ONLINE SUPPLEMENT
From Association to Causation via a Potential Outcomes Approach[1]

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Abstract of main paper

Despite the importance of causal analysis to build a valid base of knowledge and to answer managerial questions, the issue of causality rarely receives the attention it deserves in published empirical work in information systems (IS) and management research that uses observational data. In this paper, we discuss a potential outcomes framework for estimating causal effects and illustrate the application of the framework in the context of a phenomenon that is also of substantive interest to IS researchers. We use a matching technique based on propensity scores to estimate the causal effect of an MBA degree on information technology professionals' salary in the United States. We demonstrate the utility of this counterfactual or potential outcomes–based framework in providing an estimate of the sensitivity of the estimated causal effects due to selection on unobservables. We also discuss issues related to the heterogeneity of treatment effects that typically do not receive as much attention in alternative methods of estimation, and we show how the potential outcomes approach can provide several new insights into who benefits the most from the interventions and treatments that are likely to be of interest to IS researchers. We discuss the usefulness of the matching technique in IS and management research and provide directions to move beyond establishing association to assessing causation.

Keywords: Causal Analysis, Propensity Score, Matching Estimator, Counterfactual approach, Treatment Effect Heterogeneity, Selection on Unobservables, Sensitivity Analysis, MBA, IT Professionals

This online supplement provides some additional discussion that complements the discussion in the main paper. Table A1 presents matching variables used in related work.

We now discuss some of the software related issues to implement the propensity score approach outlined in the paper.[2] While we performed our analyses using Stata, this is not the only package for performing a causal analysis. Researchers may as well use other statistical packages such as R and S-plus. Regardless of choice of a particular package, it is important for researchers to first understand the basics of this approach and the assumptions involved in using this approach and therefore we strongly recommend that researchers familiarize themselves with the work of Rubin, Rosenbaum, Heckman and many others cited in the main paper. While many of

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[2] We thank the Associate Editor for suggestion to include this discussion on software issues.

the analyses reported in the main paper can be easily performed using basic commands in any statistical (e.g., Stata, SPSS, S-plus, R) or data analysis package (e.g., Excel), we mention here some in Stata that may be useful as a beginning: pscore (Becker and Ichino 2002), psmatch2 (Leuven and Sianesi 2003), pstest (Leuven and Sianesi 2003) and rbounds (DiPrete and Gangl 2004). Among other statistical packages, Rosenbaum (2002) discusses use of S-Plus and Mithas et al. (2006) discuss use of R (see also the online appendix to their paper) to conduct some of the analyses reported in the paper. Once again, we do not endorse any one particular package and instead recommend a thorough understanding of the propensity score approach (see Mithas *et al.* Forthcoming for a discussion and some useful references). Once that is accomplished, it will be easy to implement the method in the software package with which a researcher may be familiar and comfortable.

Table A1: Matching Variables Used in Related Work

Study	Covariates
Non-IT Professionals	
Pfeffer (1977)	Education, work experience, socioeconomic origin, self-employment, line or staff position
Dreher et al. (1985)	Gender, education, work experience, socioeconomic origin, self-employment, line or staff position
Wright (1988)	Education
Gerhart and Milkovich (1990)	Education, experience, firm tenure, job tenure, management level, firm size, firm sales, unit sales, return on assets
Kalleburg and Van Buren (1996)	Years of schooling, gender, race, self-employed, hours worked weekly, tenure, union status, firm internal labor market, formalization, industry, county size, establishment size, firm size, complexity/differentiation, occupation prestige, occupation level
Barth (1997)	Age, gender, education, experience, tenure, piece rate, on the job training requirement
Connolly (2003)	Education
IT Professionals	
Truman and Baroudi (1994)	Age, gender, education, IT work experience, industry, reporting level to chief executive officer
Ang, Slaughter and Ng (2002)	Gender, education, IT work experience, occupation level, industry, organization size
Mithas and Krishnan (2008b)	Age, gender, education, IT work experience, tenure at current firm, industry, firm type (dotcom or not), organization size, hours of work, headhunter contact
This study (Mithas and Krishnan 2008a)	Age, gender, education, IT work experience, tenure at current firm, industry, firm type (dotcom or not), organization size, hours of work, headhunter contact

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