (2001)	1	C-P	Business performance	Alignment	100.00
	2	C-P	Business performance	Alignment	100.00
Shin (2001)		L-S	Net profit, ROA, ROE	IT intensity	0.00
Baldwin & Sabourin (2002)		L-S	Productivity growth, Market share growth	Technology use	50.00
*Bresnahan et al. (2002)		L-P	Value added	IT stock	100.00
Davis et al. (2002)		C-P	Cycle time	Role of Strategic IT	100.00
Hitt et al. (2002)		L-S	Market value, value added, COGS, Sales, Output, Pretax income	ERP implementation	100.00
Konings & Roodhooft (2002)		C-P	Output	Selling online, Buying online	50.00
Kudyba & Diwan (2002)		L-S	Value added, Sales revenue	IT capital, IT labor	83.33
Ross (2002)		C-S	ROA, Operating income before depreciation, Net income, Labor productivity, Administrative productivity, Working capital, Revenue	IT budget, IT staff, IT sophistication	42.86
Sanders & Premus (2002)		C-P	Cost reduction, Cycle time reduction, Improved quality	IT use	100.00
Zhu & Kraemer (2002)	1	C-P	Profit margin, COGS, Inventory turnover	Alignment (EC*IT)	0.00
	2	C-P	Profit margin, COGS, Inventory turnover	Alignment (EC*IT)	66.67
Becchetti et al. (2003)		L-S	Capacity utilization, Sales	ICT investment	0.00
Byrd & Davidson (2003)		C-P	Firm performance	IT impact on supply chain	100.00
Dehning et al. (2003)		L-S	Mean cumulative abnormal return	IT role	33.33
*Devaraj & Kohli (2003)		L-P	Net patient revenue per day, Net patient revenue per admission	IT use (# of reports), IT use (CPU time), IT use (Disk I/O)	100.00
Drennan & McColl-Kennedy (2003)		C-P	Performance	Internet use	100.00
Kearns & Lederer (2003)		C-P	Competitive advantage	Alignment (IT versus BP), Alignment (BP versus IT)	50.00
Kudyba & Vitaliano (2003)		L-S	Gross operating margin	IT rate	66.67
Peslak (2003)	1	C-S	ROA, ROE, ROI, Tobin's q	IT budget	-50.00
	2	C-S	ROA, ROE, ROI, Tobin's q	IT budget	0.00
	3	C-S	ROA, ROE, ROI, Tobin's q	IT budget	-25.00
		C-P	ROA, ROE, Growth in revenue	IS budget, Technological integration, Functional integration, Strategic integration	100.00
Pollalis (2003)		C-P	ROA, ROE, Growth in revenue	IS budget, Technological integration, Functional integration, Strategic integration	100.00
Santhanam & Hartono (2003)		L-S	ROA, ROS, OI/A, OI/S, OI/E, COG/S, SGA/S, Op Exp/S	IT capability	100.00
Sriram & Krishnan (2003)		L-S	MV/ book value	IT/ book value	100.00
Tippins & Sohi (2003)		C-P	Performance	IT competency	0.00

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
Vickery et al. (2003)		C-P	Financial performance	IT use	0.00
Barua et al. (2004)		C-P	Performance	IT capability (customers), IT capability (suppliers)	100.00
Bergeron et al. (2004)		C-P	Profitability, Sales growth	IT alignment	100.00
Chen et al. (2004)		L-S	COGS/Revenues, COGS/Sales, SGA/Revenues, SGA/Sales	KM adoption	25.00
Kim & Davidson (2004)		L-S	Profit, Total expenses, Payroll expense, Operating expense, Market share of deposits, Market share of loans, Total revenue	IT expense	-14.29
*Kohli & Devaraj (2004)		L-S	Reimbursement rate	Use of DSS	100.00
Lu & Ramamurthy (2004)		L-S	ROS, ROA, OI/A, OI/S, OI/E, COG/S, SGA/S, OpExp/S	IT capability	31.25
Morikawa (2004)	1	C-P	Profitability	IT use	100.00
	2	C-P	Profitability	IT use	100.00
	3	C-P	Profitability	IT use	0.00
	4	C-P	Profitability	IT use	0.00
	5	C-P	Profitability	IT use	0.00
Nicolaou (2004)		L-S	Delta ROA, delta ROI, delta ROS, delta Operating ROA, delta Operating income/Sales, delta ES, delta SGA/Sales, delta COGS/Sales	ERP adoption	2.50
Osei-Bryson & Ko (2004)		L-S	Adjusted patient days	IT stock	100.00
Shin (2004)		L-S	Tobin's q, ROA	IT budget	50.00
Sriram & Stump (2004)		C-P	Purchasing costs, Purchasing cycle time, Purchasing process improvements	IT investment	0.00
Yaylaccigi & Menon (2004)		L-S	Adjusted patient days	IT capital, Medical IT capital	20.00
Zhu (2004)		C-P	ROA, COGS/employee, Inventory turnover, Sales/employee	IT intensity	50.00
Arvanitis (2005)		C-P	Sales per employee	Internet use, Intranet use	80.00
Bhatt & Grover (2005)		C-P	Competitive advantage	IT infrastructure, IT expertise	50.00
Cao & Dowlatshahi (2005)		C-P	Business performance	Alignment	100.00
Coltman et al. (2005)		C-P	E-business performance	IT know-how, IT infrastructure	100.00
Doms et al. (2005)		L-S	Labor productivity, Labor productivity growth	IT share of total investment	50.00
Hales (2005)		C-P	Organizational performance	Degree of B2B implementation	0.00
Hempell (2005)		L-S	Value added	ICT capital	100.00
Huang (2005)		L-P	Output	IT capital, Computer employees	0.00
Huang & Liu (2005)		C-S	ROA, ROS	IT capital	0.00
Kim (2005)	1	L-S	Gross profit, ROA, ROI, EBITDA, Inventory Turnover, net cash flow	Structural IT investment, social IT investment, community IT investment, human IT investment	4.17
	2	L-S	Gross profit, ROA, ROI, EBITDA, Sales per employee, net cash flow	Structural IT investment	50.00
Kraemer et al. (2005)		C-P	Efficiency, Coordination, Market	B2B use, B2B use	100.00
Li (2005)		C-P	Market performance	IT use	100.00
Lu (2005)		C-P	Profit, cost, internal performance, market performance	IT budget, IT knowledge capability	62.50

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
Ravichandran & Lertwongsatien (2005)		C-P	Firm performance (ROS), Firm performance (ROA), Firm performance (sales growth), Firm performance	IT capability	0.00
Ray et al. (2005)		C-P	Process performance	IT spending, IT flexibility, IT alignment (shared knowledge)	33.33
Raymond & St. Pierre (2005)		C-P	Business performance, Operational performance	AMS sophistication	100.00
Sabherwal & Sabherwal (2005)		L-S	Cumulative abnormal return	IT alignment (innovativeness and process), IT alignment (efficiency and process)	50.00
Sanders & Premus (2005)		C-P	Financial performance	IT capability	100.00
Shang & Marlow (2005)		C-P	Financial performance	Info-based capability	0.00
Wang & Chang (2005)		L-S	Performance	Innovation capital, Human capital	0.00
Zhu & Kraemer (2005)		C-P	E-business value	IT integration, IT use	100.00
Anderson et al. (2006)		L-S	Market value	Y2K spending	100.00
Ataay (2006)		C-P	Labor productivity (actual), Labor productivity (perceived)	eCRM use, EDI use, eProcurement use, eComm use, eScorecard use, eProcedure use	-16.67
Atzeni & Carboni (2006)		L-S	Partial price change	ICT capital	100.00
Banker et al. (2006)	1	L-P	Change in quality, change in time to market, change in efficiency	RPS use, OMS use, EDI use	66.67
	2	L-P	Change in cycle time, change in lead time, change in unit manufacturing cost	OMS use, EDI use	100.00
Bardhan et al. (2006)		C-P	COGS, Quality	IT spending	0.00
Byrd et al. (2006)		C-P	Revenue per employee, Profit per employee	Revenue per employee, Sales per employee	100.00
Chan et al. (2006)		C-P	Organizational success	IT alignment	100.00
Chowdhury (2006)		C-P	Internal rate of return, labor intensity and productivity	ICT capital to total capital	0.00
Cotteleer & Bendoly (2006)		L-P	Lead time	ERP implementation	100.00
Davamanirajan et al. (2006)		L-S	Average time to complete request, Productivity: Transactions per employee	Integration with general ledger, integration with funds transfer, % requests initiated electronically	50.00
Duh et al. (2006)		C-P	Performance	Extent of IT application	100.00
El-Mashaleh et al. (2006)		C-P	Profit, schedule performance, cost performance, Customer satisfaction, safety performance	IT index (degree of use)	40.00
Huang et al. (2006)		C-P	ROA, ROS	IT capability	100.00
Ismail & King (2006)		C-P	Performance	IT alignment	100.00
Lee & Kim (2006)		L-S	ROE, ROC, Profit margin, EPS growth, Sales growth	IT investment	40.00
Lee, J. J. (2006)		L-S	ROA, ROE	Hardware rate, Software rate, Training rate, Labor rate	12.50
Lee, J. N. (2006)		C-P	ROA, Sales growth, Outsourcing success	Alignment	100.00
Lin & Tseng (2006)		C-P	Organizational performance	IT application	100.00
Maliranta & Rouvinen (2006)		C-P	Labor productivity	Desktop, Laptop, Desktop w/ LAN, Laptop w/LAN, Desktop w/WLAN, Laptop w/WLAN	100.00
Mashal (2006)		L-S	ROA, ROE, net income, output	IT capital, IS labor	12.50

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
Rai et al. (2006)		C-P	Firm performance	IT infrastructure, SCM integration	50.00
Ranganathan & Brown (2006)		L-S	Cumulative abnormal return	ERP adoption	100.00
Sanchez et al. (2006)		C-P	Output/ labor	IT capital	100.00
Sanchez-Rodriguez et al. (2006)		C-P	Operational performance, quality performance	IT for top management, IT for customer relations, IT for supplier relations, IT for workforce management, IT for product design, IT for process flow, IT for quality	85.71
Shin (2006)		L-S	Gross margin, ROA, ROE	IT intensity	-100.00
Stare et al. (2006)	1	L-S	Value added	ICT investment per employee	100.00
	2	L-S	Value added	ICT investment per employee	100.00
Tanrivedi (2006)		L-P	Tobin's q, Treynor ratio, ROS, ROA	IT relatedness	50.00
Wu et al. (2006)		C-P	Financial performance	IT advancement	0.00
Albadvi et al. (2007)		C-P	Performance	IT use	100.00
Aral & Weill (2007)		L-P	ROA, Tobin's q, Net margin, COGS, New products, Modified products	Transactional IT, Informational IT, Strategic IT, Infrastructure IT, IT capability	5.00
Bardhan, Krishnan, and Lin (2007)		C-P	Gross margin, On-time delivery rate	OMS use, EMS use	25.00
Bardhan, Mithas, and Lin (2007)		C-P	Project performance	IT alignment	0.00
Bhansali (2007)		L-P	Value added, gross output	IT stock	100.00
Bharadwaj et al. (2007)		C-P	Manufacturing performance	Integrated IS capability	100.00
Chari et al. (2007)		C-S	Tobin's q	IT investment	100.00
Dehning et al. (2007)		L-S	ROA, ROS, Inventory Turnover	SCM adoption	66.67
Devaraj et al. (2007)		C-P	Performance	Customer integration, supplier integration	50.00
Huang (2007)		C-P	Performance	IT investment, IT use	50.00
Hyvonen (2007)		C-P	Performance	IT use	100.00
Kearns & Sabherwal (2007)		C-P	Organizational performance	Top management in IT planning, IT management in business planning, Top management in resource allocation	100.00
Lai et al. (2007)		C-P	Performance	IT advantage	100.00
Melville et al. (2007)		L-S	Value added	IT capital	100.00
Mishra et al. (2007)		C-P	Performance	Search USE, OIC use	50.00
Neirotti & Paolucci (2007)		L-P	Loss ratio, Net premiums per employee	IT expense / employee	100.00
Oh & Pinsonneault (2007)		C-P	Profitability, Expense, Revenue	Alignment (cost reduction strategy), Alignment (quality improvement strategy), Alignment (revenue growth strategy)	-22.22
Sanders (2007)		C-P	Organizational performance	Use	100.00
Saraf et al. (2007)		C-P	Performance	IS integration (customer), IS integration (partner)	0.00
Shin (2007)		L-S	Tobin's q, ROA, Revenue per employee	IT innovation	66.67

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
Tafti et al. (2007)	1	C-S	Productivity	IT use	0.00
	2	C-S	Value added	IT expenditure	100.00
Tallon (2007)		C-P	ROA, ROS, OI/A, COGS/Sales	IT alignment	100.00
Badri & Alshare (2008)		C-P	Profitability	IT capability	100.00
Baker et al. (2008)		L-S	Revenue per bed	IT spending, IT hardware, IT systems, IT personnel	75.00
Buttermann et al. (2008)		C-P	Firm performance	ERP systems, B2B integration, Supply chain analytics	100.00
Byrd et al. (2008)		C-P	ROA, TCO	IT infrastructure	0.00
Chari et al. (2008)		C-S	Tobin's q	IT investment	100.00
de Mendonca et al. (2008)		L-P	Labor productivity (VTI/PO)	IT tools adoption	100.00
Dibrell et al. (2008)		C-P	firm performance	IT investment	100.00
Jeffers et al. (2008)		C-P	Firm performance	IT applications	100.00
Kobelsky et al. (2008)		L-S	ROS, ROA	IT budget	100.00
Lee (2008)		L-S	ROA, ROE	Hardware rate, Software rate, Training rate, Labor rate	-37.50
Lin et al. (2008)		C-P	Firm performance	IT resources	100.00
Loukis & Sapounas (2008)		C-P	Value added	Computer capital	100.00
Neirotti et al. (2008)	1	L-P	SCA_ROA	IT adoption	0.00
	2	L-P	SCA_ROA	IT adoption	0.00
	3	L-P	SCA_ROA	IT adoption	0.00
	4	L-P	SCA_ROA	IT adoption	-100.00
Prasad & Heales (2008)		L-P	ROA, ROE, ROS, Labor cost/sales, Operating expense/sales, Selling and general expense/sales, Sales/total assets, Sales revenue/employee	IT investment, IT training, IT human resources, IT infrastructure	9.38
Radhakrishnan et al. (2008)		L-S	ROA, ROS, ROE, Altzman Z score	IT capability	43.75
Wang et al. (2008)		L-S	Delta ROA, delta ROI, delta ROE	IT capability	53.33
Chen et al. (2009)		C-P	Financial performance	IT capability	0.00
Dong et al. (2009)		C-P	Process performance	IT integration	100.00
Gaith et al. (2009)		C-P	Firm performance	IT investment, IT use, IT effectiveness	66.67
Ghosal & Nair-Reichert (2009)		L-S	Labor productivity	IT investment (digital)	100.00
Goeke & Faley (2009)		L-S	Profitability improvement, Inventory reduction	SAP adoption	50.00
Macher & Mowery (2009)		L-P	Cycle time, Yield (defect density)	IT adoption	100.00
Menon et al. (2009)		L-S	Labor productivity, Adjusted patient days	Clinical IT, Admin IT	-3.13
Ravichandran et al. (2009)		L-S	ROA, Tobin's q	IT intensity	-50.00
Ray et al. (2009)		L-S	COGS/Sales, SGA/Sales	IT budget	100.00
Sircar & Choi (2009)		L-S	Output	IT capital, IT labor	100.00
Tatari (2009)		C-P	Operational benefits	CEIS integration	0.00
Tugas (2009)		C-S	ROA, ROE, EPS	IT maturity	0.00

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
Yao, Dresner, and Palmer (2009)		C-P	Order processing cost reduction (suppliers), Order processing cost reduction (customers), Inventory reduction	BSIT adoption (with supplier), BSIT adoption (with customer)	50.00
Yao, Sutton, and Chan (2009)		L-S	ROI, ROE, ROA, ROS, EVA	IT spending	66.67
Benitez-Amado et al. (2010)		C-P	Firm market performance	Technological IT resources, Managerial IT resources	0.00
Bhatt et al. (2010)		C-P	Competitive advantage	IT infrastructure flexibility	0.00
Chang & Wong (2010)		C-P	Firm performance	IT adoption	100.00
Ordanini & Rubera (2010)		C-P	Firm performance	IT capability	100.00
Panjamapirom (2010)		C-P	Financial performance, Productivity-relative work units	IT adoption	50.00
Rai & Tang (2010)		C-P	Competitive advantage	Alignment	100.00
Ramirez et al. (2010)		L-S	Market value, Value added	IT capital	100.00
Vijayasathy (2010)		C-P	Supply chain performance	Technology use	100.00
Walsh et al. (2010)		C-P	Sales	IT use	100.00
Wu & Chuang (2010)		C-P	Financial performance, Non-financial performance	IT adoption	100.00
Yao et al. (2010)		L-S	Labor productivity, Administrative productivity	IT spending	100.00
Cao & Hoffman (2011)		C-P	Business performance	IT alignment	0.00
Chatzoglou et al. (2011)		C-P	Firm performance	IT alignment	100.00
DeGroot (2011)		C-P	Performance	IT use	100.00
Dewan & Ren (2011)		L-S	Return	IT stock	0.00
Ho et al. (2011)		L-S	ROA	IT investment	100.00
Leckson-Leckey et al. (2011)		L-P	ROA, ROE	IT expense	100.00
Mithas et al. (2011)		L-S	Firm performance	IT capability	100.00
Park (2011)		C-P	Firm performance	IT capability	0.00
Tallon & Pinsonneault (2011)		C-P	Firm performance	IT flexibility, IT alignment	50.00
Trainor et al. (2011)		C-P	Organizational performance	e-marketing capability	100.00
Antheaume et al. (2012)		L-S	EBITDA, Operational expenses, Sales	Internal integration, External integration	66.67
Aral et al. (2012)		L-P	Sales	IT adoption	0.00
Ayabakan et al. (2012)		L-S	Gross margin	IT spending	100.00
Benitez-Amado & Walczuch (2012)		C-S	Firm performance	IT capability	0.00
Bloom et al. (2012)	1	L-S	Gross output per employee	IT capital per employee	100.00
	2	L-S	Gross output per employee	IT capital per employee	100.00
Campbell (2012)		L-S	ROS, OI/A, COGS/Sales	IT investment intensity	13.33
Chang & Gurbaxani (2012a)	1	L-S	Value added	IT capital	100.00
	2	L-S	Value added	IT capital	0.00
Chang & Gurbaxani (2012b)	1	L-S	Efficiency	IT intensity, IT knowledge	50.00
	2	L-S	Efficiency	IT intensity, IT knowledge	0.00
Chen & Tsou (2012)		C-P	Firm performance	IT capability	0.00

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
Chen (2012)		C-P	Firm performance	Human IT resource, technological IT resource	100.00
Evangelista et al. (2012)		C-P	Firm performance	IT adoption	33.33
Hah & Bharadwaj (2012)		L-S	Financial performance, Adjusted patient days, Adjusted discharges	HIT capital, IT use	100.00
Hung et al. (2012)		L-S	ROA, ROE, Net income ratio, Operating income ratio	ATM investment	100.00
Kleis et al. (2012)		L-S	Patents	IT capital	100.00
Kmiecik et al. (2012)		C-P	Income growth, Profitability growth, firm performance	IT expertise, IT alignment, IT use	0.00
Kohli et al. (2012)		C-S	Tobin's q, ROA, Operating income, Total net income, Market value	IT investment	40.00
Li & Huang (2012)		L-S	Abnormal return (short-term), Abnormal return (long-term)	IT adoption	0.00
Liu (2012)		L-S	ROA, ROS, Operating income/ assets, Operating income/sales, Operating income/employees, Operating expenses/sales	IT capability	50.00
Lu & Jinghua (2012)		L-S	ROA	ERP adoption	0.00
Mithas et al. (2012)		L-S	Profitability, Operating expense, Sales	IT investment	66.67
Otim et al. (2012)		L-S	Security return, ROA	IT strategic role	100.00
Perez-Arostegui et al. (2012)		C-P	Quality performance	IT infrastructure, IT integration, IT technical knowledge, IT managerial knowledge	75.00
Rush & Melville (2012)		L-S	Cumulative average return	IT adoption	100.00
Schaefferling et al. (2012)	1	L-S	ROA, ROS, Operating expense/ sales, SG&A/sales, COGS/sales	IT capability	80.00
	2	L-S	ROA, ROS, Operating expense to sales, SG&A to sales, COGS to sales	IT capability	80.00
Tambe et al. (2012)		L-P	Value added	IT employees	0.00
Turedi & Zhu (2012)		C-P	Added value	IT infrastructure, IT labor	0.00
Ussahawanitchakit (2012)		C-P	firm performance	Technology acceptance	100.00
Vinekar & Teng (2012)		L-S	Labor productivity: revenue per employee	IT spending	100.00
Xue et al. (2012)		L-S	Tobin's q, Inventory Turnover, Payables turnover, Receivables turnover, Selling & admin cost	IT intensity	-20.00
Bayo-Moriones et al. (2013)		L-P	Operational performance, final performance	ICT intensity	50.00
Cao et al. (2013)		L-S	ROA	Strategic alignment	100.00
Chang & Gurbaxani (2013)		L-S	Efficiency	IT intensity	100.00
Chuang et al. (2013)		C-P	Firm performance	KMIT use	100.00
Germann et al. (2013)		C-P	Firm performance	deployment and use	100.00
Han et al. (2013)		L-S	Service expansion	Application software, infrastructure	100.00
Han & Mithas (2013)		L-S	Operating costs	IT labor, IT hardware, IT software	0.00

Study ^{a, b}	Sample ^c	Method - Data ^d	Dependent Variables	IT-Based Independent Variables	BVIT
Hong & Ghobakhloo (2013)		C-P	Firm marketing performance	Hardware investment, software investment	100.00
Huang & Wang (2013)		L-P	ROA, Profit margin, Total revenue	CRM use, KM use	33.33
Kalaiganam et al. (2013)		L-S	Cumulative abnormal return	IT capability (expenditure)	100.00
Karahanna & Preston (2013)		C-P	Firm financial performance	strategic alignment	100.00
Lin & Chuang (2013)		L-S	Value added	IT capital	100.00
Liu et al. (2013)		C-P	Firm performance	IT capability, IT assimilation	100.00
Mishra et al. (2013)		L-S	Stock market return	IT capability	100.00
Ong & Chen (2013)		L-S	ROA, ROS, MBE, MBA	IT capability	100.00
Rawley & Simcoe (2013)		L-S	Delta extent of vertical integration	IT adoption	100.00
Ray et al. (2013)		L-S	Vertical integration (sales), horizontal complementarity (sales), related diversification (sales), unrelated diversification (sales)	IT capital	25.00
Saldanha et al. (2013)		L-S	Labor productivity, Total inventory	IT use (for transaction), IT use (for partnering)	100.00
Tafti et al. (2013)		L-S	Tobin's q	IT intensity	0.00
Wang et al. (2013)		C-P	Manufacturing goals achievement	IT use (IT-enabled planning and control)	100.00
Wang & Huynh (2013)		C-P	Firm performance	KM adoption	100.00
Xue et al. (2013)		L-S	Cost saving, cross-selling, customization, satisfaction	IT spending, SEI use, CEI use	75.00
Zhang et al. (2013)		C-P	International performance	IT capability	100.00

Independent variables: A/R: Accounts receivables, CAR: Cumulative abnormal return, COGS: Cost of goods sold, EBITDA: Earnings before interest, taxes, depreciation, and amortization, EPS: Earnings per share, EVA: Economic value added, OI: Operating income, ROA: Return on assets, ROC: Return on capital, ROE: Return on equity, ROI: Return on investment, ROS: Return on sales, SGA: Selling, general, and administrative expenses, TCO: Total cost of ownership.

IT-related independent variables: ACF: Automated concrete feeders, AIS: Accounting IS, AM: Activity measurement, AMS: Advanced manufacturing system, AMT: Advanced manufacturing technology, ATM: Automated Teller Machine, B2B: Business-2-Business, CEI: Customer-side electronic integration, CEIS: Construction executive IS, CIO: Chief Information Officer, CRM: Customer Relationship Management, EC: Electronic Commerce, EDI: Electronic Data Interchange, EMS: Enterprise management system, ERP: Enterprise Resource Planning, HIT: Human resources IT, ICT: Information and Communication Technology, KM: Knowledge Management, LAN: Local Area Network, MPM: Measurement of milk production, OIC: Order initiation and completion, OMS: Order Management System, PC: Personal Computer, QR: Quick response, RPS: Resource planning systems, SAP: Systems, applications, and products, SEI: Supplier-side electronic integration, WLAN: Wireless LAN, Y2K: Year 2000.

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Appendix C

Graphs for Changes Over Time

Overall Trends

Figure C1 depicts how the frequency of studies on BVIT has changed over time. Figure C2 shows the change in BVIT (based on the continuous IT payoff measure) observed in the studies in our meta-analysis sample across the four eras of IT progress.

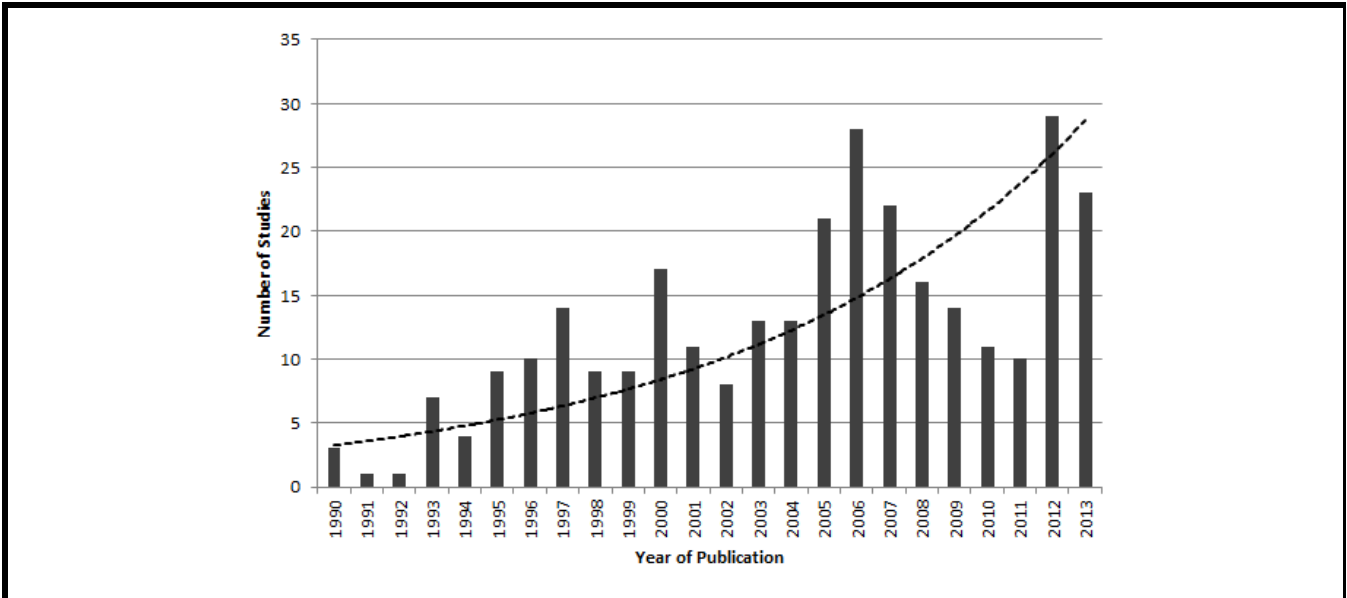


Figure C1. Number of Studies in Meta-Analysis Sample

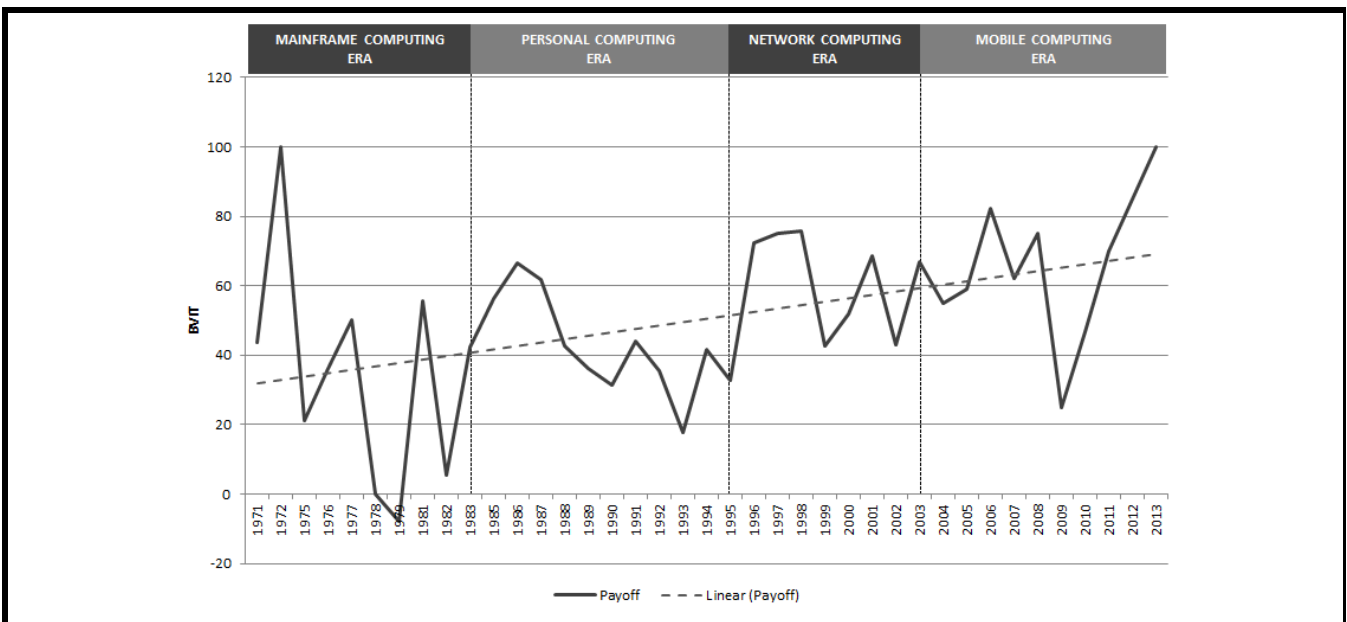


Figure C2. BVIT Over Time

Variety and Nature of Variables

Figure C3 shows the diversity of BVIT-based dependent variables and IT-based independent variables in studies over time. For each type of variables, we computed the ratio of the number of unique variables to the number of studies in each year. The ratio shows a downward trend, indicating that the more recent studies in our sample have been more focused and have examined a narrower set of dependent variables and a narrower set of independent variables compared to the studies during earlier times in the sample.

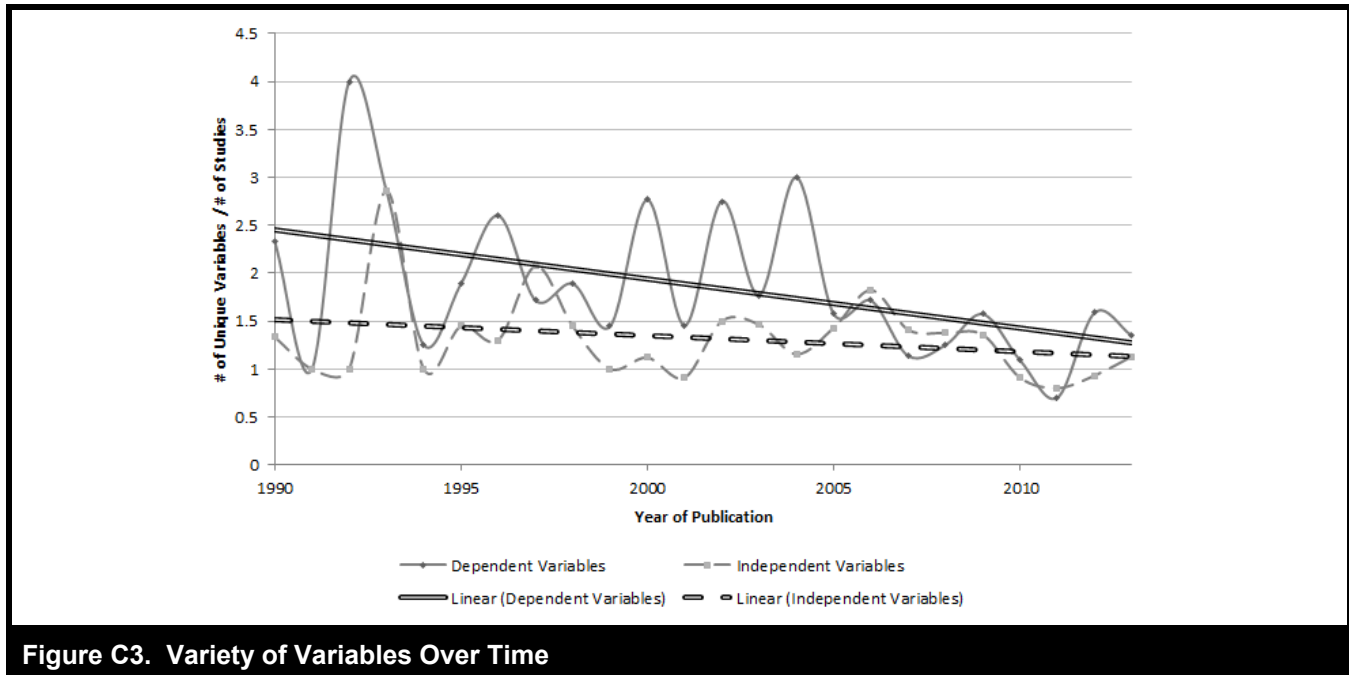


Figure C4 shows the evolution of BVIT-based dependent variables and IT-based independent variables in our sample. For both categories, the figure shows the variables with the higher incidences in larger text, where the incidence for each variable is computed as the frequency of occurrences of the variable across all studies in our sample. The figure also clusters the variables for the four computing eras. As can be seen from the figure, different variables gain prominence and fade away over time. For instance, ROA measures were used to some extent in the mainframe computing era, gained prominence during the personal computing and network computing eras, and faded during the mobile computing era. By contrast, firm performance has become more prominent over time, especially during the mobile computing era. Similarly, the evolution of independent variables shows that the focus has shifted from pure economic measures such as IT capital and IT budget during the mainframe computing and personal computing eras to measures that intervene between investment and performance, such as IT use, IT capability, and IT alignment, during the network computing and mobile computing eras.

Theories Used in Studies

Figure C5 shows the use of theories in studies in our sample. The graph is based on a ratio of the number of studies using a family of theories to the total number of studies in each year. Unsurprisingly, technological theories have been consistently used regardless of time in a majority of studies. Organizational theories have also been consistently used although by a smaller proportion of studies. However, environmental and alignment theories have only gained greater attention in recent times and in fewer studies.

Economic Regions

Figure C6 shows the distribution of BVIT over time in studies set in developed and developing economic regions of the world. The graph is based on the average BVIT across all the studies within each subsample in each year. The analysis indicates that studies in the developing regions demonstrated faster increase in BVIT over time than studies in developed regions although there was considerable variation in realized BVIT in each year.

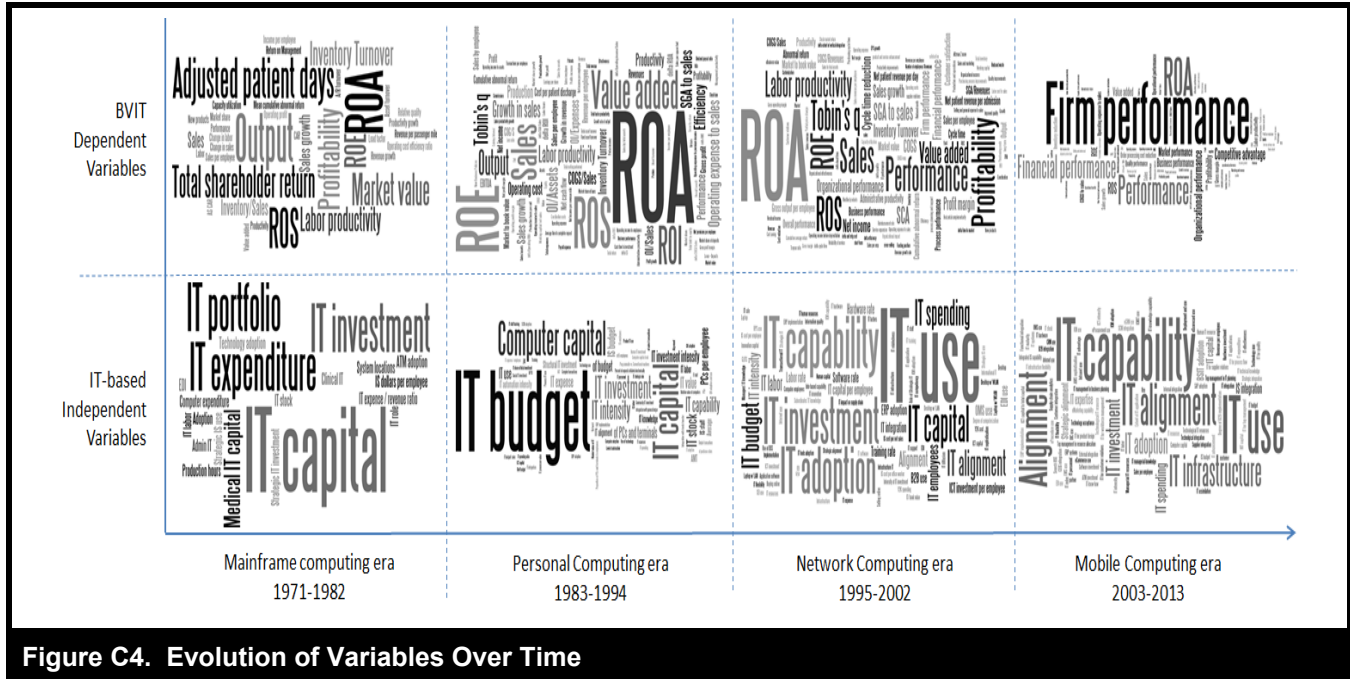


Figure C4. Evolution of Variables Over Time

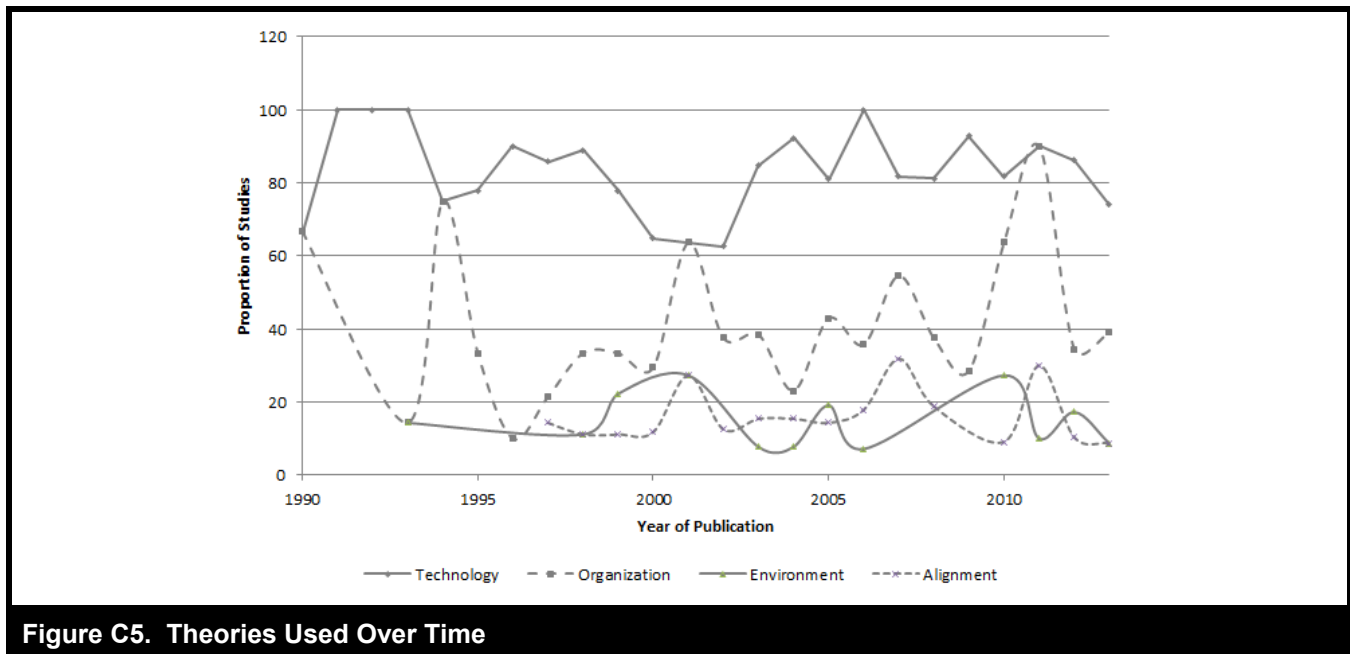


Figure C5. Theories Used Over Time

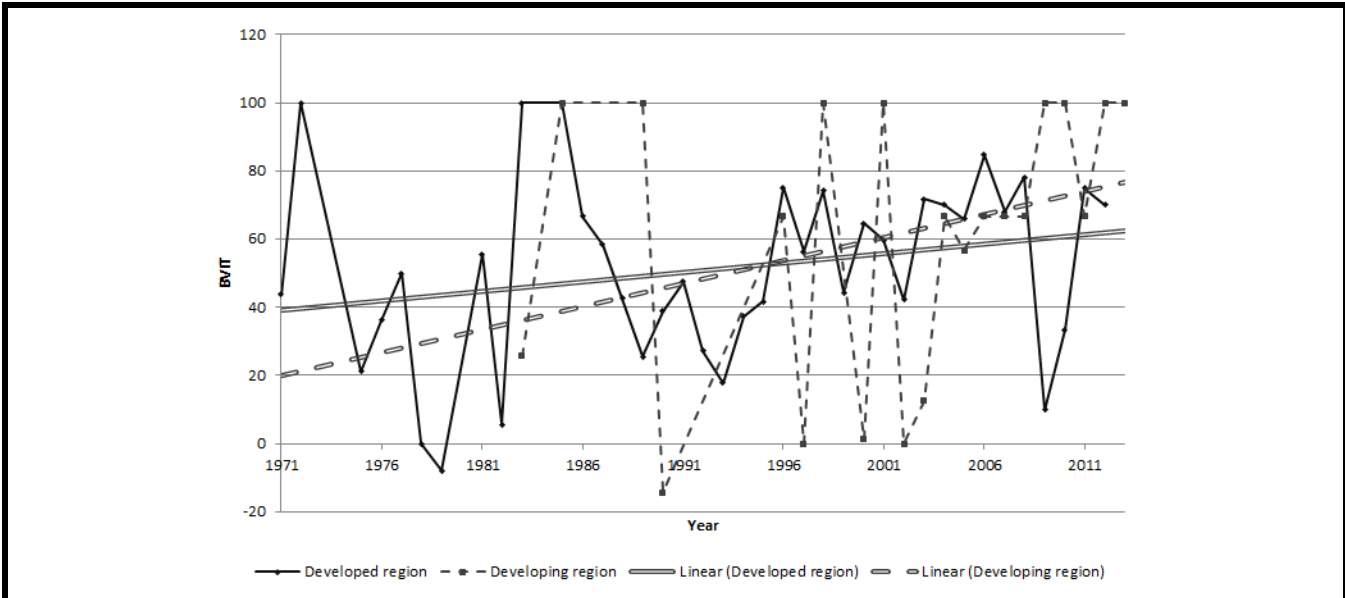


Figure C6. BVIT in Studies Set in Different Economic Regions Over Time

Analysis Methods

Figure C7 shows the distribution of BVIT over time for studies using longitudinal and cross-sectional data. The graph shows that studies using cross-sectional data find slightly greater BVIT than those using longitudinal data. However, studies using longitudinal data sources have shown a marginally faster increase in observed BVIT over time.

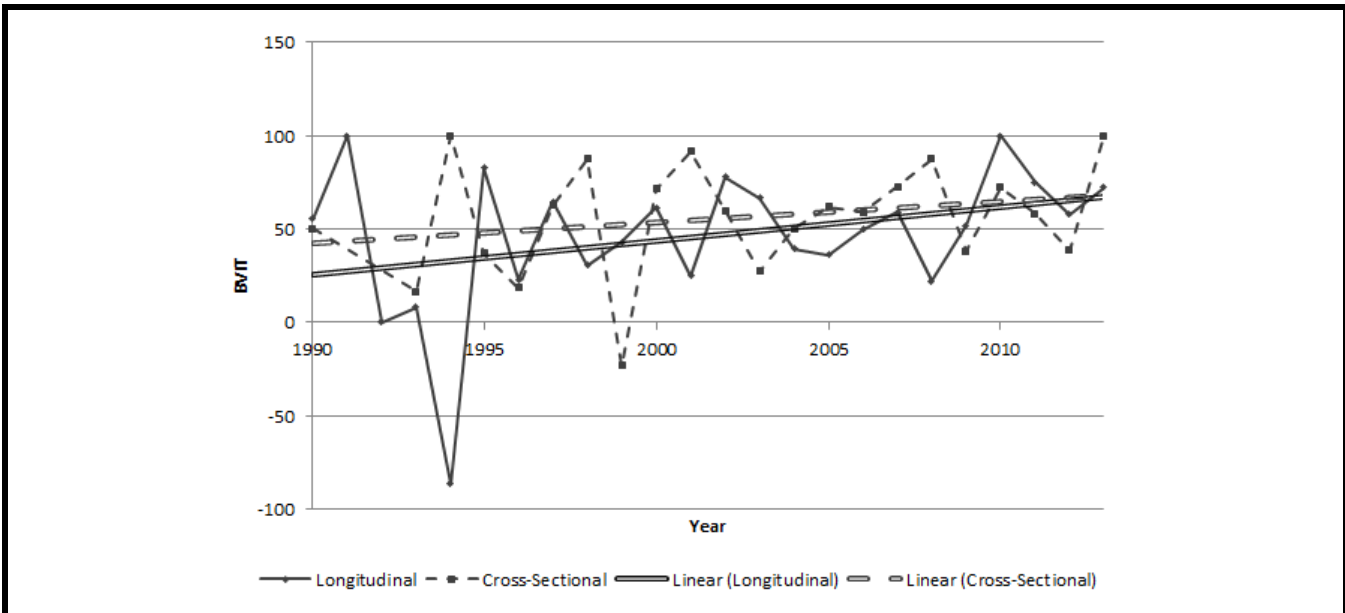


Figure C7. BVIT in Studies Using Different Analysis Methods Over Time

Data Source

Figure C8 shows the change in BVIT over time for studies using secondary and primary data. The graph shows that studies that rely on primary data demonstrate higher levels of BVIT than those that use secondary data. However, studies using secondary data sources have shown a faster increase than primary studies in observed BVIT over time.

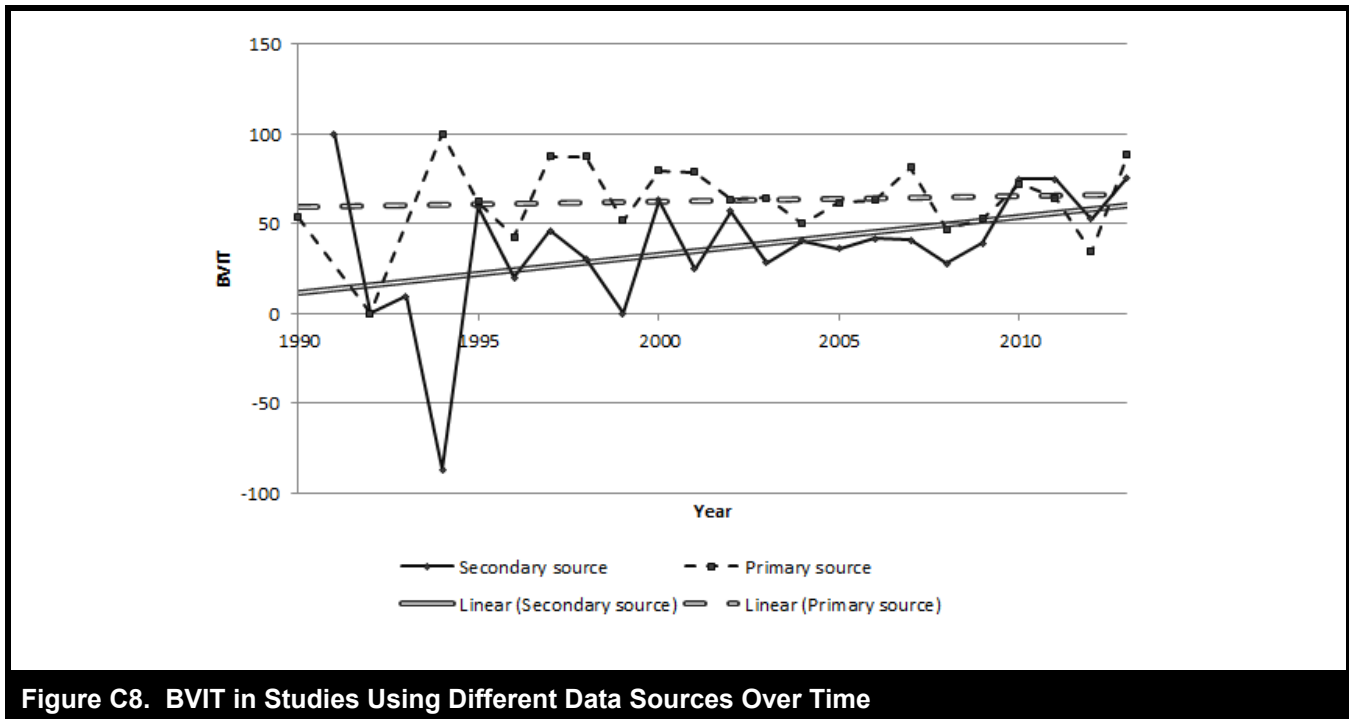


Figure C8. BVIT in Studies Using Different Data Sources Over Time