


Volume 15, Issue 4, August 2008 ISSN 0927-5371



Editor in Chief:
A. ICHINO

Co-Editors:
K.G. ABRAHAM
M. BUCHINSKY
J.J. DOLADO
K. LANG
P. OROPOULOS
F. POSTEL-VINAY
S. VROMAN
I. WALKER

Associate Editors:
J.G. ALTONJI
J. ANGRIST
D.H. AUTOR
D. BLACK
S. BLACK
R. BLANK
F.D. BLAU
A. BOOTH
P. CAHUC
E. GOULD
D.S. HAMERMESH
J. JIMENO
F. KRAMARZ
A. KUGLER
P. KUHN
V. LAVY
R. LENTZ
A. MANNING
C. OLIVETTI
D. PASERMAN
B. PETRONGLO
G. SAINT-PAUL
C. TABER
C. TEULINGS
J. VAN OURS
G. VIOLANTE
E. YASHIV

Editorial Assistant:
H. FICKEL

LABOUR ECONOMICS

Official Journal of the European Association of Labour Economists

CONTENTS


*Special Issue: European Association of Labour Economists
19th annual conference University of Oslo, Oslo, Norway
20-22 September 2007*

Guest Editor: Claudio LUCIFORA

M. Coles, Optimal unemployment policy in a matching equilibrium	537
Ö.B. Bodvarsson, H.F. Van den Berg and J.J. Lewer, Measuring immigration's effects on labor demand: A reexamination of the Mariel Boatlift	560
C. Lamarche, Private school vouchers and student achievement: A fixed effects quantile regression evaluation	575
E. Bratberg, Ø.A. Nilsen and K. Vaage, Job losses and child outcomes	591
K. Hämäläinen, R. Uusitalo and J. Vuori, Varying biases in matching estimates: Evidence from two randomised job search training experiments	604
S. Kirby and R. Riley, The external returns to education: UK evidence using repeated cross-sections	619
F. Pfeiffer and K. Reuß, Age-dependent skill formation and returns to education	631
D. Lundin, E. Mörk and B. Öckert, How far can reduced childcare prices push female labour supply?	647

(contents continued on last page of this issue)

Available online at www.sciencedirect.com



This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>



Do industries matter?[☆]

Mari Sako

Saïd Business School, University of Oxford, Park End Street, Oxford OX1 1HP, UK

Received 4 January 2007; received in revised form 18 September 2007; accepted 19 September 2007

Available online 26 September 2007

Abstract

This paper poses the question ‘Do Industries Matter?’ in order to shed light on what observation-based Industry Studies researchers can offer empirical economists using large-scale datasets. I argue that industries matter from three distinct perspectives. First, the methodological approach in Industry Studies adds value to economists’ normal activity of testing and generating theory. Data collected using Industry Studies methods can lead to new ideas and theory-building. Second, industries matter as they provide an institutional and historical context in which to study firms and workers. Such context improves the interpretation of how and why different practices and institutions fit together in specific industries. Third, recognizing differences in what is meant by an industry improves our ability to interpret specific ‘industry dummies’ in regressions. © 2007 Elsevier B.V. All rights reserved.

JEL Classifications: B4; J5; L1; L2; L6; L8

Keywords: Industry Studies; Methodology; Economics and Management; Institutions

1. Introduction

More than ever before, econometricians and observation-based Industry Studies researchers have good reasons to learn from each other for mutual benefit. This is the case in all areas of economics but particularly so in labour economics. We owe this privilege to a concurrence of two initiatives, first to create linked firm-employee data (lehd.dsd.census.gov/led/), and second to

[☆] This paper is based on a keynote speech at the Conference on the Analysis of Firms and Employees (CAFE): Quantitative and Qualitative Approaches, 29-30 September 2006 in Nurnberg, Germany, sponsored by the National Science Foundation, the Sloan Foundation, and Deutsche Forschungsgemeinschaft. I thank Julia Lane, Gail Pesyna, Hirsch Cohen, Howard Gospel, Susan Helper, Edward Lazear, Frits Pil, Kathryn Shaw, Marc Ventresca, and two anonymous referees of the journal for constructive comments.

E-mail address: Mari.sako@sbs.ox.ac.uk.

encourage economists to ground their research in direct observation of industry practices (www.sloan.org/programs/IndustryStudies.shtml).

In millions of econometric regressions that economists have run to date, it has become conventional to enter industry dummies as controls. But should we regard significant industry dummies as a cause for concern or for celebration? Not many of us have had the inclination to pose this question, as putting in controls is a methodologically legitimate and routine solution to deal with sources of variation. Some might argue that significant industry dummies are a cause for concern, and that we should strive to eliminate all fixed effects by improving the specification of general models, for example, about incentives or other determinants of performance. Improving the specification of general models is a worthy pursuit. But instead of aiming to get rid of industries as a source of variation, what if we treated industry dummies as something requiring explanation? What about unpacking the relevant institutional and historical details that industry dummies are picking up in econometric analysis?

In posing these questions, I am not arguing in favour of converting economists into historians or sociologists. Rather, this paper focuses on what empirical economists might learn from Industry Studies researchers when they analyze the workings of organizations and markets. In particular, I pose the question ‘Do Industries Matter?’ in order to shed light on what observation-based Industry Studies researchers can offer empirical economists using large-scale datasets.¹ I argue that industries matter from three distinct perspectives. First, the methodological approach in Industry Studies adds value to economists’ normal activity of testing and generating theory. Data collected using Industry Studies methods can lead to new ideas and theory-building. Second, industries matter as they provide an institutional and historical context in which to study firms and workers. Such context improves the interpretation of how and why different practices and institutions fit together in specific industries. Third, recognizing differences in what is meant by an industry improves our ability to interpret specific ‘industry dummies’ in regressions.

2. Industry studies: methodology and insight

Since 1990, the Industry Studies Program, funded by the Sloan Foundation, is associated with a particular methodological approach that takes direct observation seriously. Its methodological commitment is characterized as ‘observational science’ by the Foundation’s ex-President, Ralph Gomory (Gomory, 2005). Just as in astronomy or biology, which are not laboratory sciences, we start by observing and understanding a phenomenon in all its complexity, and then build (and modify) theories to try and explain what one observed. The systems studied involve firms, workers, markets, and institutions including the state that might engage in industrial policy. Having identified this constellation of actors and institutions that make a difference to industrial competitiveness, the Sloan Foundation has come to fund 26 Industry Centers (see Appendix for a list of these industry centers).

Research that is grounded in direct observation of an industrial setting is not an end in itself but a means to several ends. The following features constitute good Industry Studies research:²

- ✓ It addresses a question of importance to theory or policy.
- ✓ It presents rich data, including direct quotes from industry participants, perspectives from multiple viewpoints, and detailed examples.

¹ I claim that building a bridge between econometricians dealing with large data sets and case study researchers is mutually beneficial. But I concentrate, in this paper, on articulating the benefits for econometricians who constituted the majority of participants at the conference in September 2006.

² I thank Susan Helper for providing this list which was used to review papers submitted for the Industry Studies Best Paper Prize in 2006.

- ✓ Methodologies are high-quality, in that conclusions are supported by evidence, theory is appropriately applied or developed, and multiple sources of evidence are considered or triangulated. While researchers listen closely to industry participants, they do not accept statements uncritically.
- ✓ Research makes a contribution to theory, one that applies beyond the particular industry in which the analysis is applied.
- ✓ Research has a large impact on industry practice.

For labour economists, this methodological approach calls for triangulating their traditional research methods with direct observation and interviews with managers and workers. Because interviews and observation are conducted in the context of a particular industry, researchers constantly question which components of their findings are industry-specific and which are generalizable beyond the industry. It also challenges researchers to treat data, both quantitative and qualitative, as a basis for generating new ideas and theories, as much as for testing existing theories. Last but not least, the Industry Studies approach takes seriously the impact of research on policy and practice, arising out of close interactions with industry stakeholders.

Thanks to the NBER/Sloan Pin Factory Project (www.nber.org/sloan), economists are now more aware than ever before that modern economics began with a plant tour. Had Adam Smith not visited the pin-making factory, he might not have come to elaborate on the concept of the division of labour. Similarly, had Ronald Coase not undertaken a US tour to visit factories and talk to business managers, he might not have conjured up the concept of transaction costs (Coase, 1937, 1988). These ‘discoveries’ were the result of direct observation, distilling one’s understanding through familiarization over time, rather than going into the field knowing what to look for.

Nevertheless, not everyone is inclined or talented to execute this sort of fieldwork well. Within the social science research community, there is therefore a varying degree of specialization, just as in a pin factory, between those who personally undertake to visit companies and factories, and others who build on such knowledge second hand to enrich their own theoretical or empirical work.

2.1. Importance of the ‘direct feel of the economic world’

In the collaboration between the NBER/ Sloan productivity project and the LEHD project, experienced Sloan field researchers and LEHD researchers co-developed a common analytical framework to interpret their qualitative and quantitative results on the US labour markets (Brown et al., 2006). Five Sloan industry sectors were chosen for study: financial services, retail food services, trucking, semiconductor, and software. This collaboration was built on a number of important beliefs that undermine the conventional wisdom concerning the division of labour between theorist and empiricist in the economics profession.

First, there is an important notion that ‘seeing is believing’, and that observation provides insights and suggests hypotheses. During a factory visit, Martin Feldstein was struck by the fact that the shopfloor had virtually no workers. This led him to a hypothesis that there was much scope for productivity gains from non-production workers such as designers, accountants, and other managers (Feldstein, 2000).

In the words of Arthur Pigou, writing about his teacher, Alfred Marshall: ...though his main strength was undoubtedly on the analytical side, he was a tireless collector of realistic detail. He told me once that, in his early days, he had set himself to master the broad principles of all the mechanical operations performed in factories: that, after a time, when

he visited a factory, he was able to guess correctly the wages that different workmen would be getting by watching them for a few moments, and that, when his guess was significantly wrong, there was always some special explanation. In the same spirit he eagerly welcomed the opportunity of serving on the Royal Commission on Labour, on which he came into close personal touch with many representative workpeople and employers of labour. What he aimed at in all of this was to get, as it were, the *direct feel* of the economic world, something more intimate than can be obtained from merely reading descriptions, something that should enable one, with sure instinct, to set things in their true scale of importance, and not to put in the forefront something that is really secondary merely because it presents a curious problem for analysis (Pigou, 1925).

Thus, ‘the direct feel of the economic world’ is important, not only to make research agenda relevant to the priorities of business and public policy, but also for theory building.

Second, fieldwork data might give new insights into theory, leading to modification of existing theories. As (Piore, 1979) pointed out, economists in the 1930s and 1940s worked with trade unions or as arbitrators and mediators during collective bargaining. This experience gave them insights into refuting conventional theories.

In my experience, combining a survey and open-ended interviews with managers and workers facilitated a deep understanding of the field, and led to modify theories about the determinants of trust and opportunism in supplier relations. Not only did Susan Helper and I discover that factors facilitating trust was different from factors attenuating opportunism (Sako and Helper, 1998). We also found that these factors differed in the United States and Japan. For example, technical assistance to suppliers enhanced trust in Japan but not in the United States. Also, long-term formal written contracts led to lower trust in Japan but made no difference in the United States. Explanations of these differences were found in our fieldwork. For example, it became evident during factory visits that technical assistance was more in-depth and continuous in Japan than in the US. Interviews also revealed that written contracts were put to different use, with the Japanese managers emphasizing their function in breeding and institutionalizing suspicion, whilst the US managers believed they prevented opportunism. Had we delegated the fieldwork to someone else, the iterative back-and-forth between survey analysis and interpretation from the field would have not only been more arduous but also likely to have led to different results. Experienced field researchers usually connect their observations in a way that enables them to ask more probing and complex questions as the fieldwork progresses, leading to new insights.

Third, exploiting these advantages necessitates increasing the number of economists with appropriate training. To make this sort of specialization attractive, leading researchers have pointed to privileged access to quantitative data on productivity, quality, and human resource practices which are held by companies and plants. They also created a separate researcher identity by legitimizing the field of ‘insider econometrics’ through the publication of leading work in top journals such as the American Economic Review (Lazear, 2000; Bartel et al., 2004).

Economists are thus urged to get out there more, to observe factories and corporate board rooms, to interview and survey managers and workers. Objections to this suggestion on the grounds of inconvenience – that it is too time consuming, uncomfortable, or messy – are rather feeble. Objections on grounds of academic rigour – especially the absence of objectivity, replicability, and generalizability – can be addressed adequately, if we realize that every method has its shortcomings and that triangulation by multiple methods adds value (Helper, 2000).

2.2. *International Motor Vehicle Program (IMVP)*

I have seen the power of this particular research approach in the International Motor Vehicle Program (IMVP) (<http://imvp.mit.edu>), the first of the Sloan Foundation's Industry Centers. IMVP is best known for its assembly plant benchmarking study which pioneered a data-driven approach to international comparisons of productivity performance, work practices, and human resource policies (Womack et al., 1990; MacDuffie, 1995). Lean production, as an alternative paradigm to mass production, emerged through direct observation and subsequent benchmarking surveys, spurred initially by the industry sponsors' encouragement 'to look further into the issue of why Japan was getting ahead' (Holweg, 2007). It is fair to state that a strong theoretical framework of lean production emerged at the end, not the beginning, of the study. This is a typical trajectory of building theory from case study research, that takes the direction from data to theory as seriously as from theory to data in an iterative research process (Eisenhardt, 1989).

IMVP also illustrates the value of collective sharing of insights within the programme. Through close links that Industry Studies researchers maintain with the industries they study, corporate leaders comment on research findings as well as offer unprecedented access to research sites. By being part of group factory visits, researchers may learn about causal links well beyond their own focus of study. For example, the practice of Built-to-Order (BTO) places a constraint on the allowable defect rate in the paint shop. This has an influence on the predictability of component ordering and therefore on the nature of supplier relations (Holweg and Pil, 2004).

To summarize, the value of Industry Studies lies in privileged access to data held by companies and industries, and the opportunity to generate ideas and theory from such data, be they qualitative or quantitative. All good empirical economists should recognize this as part of what is familiar to them, namely the importance of good access so that they can 'wallow in the data — to get down and dirty with the data' (Hamermesh, 2006).

3. **Industry as institutional – historical context**

The growth of modern economies has long been characterized by the rise and fall of different industries. In this macro-economic context, classical economists noted that economic growth was driven by shifts in the relative importance of different industries which show life cycles in terms of sales and innovation (Marshall, 1879; Kuznets, 1930; Schumpeter, 1939). Colin Clark (1940) also made the same observation at a more aggregated level by linking the stages of economic growth to the rise and fall of three sectors in the economy, namely agriculture, manufacturing, and services which he called the tertiary sector. Later, the ideas of stages of industrial growth and technological maturity were used to analyze economic development of less developed countries (Rostow, 1960; Chenery, 1975). In public policy, certain industrial sectors, such as the automobile industry (which Peter Drucker called the 'industry of industries'), were promoted as leading sectors with spill-over effects for the whole national economy.

Economists continue to engage in the analysis of large things, such as the rise and fall of industries and nations. More recently, however, academic research has come to focus also on smaller things like individual firms, plants, work groups and employees. There is nothing wrong with this, and exploring 'the black box' has brought great insights, for example to the nature of technological development (Rosenberg, 1994). This section reviews how the shift from industry to firm as a focal unit of analysis happened in economic and management theories. Whilst this trend might be seen to have eclipsed the importance of the industry, it is argued that a rich analysis of

firms within an industry can be an important part of understanding an industry, set in its full institutional and historical context.

3.1. *Eclipse in the importance of the industry*

In both economics and management, the focus of analysis has moved in the last half century from industry to ‘inside the firm’. In economics, industrial economists informed by the structure – conduct – performance (SCP) paradigm (Mason, 1939; Bain, 1956) undertook empirical studies of specific industries. Econometric studies of the so-called ‘industry effects’, i.e. structural factors such as concentration and entry barriers that account for the variance in business unit returns, made important contributions to our understanding of inter-industry differences (Schmalensee, 1985; Rumelt, 1991; Powell, 1996; McGahan and Porter, 1997). However, industrial economics gave way to business economics and organization economics, based on game theoretic frameworks, principal-agent theory, contracting and incentive theories.

In strategic management, Porter’s five forces framework based on SCP came to be complemented by the resource-based view (RBV) (Wernerfelt, 1984) and capability-based view of the firm (Teece and Pisano, 1994). The intellectual root of the resource-based view is Edith Penrose who posed a rhetorical question, ‘Can anyone tell me - what is an industry?’ (Best and Garnsey, 1999). For Penrose (1959), industry was an incoherent concept because every firm was unique. The uniqueness derives from a distinction between resources and productive services: ‘... it is never *resources* themselves that are the ‘inputs’ in the production process, but only the *services* that the resources can render’ (Penrose, 1959). Management deploys these resources for productive use when they identify and act upon ‘productive opportunities’, in the process creating new knowledge and capabilities. Conceptualized this way, it became theoretically necessary to analyze what happened inside the firm to account for its growth.

Industrial economists, working at the level of the industry, were not seriously inconvenienced by the absence of attention to the internal dynamics of the firm. By contrast, resource-based (and subsequently capability-based) researchers came to identify firm-specific attributes, such as learning ability, first-mover advantages, causal ambiguity that limits effective imitation, and path dependent accumulation of skills, as reasons ‘why firms differ’ in the same industry (Nelson, 1991).

Thus, both organization economists and scholars holding the resource-based view contributed to shifting our theoretical attention away from industry toward the firm. Consequently, progress has been made in analyzing organizational boundaries and the internal governance of the firm, rather than in mapping out the contour of industrial structure.

3.2. *Why firms differ within an industry*

As part of a research agenda on ‘why firms differ’ in the same industry, I conducted in-depth case studies of companies in the Japanese auto industry (Sako, 2006a,b). This work was carried out as part of the International Motor Vehicle Program (IMVP). By the time I joined the program in 1993, it was well known that the Japanese automakers all applied lean production and supply rigorously (Womack et al., 1990). Lifetime employment and the main bank system were representative institutions in the labour market and financial market that facilitated the wide adoption of lean production in Japan.

But companies exhibit different capabilities, even though they belong to the same industry in the same country and are therefore subject to similar pressures and risks in the global market. In order to demonstrate this, I compared Toyota’s and Nissan’s supplier development activities

(Sako, 2004). Although both companies adopted lean production, Toyota was the industry leader in market share and profitability. This contrasted sharply with the failure and the revival of Nissan.

So what is the essence of the difference between Toyota and Nissan? I adopted a historical approach to data collection, and paid specific attention to the sequence of events. Distilled from document analysis, plant visits, and interviews was an answer to what accounted for a Toyota effect in my earlier regression analyses (Sako and Helper, 1998). Toyota had two distinctive features in its organizational design: first, the bifurcated internal structure, with the purchasing department in charge of diffusing Total Quality Control and the production engineering department in charge of teaching suppliers the Toyota Production System; and second, a systematic institution of learning for suppliers in the form of self-study groups, known as Jishuken. The former helped suppliers make continuous improvements on the shopfloor without the fear that Toyota's purchasing department would whittle away the gains through immediate price renegotiations. The latter facilitated the sharing and learning of tacit knowledge amongst suppliers. These two types of organizational design led Toyota to accumulate and transfer a broader and deeper set of capabilities to its suppliers in a sustainable manner than Nissan. But these were not very well known aspects of Toyota. Toyota was evidently happy to open up their factories for public viewing, but the more invisible organizational design for supplier development went unnoticed for a few decades.

Thus, successful firms, such as Toyota and Nissan, differ in performance because of organizational design that creates different internal incentives (Carroll, 1996). They also differ because ambiguity in what combination of practices cause success makes imitation difficult. The same framework could be applied to the development of labour unions as organizations. Unions at Toyota and Nissan also pursued quite different strategies, resulting in different structures and capabilities (Sako, 2006a,b).

To summarize, it might appear as though industry has receded in the background with the notion that each firm is unique. But in fact, a historically informed rich analysis of firms may best be conducted within an industry, as it provides an important institutional context for firms to operate efficiently and effectively. Moreover, within-industry studies help to identify unique configurations of practices and institutions both at the firm level (e.g. the Toyota effect above) and at the industry level (e.g. lean production and supporting HR practices). Indeed, a number of studies on the effects of human resource practices on firm performance in automobiles (MacDuffie, 1995; Pil and MacDuffie, 1996) or in steel (Arthur, 1994) shed much light on the nature of the industry concerned.

4. Varieties of industry and interpretation of industry effects

As argued in the previous section, the Industry Studies tradition takes the institutional-historical context of industries seriously. A single industry is chosen for study, not to control for a source of variation, but to further our understanding of specific institutions and configurations of practices in an industry. By extension, multiple industries may be studied, in order to analyze differences in such configurations that underlie the evolution of those industries.³

In testing a general model, it is often the case that industry dummies are used but brushed aside without any discussion of their significance in many econometric studies involving multiple industries (Osterman, 1994; Huselid, 1995; Huselid et al., 1997). What does it take to establish a

³ A very good recent example in the Industry Studies tradition is Berger, S. (2005). *How We Compete*. Cambridge, Mass., MIT Press.

Table 1
Different conceptions of industry

	Labour Economics	Industrial Organization Economics	Technology and Innovation	Resource-based View
What is an industry?	Built around a trade, craft, or skills	Group of firms producing close substitutes	Built around a technology	Activities carried out by a dense network of inter-firm cooperation
Industries differ by:	Technology (factor intensity and factor substitution)	Cost structure, concentration, entry and exit barriers	Nature of technology Lifecycle characteristics	Firms (rather than industries) differ in their resources & capabilities
Institutions that define industry boundaries	Labour unions in some countries Employers' associations Collective bargaining	Cartels and collusion Anti-trust policy Statistical classification	Standards (technical) Patent classification	Firms themselves design their structure, vertical scope, and in turn industry boundaries
Typology/ paradigm in use	Craft, mass, lean production	Monopoly vs perfect competition	'Technology regimes'	Cooperation vs competition
Example of industries	Car assembly plant shopfloor	Product-based markets with different concentration ratios	Producers with a specific set of technologies 'General purpose' technology pose problems with industry boundary	Car manufacturers plus (where network links are dense) dealers, service providers, component and materials suppliers

full explanation of significant industry dummies in econometric analysis? This section argues that the first step in this direction necessitates developing a typology of different conceptions of industry. A specific conceptualization of industry affects not only industry classifications but also the interpretation of industry dummies.

Industries mean different things to different subfields of social sciences (see Table 1). Alfred Marshall famously described the relationship between firms and industries by employing the metaphor of trees in a forest. But how the trees add up to a forest, and how to recognize the beginning and the end of a forest differ from discipline to discipline.

- (a) *Industrial economics* considers an industry as either demand-oriented (a market supplied by producers providing close substitutes) or supply-oriented (defined by the nature of cost and technology). An industry may therefore be defined as a group of firms producing products that are close substitutes for each other. For anti-trust regulation, common buyers, common suppliers, and shared competitive intent are evidently sufficient criteria for setting an industry boundary (McGahan, 2004). This view does not preclude some heterogeneity within an industry, as an industry may contain subgroups, each group composed of firms that are similar to one another along structural characteristics such as the degree of vertical integration and the use of brand (Caves and Porter, 1977).
- (b) *Labour economics* and industrial economics are similar in having an underlying notion that industries differ by some dimensions of technology (such as cost structure and factor

substitution). But they differ in the sort of institutions that are considered to define industry boundaries, namely unions and collective bargaining in labour economics (Freeman and Medoff, 1985), and cartels and anti-trust regulation in industrial economics. This contrast is not surprising, because labour economics had a rather different starting point, treating an industry as productive activity built around a trade or craft (Commons, 1909; Clegg, 1976). Labour economists have looked at work organization, labour relations, and human resource practices, and have focused on specific workplaces such as the assembly plant shopfloor (Katz et al., 1986; Locke et al., 1995).

- (c) Researchers who study *technology and innovation* are a broad church, including Schumpetarians ((Malerba and Orsenigo, 1996), evolutionary economists (Nelson and Winter, 1982), population ecologists (Hannan and Freeman, 1977), and historians of technology (Yates, 2005). They define an industry built around a piece of technology, and are interested in how new industries emerge and old industries die. The S-curve that illustrates the lifecycle of a product or technology translates badly into a diagram for an industry, precisely because innovation tends to happen at the margin of industries, with new entrants disturbing the boundaries (e.g. fabless companies in semiconductor, mobile operators in telecommunications) (Klepper, 1997). There are also ‘general purpose’ technologies such as electricity and ICT, that cut across a range of industries (Helpman, 1998). New technology, such as electronics, threatens the traditional boundary of an industry. Many industries, in reality, remain composite in their base technologies.
- (d) Lastly, researchers in the tradition of the *resource-based view (RBV)* have an intriguing definition of an industry as ‘carrying out an indefinitely large number of activities’ which are bound by a ‘dense network of cooperation and affiliation by which firms are inter-related’ (Richardson, 1972). Each firm is unique, with its distinctive bundle of resources and capabilities. But firms design their own internal structure and organizational boundaries (Santos and Eisenhardt, 2005). By doing so, firms affect not only their organization structure but also industry structure.⁴ In particular, the chosen degree of vertical and horizontal integration affects barriers to entry and concentration. A well-known example is IBM’s decision to outsource to Intel and Microsoft, that triggered the disintegration of the personal computer industry (Fine, 1998; Baldwin and Clark, 2000).

Thus, the definition of an industry depends on the disciplinary lens and the analytical purpose at hand. For anti-trust regulation, common buyers, common suppliers, and shared competitive intent are valid criteria for setting an industry boundary. Other institutions defined by the state, the firm, or labour unions might be relevant in interpreting inter-industry differences in labour markets and work organization. However, industry boundaries are not static and given, as scholars who study technology and innovation know well. Moreover, industry boundaries are best understood as defined by firms that may have differing views on which cooperative links are within, and which are outside, the boundary.

These different conceptions of industry have profound implications for how Industry Studies may best serve to enhance the power of econometric analysis. The rest of this paper gives selective examples to demonstrate how different notions of industry might be evoked to interpret industry dummies appropriately.

⁴ Economists always knew this strategy perspective applied in the long run: ‘in the long run, almost all observable industry-level (structural) variables are affected by firms’ decisions and are thus logically endogenous’ Schmalensee, R. (1988).

In industrial economics, the Structure-Conduct-Performance studies began by analyzing industry-level cross-section data to explain differences in average profits across industries (Bain, 1951). In such studies, industry dummies may be interpreted as capturing regulatory and institutional aspects of an industry which are not picked up by the usual characteristics of market structure such as concentration ratios. With the subsequent availability of firm-level data, within-industry variations in the performance of firms were found to be as great as inter-industry differences (Schmalensee, 1985; Cubbin and Geroski, 1987). This is a manifestation of the general statistical characteristic that within-group variance tends to be larger than between-group variance. Given this fact, there is all the more reason that industrial economists would find Industry Studies analysis useful, to explain variations within a single industry as well as to interpret industry dummies.

In labour economics, there is only equivocal statistical evidence that employee involvement (EI) improves the performance of the firm. More specifically, within-industry studies of EI tend to find positive effects on productivity (Arthur, 1994; MacDuffie, 1995), whilst cross-industry studies do not (Freeman and Kleiner, 2000). One reason for this difference may be that the type of EI that increases productivity varies by industry (Appelbaum et al., 2000). For example, companies in continuous processing industries such as steel may benefit primarily from off-line problem solving teams, while assembly-based industries such as apparel or automobiles benefit more from on-line teams and job rotation. Thus, industry-specific knowledge about work organization and technology help interpret industry dummies, leading to a further analysis that might include an interacted set of specific EI variables and industry dummies.

The conception of industry based on technology and innovation highlights the importance of technological change in interpreting industry dummies in longitudinal studies. For example, a dummy for the auto industry in the 1970s would capture the effect of a high volume industry with relatively rigid mass production technology, i.e. an interaction between size and technology type. By the 1990s, the same dummy captures something different, as it transformed into an industry with smaller volume production and flexible technology.

Another issue from the technology and innovation perspective is raised by Adam Jaffe in his study of the effects of academic research on patent and innovation activities in four industries, namely drugs, chemicals, electronics, and mechanical arts (Jaffe, 1989). His finding that private R&D spending is associated with both patenting and innovative activity in mechanical arts, but only with patenting (and not innovative) activity in electronics may best be explained by resorting to differences in the 'technological regime' of the two sectors (Winter, 1984). The mechanical arts sector is under a 'routinized regime' in which innovation results from information from R&D within the industry. By contrast, electronics is under an 'entrepreneurial regime' in which the underlying technical information that leads to innovation is more likely to come from outside the industry. This study demonstrates that the relevant industry classifications for understanding information flows related to innovation are based on a technology-based conception of industry. Classifications based on end use of products, preferred by industrial economists, are not helpful here.

Last but not least is the resource-based view that an industry is primarily a set of activities which are bound by a dense network of cooperation and affiliation. A specific set of activities may reside initially in different industries. However, with the dis-aggregation of the value chain or the unbundling of corporation functions (Sako, 2006a,b), these services have become bound by common affiliation, and may develop into a new industry. A good case in point is the microelectronics contract assembly sector, populated by firms such as Solectron and Celestica, offering 'manufacturing service' on demand (Sturgeon, 2002). As another example, payroll administration may be part of a consumer products company or a financial services company. But as

independent suppliers begin to provide such business services for companies in various sectors, they develop a common affiliation, leading to a new industry in the making.

In summary, the existing methodology for classifying industries in national statistics draws on a combination of defining an industry by its output and defining it by value-adding intermediate activities. Industry Studies researchers care about, and can study, both the activity being undertaken and the product being manufactured or services being delivered, being sensitive to the emergence of new activity-based industries. In doing so, quantitative regression analysts would do well to interpret *and* explain industry dummies by making the relevant conceptions of industry explicit.

5. Concluding remarks

In conclusion, industries do matter in three ways. First, Industry Studies matter as a methodological approach that favours a contextually rich description as a starting point. The end point, however, is consistent with the aspiration of all economists, to ‘wallow in the data’ as a way of generating new ideas and theories.

Second, industries matter because they provide an institutional context that helps interpret how various practices fit together in a specific industry with implications for performance. After a few decades of analytical shift from industry to the firm, we should consider choosing a single industry for study, not to control for a source of variation, but to further our understanding of specific institutions, historical trajectories, and configurations of practices in that industry.

Third, industries matter because there are a number of different ways in which an industry may be conceptualized, and these differences affect our interpretations of ‘industry effects’ or ‘industry dummies’ in regressions. Industry may be primarily a concept of demand, or a set of value-adding activities. Despite differences in the conception of industry, a common feature of industry across different notions is its institutional details. Consequently, however perfect the model specification, for example about workforce churning and firm performance or the impact of job tenure on career paths, some ‘industry effects’ and ‘fixed effects’ are likely to remain. I argue that we should celebrate these effects and pour more time and effort into interpreting them.

Industries matter in many ways, and should continue to do so for the purpose of understanding specific productive activities in their context, and for the purpose of creating meaningful categories which we can use to compare industries. I hope that the arguments put forward in this paper will inspire more researchers to engage in Industry Studies, and to study phenomena inside the firm in such a way as not to make industry a black box.

Appendix A. Sloan Foundation Industry Centers

Industrial Sector	Website
Airlines	http://web.mit.edu/airlines
Aluminum	http://www.sustainablealuminum.org
Biotechnology	http://www.sbic.umd.edu
Construction	http://www.ce.utexas.edu/org/ccis/
Electricity	http://www.cmu.edu/electricity
Financial institutions	http://fic.wharton.upenn.edu/fic
Food	http://foodindustrycenter.umn.edu
Forest industries	http://www.forestindustries.vt.edu
Industrial performance	http://web.mit.edu/ipc/www

Information storage	http://isic.ucsd.edu
Internet retailing	http://sloan.ucr.edu
Lawyers and professional services	http://www.industry.sloan.org/Lawyers.asp
Managed care	http://www.hcp.med.harvard.edu/Sloan/index.html
Motor vehicles	http://imvp.mit.edu/
Paper	http://www.paperstudies.org
Personal computing	http://www.pcic.merage.uci.edu
Pharmaceutical	http://web.mit.edu/pop1/index.htm
Power metallurgy	http://www.wpi.edu/Academics/Research/PMRC/
Printing	http://print.rit.edu
Semiconductor	http://esrc.berkeley.edu/csm/
Software	http://www.heinz.cmu.edu/swic
Steel	http://www.industrystudies.pitt.edu
Tele-information	http://www.citi.columbia.edu
Textile and apparel	http://www.hctar.org
Travel and tourism	http://www.industry.sloan.org/Travel.asp
Trucking	http://www.isye.gatech.edu/tip

Source: <http://www.industry.sloan.org>.

References

- Appelbaum, E., Bailey, T., et al., 2000. *Manufacturing Advantage: Why High Performance Work Systems Pay Off*. Cornell University Press, Ithaca, NY.
- Arthur, J.B., 1994. Effects of human resource systems on manufacturing performance and turnover. *Academy of Management Journal* 37, 670–687.
- Bain, J.S., 1951. Relation of profit rate to industry concentration: American manufacturing 1936–1940. *Quarterly Journal of Economics* LXV (3), 293–324.
- Bain, J.S., 1956. *Barriers to New Competition*. Harvard University Press, Cambridge, Mass.
- Baldwin, C.Y., Clark, K.B., 2000. *Design Rules: The Power of Modularity*. The MIT Press, Cambridge, Mass.
- Bartel, A., Ichinowski, C., et al., 2004. Using ‘insider econometrics’ to study productivity. *American Economic Review* 94 (2), 217–223.
- Berger, S., 2005. *How We Compete*. MIT Press, Cambridge, Mass.
- Best, M.H., Garnsey, E., 1999. Edith Penrose, 1914–1996. *Economic Journal* 109 (453), F187–F201.
- Brown, C., Haltiwanger, J., et al., 2006. *Economic Turbulence: Is a Volatile Economy Good for America?* Chicago University Press, Chicago.
- Carroll, Glenn R., 1996. A sociological view on why firms differ. *Strategic Management Journal* 4 (4), 237–249.
- Caves, R.E., Porter, M.E., 1977. From entry barriers to mobility barriers: conjectural decisions and contrived deterrence to new competition. *Quarterly Journal of Economics* 91 (2), 241–262.
- Chenery, H., 1975. *Patterns of Development 1950–70*. Oxford University Press, Oxford.
- Clark, C., 1940. *The Conditions of Economic Progress*. Macmillan, London.
- Clegg, H.A., 1976. *Trade Unions Under Collective Bargaining*. Blackwell, Oxford.
- Coase, R., 1937. The nature of the firm. *Economica* 4, 386–405.
- Coase, R.R., 1988. The nature of the firm: origin. *Journal of Law, Economics, and Organization* 4 (1), 3–17.
- Commons, J.R., 1909. American shoemakers, 1648–1895: a sketch of industrial evolution. *Quarterly Journal of Economics* 24, 39–84.
- Cubbin, J., Geroski, P., 1987. The convergence of profits in the long run: inter-firm and inter-industry comparisons. *Journal of Industrial Economics* XXXV (4), 427–442.
- Eisenhardt, K.M., 1989. Building theories from case study research. *Academy of Management Review* 14 (4), 532–550.
- Feldstein, M., 2000. The NBER — Sloan Project on Productivity Change. American Economic Association. www.nber.org/sloan/AEAintro.html (accessed 10 October 2006).
- Fine, C.H., 1998. *Clockspeed: Winning Industry Control in the Age of Temporary Advantage*. Perseus Books, Reading, Massachusetts.
- Freeman, R.B., Kleiner, M.M., 2000. Who benefits most from employee involvement: firms or workers? *AEA Papers and Proceedings* 90 (2), 219–223.

- Freeman, R.B., Medoff, J., 1985. *What Do Unions Do?*
- Gomory, R., 2005. *Industry Studies: An Observational Science*. Industry Studies Annual Conference, Cambridge, Mass. USA.
- Hamermesh, D.S., 2006. *Fun with Matched Firm-Employee Data: Progress and Road Maps*.
- Hannan, M.T., Freeman, J., 1977. The population ecology of organizations. *American Journal of Sociology* 49, 929–964.
- Helper, S., 2000. Economists and field research: you can observe a lot just by watching. *American Economic Review* 90 (2), 228–232.
- Helpman, E. (Ed.), 1998. *General Purpose Technologies and Economic Growth*. MIT Press, Cambridge, Mass.
- Holweg, M., 2007. The geneology of lean production. *Journal of Operations Management* 25 (2), 420–437.
- Holweg, M., Pil, F.K., 2004. *The Second Century*. MIT Press, Cambridge, Mass.
- Huselid, M.A., 1995. The impact of human resource management practices on turnover, productivity, and corporate financial performance. *Academy of Management Journal* 38 (3), 635–672.
- Huselid, M., Jackson, S.E., et al., 1997. Technical and strategic human resource management effectiveness as determinants of firm performance. *Academy of Management Journal* 40 (1), 171–188.
- Jaffe, A.B., 1989. Real effects of academic research. *American Economic Review* 79 (5), 957–969.
- Katz, H., Kochan, T., et al. (Eds.), 1986. *Transformation of American Industrial Relations*. Basic Books, New York.
- Klepper, S., 1997. Industry life cycles. *Industrial and Corporate Change* 6 (1), 145–181.
- Kuznets, S., 1930. *Secular Movements in Production and Prices*. Houghton Mifflin, Boston, Mass.
- Lazear, E.P., 2000. Performance pay and productivity. *American Economic Review* 90 (5), 1346–1361.
- Locke, R., Kochan, T., et al. (Eds.), 1995. *Employment Relations in a Changing World Economy*. MIT Press, Cambridge, Mass.
- MacDuffie, J.P., 1995. Human resource bundles and manufacturing performance: organizational logic and flexible production systems in the world auto industry. *Industrial and Labor Relations Review* 48 (2), 199–221.
- Malerba, F., Orsenigo, L., 1996. The dynamics and evolution of industries. *Industrial and Corporate Change* 5 (1), 51–87.
- Marshall, A., 1879. *The Economics of Industry*. Macmillan, London.
- Mason, E., 1939. Price and production policies in large-scale enterprise. *American Economic Review* (Suppl. 29), 61–74.
- McGahan, A.M., 2004. *How Industries Evolve*. Harvard Business School Press, Boston, Mass.
- McGahan, A.M., Porter, M.E., 1997. How much does industry matter, really? *Strategic Management Journal* 18, 15–30 (Special issue on Organizational and Competitive Interactions).
- Nelson, R.R., 1991. Why do firms differ, and how does it matter? *Strategic Management Journal* 12, 61–74.
- Nelson, R.R., Winter, S.G., 1982. *An Evolutionary Theory of Economic Change*. Harvard University Press, Cambridge, Mass.
- Osterman, P., 1994. How common is workplace transformation and who adopts it? *Industrial and Labor Relations Review* 47 (2), 173–188.
- Penrose, E., 1959. *The Theory of the Growth of the Firm*. Basil Blackwell, Oxford.
- Pigou, A.C., 1925. In Memoriam: Alfred Marshall. *Memorials of Alfred Marshall*. A. C. Pigou. Macmillan, London.
- Pil, F.K., MacDuffie, J.P., 1996. The adoption of high-involvement work practices. *Industrial Relations* 35 (3), 423–455.
- Piore, M.J., 1979. Qualitative research techniques in economics. *Administrative Science Quarterly* 24 (4), 560–569.
- Powell, T.C., 1996. How much does industry matter? An alternative empirical test. *Strategic Management Journal* 17 (4), 323–333.
- Richardson, G.B., 1972. The organization of industry. *Economic Journal* 82, 883–896.
- Rosenberg, N., 1994. *Exploring the Black Box*. Cambridge University Press, Cambridge.
- Rostow, W.W., 1960. *The Stages of Economic Growth*. Cambridge University Press, Cambridge.
- Rumelt, R., 1991. How much does industry matter? *Strategic Management Journal* 12 (3), 16.
- Sako, M., 2004. Supplier development at Honda, Nissan and Toyota: comparative case studies of organizational capability enhancement. *Industrial and Corporate Change* 13 (2), 281–308.
- Sako, M., 2006a. Outsourcing and offshoring of business services: implications for productivity. *Oxford Review of Economic Policy* 24 (4), 499–512.
- Sako, M., 2006b. *Shifting Boundaries of the Firm: Japanese Company - Japanese Labour*. Oxford University Press, Oxford.
- Sako, M., Helper, S., 1998. Determinants of trust in supplier relations: evidence from the automotive industry in Japan and the United States. *Journal of Economic Behavior and Organization* 34, 387–417.
- Santos, F.M., Eisenhardt, K.M., 2005. Organizational boundaries and theories of organization. *Organization Science* 34, 387–417.
- Schmalensee, R., 1985. Do markets differ much? *American Economic Review* 75, 341–351.
- Schmalensee, R., 1988. Industrial economics: an overview. *Economic Journal* 98, 643–668.
- Schumpeter, J.A., 1939. *Business Cycles*. McGraw Hill, New York.
- Sturgeon, T., 2002. Modular production networks: a new model of industrial organization. *Industrial and Corporate Change* 11 (3), 451–496.

- Teece, D., Pisano, G., 1994. Dynamic capabilities of the firm: an introduction. *Industrial and Corporate Change* 3 (3), 5.
- Wernerfelt, B., 1984. A resource-based view of the firm. *Strategic Management Journal* 5, 171–180.
- Winter, S.G., 1984. Schumpeterian competition in alternative technological regimes. *Journal of Economic Behavior and Organization* 5, 287–320.
- Womack, J.P., Jones, Daniel T., Roos, Daniel, 1990. *The Machine that Changed the World*. Harper and Row, New York.
- Yates, J., 2005. *Structuring the Information Age: Life Insurance and Technology in the Twentieth Century*.