School of Economics

Working Paper 2005-04

Towards a Relational Economics: Methodological Comments on Intellectual Property Strategy, Industrial Organisation, and Economics

Eran Binenbaum

School of Economics
University of Adelaide University, 5005 Australia

ISSN 1444 8866

Towards a Relational Economics

Methodological Comments on Intellectual Property Strategy, Industrial Organisation, and Economics[1]

This version: June 4, 2004

by Eran Binenbaum
University of Adelaide

Comments more than welcome at eran.binenbaum@adelaide.edu.au

1. Introduction

This paper sketches elements of what it intends to be an improved methodology for theoretical and applied economic analysis, and applies these to the area of economics of intellectual property strategy, which may be viewed as a subset of the field of industrial organisation.

A core question addressed here is: Can mainstream economic methodology be improved, and if so, how? In the process, we shall also consider the following questions: Is there much scope for improvement of intellectual property strategy? Is such improvement valuable? Can economics, and in particular the field of industrial organisation, help achieve it?

The improvements in economic methodology that are suggested in this paper may be summarized under the heading of *relational economics*. An important aspect of this methodology is an emphasis on inter-organisational relations. Industrial organisation is perhaps the field of mainstream economics that traditionally focuses most clearly on these relations. It will be argued below that this field is currently undergoing a process of 'natural' expansion of its scope – an expansion which will enable it to take centre stage in the emerging methodology of relational economics.

[1] Many thanks are due to Piet Beukman, Peter Hall, Magnus Holmen, Phil Killicoat, Tin Nguyen, Jason Watson, Kim Weatherall, and Beth Webster, for ideas, interviews, conversations, and email exchanges. Research assistance from Jason Gordon, Michael Heim, and Nikki Macor is gratefully acknowledged. Any responsibility for errors is solely mine.

Thus, this paper aims to serve the triple purpose of contributing to economic methodology; to the meta-theory and methodology of industrial economics – and of the economics of intellectual property strategy in particular; and to intellectual property strategy itself, which is used as an exemplar of the shortcomings of mainstream economic methodology. However, the paper's emphasis will be positive rather than negative; it focuses on the scope for improvement rather than on the development of critiques.

2. The Gulf Between Economics and Management Studies

What is the future of economics? This is not a futile question, but rather one that may spur innovative economic research and may thus hasten the arrival of that future. The discipline of economics is changing. Four trends are particularly worthy of mention.

First, interest in departures from *Homo Economicus* – defined as the set of behavioural assumptions that underpin traditional neoclassical microeconomics – has increased among economic modellers. The pioneering work of Simon (1982), followed by advances in behavioural and experimental economics, has resulted in a widespread belief among mainstream economists that quasi-rationality is a better modelling assumption in many economic settings than perfect rationality (Thaler 1994). Various schools of thought in social economics have long argued that Adam Smith's dichotomy between self-interest which is mainly operative in the marketplace – as well as in economic life more generally – and concern for others, which, according to Smith, is – or ought to be – more important in other realms of life (Smith 1759; 1776), is unwarranted (Binenbaum 2004a; Lutz 1999; Lux 1990). The interest in departures from the self-interest assumption has increased in mainstream economics. It is now considered cutting-edge mainstream economics to incorporate insights from mainstream psychology and sociology into contract theory, market analysis, finance, and game theory (Akerlof 1984; Rabin 1993, 1998). For example, corporate culture – relevant, for instance, to the compatibility of prospective partners, and hence to IPS – can be subjected to game analysis (Hermalin 2001). The trend to make economics more sophisticated in a cognitive and motivational sense has been confirmed and reinforced by recent Nobel prizes for Akerlof, Kahneman, and Smith,

as well as Rabin's recent Clark Medal, and has enhanced the discipline's real-world relevance.

Second, improved econometric techniques and vastly increased data supplies and software capacity have also increased economists' capacity for bridging the gap between theory on the one hand and empirics and policy or management advice on the other.

Third, economic analysis is witnessing an amazing proliferation of models to analyse a wide variety of difficult topics such as choice under uncertainty, strategic interaction, research-and-development (R&D) collaboration and consortia, intellectual property (IP) licensing, etc. etc. Economists need to 'sell' their work and adapt their analyses for real-world relevance while improving rigour to elicit peer admiration. These complex incentives are perhaps the main driving forces behind the current acceleration in the discipline's progress in terms of quantity, quality and scope of research output.

This is closely related to the fourth and final trend that I wish to highlight. The connection between economics and business studies is being strengthened through economists' increased interest in entering the firm's 'black box' and business schools' and management scholars' desire to add theoretical and empirical rigour and insights from game theory and contract theory to their research portfolios and toolkits. This connection has long been rather weak, with economists and management scholars sceptical or downright dismissive of each other's methodologies. In fact, the common institutional separation between economics and management studies into separate academic departments does not make sense according to practically any definition of economics (Binenbaum 2002). Business schools are keen to hire economists. Even more tellingly, leading consulting firms like McKinsey's require their management strategy experts to take crash courses in game theory (pers. com. Phil Killicoat). (Altough it is equally telling that these are only crash courses.) The firm is at the core of production, which in turn is at the core of market-based economic systems, and the 'black box' treatment of a firm as a profit-maximising machine is no longer the undisputed core modelling assumption concerning firm behaviour in mainstream economics (Simon 1982). As the axiom of perfect profit maximisation clashes with the neoclassicals' beloved tenet of methodological individualism, its footing on the slippery slopes of economic analysis is even less sure than its counterpart in economic analysis of individual behaviour – perfect

rationality. This is certainly recognised by most mainstream economists, and a vast literature applying the neoclassical and game theory apparatus to intra-firm processes has emerged.

However, the level of cross-fertilisation between economics and business studies, while having risen, is still sub-optimal. There is still a vast methodological rift between orthodox economists' modelling approaches and purported positivism on the one hand and the eclecticism and methodological pluralism shared by business schools, real-world managers and heterodox economics on the other. Mainstream economists tend to have a poor understanding of their own methodology (Hausman 1992), but their *de facto* methodology is very far removed from that of, say, the field of strategic management (with Michael Porter, who is often considered its leading practitioner, being somewhat atypical in that he has a firm grounding in mainstream microeconomics). This, combined with economists' poor marketing skills, may have resulted in a continuing under-appreciation of the potential contributions of economics to strategic management.

At the same time, mainstream economics could benefit from some version of the *Gestalt* approach that is characteristic of management studies. Due to the dismal science's preference for theoretical and empirical rigour – i.e., mathematical and statistical sophistication – peers who produce parsimonious and aesthetical models and obtain compelling results are highly regarded in the profession. Much less emphasis is given to inter-field intra-disciplinary as well as inter-disciplinary cross-fertilisation. Thus, mainstream economics may be suffering from misdirected specialisation. To be sure, many economists realise the importance of eclecticism and are willing to look at any sources to find stylised and modellable facts. But they lack a methodology for rapidly accessing a wide variety of fields and disciplines. Since, in the absence of such a methodology, doing so would require amounts of research assistance that are out of reach for the vast majority of academic economists, they have to make do with cursory searches and gut intuition to get their modelling input. Multidisciplinary work among academics would be an alternative, but here the methodological, conceptual and cultural gaps between the disciplines – in particular their mutual prejudices and under-appreciation – constitute significant obstacles. The gaps between the fields of economics are not as great, but here, again, tools for rapid access to multiple bodies of literature are lacking. Even within a field, say law-and-economics, there are many distinct sub-fields that may have little interaction. And, as

will be further argued below, this lack of interaction may be sub-optimal given the untapped potential for rapid access to literatures one is unfamiliar with.

In summary, mainstream economics is still – though less than before – suffering from insufficient cross-fertilisation with other disciplines and also – perhaps even more than before, due to rapid increases in the sheer amount of research output – among fields and probably even sub-fields of economics. I submit that the root cause[2] of these problems can be found in economists' *de facto* methodology of parsimonious modelling that emphasises the quality of modelling technique over the quality of modelling input, and in particular in this methodology's neglect, ignorance, or implicit disdain of systemic, taxonomic and cognitive considerations. A way forward for economics is to become better integrated with management studies, but this requires an improved methodology that integrates economic insights into a larger framework and makes them accessible to management experts. If this meta-theoretical research program is realised, which I trust it will, both economics and management studies will benefit, with the latter becoming what it logically ought to be, namely a field of economics, and the former fully rather than half-heartedly adopting the eclecticism of the latter without surrendering any rigour (although it is always good to have heterodox economists around who do not believe in the mainstream notions of rigour), which it probably never would. As will be argued below, an improved methodology would actually, in a sense, be more rigorous than the existing practices.

3. The Economics of IP Strategy As Exemplar

What would this improved methodology look like? I shall only sketch some of its more salient points in this paper, with many blanks to be filled in elsewhere.

Rather than discuss methodology in the abstract, let us consider a concrete sub-field of economic research, namely the economics of IP strategy (TEIPS; IPS). I selected this field in particular – as a case study for the purpose of sketching the new methodology – for the following reasons. First, it is exemplary of a sub-field to

[2] This paper is not history-of-thought paper, which is why I use the word "root cause" instead of rendering a historic account of how economic methodology emerged. It is a root cause only for the purposes of this paper.

which the conventional economic methodology is ill-suited – as will be argued below. Second, it is at the core of understanding the knowledge economy, and thus likely to become more important relative to other sub-fields of economics. Third, IPS is a sub-field of strategic management. Fourth, it is an area with which I am fairly familiar, having written two of my Ph.D. dissertation chapters on IPS (which led to three publications: Binenbaum et al. 2003, 2004; Binenbaum 2004b). Fifth, as explained in the next section, it is highly suitable to be used as an examplar for the development of a new methodology because it clearly lacks a hard core of a small set of canonical choice problems. Sixth and finally, TEIPS is part of this paper's topic: I would hope for the paper to contribute to the meta-theory and practice of IPS.

4. Irreducible complexity as a distinctive feature of the economics of IPS

Readers unfamiliar with economics or critical of mainstream microeconomics may argue that irreducible complexity is a feature of economic reality (see, for instance, practically any book written by Israel Kirzner). The position that I'd like to defend is not quite that radical. Various fields of economics, including for example core neoclassical microeconomics, labour economics, industrial organisation, and finance, are centred around a small number of *canonical choice problems*: for instance, in the case of core micro theory, the textbook consumer and firm choice models. These are then the building blocks for analysing systemic interactions, in particular markets. The point here is that such canonical choice problems are lacking in the economics of IPS, because there is no way of cutting down the key choices to compelling parsimonious models. Two of the key choices, in the case of IPS, are (a) an R&D organisation's response to its need for a proprietary technology input, and (b) whether or not to take out IP on a given research result. Let's consider each in turn.

Consider organisation X – a for-profit or nonprofit organisation that is active in R&D. Suppose a member of X's research staff or legal team notifies the relevant manager or CEO that an enabling technology needed for a planned R&D project is

actually owned by somebody. Potential strategies for dealing with this problem include the following.[3]

1. X may negotiate for a license as a gift (in some cases relevant for nonprofits) or in exchange for royalties.
2. X may unilaterally access the technology - potentially leading to legal conflict.
3. X may contest the IPR either in court or at the IP-granting agency.
4. X may attempt to 'invent around' the technology, possibly leading to a valuable asset (in exchange or collaborative relations) that may compete with the original input.

Note that even when any of the potentially adversarial moves (the second, third or fourth options) are not carried out, they may still play a role as implied, perceived, or explicit threats, in combination with one or more of the other options.

5. X may initiate an R&D partnership with the input's owner; use rights to the input may be part of the partnership's package deal.
6. X may join or initiate a consortium or patent pool. The consortium may include other parties interested in the proprietary input, and may focus on the input or have some broader theme.
7. If the input is critical and unavailable, X may abandon the R&D project.
8. X may abandon the R&D program, but catalyse or contract with other organisations better able to deal with the input problem to undertake the R&D program instead. This may involve the other organisations' use of any of the first six options.
9. Funding opportunities might be available in combination with some of the aforementioned options. For example, in the case of an international nonprofit, perhaps the home government of the input's owner might be willing to help subsidise use of the input.
10. In the case that X is a for-profit firm, a merger with or acquisition of the input's owner might solve the problem.
11. Institutional solutions at a more general level than those mentioned so far may be found, for example through international treaties or lobbying efforts.

While the list does not completely overlap nonprofits and for-profits, we do have about 10 alternatives in either case. For each of these alternatives, we can

[3] Variations of this example have been used in Binenbaum, Pardey & Wright (2001), Binenbaum (2004), and Binenbaum & Pardey (2004).

identify subsets of nested choices. The result is a decision tree and, if other players' actions are taken into account, a game tree. No matter which branch, sub-branch, sub-sub-branch, etc., is followed, at some point we arrive at a situation which can actually be mathematically modelled as a game. However, the initial problem, which is easily enough posed in a few words – "the need for a proprietary input" – cannot be fruitfully addressed by a full game model, as it is too complex. And there is no compelling way of assuming away enough options and other complicating factors so that the problem can be reduced to yield a parsimonious model that can serve as a canonical choice problem.

Next, consider the choice whether or not to seek IP protection. Abstracting from multiple jurisdictions and from issues of timing, this can be reduced to a binary choice problem. As the direct costs are relatively unproblematic, let's focus on the benefit side of this choice. A number of motives – mostly well-known in the literature – for seeking IP protection can be discerned.

Clarification of Rights. IP serve a clarifying role and may reduce transaction costs, for example by clearly establishing partners' technological contributions in a collaboration.

The Defensive Motive. IP can prevent others from appropriating the technology.

The Direct Revenue Motive. The IP holder may license the technology in exchange for royalties.

Technology Transfer and Development Incentives. A licence may give a partner firm incentives for downstream development and commercialisation, thus realizing the potential value of research results.

The "Bargaining Chip" Motive. IP can be used to strengthen its holder's bargaining position in collaborations, patent pools, and consortia.

The Threat Motive. The threat of infringement lawsuits may make other players behave in ways compatible to the IP holder's objectives.

The Signalling Motive. IP may demonstrate its holder's innovative capability and enhance its reputation, making it a more attractive partner.

Control of Technology and Liability. The control of a technology afforded by IP may enable its developer to prevent others from using the technology in ways inimical to the developer's objectives, for example by exposing the developer to liability lawsuits.

Notice that each motive is based on some sort of games, i.e. strategic interaction. However, these games are all different and cannot be neatly combined into a single model. Thus, again, we have elements of the original problem which lend themselves for modelling, but a canonical choice problem cannot be constructed.

On the input side, we looked at the different options for dealing with a problem, and didn't even talk about the associated costs and benefits. On the output side, we simplified the problem to a binary choice, but then identified a number of disparate potential categories of benefits. In either case, a canonical choice problem is unavailable. Having dissected the choice problems on the input and the output side in this way, let's move up one level. We need to combine all such input and output choices of a decision-making unit into a single portfolio problem. Note that in financial economics we have very neat portfolio models that serve as the field's canonical choice problems. These concern investment under uncertainty, as do R&D choice problems (which are closely connected to IP problems). However, while the latter exhibit uncertainty and portfolio complications similar to the former, in addition they feature complicated strategic interactions – as discussed – that cannot be fruitfully ignored.

As a final element of the irreducible complexity of IPS, consider the interaction between each player and the overall system. Players who understand the innovation system they are part of will make better-informed IP choices. However, this implies that we have one big game, in which the players' strategies and expectations are simultaneously determined through some type of dynamic solution concept. As will be obvious to anyone familiar with game theory, such an analysis is most certainly *not* feasible.

5. Why should we care?

If there is a disconnect between strategic management of IP and economics, why should IP strategists care? Do economics and game theory have anything valuable to offer? The answer is, they do. Game theory is none other than the logic of strategic interaction, and games reflect real-world patterns.

For example, suppose you are the manager of a small biotech firm negotiating the licensing of your technology to a multinational for whom it is useful in

conjunction with other technologies already in its portfolio. Thus, for you, valuation of the technology is not a relatively straightforward exercise in market assessment. Consequently, the multinational possesses superior information about how valuable it considers the technology to be, and it is not going to volunteer the information. In such a situation, you may benefit from an understanding of the literature on revelation mechanisms (Salanie). With the proper bargaining strategy, you may elicit actions from the other side that implicitly reveal their preferences. This may allow you to reap a far greater share of the value generated by the deal than you would otherwise.

This example concerns essentially a zero-sum game: bargaining about the division of a given (but, to you, unknown) total net benefit. Perhaps even more compelling are examples of the usefulness of insights emanating from games that exhibit potential Pareto improvements. For example, consider a situation where two AIDS researchers each may either share or not share their data with the other. Assume that the two data sets are synergistic: their combined value is greater than the sum of their separate values. "Value" in this case may depend on the likelihood and speed of finding an AIDS cure. By sharing your data, you benefit the other researcher as well as patients, but you also reduce your own expected net benefits, as the other side captures part of your market (for a firm) or publication potential (for an academic). This situation can be viewed as a Prisoners' Dilemma with additional externalities, where the Pareto-optimal solution is for both researchers to share their data, but in the unique Nash Equilibrium, neither does. As a result, everyone – researchers and patients – is worse off than could be the case. This may well reflect a common pattern in real-world interactions between R&D units. Such game analysis might also point to ways to resolve the dilemma, perhaps through IP arrangements that change the incentive structure or allow credible commitments, so that both researchers in fact do share their data and the medicine is discovered sooner, saving lives.

The Folk Theorem is another important result. Partnerships can be viewed as cooperative equilibria in multi-stage games. What the Folk Theorem says is that when the time horizon in such games is unclear, a wide range of equilibria may be sustainable. This means that players may be stuck in a 'low' equilibrium and have the potential, with some improved partnership arrangement, to move to a higher one. Again, such insights may well be applicable to real-world situations.

There are many more such examples where game theory may help managers better understand strategic interaction. No wonder that business schools are increasingly serious about incorporating applied game theory courses into their MBA programs, with the top schools being the innovators.

Generally, incentive problems are an important source of potential Pareto improvements and therefore may provide rationales for government policy or business opportunities, following the logic of Coase (1960). Categories of incentive problems include market power; externalities, including public goods; problems associated with asymmetric information, including moral hazard (hidden actions), adverse selection (hidden characteristics where the ignorant player moves first) and signalling (hidden characteristics of the player who moves first); distortion and misinformation to disadvantage rivals; Prisoners' Dilemmas; game dynamics, including hold-ups, commitment problems, and punishment strategies; and incentive problems associated with cognitive limitations (for example, the common over-estimation by organisations of their own capabilities may hamper partnerships – Heller & Eisenberg 1998) Any time there is inefficiency due to an incentive problem, there may be scope to reduce the inefficiency and make the parties involved better off. This may, in fact, be an under-appreciated source of business opportunities, as managers may generally not be aware of some of these concepts.

There are many hybrids of types of incentive problems. For instance, the "tragedy of the anticommons" (Heller & Eisenberg 1998), which is the consequence of there being too many property rights, with many pieces of complementary IP assets dispersed among various owners, is an amalgam of many of these incentive problems.

6. Meta-Modelling of Relations

Given that insights from game theory are relevant to IPS, and given the latter's irreducible complexity, there is a gap between the two which it is worth bridging. How to do this? For this purpose, I propose an approach that may be called meta-modelling of relations (MEMOREL). This is less pretentious than it sounds. Meta-modelling just means organizing models into a larger system. As the subgames that are amenable to modelling all form a part of the same system – and even need to be combined to understand a single individual choice problem – and as these cannot be

combined into a single big model, a feasible strategy is to organise them using a taxonomic effort. In particular, the relevant games can all be classified using a taxonomy of inter-organisational relationships. Relevant types of relationships include gift, exchange, theft, adversarial relations including competition, coordination including collusion, collaboration (joint production), communication, command and ownership, catalysis (the provision of incentives), and discouragement (disincentives). There is some overlap between these types, and – just as the incentive problems – they often form hybrids. For example, two organisations may have a relationship with both competitive and collaborative elements. If we take the above example on the need for a proprietary input, each of the options identified leads into some combinations of these relation types. When we analyse a specific relationship, these various types provide a valuable checklist. Is there a gift element in the relationship, an exchange element, and so on (Binenbaum, Pardey & Wright 2001)? As an organisation makes its IPS choices, with each choice it will have to take into account the relational implications of its prior choices. If one choice yields a competitive relationship with organisation A, this might affect another choice that would generate a collaborative relationship with A. Thus we should think of organisations having portfolios of relationships as well as portfolios of IP assets.

The taxonomy of relationships may help organise insights from the literature so that they can be accessed for IPS purposes. For example, when contemplating a choice that would lead to a relationship that has both competitive and collaborative elements, a literature search system should be able to pick this up and lead the analyst quickly to references such as Hamel, Doz & Pralahad (1989) or Fusfeld & Haklisch (1985).

A decision tree mapping would link the alternative strategies in a choice problem such as 'needing a proprietary input' to analyses of subgames amenable to rigorous analysis. Thus a sub-sub-sub-branch of the tree might be the decision to settle or not to settle patent litigation. Here, one could be directed to a reference such as Somaya (2003). To give another example, in the same problem, a research joint venture may occur as a sub-branch of the inventing-around or partnering-with-IP-owner strategies. In either of these sub-branches, we might be directed towards a reference such as Hernan et al. (2003). To understand the game, we need to understand the subgames.

MEMOREL is closely related to meta-theory. Transaction cost economics (Williamson 1975, 1985) is concerned with the contrast between markets (exchange, competition) and hierarchies (command); industrial organisation, with competition versus collusion; and the innovation systems literature (Nelson 1993), with collaborative networks. This means that to understand a single choice problem, which as we saw involves multiple relationship types, we may need to access several of such paradigms and fields.

As the innovation system in which IP strategists operate is so complex, it is a worthwhile exercise just to figure out what's there. What would constitute a complete description of the system? In doing so, it is helpful to realise that we do not just need the nodes of the system (the players) but also all of the different types of relationships between them. This is where some analyses go wrong. For instance, a recent comparative OECD study on national innovation systems in biotechnology used exclusively data on collaborative relations, ignoring all other types of relations between the players.

In addition to relation types and decision trees, I suggest that MEMOREL would also involve the use of a number of additional taxonomies and concepts. One of these is the list of benefits of IP ownership. At least three of the items on this list each have a separate body of literature devoted to them: the defensive use of patents; royalty generation; and the use of patents as bargaining chips (see Somaya 2002 and references cited therein). Clearly, these literatures are complementary, especially in the sense of their insights needing to be combined in order to analyse a single decision (whether or not to seek IP ownership, for example).

Game theory does not require rationality, self-interest, profit maximisation or exogenous preferences. As it is a logic of strategic interaction, the requisite components to fully describe a game can also be used as building blocks for systemic description. Thus, additional taxonomies that can be used for MEMOREL include those of players, objectives, choice variables (including types of IP), technologies, information structure and flows, and types of incentive problems. Players, objectives, technologies, choice variables and information structure are components of game models. The better we manage to specify them, the better we understand the strategic interaction, even when we don't explicitly model a game.

Technologies are, of course, critical to the system. The global IP system, in particular the patent system, allows for the identification of separate chunks of

technology. These are owned by players in the system and also have relationships between them. Technologies can be complements or substitutes, and some technologies enable the development of further technologies. These relationships between technologies are closely related to the relationships between the players (Teece 1986). For instance, Graff et al. (2003) explain the recent wave of merger activity in the life sciences by reference to the companies' need to combine complementary IP assets.

Another key element of MEMOREL is a checklist of incentive problems, as discussed above.

With all these interlocking elements in place, we can hope to apply economic insights to understanding the innovation system and design appropriate IP strategies.

The result would be a coherent structure of game trees and taxonomies that would incorporate myriad contributions from the literature. With the help of such a structure, an analyst would be able to quickly identify most of the known relevant aspects to an IP-related decision and have access to insights that would otherwise be too disparate and difficult to locate. For instance, following up on the litigation settlement example, someone interested in the choice of litigation vis-à-vis other options of dealing with the need for a proprietary input, could access a MEMOREL schematic posted on the Web, and, following the game tree, quickly locate Somaya (2003) and that article's insights. According to the game-theoretic principle of backward induction, players solve games backwards, starting from the last subgame. Thus, in weighing whether to litigate or pursue some other option, players should anticipate the possibility of settlement of litigation.

In addition, the structure would facilitate the design of information systems that support IP decisions. Having identified all relationship types between players, we can be more confident that we won't overlook important data types that would affect our analyses. The empirical and practical challenges of a fully informed IPS are daunting. However, rapid improvements in information technology allow for the use of ever larger and more complex datasets in management information systems. In summary, due to improvements in data systems, changes in economics and game theory, and historical under-use of economic insights by IPS practicioners, there is scope for improvement in IPS.

MEMOREL would lend itself well to be integrated with existing methods for the innovation management process, such as the Delphi method (Betz 1996),

brainstorming, and scenario planning. There may have been a perception among management experts that mainstream economic methodology sacrifices too much realism to produce practically applicable insights. However, what microeconomic and game models and the associated empirical tests do is identify patterns (such as incentive problems) that are intermittently relevant to real-world situations. These models don't claim to describe laws, but rather provide tools that enhance understanding of strategic interactions and potential efficiency improvements. They are no substitute for, but complements to, analysts' intuitions. Their insights will become accessible and applicable for managers and lawyers only if they are organised in a user-friendly way, in an encompassing coherent structure. It is only then that their potential for improving IPS may be realised. Once a MEMOREL source is in place, it can be used to help structure the process of IPS design. Especially if supported by attractive visual representations, MEMOREL would help IP strategists develop Gestalt intuitions, i.e. intuitive integrative insights into the system.

In summary, MEMOREL could lend more structure and completeness to IPS at the conceptual, analytical and empirical levels. To be sure, much about MEMOREL still needs to be worked out. But, thinking about economic methodology, one realises that the need for such a methodology is almost a historical necessity, as will be argued in the next section.

7. The Fundamental Methodological Transformation

The *de facto* methodology of the discourse in economics is centred around a hierarchy of canonical choice problems, with the general microeconomic model of consumer and producer behaviour at the top of the hierarchy. At the next level are canonical choice problems for major fields of economics such as finance or industrial organisation. There may be one or more levels lower down, with economists trying to develop canonical choice problems (including multi-agent choice problems, *i.e.* games) for each sub-field, sub-sub-field, etc. Mainstream economists face powerful incentives to do so. Once a distinct area of research emerges, "you" – if you are willing to put yourself in the shoes of a mainstream academic economist –, being interested in contributing to that area, would almost die for producing the future canonical choice model for that area. Hence, if after decades of attempts, such a

canonical choice model is absent from an area of economic research – in particular one with such obvious relevance and funding potential as TEIPS – that may simply mean that it is intrinsically unavailable. And, in the case of TEIPS, it probably is. That is a good thing, because due to the disciplinary dynamics of mainstream economics, economists are arguably addicted to generating and reinforcing canonical choice problems.

The compelling power of canonical choice problems has been undermined by all of the aforementioned trends in economics: the erosion of *homo economicus*, which used to be the foundation *par excellence* for canonical choice models; the improved econometrics, computing power, and data provision, which reduce the need for parsimony; the explosion of modelling creativity, which is slowly co-evolving with an emergent free-spirited modelling culture that prizes those papers that break free from the mould of pre-existing exemplars; and, finally, mainstream economists' increasing dissatisfaction with the black-box approach to the firm, which used to be so helpful precisely because it solidified one of microeconomics' two core canonical choice problems, namely that of the profit maximising firm.

Economics is therefore ripe for abandoning its obsession with canonical choice problems, and for a fundamental methodological transformation. That transformation will have to accommodate the increasing need to address systemic complexity and will need to be conducive – rather than inimical – to the intra- and interdisciplinary inspirational exchange of ideas. It will therefore have to get serious about considering the question of what constitutes a full systemic description. It will also have to acknowledge and incorporate the simultaneous existence – even within a single choice problem – of multiple relationship types. Mainstream microeconomics, by its nature, considers itself as being virtually identical to game theory, with the absence of strategic interaction – as in the textbook account of perfect competition – as a special case. As game theory is about modelling relationships, economics will have to come to grips with their inherent complexity. Moreover, in providing systemic descriptions, the nodes – decision-making units – need to be somehow connected, and it is critically important to understand the various ways in which they can be connected. In a nutshell, economics is in need of a move towards MEMOREL – a meta-theoretical structure which combines systemic thinking and relational thinking, and which closely follows the logic of game theory. If the profession

accomplishes this fundamental transformation, its contribution to and standing in society are likely to be further enhanced.

8. Limited Understanding of IPS

There is another reason why MEMOREL offers TEIPS - and therefore IPS – substantial scope for improvement: It may assist in rationalising the process of strategy design.

The quasi-rationality of economic agents is by now a well-accepted insight in economics (Thaler 1994). Quasi-rationality is not random but follows certain patterns. The list of cognitive errors and judgemental biases is long. These include self-overestimation; a bias towards information that is easily accessible from memory; anchoring, the tendency to give information acquired at an early stage a special status; preference reversals when (what ought to be) irrelevant alternatives are added to the choice set; a failure to ignore sunk costs; a failure to consider opportunity costs; animal spirits in financial markets; etc. etc. (Shiller 2001; Frank 2002; Heller & Eisenberg 1998). An important point to make here is that people do have a capacity to learn and become more rational, i.e. to come closer to actually pursuing their own objectives. For example, people can learn about ignoring sunk costs and considering opportunity costs.

All this applies to any kind of economic behaviour, including IPS management. Szakonyi (1996:14.8-9) reports that "few R&D organisations have an R&D strategy – or have established the preconditions required for developing and R&D strategy." Davis & Harrison (2001) document the existence of five different levels of awareness of IPS in firms: defensive (the lowest level); a focus on cost control; a focus on profit generation, but limited to profit centres; strategically integrated IPS; and visionary IPS (the highest level). Each level builds on all lower levels. This demonstrates that rational IPS is by no means a given and that rationalisation and learning are key aspects of IPS.

These considerations strengthen the case for there being much scope for improvement in IPS, and thus the case for the value of MEMOREL. Consultants and managers tend to be highly intelligent people and put great faith into their own gut feeling. But the evidence of behavioural economics indisputably indicates that human

intuition, while performing impressively in pattern recognition, simultaneously suffers from systematic shortcomings that bias such recognition. The logic of human learning suggests that these shortcomings are not inevitable. A structure that facilitates cross- and intradisciplinary inspiration may assist those who think themselves smart, but are only dimly aware of other smart people's relevant insights, to improve their prowess in applied analysis.

9. MEMOREL as a Public Good

To put a MEMOREL structure of insights from the various literatures as well as a corresponding data system in place would require a multidisciplinary team of experts. The taxonomic structure of MEMOREL could help arrange the necessary division of labour and coordination between the collaborators. This could be analogous to the organisation of constructing a building. Because the structure of the building is planned in advance, the different construction specialists can be coordinated properly, and a fairly large team can jointly produce the building. The lack of such a structure may so far have precluded the design of a conceptual, taxonomic and analytical system bridging the gap between economics and IPS. For this very reason, there is scope for improvement in the (meta-)theoretical foundations of IPS.

It is clear that there are significant economies of scale and scope in such an effort. There are economies of scale due to routinisation of collection and compilation of data and literature abstracts. There are economies of scope, because adding elements to systemic structures tends to enhance the value of the elements already included in the structure. The insights from the different literatures are largely complementary and synergistic. There is tremendous value added in getting a systemic overview rather than a view of the parts.

Thus, the provision of MEMOREL is a natural monopoly; additionally, it has important public goods aspects, as do many kinds of information and analytical tools. Private players – commercial data providers and consulting firms – have an incentive to sell their data and insights on a piecemeal, customer-by-customer basis only. There is room here for a division of labour between the public and private sectors. Due to the technological characteristics of the production and use of MEMOREL, it would

make sense to provide data as well as the general analytical system collectively rather than privately. For instance, an Open Source structure could be developed for contributions to TEIPS literature. An author could post a paper – with standardised abstract – at the appropriate location (e.g. a node in a game tree) in the open MEMOREL source. There would still need to be people to design and coordinate the MEMOREL structure. In addition, a MEMOREL-related data system could also be made publicly available; here an Open Source setup might be appropriate as well. The conditions that are conducive to Open-Source (as opposed to IP-based) technology systems (Lerner & Tirole 2002) may hold in both cases. Access could be restricted to players who supply data to the system. A function that would be much more difficult to provide collectively would be expert analysis and understanding of the data and concepts publicly offered. So, there could be a publicly available system of data and concepts in place, with private expert consultants competing to use these for customer-specific applications. One possible funding arrangement for such a structure could be a consortium of leading consultancy firms, who might perceive membership in such a consortium to yield a net benefit due to the likely positive impact on the quality of their services. Note that the system would probably not negatively impact their distinctive expertise as their commercial *raison d'être*, because the open-source MEMOREL system would require specialist knowledge to be fruitfully accessed and applied.

An increased awareness of IPS and MEMOREL could have a significant economic impact, as players would be better able to (1) reduce inefficiencies due to incentive problems and (2) identify valuable novel combinations of partners and IP assets due to improved information and combinatorics.

10. Relational Economics

MEMOREL can be viewed as a subset of *relational economics*, which can be defined as a methodology that emphasises **relationships** between (1) decision-making units, (2) economic concepts, (3) fields of economics, (4) paradigms of economics, (5) economics and other disciplines, (6) the academic economic literature and its real-world applications, and (7) different types of economic data. We shall next consider each of these aspects of relational economics in turn. While reading the following

overview, the reader should bear in mind the following key point: relational economics *complements methodologies commonly used in economics by developing meta-structures*. An example of a meta-structure is a typology of economic relationships. Another important example is bibliometric analysis of economic research.

(1) Decision-making units. MEMOREL is the composition of larger structures, such as decision trees, that embed game models without actually integrating them into a single large model. To analyse an irreducibly complex choice problem, such as the aforementioned need for a proprietary input, we may not always need to go as far as a complete MEMOREL analysis, which would be quite time-consuming and has – to my knowledge – never been carried out yet. Instead, a verbal analysis of the choice problem that is implicitly informed by game-theoretic knowledge and that organises large amounts of case-specific information into a complete set of relationship types will often prove a cost-effective method for generating insight. Such an analysis may be dubbed Verbal Relational Analysis (VERELAN) and is attempted in Binenbaum & Pardey (2004), which is a policy piece on the IP strategy of International Agricultural Research Centres.

In analysing choice problems, MEMOREL occupies a middle ground between VERELAN and what may be termed Real Games. A Real Game is a complete and integrated single game model applied to a real-world situation – which in some cases may be feasible and worthwhile. As a step in constructing a Real Game, a MEMOREL structure could be consulted to make sure no relevant relationship types and subgames are overlooked. Note that the applicable MEMOREL structure could pre-exist at the time that the Real Game is constructed, as MEMOREL structures could be developed to be applicable various sets of Real Games. VERELAN, in turn, could be a step in the creation of a MEMOREL structure.

As explained above, relational economics can be used to analyse not only complex choices but also economic systems such as innovation systems (as well as intermediate-level phenomena between the extremes of single choice problems and systems). Analysts of innovation systems may easily mistake a complete description of the nodes of a system for a complete description of the system. When the nodes are decision-making units, we need to be careful not to overlook relevant types of connections (relationships) between them, as happened in the aforementioned OECD

study which mostly ignored the kinds of relationships that are studied in the conventional industrial organisation literature.

(2) Economic concepts. There may be much scope for the creation of useful structures that link together economic concepts in order to make them more easily accessible and combinable. While the economic literature develops many concepts, there appears to be little literature beyond textbooks that attempts to link them together in larger structures such as taxonomies. MEMOREL would be but one of the ways to do this (as we do not need to use models as the objects to be organised).

(3) Fields of economics. Fields, sub-fields, sub-sub-fields, et cetera, of mainstream economics, tend to evolve naturally around canonical choice problems. The resultant set of hyper-specialised literatures may contain many insights, but most of the papers that contain them are rarely cited and probably rarely applied. The economic value of much of the economic literature is thus questionable. This situation may be improved by structuring systems of insights in such a way that they are accessible for economists outside of the areas of specialisation, and through collaborative structures that allow for larger teams than are currently customary in the economics profession. Thus, relational economics would not only provide structures of concepts, but also methods and (inter-)organisational structures that facilitate economies of scale and scope in economic research.

(4) Paradigms of economics. Economists are not only divided into a panoply of specialisms, but are also divided in different schools of thought whose insights may be competing or complementary. Where these insights compete with each other, econometric testing is often not feasible, because, to do this, models common to alternative hypotheses must be specified. However, the insights can be structured to clarify the origins of differences, to transcend these by relating them to sets of alternative assumptions and methods for selecting the appropriate assumptions. Where econometric testing of alternative hypotheses is feasible, it should be borne in mind that economic hypotheses are different from their counterparts in the hard sciences. Since the assumptions underpinning the hypotheses may or may not hold, all that econometric testing does is to provide evidence on the relative prevalence of different patterns. In contrast to natural laws, alternative economic hypotheses can coexist in the real world because different sets of assumptions will often be satisfied in different real-world data-generating processes. So the role of economics and econometrics is to assist us in pattern recognition; they help us identify common

patterns rather than universal laws. When we pragmatically recognise this, it becomes easier to integrate and synthesise insights from the different schools of thought.

Complementarities and syntheses between insights emanating from different schools of thought are awaiting discovery. There appears to be an under-supply of such meta-paradigmatic analyses, especially where applications to real-world problems are concerned.

The field of bibliometrics is currently under-used in economic analysis. On many theoretical and real-world issues, economists disagree. For analytical purposes, it would often be highly useful to juxtapose, organise and integrate different expert opinions. Bibliometric analysis with improved citations data, that differentiate between types of citations such as "invoking as an authority opinion", "referring for proof", "criticising", etc., would be very useful in this context. An example of the applicability of such work – namely, in antitrust court cases – is provided below.

(5) Other disciplines. All the fundamental assumptions of economics properly belong to the subject matter of other disciplines. Some assumptions are technological, others are psychological or sociological in nature. To bridge the large cultural and methodological gaps between economics and engineering and the social sciences, it would be useful to embed the sets of assumptions that economists can choose from for their models into larger structures that both economists and experts from other disciplines can relate to. To be sure, multidisciplinary research teams may not always be the optimal solution to complex problems, as bridging the interdisciplinary cultural and other gaps may prove too costly. As an alternative, multidisciplinary collaborations could focus on the assumptions themselves, yielding menus of assumptions (complete with their pros and cons from the perspective of their 'mother disciplines') that economists can then use to select modelling assumptions from depending on the nature of their specific research projects (which would in this scenario be carried out by the economists alone).

(6) Real-world applications. It is the role of consultants, advisors, expert witnesses in court cases, and other analysts to bridge the gap between the academic economic literature and its application to real-world problems. As explained above, this role would be greatly facilitated by larger structures – such as MEMOREL structures – that embed insights from the economic literature, thus enhancing that literature's economic value.

(7) Data. A relational economics would involve an improved system of relational databases. Once we have a complete set of relationship types, we are in a much better position to design data sets describing systems of economic players. As discussed above, considering the current advanced state of information and communication technology, the potential economies of scale and scope of integrated data sets for economic systems have not yet been realised. As a result, inefficiencies caused by missing and asymmetric information are likely to be unnecessarily large. As commercial data providers do not have the incentives to create the integrated and well-structured data sets that would be most cost-effective to players in the economy, collective action to (1) integrate data sets, (2) elicit additional data supplies, (3) make the integrated data sets conform with the structures of economic logic such as MEMOREL, and (4) make the integrated data sets quickly accessible and transparent, is called for. An example of useful data would be on inter-organisational R&D partnerships. For instance, small biotechnology firms that need partnerships with a multinational pharmaceutical firm for development and marketing purposes could benefit from a data set that conveys information on past performance and policies of multinationals in such partnerships. Such data could be combined with data on competitive relationships, vertical relationships, ownership trees, complementary and competing IP assets, etc. etc. As the players in innovation systems have headquarters in specific locations, local network economy mapping initiatives (NEMIs) could fill the void left by insufficient and fragmented data supplies by existing data providers, and could standardise their specifications and merge their data sets with a global consortium of NEMIs (CONEMI). A structure of NEMIs and CONEMI, funded collectively in some way, would take a significant effort to properly design, and would require incentives for data sharing (for instance, anybody wanting to access a CONEMI data set would have to agree to supply data to it). Once in place, however, such a structure could prove highly cost-effective and vastly superior to the currently existing data supplies. Strategic decision-making might well be significantly enhanced and sped up by it.

Relational economics, consisting of these seven aspects, will be complementary to the current conventional methodology of parsimonious modelling and hypothesis-testing carried out by very small teams of specialised economists. It will enhance this conventional methodology rather than compete against it.

11. Industrial Organisation as a Future Centrepiece of Relational Economics?

How, realistically speaking, could a relational economics evolve out of economics as it is currently practiced? It appears to be a long way removed from current economic methodology. The answer may be found in the field of industrial organisation (IO).

The structure-conduct-performance paradigm of IO, developed in the late 1930s and 1940s, gave way to an IO approach predominantly based on game theory in the latter decades of the 20th century (Waldman & Jensen 2001: 5-7). The game-theoretic approach analysed a large number of permutations of vertical and horizontal market structures, based on underlying technologies. These analyses were often linked to antitrust legal and policy cases. While the number of permutations of market structure is large, it is not unmanageably large, and the mainstream theoretical IO literature seemed to have reached a certain degree of saturation by the 1990s. Thus, a reviewer of an edited volume on *Applied Industrial Organization* (Aiginger & Finsinger 1994) commented: "While the theoretical advances in *Industrial Organization* over the last couple of decades have been exciting and fruitful, the nature of much of the recent theoretical work has turned from major innovation to refinement. In contrast, there are still rich fields to be mined in empirical IO" (Suslow 1997).

This perception no longer exists today. A strand in the IO literature that seeks to endogenise technology – thus moving IO towards the economics-of-innovation literature – has always coexisted with the exogenous-technology IO research, but has recently become so important that theoretical IO is now being seen as an exciting field full of opportunities for innovative research. Sutton (1998) may have been a decisive part of this development. Nowadays, the two leading field journals (the *International Journal of Industrial Organization* and the *Journal of Industrial Economics*) are publishing so many articles that focus on innovation and technology dynamics that it has become hard to distinguish between the fields of IO and economics of innovation. This trend has perhaps been reinforced by an increased emphasis in the economics-of-innovation literature on inter-organisational relationships.

The increased importance of innovation within the field of IO may enable it, in turn, to assume a central role in the discipline of economics and its methodology. Two aspects of IO that would be conducive to such a role were already in place prior

to this recent trend. First, IO may always have been the field of economics *par excellence* that is concerned with inter-organisational relations. Second, IO is the field of economics that by its nature comes closest to bridging the gap between strategic management and economics, which would, as argued above, benefit both. Reinforcing these two aspects, the more prominent role of innovation in IO may now be forcing the latter to give pride of place to the relationship types of collaboration, communication and perhaps even gift, in addition to the relationship types it has traditionally considered, namely competition, collusion and exchange. This is obvious in the case of collaboration and communication: Collaborations are seen as critical to innovation, and these are difficult to select, design, and coordinate – hence the importance of asymmetric information and communication. Additionally, trust and a mutual willingness to go beyond formal contractual obligations are seen to be important success factors in collaborative R&D (Nooteboom 1999, 2002). Thus, there may be a significant gift element in collaborative R&D.

As consideration of innovation prompts consideration of additional relational types, IO may be well-positioned to assume a central role in moving economics towards the relational-economics methodology. IO itself might greatly benefit from embracing the seven aspects of relational economics. For example, funding for IO research might improve as a function of its being rendered more applicable to antitrust court cases. Economic experts wishing to cost-effectively develop systemic analysis of the players relevant to the lawsuit under consideration could employ existing VERELAN or MEMOREL templates to make sure not to overlook key interactions between those players. In arguing their cases, the opposing sides might benefit from existing user-friendly databases of academic contributions developed with the aid of advanced bibliometric techniques that distinguish between different types of citations (as discussed above). As a result, the quality of legal antitrust decision-making could be increased, while simultaneously transaction costs could be educed. Of course, this requires that the VERELAN/MEMOREL templates or the high-quality databases of academic papers first be developed, so that all expert witnesses in antitrust cases have access to them. It is understandable that the field of IO and economics generally have not yet caught up with the recent spectacular advances in information and communication technology, but they would need to apply the principles of relational economics in order to most fruitfully do so.

12. Synopsis: The paper's arguments in a nutshell

There is a methodological gulf between economics and strategic management, including intellectual property strategy (IPS). As a result, both academic communities suffer, because they are not fully benefiting from complementarities between their insights. This paper suggests that there is potential for improving IPS; that doing so may well have a substantial economic impact; and that economics can play a key role in this endeavour. The argument can be summarised as follows:

1. The fundamental problem of the economics of IPS is its irreducible complexity.
2. Economics can deal with this problem through meta-modelling of relations.
3. This requires certain theoretical and applied methodologies – and as these, by and large, have not been implemented so far, there is scope for improvement.
4. The gap between actual and potential quality of IPS is exacerbated by cognitive obstacles, which can be overcome – hence, again, there is scope for improvement.
5. The characteristics of the technology for producing IPS inputs and improving IPS, coupled with incentive problems and the potential for institutional innovation to solve these problems, jointly imply another source of potential improvement of IPS.
6. Incentive problems are pervasive in innovation systems; their mitigation could yield significant economic benefits; and improved IPS interaction would contribute to such mitigation – thus improved IPS may yield substantial benefits.

This paper puts this argument in a larger methodological context. It argues that economics needs to supplement its focus on parsimonious modelling and hypothesis testing with an increased attention for relationships between (1) decision-making units, (2) economic concepts, (3) fields of economics, (4) paradigms of economics, (5) economics and other disciplines, (6) the academic economic literature and its real-world applications, and (7) different types of economic data. An economics that sufficiently takes into account these interrelationships may be called *relational economics*. It should be noted that relational economics would be more 'rigorous' than current economic methodology, as true 'rigour' is philosophical in nature rather than narrowly mathematical. For instance, it may not be good enough just to use a precise mathematical model and then test the resulting hypotheses, because we might need to be very careful about the assumptions on which the model is based. To be more careful about the assumptions, we need to understand the real-world system that we are seeking to model. And to understand the real-world system,

it would be very useful to understand what might constitute a complete description of the system. To understand what would constitute a complete (or feasibly close to ideal of completeness) systemic description, we need to have an idea of what the relevant relation types are, so as not to overlook relevant interactions between the players that are the nodes of the system.

Relational economics does not seek to supplant, but rather to integrate and supplement the conventional mathematical-theoretical and econometric-empirical methods of economic research, thus improving the quality of these methods and enhancing the applicability and value of this research.

Of the seven aspects of relational economics – i.e., seven levels of interrelationships – this paper pays particular attention to aspect (1), inter-organisational relationships. Two important IPS choice problems, namely the need for a proprietary research input and the choice whether or not to seek IP protection, may both be *irreducibly complex*, i.e., not amenable to analysis using the standard methodology of parsimonious modelling and hypothesis-testing. They may, however, be analysed using relational economics, especially its component MEMOREL (meta-modelling of relationships). Using MEMOREL, such choice problems can be seen to be composed of sub-problems that *are* amenable to parsimonious modelling and hypothesis-testing. The insights from these sub-problems then still need to be combined by the analyst through other methods, including *Gestalt* intuition. Relational economics may thus render conventional economics more insightful, more valuable, and more applicable to real-world problems.

This paper then argues that industrial organisation (IO) may be the field of economics best placed to make economics more relational. IO is naturally close to strategic management, and may thus serve as a bridge between management studies and economics. It is also naturally preoccupied with inter-organisational relationships. And due to the increased prominence in the IO literature of innovation, IO is poised to incorporate into its analyses the relationship types of collaboration, communication and gift, thus supplementing its traditional focus on competition, collusion, and exchange. This consideration of a broader range of relationship types may enable IO to embrace relational economics and help move economics in the same direction. It may also enhance the value of academic IO research in real-world applications such as expert testimony in antitrust lawsuits.

It is understandable that the field of IO and economics generally have not yet caught up with the recent spectacular advances in information and communication technology, but they would need to apply the principles of relational economics in order to most fruitfully do so.

References

Aiginger, Karl and Jorg Finsinger. 1994. Introduction. In Aiginger, Karl and Jorg Finsinger, editor, Applied industrial organisation: towards a theory based empirical industrial organisation. Dordrecht: Kluwer Academic Publishers.

Akerlof, George A. 1984. An Economic Theorist's Book of Tales: Cambridge University Press.

Arthur, W. Brian. 1994. Increasing returns and path dependence in the economy: The University of Michigan Press.

Audretsch, David B. and Talat Mahmood. 1994. Entry, growth, and survival: the new learning on firm selection and industry evolution. In Aiginger, Karl and Jorg Finsinger, editor, Applied industrial organisation: towards a theory based empirical industrial organisation. Dordrecht: Kluwer Academic Publishers.

Basov, Suren. 2002. Bounded rationality: static versus dynamic approach. Melbourne: University of Melbourne.

Baumol, William J. 2002. The free-market innovation machine: analyzing the growth miracle of capitalism. Princeton: Princeton University Press.

Benkler, Yochai. 2002. Intellectual property and the organisation of information production. International Review of Law and Economics, 22: 81-122.

Betz, Frederick. 1996. Forecasting and planning technology. In Gaynor, Gerard H., editor, Handbook of technology management. New York: McGraw-Hill.

Binenbaum, Eran, Philip G. Pardey, & Brian D. Wright. 2001. Public-Private Research Relationships: The Consultative Group on International Agricultural Research. American Journal of Agricultural Economics, 83(3): 748-53.

Binenbaum, Eran. 2002. The power of the provisioning concept.

Binenbaum, Eran. 2004. The Intellectual Property Strategy of International Agricultural Research Centres. Australasian Agribusiness Review, 12: paper 3.

Binenbaum, Eran & Philip G. Pardey. 2004. Intellectual Property Strategy in the Context of Inter-Organisational Relations: The Case of International Agricultural Research.In Evenson, R.E. & V. Santaniello, editors, The Regulation of Agricultural Biotechnology. Oxon, UK: CABI Publishing.

Boldrin, Michele and Levine, David K. forthcoming. Economic and game theory against intellectual monopoly.

Brocas, Isabelle. 2004. Optimal regulation of cooperative R&D under incomplete information. The Journal of Industrial Economics, 52(1): 81-119.

Cartwright, S. and Cooper, Cary L. 1996. Managing mergers, acquisitions and strategic alliances: integrating people and cultures. Oxford: Butterworth Heinemann.

Coase, Robert. 1960. The problem of social cost. Journal of Law and Economics, 3: 1-44.

Cohen, Wesley M. and Richard C. Levin. 1989. Empirical studies of innovation and market structure. In Schmalensee, R. and Robert D. Willig, editor, Handbook of Industrial Organization. Amsterdam: North-Holland.

Darby, Michael R., Zucker, Lynne G. and Wang, Andrew. 2004. Joint ventures, universities, and success in the advanced technology program. Contemporary Economic Policy, 22(2): 145-61.

Davis, Julie L. and Harrison, Suzanne S. 2001. Edison in the boardroom: how leading companies realize value from their intellectual assets. New York: John Wiley & Sons, Inc.

Dunning, John H. 1995. Reappraising the eclectic paradigm in an age of alliance capitalism. Journal of International Business Studies, 26(3): 461-96.

Dunning, John H. 2001. The eclectic (OLI) paradigm of international production: past, present and future. International Journal of the Economics of Business, 8(2): 173-90.

Favereau, Olivier and Lazega, Emmanuel, editor. 2002. Conventions and structures in economic organisation: markets, networks and hierarchies. Cheltenham: Edward Elgar.

Frank, Robert H. 2002. Microeconomics and Behavior. 5th ed: McGraw-Hill/Irwin.

Freeman, Chris and Soete, Luc. 1999. The economics of industrial innovation. 3rd edition ed. Cambridge: The MIT Press.

Fritsch, Michael and Lukas, Rolf. 2001. Who cooperates on R & D? Research Policy, 30: 297-312.

Fusfeld, Herbert I. and Haklisch, Carmela S. 1985. Cooperative R&D for competitors. Harvard Business Review, 63(November-December): 60-68.

Gaynor, Gerard H., editor. 1996. Handbook of technology management. New York: McGraw-Hill.

Graff, Gregory D., Gordon C. Rausser, & Arthur A. Small. 2003. Agricultural biotechnology's complementary intellectual assets. Review of economics and statistics, 85(2).

Hamel, G., Y.L. Doz, & C.K. Pralahad. 1989. Collaborate with Your Competitors - and Win. Harvard Business Review, 89(1): 133-9.

Hausman, Daniel M. 1992. The inexact and separate science of economics. New York: Cambridge University Press.

Heller, Michael A. & Rebecca S. Eisenberg. 1998. Can patents deter innovation? The anticommons in biomedical research. Science, 280.

Hermalin, Benjamin E. 2001. Economics and corporate culture. In Cartwright, S. et al, editor, The international handbook of organizational culture and climate. Chichester: John Wiley & Sons, Ltd.

Hernan, Roberto, Pedro L. Marin and Georges Siotis. 2003. An empirical evaluation of the determinants of research joint venture formation. The Journal of Industrial Economics, 51(1): 75-89.

Holmstrom, Bengt R. and Jean Tirole. 1989. The theory of the firm. In Schmalensee, R. and Robert D. Willig, editor, Handbook of Industrial Organization. Amsterdam: North-Holland.

Khanna, Tarun, Gulati, Ranjay and Nohria, Nitin. 1998. The dynamics of learning alliances: competition, cooperation, and relative scope. Strategic Management Journal, 19: 193-210.

Lerner, Josh and Jean Tirole. 2002. Some simple economics of open source. The Journal of Industrial Economics, 50(2): 197-234.

Lessig, Lawrence. 2002. Architecture of innovation. Duke Law Journal, 51(6): 1783-801.

Lutz, Mark A. 1999. Economics for the common good: two centuries of social economic thought in the humanistic tradition. London: Routledge.

Lux, Kenneth. 1990. Adam Smith's mistake. Boston: Shambhala Publications, Inc.

Mintzberg, Henry, Quinn, James Brian, Lampel, Joseph B. and Ghoshel, Sumantra, editor. 2002. The strategy process: Prentice Hall.

Mirowski, Philip. 2002. Machine dreams: economics becomes a cyborg science. Cambridge: Cambridge University Press.

Moglen, Eben. 1999. Anarchism triumphant: free software and the death of copyright. First Monday.

Narula, Rajneesh and Hagedoorn, John. 1999. Innovating through strategic alliances: moving towards international partnerships and contractual agreements. Technovation, 19: 283-94.

Nelson, Richard R., editor. 1993. National innovation systems: a comparative analysis. New York: Oxford University Press.

Nooteboom, Bart. 1999. Interfirm alliances. London: Routledge.

Nooteboom, Bart, editor. 2002. Trust: Forms, Foundations, Functions and Failures. Cheltenham: Edward Elgar.

Panzar, John C. 1989. Technological determinants of firm and industry structure.In Schmalensee, R. and Robert D. Willig, editor, Handbook of industrial organization. Amsterdam: North-Holland.

Pelc, Karol I. 1996. Knowledge mapping: a tool for management of technology.In Gaynor, Gerard H., editor, Handbook of technology management. New York: McGraw-Hill.

Perry, Martin K. 1989. Vertical integration: determinants and effects. In Schmalensee, R. and Robert D. Willig, editor, Handbook of industrial organization. Amsterdam: North-Holland.

Rabin, Matthew. 1993. Incorporating Fairness into Game Theory and Economics. American Economic Review, 83: 1281-302.

Rabin, Matthew. 1998. Psychology and Economics. Journal of Economic Literature, 36: 11-46.

Reinganum, Jennifer F. 1989. The timing of innovation: research, development, and diffusion.In Schmalensee, R. and Robert D. Willig, editor, Handbook of industrial organization. Amsterdam: North-Holland.

Rivette, Kevin G. and Kline, David. 2000. Rembrandts in the attic: unlocking the hidden value of patents. Boston: Harvard Business School Press.

Rivette, Kevin G. and Kline, David. 2000. Discovering new value in intellectual property. Harvard Business Review, 78(January-February): 54-66.

Shiller, Robert J. 2001. Irrational Exuberance: Broadway.

Simon, Herbert A. 1982. Models of Bounded Rationality. Cambridge, MA: MIT Press.

Smith, Adam. 1759. The theory of moral sentiments. Glasgow ed. 1976 ed. Oxford: Clarendon Press.

Smith, Adam. 1776. An inquiry into the nature and causes of the wealth of nations. 1976 ed. Chicago: University of Chicago Press.

Somaya, Deepak. 2002. Theoretical perspectives on patent strategy: University of Maryland.

Somaya, Deepak. 2003. Strategic determinants of decisions not to settle patent litigation. Strategic Management Journal, 24: 17-38.

Suslow, Valerie Y. 1997. Review Of: Applied industrial organisation: Towards a theory based empirical industrial organisation. Journal of Economic Literature, 35(1): 163-65.

Sutton, John. 1998. Technology and market structure: theory and history. Cambridge: The MIT Press.

Szakonyi, Robert. 1996. The process of developing an R&D strategy.In Gaynor, Gerard H., editor, Handbook of technology management. New York: McGraw-Hill.

Teece, David J. 1986. Profiting from technological innovation: implications for integration, collaboration, licensing and public policy. Research Policy, 15: 285-305.

Thaler, Richard H. 1994. Quasi Rational Economics. Reprint edition. Russell Sage Foundation.

Thursby, Jerry G. and Thursby, Marie C. 2004. Are faculty critical? Their role in university-industry licensing. Contemporary Economic Policy, 22(2): 162-78.

Tisdell, C. 1996. Bounded rationality and economic evolution. Cheltenham: Edward Elgar.

Waldman, Don E. and Elizabeth J. Jensen. 2001. Industrial Organization: theory and practice. 2nd edition ed. Boston: Addison Wesley.

Williamson, Oliver E. 1975. Markets and hierarchies: analysis and antitrust implications. New York: The Free Press.

Williamson, Oliver E. 1985. The economic institutions of capitalism: firms, markets, relational contracting. New York: The Free Press.