TOURNAMENT DETERMINANTS IN INPUT-OUTPUT RELATIONS

Kenning Marchant, Ph.D.
Credit River Institute
Toronto (Mississauga), Canada

Abstract

 This paper identifies several sectors where tournaments rather than markets make allocative decisions, including professional sports and entertainment, patents, goods subject to network effects, the introduction of new businesses and products, post-secondary education, job markets, positional goods, and elections. Using a model of the information processing infrastructure of input-output relations, these 9 sectors are examined. As a result of tournament effects, three display positive contributions in terms of instrumental economies; three display instrumental economies with skewed reward structures; and three evidence instrumental diseconomies.

Introduction

This working paper is part of a research program on the psychology and economics of the information processing infrastructure underlying input-output results. The paper focuses on tournaments in contrast to markets in determining properties of economic systems.

We believe we live in a 'market' economy. However, many economic decisions are decided on the basis of tournaments rather than exchange; we live in a mixed market and tournament economy. While both may involve forms of 'competition', the characteristics of the two forms of competition are different, as can be their resulting allocative effects.

Tournaments vs. Markets
An economic market rewards relative contribution with relative rewards based on exchange of value for value. A tournament rewards rank on some performance scale regardless of relative contribution; indeed, very small differences in performance can lead to very large differences in rewards. In particular, tournaments typically assign small or no exchange value to the efforts or contribution of participant losers by comparison with winners.

Markets and tournaments are easily confused because both are sometimes characterized in terms of "winners" and "losers" based on "competition". But being a successful retailer as opposed to a very successful retailer, or driving a used rather than a new car,

are respectable and practical options, not 'losing out'. In true markets, there is room for buyers and sellers of range of products within a category, with a corresponding range of prices. In tournaments, there are absolute winners and absolute losers. In the extreme phrase of a sportswear advertisement at the Atlanta Summer Olympics, "You don't 'win' silver. You lose gold."

Auctions vs. tournaments

Auctions as an extreme form of price rationing may appear to have similarities with formal tournaments. Both can be seen as creating 'losers'. However, auctions are rarely used for jobs; rather they are used for goods. The contribution – the price – is only paid by the winner of the auction. (The tournament counterpart of an auction is a raffle.)

Formal vs. Implicit Tournaments
There are both formal and implicit tournaments. A formal tournament is one where the rules and rewards are specified in advance by a tournament promoting authority, such as first place in the Boston marathon, an academic prize for standing first in the class, or winning a job competition. An implicit tournament is one which has tournament like results. Examples are the 'markets' for operating systems for personal computers, or best selling books, or popular music 'hits'.

In summary, tournaments are characterized by a highly skewed reward structure which is specified (formal) or predicted (implicit). Where it is specified in advance it is a formal tournament. Where it is a predicted, albeit impersonal result based on past experience, it is an impicit tournament.

The Analytical Model

The conventional neoclassical analysis of tournaments focuses on effort levels, incentive effects, monitoring and moral hazards from the standpoint of the firm, or the principal, i.e tournament promoter, notably employer-employee relationships. (Lazear & Rosen, 1981; Malcolmson, 1984; McLaughlin, 1988; Krakel, 2000; Moldovani & Sela, 2001). These typically conclude that tournaments are more 'efficient' – elicit more effort at less cost – for the employer or other tournament sponsor.

It is less clear that tournaments are efficient for non-winner participants, or from the vantage point of objective economic performance.

A companion paper entitled "Cognitive Infrastructure of Input-Output Relations" for this Conference presents a mathematical model which connects empirical psychology with input-output matrices in economics. This analytical framework explore and specifies in discrete mathematics mechanisms underlying I-O connecting empirical cognitive psychology with economic significance.

This model specifies a logical infrastructure of information processing and decision-making underlying input-output tables. The central concept is that an economy is a system of partitions generated by sets of logical formulas called production rules. There are 3 main classes of production rules. All production rules must be learned before they can be used.

1. Lifestyle production rules, which specify how goods and services may be acquired to advance personal goals. Different combinations of lifestyle production rules define different personal lifestyles.

2. Instrumental economy production rules, which specify how goods and services are produced and presented. Each instrumental economy is imparts some standard feature, which in combinations define products and their presentation. Mathematically, these are a string.

3. Institutional production rules, which specify how relations of exclusion (property), exchange (contract) and conflict resolution (matching varieties of 'supply' and 'demand' occur.) The latter include markets, tournaments, and hierarchies.

Partitions may operate at various levels of detail. An input-output table is a matrix of two intersecting systems of partitions, each defined by the same equivalence relation[1], i.e. row and column classification system. It can thus in principle display exchange relations at various levels of aggregation, from individuals and individual enterprises, to regions and industries.

For each individual, a set of lifestyle production rules partition an income into a set of expenditures on goods and services. The price which is paid for each is notionally a set of micropartitioned income shares in the cost of production and presentation.

Across all individuals, consumer purchases accumulate directly and indirectly as sellers' revenues, defining a partition of total expenditures by selling enterprise.

Each enterprise's revenues are partitioned into income shares to purchase instrumental economies to produce and present products.

To this specification must be added institutional arrangements, including institutions of conflict resolution, e.g. markets vs. tournaments.

In system terms, institutions to match varieties of 'supply' and of 'demand' are required, in both product and labour markets.

Variety (Ashby, 1961) refers to the number of states in a frame of reference. Where the varieties are subject to a logical transition, as in production rules to match supply and demand, there must be reciprocal varieties (products or services for prospective

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[1] A partition is defined by an equivalene relation, and vice versa: Grätzer, 1979.

purchasers, or vice versa). 'Variety' may refer to just numbers of the one and the other, or to numbers and variations, e.g. shoe sizes. Where there is a mismatch, then variety (numbers or variations or both) on the one side must be amplified or on the other attenuated.

Amplification can be achieved only through expansion of the application of instrumental economies: either increased application of existing instrumental economies, or the development and introduction of new ones. An instrumental economy produces more output for the same input, or the same output for less input. Examples are physical capital, skill specialization, organizational capital, and coding.

Attenuation occurs through rationing arrangements, such as by auction or first come first served. Tournaments are a particular form of variety attenuation.

The differences between 'markets' and tournaments lie in the different types of system response to the excluded subset, the 'losers'.

Tournaments, whether formal or implicit, limit the variety which will be matched with 'winnings'. Express tournaments specifically require a continual supply of losers (e.g. professional sports, elections). Many tournaments are part of *tournament systems*: for example, the tournaments to select professional athletes for team sports are infrastructure for the formal tournament of league competition; and this may in turn be part of an implicit tournament for survival of teams in smaller cities.

Markets, in principle, should lead to adaptive expansion of instrumental economies to mop up unabsorbed variety, though expansion of production (application of known instrumental economies), or through discovery and implementation of new instrumental economies, i.e. improvements in productivity. In optimal markets, there are no losers; all participate as winners because everyone's skills are employed in generating goods and services in which are available for purchase with the incomes obtained.

The impacts of tournaments vs. markets, of the extension or constriction of instrumental economies, are key infrastructure to patterns in input-output relations. An input-output table is in fact a system of instrumental economies: each industry expresses a distinct combination of instrumental economies. Each row reflects a combinatorial 'grammar' of instrumental economies from direct and indirect sources.

The following summarizes some of the features of 9 tournament-based sectors. The 3 analytical columns correspond to the

Tournament Sector	Psychological properties	Discrete Analytics	Economic implications
Post-secondary education	• Long-term memory, automaticity, skill development	• Instrumental economy (skill) production • Signalling	• Production of specialized skills • Necessary sorting function

		economies (qualified by tournament effects) • Production of future input-output relations	• Can be positional good
Professional sports	• Overestimate likelihood of personal success • Stronger emotional identification with winning than with losing	• Variety attenuation constricts implementation and expansion of instrumental economies	• Must produce continual supply of losers • Unrecoverable investment by losers • Cost shifting from losers to winners/tournament promoters • Extraneous influences (cheating)
Entertainment arts	• Limited audience working memory / cognitive accessibility as basis of tournament effect • Overestimate likelihood of personal success • Stronger emotional identification with winning than with losing	• Variety attenuation in intermediation (agents, mass media exposure) • Variety attenuation in frequency of audience selections	• Statistical distribution produces skewed financial rewards • Relative do not reflect relative performance • Gate-keeping roles (access to agents, mass media exposure)
Patents of invention	• Overestimate likelihood of personal success	• Portfolio effect (insurance / instrumental economy • Intellectual property may lead to underutilization of instrumental economies	• Implementations enhance productivity • Monopoly effects – successful patents • Underutilization due to under-exploitation
Network goods	• Logic of personal connectivity/ compatibility	• Strong single instrumental economies from standardization	• Natural public good advantages are privatized

New business/ product introductions	• Overestimate likelihood of personal success	• Expand or introduce instrumental economies • New industries become new input-output rows and columns	• Trial-and-error failures offset gains
Job placement and internal labour markets	• Cognitive asymmetries between employers and individuals	• Job placement a skill/production need matching process • Internal labour markets may emphasize instrumental economies of only local scope	• Skills assignment, and management assignments are necessary economic functions • Supplementary rewards to instrumental economies of only local scope (organizational culture)
Positional goods	• 'Status' as top-level goal contributing to other top level goals (control of material resources, sexual access)	• Tournament effects generate instrumental diseconomies	• Increasing resources required to maintain or obtain rank
Elections	• Overestimate likelihood of personal success	• Tournament effects generate instrumental diseconomies	• Absent regulation, can absorb increasing resources for same number of elective offices • May promote electoral plutocracy over representative democracy

Not all tournament systems have common characteristics. They vary in the composition of choice sets; the degree of exclusion or rationing; the attenuation procedure; and the systemic as well as local results. Alternatively, tournaments may generate income/reward inequalities which are not directly market tested.

Tournament Sectors and Properties of Tournament Effects

1. Post-secondary education

Education, and particularly post-secondary education, are systems where rank is important; hence they are tournament based systems. The main basis for this is grading, marks which accumulate to generate rank, which influence, perhaps control, future prospects, such as admission to undergraduate, then graduate or professional programs, or to an academic career, or to jobs with higher incomes. This includes access to programs at universities with a major academic 'brand' (see Signalling, below).

Education is an important sector of the economy (Stahner, 1999; Cohn, 1975). Among OECD countries, education systems are estimated to comprise from 3 (Japan) to 7 (Canada) per cent of GDP (OECD, 1995).

Producing instrumental economies and higher incomes

The educational system plays a large role in producing the skills required by an economy based on specialization; that is in producing the instrumental economies represented by 'human capital'. Indeed, it could be said that education is a principal source of all instrumental economies (the other source is practice and experience), including physical capital which embodies human skills, and organizational capital. The educational system also generates and adds new specialties.

Skill specialization is, of course, a relatively recent phenomenon in the evolutionary history of humankind. The configuration of human bodies and brains is a standardized adaptation to hunting, fishing, gathering and limited self-production of clothing and shelter by individuals or family groups. However, the human brain is clearly adapted to 'tuning' to varied and complex environments. And human beings have been able to engineer many such environments to interface with standardized human beings to accomplish many kinds of tasks, both organizationally and technologically. A pervasive example is the system of production and use of automobiles, including roads, parking, fuel, identification systems, rules of the road and regulatory enforcement, insurance, etc.. The physical and organizational environment has been configured to 'fit' with human beings to achieve widely varied and specialized physical results.

The principal adaptive flexibility of the human being is cognitive (including learned fine and gross motor contol). This is what the educational system supplies. However, it has been empirically demonstrated that acquiring expertise takes time and practice – in particular so that skills can be formed largely automatically, so as to economize on the limited human attentional or working memory resources (e.g. Ashcraft 1994, 1998; Anderson & Lebiere, 1998). Humans can only consciously process 7±2 bits or chunks of information at a time (Miller, 1956). This means they can at best perform one task at a time – unless it is ones which have become so well learned they are subject to automaticity, such as walking and talking one's native language. It also applies to learning – which must in most instances be repeatedly processed through limited working memory to be stored in long-term memory.

The sorting function

The educational system plays a large role in the necessary function of sorting out who does what in an economy based on specialization. In a specialized economy, roles perceived as needed to be assigned other than by price. In the terminology of the analytical model, the varieties in skill requirements need to be matched with the varieties in skill production, and vice versa.

Sorting usually begins in secondary school. It is partly based on self-selection – what intrinsically interests or extrinsically motivates particular individuals (e.g. money or status or aesthetic interests). Howver, it is also based on the educational system grading and assigning some to course streams or programs and excluding others, usually through tournament mechanisms. These factors become more marked through post-secondary education and beyond, including accumulated work experience.

Self-selection of educational choice has some of the same economic properties as the introduction of new businesses or products(see below), i.e. there are trial-and-error features and failure rates. While career-determining choices should not be wholly assigned to the social or economic system, not all self-selections will be economically productive. Where education is seen as a consumption (lifestyle production) good – not a bad thing – this is not a problem. However, the same question arises as in new business and new product introductions: how much waste (or slack) is appropriate? It is noted that education is, for most or all, publicly subsidized, as well as being a significant part of the economy.

Tournaments for the purpose of sorting and assigning are different from tournaments to generate winners and losers. While the educational system involves both, a sorting function based on everyone having access to sufficient level of education to earn a living in the economy of their time is a far less harsh tournament system than others. (It may nonetheless lead to disappointments.) Some will nonetheless acquire, or be assigned, more advantages than others.

How well the educational system is performing skill production and sorting is an empirical question, and a policy question. So is the question of how well educational systems are forecasting and catering to the production of future specialized job skills .

A particular feature of education systems is production for their own staffing needs. Within academia, there are also tournament features, such as 'up-or-out' tenure policies. There are stong tournament features in academic publications and prizes (e.g. Hodgson, 1999).

Signalling

The education system is organized to produce graduation diplomas and other credentials - degrees, academic specializations, and institutional brands - as signaling devices. Signalling is an instrumental economy. It encodes and epitomizes, and economizes on

the effort of those who use and employ their educational products – individuals with certified skill sets.

However, signaling may strengthen tournament effects where, for example, employers opt more readily for known over 'safe' or 'prestigious' brands of education or experience.

Education as a lifestyle good; education as a positional good

Education has value other than as a set of productive skills. It may also be important to the development of lifestyle production sets, such as appreciation of literature, music or public affairs.

Education can also be a 'positional' good (Hirsch, 1976; Adnett, 2000) signaling rank or status (see discussion of positional goods, below).

Amortizing the educational investment

People spend a lot of time acquiring an education, and consume a lot of other people's time in doing so, especially that of teachers. Input-output tables normally do not include the time investment of individuals in education. However, Stahmer has prepared linked time-money-physical input-output tables based on the German economy in 1990, and which include the acquisition and amortization of education (Stahmer, 1999). The time expended on education, by both the student and the educational system is estimated tracked, and are 'depreciated' across future employment, and earnings. Different 'depreciation' values apply to elementary, secondary and post-secondary educational attainment.

Producing future input-output relations

The main infrastructure of industry input-output tables comprises grammars (combinatorial strings) of instrumental economies. As a result, industry identifiers for rows and columns could be seen as encoding those instrumental economy grammars. As they change, the structure of the input-output relations change. Accordingly, the education system is involved in the 'production' of input-output relations from one time period to another; i.e. that the education system is a production rule (logical formula) in which input-output matrices are terms, e.g.

$$[M]_{Germany,\ 1990} \rightarrow [M]_{Germany,\ 1991}$$

(From the current discussion the educational system would impliedly be the educational system as the antecedent term. However, since job experience is also important to the production of skills, it is the goods and services production sectors as well as the educational system which delivers skills (and instrumental economies in general) to the next time period.)

2. Professional sports

The properties of tournament effects in professional sports contrast with those in the educational sector in a number of respects.

Professional sports are an example of both formal and implicit tournaments in various layers: development and selection of players (and ongoing selection and deselection), formal tournaments as entertainment product which attracts direct and indirect revenues; implicit internal tournaments for players salaries; and further implicit tournaments for the existence or survival of team franchises in larger vs. smaller cities.

Tournament effects and participants

Major professional sports such as football (soccer) and, in North America, American football, baseball, basketball, and hockey are both highly paid and high status. They also involve a rigorous, multiyear selection process in which only a small fraction of good players reap the rewards[2]. In the meantime, the hopeful will have invested a significant proportion of their youth. Training as a professional athlete when one, in the end, doesn't become one means that very job-specific skills cannot be recovered (amortized) through later earnings. (The available jobs may extend to coaching, scouting, or refereeing as well as playing.)

In addition, their un- or under-remunerated efforts will have implicitly subsidized the efforts of those who do succeed, by providing teammates and competitors, i.e. the losers in the professional sports tournaments subsidize the development of the winners. They invest a large amount of time which they cannot later recover in higher or postponed earnings (cf. Stahmer, 1999). Without the prior participation of losers as team members or opponents in the developmental years, it would not have been possible for the winners to win. When they do win, they appropriate the value of both their own and the losers' efforts. In effect, the costs of developing the skills of the players who succeed are shifted significantly to those who do not.

Tournaments may also for similar reasons be seen as 'efficient' from the standpoint of tournament promoters (cf. Lazear & Rosen, 1981; Malcolmson, 1984).

Professional sports cost-shifting is analogous to cost-shifting through externalities, tariffs or monopolies, which arrange transfers from one set of participants in an economy to another.

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[2] The US National Collegiate Athletic Association states on its website (May 2004) that: "Instead of focusing on which college can lead to a career in the pros, consider that: There are nearly 1 million high-school football players and about 550,000 basketball players. Of that number, about 250 make it to the NFL and about 50 make an NBA team. Less than 3 percent of college seniors will play one year in professional basketball. The odds of a high-school football player making it to the pros at all--let alone having a career-- are about 6,000 to 1; the odds for a high-school basketball player--10,000 to 1. "

Becoming a top professional athlete may also lead to 'sponsorhip' advertising or other promotional opportunities in the entertainment arts sector, so that the proceeds of winning are supplemented for some. This is especially true for the top few 'stars', such as Olympic gold medallists or top scoring football, hockey, etc. players. There is thus a 'tournament within a tournament', since such additional rewards accrue is proportionately to the top few, and negligibly or not at all for the lower ranked players.

In contrast, in a regular job, the incentive, the salary, is also the reward. There is no in principle appropriation of the benefits of others; and most education and experience has some transferability, unlike advanced skills very specific to a particular sport (little overlap of production rule sets).

Psychological bases for tournament participation

There are at least 4 psychological factors at work, all of which can be expressed in production rule form as experimental results.

1. Many people overestimate their chances of success, and under-appraise the likelihood of failure. This may be partly because the bad-news scenario is less attractive to contemplate. The status and monetary rewards appear to be worth the final risk, perhaps because prople tend to overestimate their likely chances of success; they do not make decisions based on rational expectations. (Fischoff et al., 1977; Kahneman & Tversky, 1983; Mahajan, 1992; Paese & Kinnaly, 1993; Clark & Friesen, 2003)

2. As lotteries demonstrate, the bigger the prize, the more people are likely to be attracted to participate, without similar attention to the odds of winning. They intuitively but 'irrationally' consider that a bigger prize better justifies participation, even though odds of success are low or lower.

3. There are lock-in and sunk costs effects as people become more invested. They are reluctant to write off their investment or their hopes.This may be reinforced by peer or family pressures.

4. Tournaments tend to focus attention on winners. It is easier and more congenial for observers to identify with winners (Cialdini et al., 1977; Tesser & Campbell, 1983; Lockwood & Kunda, 1997). As evolutionary psychology points out, and as marketing illustrates every day, people seek status even if vicariously. It is an evolutionary throwback to competition for mates, where status can play both a direct and an indirect role.

There is thus a psychological basis for the significant cost shifting from winners to losers which such tournaments contrive.

Input-output-implications

The input-output presentation of the time investment is suggested by Stahmer's input-output tables in time units applied to education. The same principles would apply to years of training as an athlete – but only if there are athletic career earnings against which it can be amortized. (Note that professional athletes typically have shorter remunerative careers than other occupations. This is sometimes advanced as a rationale for high salaries among professional athletes.)

A simplified version of a tournament leading to selection of professional sports teams could take the following form.

There are p=20,000 players, each of whom invests 15,000 hours of time over a 10 year period in playing and practicing. It is important that this is a joint contribution, since players must play on teams and against other teams. Logically, for players p_1 ….. p_p

$$[(p_1 , 15000) \& (p_2 , 15000) \& …..(p_{p-1} , 15000) \& (p_p , 15000)]$$

The selection process will result, say, in 10 teams of 20 players each for each of 3 leagues ranked A, B and C. Players in the A league are paid $500,000 per year, in the B league $100,000 per year, and in the C league, $50,000 per year, in each case for 10000 hours of play and practice over 5 years. The tournament will conclude as follows:

League	Per player time invested	Per player remuneration	Per hour return (undiscounted)	Total hours	Total remuneration
A	20000 hrs.	$2.5M	$125	4M	$500M
B	20000 hrs.	$0.5M	$25	4M	$100M
C	20000 hrs.	$ 250000	$12.50	4M	$50M
None	10000 hrs.	0	0	194M	0

This can be expressed as a simple production rule set:

$[(p_1 , 10000) \& (p_2 , 10000) \& …..(p_{p-1} , 10000) \& (p_p , 1000)]$, [Selection Procedure] →
$[(p_{1A} , 20000, \$2.5M) \& (p_{2A} , 20000, \$2.5M) \& …..(p_{20A} , 20000, \$2.5M)]$
  $\& [(p_{1B} , 20000, \$0.5M) \& (p_{2B} , 20000, \$2.5M) \& …..(p_{20B} , 20000, \$2.5M)]$
  $\& [(p_{1C} , 20000, \$250K) \& (p_{2C} , 20000, \$250K) \& …..(p_{20C} , 20000, \$250K)]$
  $\& [(p_{1None} , 10000, \$0) \& (p_{2None} , 10000, \$0) \& …..(p_{19400None} , 10000,)]$,

The tournament selection procedure production rules produce an equivalence relation of (partition into) 4 classes with the associated partition of remuneration.

If such results are co-located in Stahmer time and money input-output framework, the 15,000 training time investment would be treated as a human capital investment to be amortized over a relevant earnings period, in this case 5 years. For example, a 'straight line' amortization rate would allocate 3000 hrs. of the training time to each of the 5 years. The amortization procedure implies a monetary value to be assigned.

It can be seen that the 'problem' with such a tournament is that 97% of participants will have no income against which to amortize a significant investment of time – an average of 20 hours per week over 10 years, which could have been devoted to alternative human capital development. Neither the percentages of winners vs. losers nor the training time commitments to reach well paid professional levels in major sports are unrealistic.[3]

Earlier in the 20th century, professional athletes were paid considerably less; indeed for some it was a part time career. A combination of free market developments (in North America) and the intervention of competition policy (in the European Community) changed this. Obviously, lower salaries does not change the fact that those who do not make it have no income stream to amortize their time investment against. However, the incentive effects could be quite different.

Where tournament effects can result in (1) overinvestment of time and effort, (2) indirect subsidization by one set of players in favour of another, and skewed rewards, there can be corresponding impacts on input-output relations, in comparison to competitive market equilibrium results. There can not only be allocative effects, but organizational effects which influence economic efficiency and performance.

In input-output terms, a principal set of effects can be reflected in a Stahmer input-output format. There is wasted time and effort, a weakening of human capital, an inability to depreciate the time invested – as there is for winners, or as there would be if the time and effort had been invested in education. The skills the losers have developed are unlikely to be significant as productive instrumental economies either to the individuals or to the economic system as a whole. Several years of opportunity to develop skills which could be deployed as instrumental economies, have been lost. That is a non-recoverable cost.

The 'losses'[4] from the professional sports tournament system are increased by players who have short careers, due to injury, ability or performance. They will have invested the same developmental time regardless of the length of the career.

Tertiary tournament effects

These effects can also lead to a badly aligned cost structure for 'league' purposes. In both North America and Europe, only very large cities can afford the salary bill for top rung professional teams. Smaller cities can be outbid, absent corrective action.

Reward partition

There are also skewed rewards, partly from the implicit time value subsidy from losers, partly from the monopolistic nature of the business, partly from the skewed nature of

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[3] See footnore 2.
[4] Note that these would be styled opportunity costs in the neoclassical framework. There are not so styled here because the concepts, in the context of the different analytical frameworks, are not the same. In particular, they are not merely private but social costs as well, as the input-output framework displays.

tournament rewards among winners, with 'superstars' rewarded with high multiples of the salaries paid to 'journeyman' players.

The reward structure partition is not systematically associated with the expansion of instrumental economies – i.e. variety amplification. There may be expansions of leagues to include additional teams: the National Hockey League in Canada and the United States expanded over the latter part of the 20th century from 6 teams to 24, including cities in warm weather places like Florida. Such extensions are expanded implementation of the instrumental economy system which the professional league system represents. There is certainly introduction of new instrumental economies (technologies) in equipment, and in the venues and their entertainment equipment. This may be part of a general expansion of the entertainment industries.

Tournaments also have different price-setting features from market competition. Under market competition, the price tends to be driven down by increase in supply. In tournaments. Since the number of winners is necessarily restricted, ordinary market forces are kept at bay. The pressure for prices, i.e. prizes, is to keep them high, partly because they are (from the standpoint of all except losers) efficient incentives.

A continual supply of losers

The tournament procedures in professional sports need a continual supply of losers. This is the case for team sports, to ensure continual competition for existing places. It is also to ensure that teams have 'choice' on the replacement of retiring or injured players with new recruits. Job markets, in contrast, do not require a continual supply of permanent losers, even if the preference of prospective employers for 'choice' means there will be losers in particular tournaments.

Multiple tournaments in individual sports, such as whole seasons of professional tennis tournaments, are not like multiple tournaments in employment markets. The latter commonly result in more people being placed. The 'losers' in one hiring competition may succeed in another; and the variety of the competition may be reduced as those hired are no longer competing for jobs. Multiple tennis tournaments, in contrast, are part of a larger tournament of rankings, to be eligible for which a minimum number of accredited tournaments. It may mean more opportunities to win some particular tournament, but the most important prizes are the main, or rankings tournament.

Extraneous influences in tournaments

The perceived importance of winning creates incentives to cheat. Two principal examples are doping and rigged contests. The latter are usually based either on politics, or on lead players accepting payments to 'throw' games so that others can reap large wagers on the outcomes of those games. There have also been issues involving 'judged' athletic events,

such as figure skating and diving. Issues of nationalism, international politics or bribery have all been alleged.

3. Entertainment arts

There is a concentration of superior rewards for the few among the many in most of the entertainment arts, such as actors in films and television, performers in popular and classical music, and authors of books. This occurs even though the differences between those and a number of others who are less fortunate, seem small or negligible. In general, tournament effects in the entertainment arts commonly distort the effects of small differences in relative performance. Certainly, rewards are not scaled proportionate to performance, but have strong winner-take-most effects. (Frank & Cook, 1999; Vogel, 2001; De Vany, 2002). The pattern of rewards has the characteristics of 'normal' distributions.

In the case of casting for film and television, or recruitment of musicians, there are frequently casting calls or auditions which are formal tournaments, for a particular production or performing group. In solo classical music, winning one of the few major competitions at a young age may be a prerequisite to a 'star' career. Performing artists and authors may be in implicit tournaments to gain the attention of agents, i.e. gate-keepers. . In the case of popular or classical music, radio play may be a key implicit tournament, particularly in popular music where high repeat plays are a factor. The proliferation of media outlets and use of the internet may or may not be changing these patterns.

There are also reinforcing tournament effects, particularly in recorded music. Live concerts promote, and are promoted by, compact disc sales. Similar considerations apply to television personalities or newspaper critics favourably reviewing films or books.

Moderation of tournament effects

In some sectors of the entertainment arts industries there may be larger numbers of consolation prizes than in professional sports: bit or chorus parts, backstage and production jobs; more extensive opportunities for lower paid local engagements. This may soften, but does not eliminate, strong tournament effects. Compared to professional sports, there may be more opportunities to earn some return to time investment in skill development, although many such careers may be low pay.

The role of intellectual property

Legal rights and protections, especially intellectual property in the form of copyright for composition and performance is an essential element in revenues and revenue patterns.

Entertainment industry 'tournaments' occur significantly through the implicit tournament of the final product – there is wide disparity in film box office and composition and performance royalty returns – and partly from the implicit tournament of the 'stars'. A recognizable 'star' is commonly seen as essential to movie or CD sales, or to the ability to attract necessary front-end financing.

As with patents, there are questions as to the extent to which legal protection should be provided for the underlying intellectual property. As John Locke (1694) noted, there may be a felt natural 'ownership' (exclusionary) interest in the fruits of one's own labours, especially vis-à-vis strangers. However, questions are raised both about the length of copyright protection (up to 95 years after the author's death in the case of the United States); and about what unremunerated copying should be permitted, e.g. as fair use for educational purposes. (Lessig, 2003).

The role of collective rights organizations in the entertainment industries should be noted. They exist to collect and distribute copyright (including performance royalties) on behalf of large numbers of composers and performers. They represent the instrumental economy of a collection agency system for rights holders; and they provide an economy to users in the form of 'one stop shopping', or at least one stop payment.

Psychological basis for tournament effects

This is probably based on the mass market individual being prepared to remember or accord positive recognition to only a perceived 'top few' This is responsive to most individuals having time and attention mainly for a top few in each category in long-term memory, though the list may vary across individuals. Another factor may be the role of identification or sexual attraction, both of which are selective. The vicarious status obtained from identification with stars or roles may also be important (Lockwood & Kunda, 1997).

Hence rankings, ratings and recommendations can be influential. They are seen by individuals as economizing on their own attention and information acquisition.

Media are used for social intercourse which depends on a shared data base.

As with professional sports, high status and monetary rewards for the few may motivate far more to seek high profile entertainment arts careers than can be realistically accommodated. There are also intrinsic motivations: many musicians enjoy making music.

The importance of attention to learning and behaviour means that the entertainment industries are significantly involved in gaining and selling attention. This is most apparent in the advertising based media, such as newspapers and 'free' television. The entertainment industries know a lot about how to get and maintain people's interests. This is of great, even essential importance to sellers of consumer products. People need to learn, or be taught about the advantages of particular products, or they are unlikely to be

incorporated in lifestyle production rules. Hence the entertainment industries have widespread direct as well as indirect economic impacts.

Tournaments as an entertainment form

Contests and tournaments have long been a staple of radio and television as an entertainment form in their own right. In recent years, these have included programs such as 'Survivor' (an adventure elimination tournament), and 'American Idol' (voting audience chooses new pop star). This is evidence of the strong psychological basis

Extraneous influences in tournaments

Some aspects of the entertainment industries may be susceptible to 'political' influences. This is sometimes said to be true of major performing arts awards or placement in influential competitions involving judging, as in judged athletic events.

4. Patents

Patents are inherent tournaments because of their legal premise: whoever invents first gets the patent, and no others, even if they invented the same thing independently. Inventions are, in principle, instrumental economies, though their impact, obviously, depends on their use.

Patents may be applied for by independent inventors or by businesses, many of which have the capacity to develop and produce new products, notably in the patent-based pharmaceutical sector. There can be very large rewards for successful invention. For both classes of inventor, individual and corporate, there are implicit tournament effects.

However, their positions are quite different. Few inventors can make a livelihood that way (there are rare examples – such as Jerome Levenson, who invented the cam corder concept, illuminated highway signs, and numerous other inventions which were commercialized) unless they win mutiple tournaments. In any case, only about 25% of US patents in recent years have been granted to individuals, the remaining 75% to corporations and other research organizations; and many of the individual patent holders are located within corporations.(United States National Science Foundation, Science & Engineering Indicators '93. The business of being in R & D includes three things – three classes of instrumental economy sets - not typically available to the individual inventor: (1) a large litigation budget to defend one's patent interests, since users may not pay for technology if they aren't forced to[5]; (2) companies in the R & D business develop 'portfolios' of patents which diversify their risk/reward prospects; and (3) larger

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[5] A famous example is the use by automotive companies of an individual inventor's patented technology for variable speed windshield wipers for cars. Similar problems occur for individual composers and performers in the copyright arena; or, less frequently, for trade marks or trade names. Film and record companies as regards illegal copying, and owners of major brand names and logos, are often aggressive in litigation enforcement of their rights.

companies have the advantage of being able to bring new inventions into production themselves.

The tournament effect in some industries may depend on 'predictable factors' such as demographic and epidemiological (incidence of disease) factors. For example, in the pharmaceutical business, there is more interest in catering to high incidence diseases in the industrialized world where there is ability to pay than to high incidence diseases in the highly populated developing world where there is not. For common diseases, there is a strong tournament effect in being the first, not only because that is the test for obtaining the legal protection of a specific patent, but because the first in often has an inherent marketing as well as technological advantage.

Patents and copyrights are forms of property created by statute. Unlike property in goods, the exclusivity feature of property is not required to facilitate use. Patent or copyright material can be used by many without physically interfering with each other. The rationale for intellectual property is different – some combination of incentive to creation, and public recognition of the creator's felt proprietary interest in her or his own work.

In some cases, the patent tournament may restrict the application and spread through the economy of available instrumental economies. This is most clearly the case where intellectual property use is effectively discouraged by restrictions on its availability, including royalty or licensing terms which discourage use, or absolute refusal to license. The same considerations apply to secret proprietary know-how, such as computer operating system source codes.

5. Goods subject to network effects

Goods which involve connective standards, or shared communications among many persons (or computers) involve 'network' effects (Liebowitz & Margolis, 1998) which lead to one format dominating a market or markets. This is based on the private owner capturing benefits of the positive externality which users confer on each other.

The advantages of being the sole or main standard define a strong tournament effect. Examples are the VHS format in video-recording; Microsoft Windows for personal computer operating systems; Microsoft Office rather than some less widely used software as a employment skill; the compact disc format; and now the Google internet search engine. Usually these are protected by combinations of intellectual property rights (patents, copyrights, trade marks, industrial designs). However, it is the network effect which is the principal source of the tournament effect. If the standards were open ones, the network effect would be a public rather than a private good which would be feely used, like electric plug standards, human languages, or the conventions of double-entry accounting.

Goods or industries subject to network effects may be associated with near-monopolies or monopoly practices (e.g. US antitrust and EU competition actions against Microsoft). The

desire of users for connectivity, compatibility and convenience provides the basis for a natural quasi-monopoly, or for tendencies to monopolization which can be reinforced by business practices. They may also be seen by some as discouraging more effective technology. For example, the Beta format is technically superior to the VHS format in picture quality; and Apple/McIntosh users may maintain that is a superior personal computer to the principal alternatives and their operating systems.

Where network effects apply, it is a matter of the implicit tournament 'winner' appropriating the benefits of externalities conferred by users. In addition, there may be higher costs, or there may be pervasive deployment of a 'second best' technology, i.e. instrumental economy.

In contrast to the professional sports implicit tournament model, the contributions of competing operating systems are separate rather than joint. The psychological basis for the tournament is in the users rather than in competing participants. Competitor operating systems are either discouraged from entering the market altogether; are subsidized by volunteer effort or contributions from those otherwise remunerated (e.g. academics contributing to Linux) [6]; or withdraw from the market after incurring the costs of launching a competing system (e.g. IBM OS/2).

Compatibility effects

Closely related to network effects are compatibility effects. For example, the sale of printers is a form of tournament in which significant subsequent revenues accrue through the sale of proprietary print cartridges.

6. The introduction of new products and enterprises

A significant proportion of new businesses, and new product introductions by existing businesses fail; (Headd, 2003) and only a small proportion of those which do not fail will be highly profitable. An even smaller proportion will grow into very large businesses, e.g. leading to flotation on a major stock exchange. The introduction of new products and new enterprises has two particular tournament properties. One is that setup, startup and initial production costs are incurred before clear confirmation can be obtained as to the viability (or profitability) of the new product or enterprise. The other is the empirical feature that a large proportion will fail, and only a relative handful will be big profit makers.

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[6] IDC, the information technology intelligence and advisory firm:
Microsoft's share of worldwide server operating environment (SOE) new license shipments grew from 50.5 percent in 2001 to 55.1 percent in 2002, while the company's client operating environment (COE) new license shipments inched up from 93.2 percent to 93.8 percent of the worldwide COE market. By comparison, paid shipments of Linux SOEs captured 23.1 percent of the market, and Linux COE paid shipments accounted for 2.8 percent of the market total in 2002.

Some of this pattern may be due to ignorance or incompetence. People may start businesses for perceived intrinsic rewards such as being one's own boss, rather than a realistic appraisal of business success. Many new businesses and new business failures result from errors in judgement, e.g. inexpert choice of retail locations. Caprice can sometimes play a role: otherwise sound new ventures in the travel industry were crippled by the impact on air travel of the 9/11 attacks on New York and Washington.

Successful new businesses and new product introductions are important to economic growth, progress and employment. However, failures consume resources which could otherwise have been deployed to other purposes. For the entrepreneur, there may be a temporary wealth transfer to her suppliers and employees until the business closes. However, if a higher proportion of the resources devoted to new business and new product introductions led to successful new businesses or products, both entrepreneurs and the economy as a whole would be better off. This would also weaken the tournament effect.

An input-output table is conventionally presented with industry sectors as principal rows and columns. A microsimulation approach would conceive of input-output relations in terms of individual enterprises. As noted, the core of an enterprise can be represented by sets of instrumental economies.

An economy, and its input-output tables, is constantly changing. Deployment of existing sets of instrumental economy production rules may expand (e.g. through construction of new plants, or the opening of franchises); or substantially new instrumental economy production rule sets may be introduced by the processes of introducing new businesses, products or technologies. The process by which new enterprises are implemented may thus produce new industry sectors, such as information technology which was very new at the time of Leontieff's original tables.

But enterprises and sectors are more than labels; they represent distinctive sets or 'grammars' of production rules. More particularly, they represent sets of production rules which express instrumental economies, such as specialization and spreading of embodied human effort in capital equipment (e.g. economies of scale). Indeed, a central idea in input-output tables is to draw attention to the combinatoric feature of instrumental economies – that the economies inherent in all or virtually goods and services are distributed directly or indirectly to virtually every other industry through recombinant use or assembly.

It also invites, as an input-output line of analysis, what the direct and indirect effects of successful versus unsuccessful business and new product introductions are; or comparative studies that might point to reasons for lower social investment with higher results being achieved. Input-output analysis also tracks changes in the structure of an economy, including indirect effects. It could thus equally track the retirement of businesses and industries, which may also have elimination tournament properties.

7. Job placement and internal job tournaments

The skill development and sorting roles of education are, of course, complemented by another sorting function –job 'market'. This, too, is characterized by tournaments, since each hiring from among a set of candidates > 1 is a tournament for that position. However, assuming there are enough tournaments that almost everyone can win, i.e. that almost everyone can get a job, the system of tournaments acquires some of the characteristics of a market.

However, strong sectoral tournament effects, and the role of incumbency and seniority mean that employment 'markets' are not thoroughly contestable. Most (Doering & Piore, 1971; Gibbons & Waldman, 1999) or significant numbers of those in higher paid jobs are promoted from lower-paid jobs in the same organization, with new employees recruited only at specific points in the hierarchy, thus segregating an 'internal' labour market. There are reasons for incumbency. Employers need people who come to work knowing their jobs and the organization. Employees like stability of employment. However, incumbency means that most jobs are not open to formal competition from others who would like them, especially outside the organization. The fewer positions there are in a job category, the more likely tournament effects occur. For example, there is a limited 'market' for chief executive officers of large corporations. There are only a small number of justices on a country's highest court. Moreover, the reasons for 'promotion from within' may have reference to local or organization-specific production rules – familiarity with the corporate culture and its personnel. Since internal labour 'markets' depend on particular patterns of experience, they may exhibit path-dependence and lock-in effects (Liebowitz & Margolis, 1998). These may compromise innovation and adaptation. This then becomes another effect of tournaments.

8. Positional goods

Hirsch (1976) introduced the concept of 'positional' goods, which are inherently limited as indicative of rank status. Examples are exclusive addresses or seaside properties, master art works of the 'masters', degrees from 'top' universities, or other scarce status-symbol goods. A principal sought advantage of the positional feature is signaling to others. There is now a considerable literature on positional goods. (e.g. Frank & Cook, 1999).

It is more accurate to say of positional goods have a positional (status rankng) feature rather than that they are entirely positional. A villa on the Riviera or a Rolls Royce may be strongly positional, but they are still a home and a car respectively. A degree from a good university with a not-so-well-known name is still a quality university education. In addition, the supply of such positional goods is not so closely attached to rank that more cannot be produced. Indeed, more shoreline villas, more penthouse apartments in world class cities (and more of those, too), more luxury automobiles are produced all the time. Pure rank is softened by stratification in which membership classes are open to

expansion, e.g. an "upper middle class" lifestyle. Perhaps only works of deceased artists truly are truly in permanently limited supply.

The economic issue with goods which are in limited supply as ordinal rankings is that more and more resources must be devoted to gaining or maintaining them, running harder to stay in the same place (Frank & Cook, 1999; Hopkins & Kornienko). The ever-rising prices for works of art by the great masters, or for a US Ivy League education, would appear to confirm this. So does the phenomenon of jobs which formerly required a secondary education now requiring a university degree, and those formerly requiring a university degree now requiring a post-graduate or professional degree, i.e. more front end investment for the same career income stream. To the extent that more resources must be devoted to obtaining or maintaining the same thing, positional goods are a source of instrumental diseconomies. That the overall allocation of resources matters is illustrated by health care sector comparisons between countries. The United States consumes a larger share of its GDP providing care for a smaller proportion of its population, mainly through market-based mechanisms, than most other industrialized countries with significant public funding of health care provision. To some extent, health care is a positional good in jurisdictions where it can be privately purchased. Universal public health care is directed to eliminating health care as a positional service.

9. Elections and political competition

Electoral politics is perhaps not typically thought of as 'industry'. However, in democracies it is a large, ongoing tournament industry. The formal tournaments are the periodic elections, but campaigning, shadow elections, and competition for the informal tournament of moral authority or political capital as reflected in the support of public opinion, are continual.

The political industries comprises a number of activities: direct and indirect financial contributions to candidates and parties; political lobbying; direct use of mass media through advertising and owned or ally-controlled outlets (such as newspapers associated with party viewpoints); and indirect use through obtaining news and current affairs coverage, and event competition to obtain that; public policy research institutes and political action organizations which provide inputs to political deliberations and employ many out of office appointees.

This is an example of a necessary tournament, choosing who will and will not exercise governmental power on our behalf, which creates an expanding set of industry requirements in its wake. It appears to have some of the same problems as positional goods – more and more resources are required for effective participation, especially in the United States.

A significant concern with strong tournament effects involving positional features is the potential misallocation of resources. For example, the incentive effects of tournaments may lead to overinvestment in that sector, to the cost not only of participants, but the

economy as a whole: if the efforts of losers had been differently directed, they could have been producing other valuable goods and services. The cost of goods or lifestyles with strong positional features may similarly consume greater and greater resources simply because of tournament effects.

Elections are inherently tournaments; and the winners are, at least collectively, in a position to wield considerable power, including the power to confer economically important benefits on industries through tax and regulatory arrangements (including international trade rules) and government contracting. For both reasons, money is attracted to politics both when election campaigns are on, and during the business of governments once elected. This includes expenditure on lobbying, public relations, and political marketing and advertising. The larger part of the political industry is made up not of the salaries and expenses of elected officials, but of outside interest groups. In the United States, judicial interpretations of constitutionally-protected free speech have limited the scope for limiting the political-market driven scope of the political industries.

A different approach is taken in Canada (the following illustration is based on the federal level). There are legislated limits on how much each candidate and each national party may spend in an election. This is supported by government funding based on votes in the prior election; this funding supplements private fund-raising, in which the contributions per individual are limited, and those of corporations and unions are restricted to small donations. Organizations not political parties fielding candidates are severely restricted in the amounts they can spend for 'political' advertising to influence an election campaign. In contrast to the US court decisions, these restrictions were found to be consistent with Canada's constitution, which includes free speech as one of several democratic rights.

These arrangements have several input-output effects, of which two are particularly important. First, they restrict the relative size of the 'election industry' in the aggregate. There is a 'collective', i.e. legislated determination of what the appropriate overall size of the election sub-industry is. Second, they make the electoral tournament considerably more equal at both the constituency/candidate and national party levels.

This draws attention to an important and limiting feature of the Pareto criterion as an indicator of optimality in a market system. Because it is indifferent to incomes or endowments, it is only reliable as a guide to optimality when one can be sure the income distribution it is implementing is the right one. The Canadian election system is a perhaps rare example of such a distribution. The US market-based health care and electoral systems could be Pareto optimal in a skewed income distribution system, but may not be optimal or efficient in a more objective sense.[7]

To what extent are tournaments necessary – even if they were seen to have undesirable consequences? Political candidacies are an example of a necessary tournament. It is inherent in representative democracy that only a limited number of people can govern, and that only one individual can be Prime Minister or President.

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[7] This issue is discussed in a companion paper for this conference, The Cognitive Infrastructure of Input-Output Relations

Summary and Conclusions

The above sections identify nine varied sectors in which tournaments rather than markets play a significant role in determining outcomes. These impacts are projected from the production rule level, especially instrumental economies or diseconomies, and amplified through input-output linkages. In all cases, tournament effects have a significant psychological dimension.

Tournaments are devices to match varieties of 'supply' and 'demand' by means of variety attenuation; whereas instrumental economies improve matching by variety amplification. The central economic test is thus deployment, or not, of instrumental economies.

Three of the sectors use tournaments to contribute to the *expansion of instrumental economies*. Education produces instrumental economies in the form of skills, and uses tournament procedures in the necessary procedure of sorting assignments to various specializations. The introduction of new businesses and products extends the application of instrumental economies or implements new ones; however, trial and error failures represent a cost. Patents also introduce new instrumental economies. However, the legal protections afforded patents may also limit their implementation. In addition, some patents may not be implemented (commercialized) as extensively as they might for institutional reasons, e.g. lack of access to the requisite organizational resources.

Tournament effects in three of the sectors are associated with the implementation of instrumental economies but have *skewed reward structures*. Network effects are a phenomenon of a natural public good being privately exploited. The entertainment arts display patterns of returns which have the common characteristics of statistical distributions rather than relative performance scales, i.e. extraordinary rewards to the few, and progressively more modest rewards to the many. Internal labor markets in organizations provide supplementary rewards to production rule skills which are of primarily local effect, i.e. familiarity with a particular organization, its 'culture', and its personnel.

Tournament effects in the remaining three sectors are associated with *instrumental diseconomies*. Professional sports misallocate, and misappropriate, the skill development resources of those who prepare but are not chosen. They may also limit the extension of the instrumental economy systems they represent, e.g. to franchises in larger markets. Positional goods or jobs can consume increasing resources to achieve the same outcome. Elections for political office have both tendencies. However, resource misallocations in that sector can be moderated by controls on election financing and expenditure.

Together, these nine sectors represent a significant proportion of and range of direct and indirect impacts on economic activity. While tournaments may in some cases be necessary or inevitable, they raise important issues, such as deleterious overinvestment of time or resources by eventual losers, and on an ongoing basis; lower overall utilization of human skill resources; undue concentration of revenues or market control; and rising

consumption of resources for the same positional outcomes. These can have pervasive multiplier (input-output effects) through the economy. Issues of fairness, including income equity, are also raised. Tournaments should not be assumed to represent "healthy" competition. Like good and bad cholesterol, not all forms of competition are 'good'.

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