Micro

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Micro-Economic Policy Analysis Branch Bulletin

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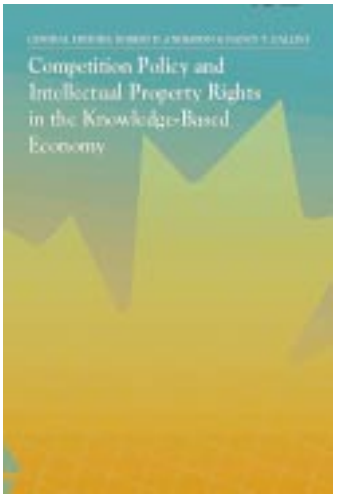
Does Competition Policy Support Innovation Policy?

Technological innovation and diffusion are powerful sources of economic growth, being inexorably linked to productivity improvements and real income gains. Higher rates of innovation lowers production costs, improves the quality of goods and services, and fosters the development of new goods and new or improved ways of making goods. Hence, ensuring the rapid diffusion of new technologies and information is vital to improving the economic and social well-being of Canadians. Thanks in large part to advances in computers and communications, the growing role played by innovations, information, and technologies is forging what is widely known as the knowledge-based economy.

Two competing forces influence the relationship between technology development and diffusion. On one side are the incentives to innovation, including intellectual property rights. On the other is the desire to promote a level playing field among competing producers. If the innovator is able to limit competition, then society as a whole suffers from inefficient production. At the same time, there may be benefits to be derived from economies of scale in advertising, research and development (R&D), and learning processes that advance human welfare over the medium to longer term. Thus the challenge is to strike an appropriate balance between higher rates of technology diffusion (with, perhaps, a reduced rate of innovation) and higher rates of technological innovation (with possibly more limited diffusion), while stimulating economic growth and improving resource allocation.



Industry Canada's most recent research volume focuses on the application of competition policy vis-à-vis intellectual property rights and innovation. Leading specialists in the legal and economic dimensions of competition policy and intellectual property were asked to ruminate on matters of balance between incentives for innovation and vigorous inter-firm rivalry in markets for goods and services. The results are found in Competition Policy and Intellectual Policy Rights in the Knowledge-Based Economy, the ninth volume in the Industry Canada Research Series. The exercise was planned and overseen by Robert Anderson, then with the Competition Bureau, and Nancy Gallini of the University of Toronto, who together served as the general editors for the volume.

Also featured in this issue of *MICRO* are reports on the presentations made by Professors Peter Howitt, Elhanan Helpman, George Akerlof, and Robert Summers under the auspices of Industry Canada's Distinguished Speakers in Economics program.

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INDUSTRY CANADA RESEARCH AND PUBLICATIONS PROGRAM

RECENT RELEASES

WORKING PAPER SERIES

No. 23: *Restructuring in Canadian Industries: A Micro Analysis*, Sunder Magun.

This study examines how, and to what extent, restructuring has affected company performance in Canada. It uses company-based data compiled from an interview survey of individual firms.

OCCASIONAL PAPER SERIES

No. 18: *Reducing Regulatory Barriers to Trade: Lessons for Canada from the European Experience*, Ramesh Chaitoo and Michael Hart.

This paper focuses on regulatory and standards-related barriers to trade and examines the European approach, with a view to informing and perhaps improving Canadian initiatives in this area.

DISCUSSION PAPER SERIES

No. 6: *International Market Contestability and the New Issues at the World Trade Organization*, Edward M. Graham.

In December 1996, Ministers of the member nations authorized the formation of working parties to examine whether rules should be added or changed in the body of multilateral trade law in order to address the linkages between trade and investment, and between trade and competition policy. This paper explores the possible directions for their studies.

FORTHCOMING

WORKING PAPER SERIES

No. 24: *Canadian Government Policies Toward Inward Foreign Direct Investment*, Steve Globerman and Daniel Shapiro.

No. 25: *A Structuralist Assessment of Technology Policies: Taking Schumpeter Seriously on Policy*, Kenneth Carlaw and Richard Lipsey.

OCCASIONAL PAPER SERIES

No. 20: *Aboriginal Businesses: Characteristics and Strategies for Growth*, David Caldwell and Pamela Hunt.

ANNOUNCEMENT

DISTINGUISHED SPEAKERS IN ECONOMICS PROGRAM

Please see page 15 of this issue for the 1998/99 schedule of speakers.

MICRO is a quarterly newsletter highlighting micro-economic research findings, published by the Micro-Economic Policy Analysis Branch of Industry Canada. This edition was prepared under the general editorship of Mr. Rick Cameron. Mr. Gilles Mcdougall has also contributed to this issue. Abstracts of Industry Canada research volumes, and the full text of working papers, occasional papers, discussion papers, and MICRO can be accessed via STRATEGIS, the Department's online business information site, at http://strategis.ic.gc.ca. For more information about our research publications, or to place an order, contact the Micro-Economic Policy Analysis Branch, Industry Canada, 5th Floor, West Tower, 235 Queen Street, Ottawa, ON, K1A 0H5. Telephone: (613) 952-5704; e-mail <micro@ic.gc.ca>; or facsimile: (613) 991-1261. ISSN 1198-3558.

Competition authorities should not attempt to counterbalance perceived excesses or deficiencies of intellectual property protection.

Does Competition Policy Support Innovation Policy?

Innovation and technological change exert a pervasive influence throughout the economy. Economists have long recognized that technical progress, together with the speed at which new ideas and methods are disseminated, are central to the process of economic growth. Both are important for increasing economic and social well-being and improving resource allocation.

For businesses, on the other hand, the name of the game is seeking and securing a competitive advantage – at a cost to their rivals. One legal avenue they can pursue to achieve that goal is non-price competition – specifically, the use of intellectual property rights (IPRs). The exercise of innovator's rights, and therefore its reward, limit competition by restricting certain practices that have IPR implications, such as copying.

Competition policy and the protection of intellectual property rights are key instruments of government policy that provide incentives for innovation and the rapid diffusion of new technology. Specifically, IPRs (especially patents and copyrights) provide the incentive to innovate and create competitive advantages by preventing the widespread copying of new inventions or creative works. Without these rights, an innovation could be copied, and both the incentive to innovate and the returns from innovation would be diminished. Competition policy, on the other hand, is a set of legal rules designed to promote competitive market structures and commercial practices in order to ensure that the allocative advantages of the market are realized.

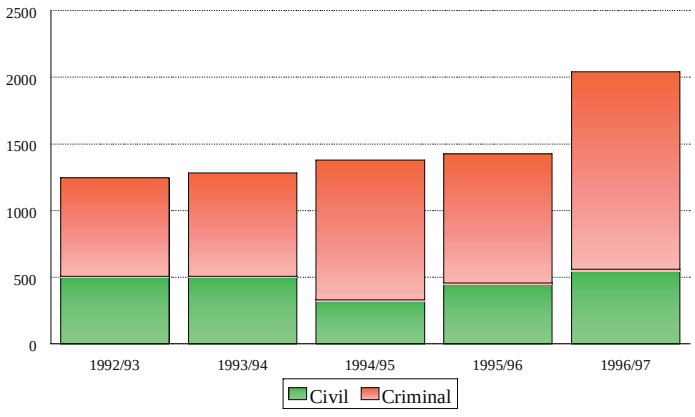
Striking an appropriate balance between IP protection and competition policy is key to increasing innovation and efficiency in a knowledge-based economy. The research assembled in this volume presents an analysis of the relationship between intellectual property and competition policy from both legal and economic perspectives. It is intended to provide practical advice on the application of competition policy vis-à-vis IP rights. The focus of the volume is on competition issues relating to patents, although aspects of the analysis may be applicable to other forms of intellectual property.

Balancing the Goals Between Innovation and Diffusion

A broad set of issues is related to the interaction between competition policy and intellectual property rights. As noted above, IPRs provide important incentives for innovation and can facilitate the diffusion of new technologies, while competition policy is an instrument that guards against the abuse of market power by limiting the set of restrictive practices and contractual arrangements that can be used by firms. Their interaction affects both a patentee's ex ante incentive to innovate and its ex post incentive to diffuse new technologies. Broadly speaking, the wider the set of practices legally permitted, the greater the flexibility that the innovator has to increase the return from his investment in R&D and to restrict imitation and other potential rent-dissipating activities of licensees. On the other hand, such restrictions may have welfare-reducing effects – for example, by excessively limiting access

Complaints to the Competition Bureau

Civil and Criminal Matters: 1992/93 - 1996/97



Annual Reports of the Director of Investigation and Research, Competition Act

Stronger patent rights may actually encourage the efficient diffusion of intellectual property and increase welfare.

to new technologies or suppressing incentives to develop improvements or substitutes. Thus it would seem that a set of guiding principles on the competition policy treatment of IP is needed. Addressing this shortcoming is the first step towards providing optimal incentives for innovation and efficiency in a knowledge-based economy.

The paper by Nancy Gallini and Michael Trebilcock presents three alternative conceptual approaches to the analysis of competition policy issues relating to intellectual property licensing and innovation. The approach supported by the authors is that competition authorities should focus primarily on the allocative effects of contracts and licensing restrictions on diffusion and pricing, rather than attempt to "counterbalance" perceived excesses or deficiencies of IP protection. Where innovation concerns arise, such as in joint ventures or in the suppression of a rival's incentive to conduct research, they argue that applying the potential-competition approach to technology and product markets may be sufficient to analyse the impact of a licence on innovation, diffusion, and prices. Mrs. Gallini and Mr. Trebilcock also highlight two basic principles that are common to all papers in the volume:

- Competition policy should not presume that an intellectual property right confers market power.

- Competition policy should recognize that licensing restrictions may actually increase welfare if they encourage the efficient diffusion of intellectual property.

The first principle, which is also emphasized in the U.S. Antitrust Guidelines for the Licensing of Intellectual Property, is critical to the sound application of competition policy vis-à-vis IP rights. It reflects the fact that, in most instances, good substitutes are available for patented products and processes. The second principle is also basic to the appropriate application of competition policy towards licensing practices. It reflects the fact that licensing restrictions generally increase the incentive for patent holders to make their technology available to users.

Don McFetridge examines the importance of IPRs to the diffusion of new technology, with particular attention being paid to the Canadian experience with compulsory licensing. He asks whether compulsory licensing (a weakening of patent rights) has resulted in greater production and use of innovations in Canada. While recognizing that compulsory licensing may provide on-the-job experience that generates spillovers for facilitating subsequent innovations, he argues that it has not been an effective solution for encouraging R&D and diffusion in Canada. He finds that, in contrast to the situation in the United States, compulsory licensing in Canada has not been used as a first-hand remedy to counter the anticompetitive exploitation of patents. While the U.S. and Canadian policies differ in several regards, Canada's accession to the NAFTA [North American Free Trade Agreement] and the TRIPs [Trade-Related Aspects of Intellectual Property] agreements resulted in amendments to the Patent Act that have reduced the potential for conflict with U.S. policies. Mr. McFetridge concludes that, in general, compulsory licensing is not an effective mechanism for encouraging local working of a patent since it provides access without the transfer of knowledge necessary for commercial use of the innovation.

The paper by Robert Merges also emphasizes the importance of intellectual property rights to the diffusion of innovations. The author's key message is that stronger patent rights may lead to greater diffusion. Following an analysis of the impact of patent rights on the organization of the production and diffusion of innovation, he concludes that stronger patent rights encourage firms to enter into licensing arrangements rather than to vertically integrate production. An implication of this reorganization response to increased patent protection is that the traditional strategy of "killer portfolios" by large, vertically integrated firms may be of diminishing concern to antitrust authorities. However, he warns that new patent-acquisition strategies have emerged, requiring vigilance by competition authorities.

Although there is a certain degree of market power associated with IP rights, the competition policy treatment of these rights should be subject to a rule-of-reason standard.

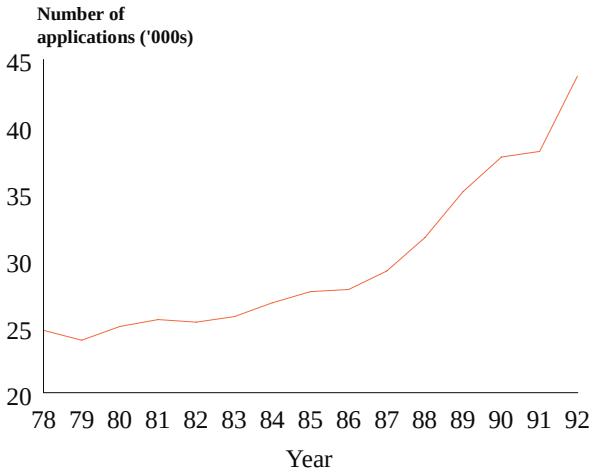
IP and Contractual Arrangements: Evaluating Anticompetitive Effects

The existence of innovator's rights means that the holder of those rights could limit competition by resorting to certain restrictive practices; in other words, IP rights confer a certain degree of market power. Alternatively, the innovator may choose to allow others to use those rights under some type of contractual arrangement. Thus the innovating firm may be able to leverage its market power from one market to another. Particular licensing practices and arrangements may afford IPR holders an opportunity to take advantage of this possibility.

William Baxter and Dan Kessler present an analysis of the economics of "tying" in the context of IP, contrasting the Canadian and U.S. legal approaches. Tying exists when a producer sells a product only to those who also buy a second product from that producer; for example, a manufacturer may sell replacement parts for a machine on the condition that the buyer will also purchase repair services. The authors note that the Canadian policy approach is more consistent with general economic principles in that it avoids the across-the-board prohibition, or per se nomenclature, found in the U.S. approach and enables the appropriate balancing of beneficial and adverse welfare implications of tying in particular cases. They also argue that a justification for tying is to enhance the return from R&D investment, although they caution that such a policy may only alter the type, not the quantity, of R&D activity undertaken. The main recommendation drawn from their paper is that the competition policy treatment of tying in the area of intellectual property licensing be subject to a rule-of-reason analysis – that is to say, that the policy take into consideration the potential efficiency-enhancing objectives of the tying arrangement rather than prescribe an across-the-board prohibition. They conclude that the Canadian approach is better designed than the U.S. approach in this regard.

Exclusivity provisions of licensing contracts, including contracts to a single licensee, exclusive dealing, and territorial restrictions, are the subject of investigation by Patrick Rey and Ralph Winter. The authors note the contrasting approaches that are found in competition policy towards these practices, especially between North America and the European Union. As in the treatment of non-IP goods, they recommend that competition policy follow a rule-of-reason approach towards these restrictions for IP, but that it be mindful of the fact that exclusivity restrictions can reduce incentives for future innovation. Hence, they propose that competition authorities be prepared to intervene in cases where IPRs foreclose markets from potential innovators. In particular, Messrs. Rey and Winter recommend that competition authorities be prepared to challenge exclusivity restrictions in the area of intellectual property licensing insofar as they impact on future potential competition in technology and product markets.

Patent Applications in Canada, 1978-92



Source: Rafiquzzaman, Mohammed and Lori Whewell (1998)

The paper by Jeffrey Church and Roger Ware considers the interaction between competition policy and IPRs in the context of network industries, where issues of standardization and compatibility are important. Prominent examples include consumer electronics, information processing, and telecommunications, including the facsimile machine and the Internet. Messrs. Church and Ware encourage competition authorities to recognize that the degree of market

Competition policy may also have a role to play in protecting consumers.

power conferred by IPRs may sometimes be excessive in such industries and that the normal effects of IPRs are often reinforced by network externalities and particularly by heavy first-mover advantages. They note that the level of IP protection in network industries – including the protection provided by patents, copyrights, and legislation pertaining to integrated circuit topographies – has been getting progressively stronger. Licensing restrictions that include the refusal to license, horizontal agreements, exclusive dealing, and the tying of software with copyrighted operating systems compound this market power issue. Where these problems arise, the authors argue that competition policy can play an important role in mitigating the market power conferred by IPRs. In particular, they propose that in network industries, competition policy should be used to constrain the abuse of market power through licensing restrictions.

Suzanne Scotchmer examines the efficiency and anti-competitive implications of research joint ventures and related horizontal arrangements. Recognizing that both Canadian and U.S. competition policies are more suspicious of horizontal than vertical arrangements, she nonetheless points out that there may be redeeming efficiency benefits to both types of arrangements. Mrs. Scotchmer contrasts ex ante and ex post licensing, noting that while both facilitate the diffusion of innovations, the former is more effective at reducing inefficiencies from wasteful R&D. Although joint ventures have the undesirable potential of facilitating monopolization and reducing R&D spending, she cautions against overemphasizing this concern. Accordingly, Mrs. Scotchmer recommends that horizontal (inter-firm) arrangements involving intellectual property be evaluated under a rule-of-reason standard.

Competition Policy and IP: Further Views

The new Industry Canada research volume also examines the issue of competition policy and intellectual property in a broader perspective. A number of papers are devoted to a comparative analysis of competition policy towards IP in Canada, the United States, and, to a lesser extent, the European Community.

Derek Ireland discusses various facets of the Canadian policy environment and highlights specific aspects of consumer behaviour relevant to the application of both IP and competition policies. He stresses that consumers' concerns are not always taken into account under those policies. For example, he warns of the dangers of providing strong IP protection in response to rent-seeking behaviour by producers, especially in the case of technologies that are relatively unknown and have potentially harmful consequences for consumers. Mr. Ireland's message is more cautionary than prescriptive in noting that competition policy may have a role to play in balancing these components of the welfare calculations, especially for technologies or products about which innovators have more information than do consumers (i.e., where there is asymmetric information).

Will Tom and Joshua Newberg discuss the competition policy treatment of IPRs in the United States. They provide a historical treatment of a rich assortment of laws, guidelines, and cases from the early days of the Sherman Act up to the present-day U.S. Antitrust Guidelines. The authors note that the 1995 Guidelines view IPRs as essentially similar to other forms of property rights, in contrast to the legal doctrine that was applied in preceding decades. This approach avoids the harmful effects of both excessive hostility towards the monopoly rights granted to the innovator and excessive deference towards licensing practices based on their potential effects on innovation. The authors argue that certainty about the conditions in which innovations may be carried out is critical to a healthy and active research environment and to the wide diffusion of innovations. According to Messrs. Tom and Newberg, a separate legal regime is not required to address competition policy concerns relating to intellectual property. Rather, the application of existing competition law can be tailored to satisfy the special considerations of intellectual property and the rights conferred under patent law. They also believe that guidelines for the competition policy treatment of intellectual property can promote the

Competition authorities should provide clear and predictable rules to minimize uncertainty that could impede technological progress in the high-tech sectors.

discovery and diffusion of innovations by providing a more certain policy environment in which firms can operate.

Robert Anderson, Paul Feuer, Brian Rivard, and Mark Ronayne explore the welfare and policy implications of using patents to segment markets internationally. They argue that patents and other IPRs that are national in scope may, in various circumstances, be efficient and practical. Indeed, in the multilateral context, a certain degree of territorial divisibility of rights may be needed to prevent an undesirable lowering of standards of protection. Messrs. Anderson et al. suggest that at some point in the future, consideration be given to implementing a policy of "exhaustion" of IP rights across the NAFTA area, on the grounds that it would foster competition and the free movement of goods and services. This would be comparable to the policy applicable in the European Union, where legitimately made patented articles that are placed on the market in any member state may move freely throughout the Union. A precondition for the implementation of exhaustion is the effective convergence of IP and competition policies. Accordingly, the authors propose that, as competition and intellectual property enforcement policies converge and economic integration deepens, consideration be given to adopting a policy of exhaustion of IPRs across the NAFTA area, or at least in Canada and the United States.

The Interface Between IP and Competition Policy: Addressing the Tough Questions

Several important issues raised in the papers were revisited for further analysis during a round-table discussion where the initial versions of the papers were reviewed. While consensus was not achieved on all of them, a lively exchange took place on a wide range of questions: What role should competition policy play when patent protection is overreaching? Should competition policy challenge the growth of a firm if its size is attributable to the legal accumulation of patents? Should the level of intervention by competition authorities aimed at constraining contentious IP practices vary across industries? Does compulsory licensing reduce the incentive to innovate? Should the refusal to deal or license an essential facility be treated as an abuse of dominant position under the Competition Act?

Further observations emerged from the Symposium:

- In technologically complex sectors, such as network industries, IP rights can sometimes facilitate the undue exercise of market power. While an active competition policy can serve to check this tendency, it is important that clear and predictable rules of reason be formulated to deal with cases in which IPRs are abusive or simply too broad. Uncertainty in the policy could impede technological progress in these industries.

- Policy makers and administrators should move cautiously when imposing open interfaces or compulsory licensing, since such interventions have the potential to turn the competition authority into a regulatory body. While such action by competition authorities or courts may nonetheless be appropriate in some contexts (particularly in the case of network industries), where possible it should be implemented in ways that require a minimum of ongoing regulatory supervision.

- Ensuring an appropriate balance between competition and IP policies, especially as they apply to complex technologies, may best be served by the participation of the competition authorities in reviews of the relevant legislation.

In summary, both competition policy and intellectual property rights play vital roles in fostering technological innovation and diffusion. Accordingly, these policy instruments are best viewed as fundamentally complementary rather than antagonistic. Moreover, wherever there are conflicts between the two policies, competition policy authorities should apply rule-of-reason analysis to the design and implementation of enforcement measures towards IP. They should be mindful of the important contribution of IP to economic growth, as well as its potential

Technological innovation and capital accumulation are both important and critical factors of long-run economic growth.

for adverse market power effects. At the same time, the complexity and rapid growth of new technologies, the expansion of markets internationally, and the multitude of recent trade agreements require further analysis of the way in which intellectual property is and should be treated under competition law. This research volume offers a solid starting point for such an analysis and should therefore contribute to the sound application of competition policy vis-à-vis intellectual property in the emerging knowledge-based economy.

DISTINGUISHED SPEAKERS SERIES

PETER HOWITT ON THE ROLE OF INNOVATION AND CAPITAL IN GROWTH

The relative roles of technological innovation and capital accumulation as determinants of long-run economic growth have attracted substantial professional interest, and even enthusiasm, over the past two decades or so. Canadian economists have been active in the debate for some time. As far back as 1834, John Rae attacked Adam Smith's views, arguing that growth was not merely a matter of accumulating capital in the long run but that economies also needed to discover new ways of doing things – making innovations and improving technological knowledge – in order to grow.

It was, and in many ways still is, a controversial point of view, says Peter Howitt, Professor of Economics at Ohio State University. In a March 1998 Distinguished Speakers in Economics presentation, Professor Howitt examined the relative roles of technological innovation and capital accumulation as determinants of economic growth and long-run accumulation. He argued that both are important and critical factors as determinants of economic growth over the long term.

There can be no doubt that technological change is one of the most important determinants of the shape and evolution of the economy. Technological change has improved working conditions, made possible the reduction in working hours, provided an increase in the flow of products, both old and new, and added many new dimensions to our way of life. And until fairly recently, models of economic growth and even empirical studies were unanimous in suggesting that technical progress was the most important factor in determining the rate of growth of an economy.

Professor Howitt, however, disputes the conclusions of these vintage neoclassical models of growth as represented by the Solow–Swan model, augmented to have exogenous technological progress. He maintains that these models always lead to the conclusion that unless there is continual technological innovation, growth will ultimately peter out. The models assume that if the economy were to collect more and more of the same kinds of capital equipment and use them in the same ways as before to produce the same goods as before, then diminishing returns would ultimately set in and people would not accumulate capital any more. Even measures that stimulate investment in capital equipment would be neutralized in the long run, having no effect on the long-term growth rate, although they would raise the level of output in the economy. Thus, implicit in the neoclassical approach is the premise that

Capital is an important input into the innovation process.

technological progress is the fundamental determinant of long-term growth.

This view was challenged by the earliest of the endogenous-growth models, recounts Professor Howitt. In these capital-based approaches, it was argued, in essence, that stimulating capital investment leads to an associated increase in the stock of knowledge through learning-by-doing, spillovers, and the like, and thus to an increase in productivity. Unfortunately, notes the academic, there is a great deal of evidence against the approach of the early endogenous models. Moreover, he adds, these models came up with essentially the same implications as the Solow–Swan model: the long-run rate of growth is determined by the rate of growth of productivity, which is itself determined by the rate of technical innovation.

Professor Howitt thinks that both approaches are missing the mark. What is needed is an innovation-based approach rather than a capital-based one. The earlier models lacked an adequate treatment of the role of capital as a factor of production in the innovation technology, he says. They made the simplifying assumption that the only input into the R&D process is labour – and that is simply wrong, asserted the speaker.

- *Unless there is continual technological innovation growth will ultimately falter because of diminishing returns.*
- *Without sufficient incentive in the economy to accumulate capital, the incentive for people to continue to discover new techniques, products, innovations, and markets is likely to be choked off.*
- *The effects of changing the pace of capital accumulation or the pace of innovation are likely to take considerable time to accumulate. Moreover, when increasing the pace of innovation, output may fall at first before eventually moving to a higher growth path several decades into the future.*

Mr. Howitt and colleague Philippe Aghion have built on the earlier generations of endogenous-growth models by developing the capital sector and its link to the innovation process. They think the earlier argument can now be turned around. That is, if there is not sufficient incentive in the economy to accumulate capital, then the incentive for people to continue to discover new techniques, products, innovations, and markets is also likely to be choked off. This is because, typically speaking, innovations that bring new technologies on line require increasing amounts of capital for their implementation; indeed, increasing amounts of capital are required for the production of new ideas in the first place. R&D tends to be a capital-intensive activity, in terms of both human and physical capital. Thus, stimulating capital raises output and incomes, and that in turn stimulates more R&D via a scale effect from the size of the market (in other words, there are increasing returns to the production of ideas). Likewise, having more R&D raises more capital, which in turn produces more income. The implication, says Professor Howitt, is that capital accumulation is also a critical determinant of long-term economic growth.

A great deal of empirical research was done after endogenous-growth models became fashionable, and much of this work was critical of the basic ideas of those models, said Mr. Howitt. He reexamined the interpretation of the existing evidence, taking into account two key factors: 1) capital is an important input into the innovation process; and 2) endogenous technology needs to be seen in the global context and not within the context of a single economy, even one as large as that of the United States. In light of these new perspectives, Professor Howitt concluded that the available evidence is much more supportive of the idea that endogenous technology is important in the long run.

He also talked about the response patterns observed in aggregate growth as a result of changes in the pace of capital accumulation and in that of innovation. There are considerable lags involved in both cases. When investment in either physical or human capital increases, the capacity

Macroeconomists have traditionally played down the the role of technology largely due to their inability to analyse the forces that shape technological change.

output of the economy will rise but only gradually at first, because the annual investment represents only a small portion of the total stock of capital, so that the effects take considerable time to accumulate. The effects take even longer when the pace of innovation is increased, with lags being measured in decades rather than years. Moreover, added the speaker, the response pattern is non-linear because of capital obsolescence. When increasing the pace of innovation, new ideas, techniques, and machines come faster and the economic value of older technologies is destroyed at faster rates, which means that output may not rise but rather may fall at first, before eventually moving to a higher growth path over a more distant time horizon.

In conclusion, Professor Howitt believes that capital knowledge are both important and are critical to long-run economic growth: if knowledge in an economy does not grow, this will choke off incentives to accumulate capital; and if capital does not grow, the incentive to accumulate knowledge will also diminish. They are two facets of the same dynamic.

ELHANAN HELPMAN ON GENERAL PURPOSE TECHNOLOGIES AND ECONOMIC GROWTH

Much has been said and written about the causes of growth, whether economic, political, or other. Economists traditionally emphasize the roles of capital and labour, though more recently they are also paying attention to political and technological factors. In a recent Distinguished Speakers in Economics presentation, Professor Elhanan Helpman of Harvard University examined the importance of technological factors in economic growth.

According to Professor Helpman, economic historians have long placed great weight on technology as a force in economic growth. In contrast, most macroeconomists have traditionally downplayed the role of technology because of their inability to analyse the forces that shape technological change. However, things are changing, he pointed out, thanks to efforts linking the microeconomic aspects of the innovation process to macroeconomic phenomena.

So how do economists think about technological progress?, asks Mr. Helpman. On the one hand, they think of it as an incremental process that improves the efficiency of resource deployment, he explains. That is not to say that progress is uniform across sectors or even across time, but, overall, it is a smooth process. On the other hand, they also think of technological progress as including drastic innovations. The introduction of the steam engine or of the microprocessor/computer provides examples of drastic innovations, said Dr. Helpman.

There is no debate about incremental technological progress, says the Harvard academic. All economists agree that incremental progress is vital for economic growth. Moreover, small improvements, serendipitous or intentional, take place within the normal course of business. What's more, many incremental innovations follow on the heels of drastic innovations.

Drastic innovations are another matter. According to Professor Helpman, drastic innovations introduce discontinuity into the normal course of development. That is, they lead to the replacement of old technology with new technology (where the old technology played a major role in manufacturing or the provision of goods and services) or an old material with a new material. Discontinuity in this sense does not necessarily imply discontinuity in the observed pattern of resource allocation or the evolution of output. This is simply because the introduction of a superior technology can sometimes be gradual so that even if the technology itself is drastic, its introduction may begin with a negligible absorption of resources and gradually expand over time until the technology is fully absorbed in the economic system.

In order to understand properly the relationship between the causes and consequences of shifting resources, indus-

A variety of channels lead to lower productivity in periods following the arrival of GPTs.

trial reorganization, and productivity slowdowns, it is important to make a distinction between gradual and drastic innovations, says the Harvard economist. A focus on incremental change may lead to overlooking the major innovations and the true cause of the change. Moreover, the forces driving incremental innovation may differ from those driving drastic changes, especially with respect to the risks and uncertainties involved.

Drastic innovations qualify as "general-purpose technologies" (GPTs) if they have the potential for basic use in a wide range of sectors in ways that will fundamentally alter each sector's mode of operation. They are enabling technologies that open new opportunities rather than offer complete final solutions; because they have many varied uses, they present much scope for improvement initially and for innovational complementarities with other technologies; hence, they provide opportunities for incremental innovations.

- *On the one hand, technological progress is an incremental process that improves the efficiency of resource deployment; on the other hand, it also includes drastic innovations.*
- *Incremental technological progress is important and key to economic growth.*
- *Drastic innovations introduce discontinuity into the normal course of development. Drastic innovations qualify as what know as general purpose technologies, or GPTs.*
- *The introduction of the GPT is typically followed by a decline in output while the industry reorganizes itself around the new technology.*

GPTs have potential effects on aggregate output and productivity, reports Dr. Helpman. In that regard, he cites the analogy between the introduction of electricity and that of the microprocessor/computer. It has been suggested that the impact of computers on productivity is similar to that experienced following the introduction of other GPTs, most notably electricity. In both cases, productivity growth slowed down for several decades before picking up over time.

Theoretical work has uncovered a variety of channels that lead to lower productivity in periods following the arrival of GPTs, continued Professor Helpman.

Economies, or output, evolve in very long cycles, and each cycle typically comprises several phases. One crucial phase, at the beginning of the cycle, includes activities such as secondary innovations following the introduction of the GPT, the reorganization of productive capabilities, and so on. It is at this stage that we typically see output declining while the industry reorganizes itself around the new technology. In a later phase, output rises quickly as manufacturers of final products realize the productivity-enhancing features of the new technology.

The industrial order in which the GPT is adopted may also affect productivity. Every sector has to develop specific tools and machines that will use the new technology. As well, there are coordination problems with respect to interchangeability between sectors. Because there is no natural order in which sectors will adopt new technologies, these factors suggest that cyclical adjustments will take place at the industry level. Depending on the size of the industry in the economy, these adjustments may or may not affect the overall economy, says Professor Helpman.

Four factors influence the pace of take-up of new technology at the industry level:

1) the productivity advantage of the new technology at the sectoral level: the greater that advantage in any given sector, the more likely it is that the sector will adopt the GPT;

2) the capital stock or capacity output of old technology equipment: the greater that capacity, the less inclined will be the industry to adopt the new technology;

Actual behaviour is likely to differ from economically predicted behaviour because of the many non-economic factors usually not accounted for.

3) the demand faced by the sector: the greater the demand, the more likely the industry will be to adopt the GPT; and

4) the productivity of resources in secondary innovations: for example, if retooling in one sector is easier than in another, the more likely that sector will be to adopt the new technology.

These factors, particularly the stock of old technology equipment, help to explain why the telecommunications and automotive sectors were among the very last to adopt digital technologies, remarked the Harvard academic.

Overall, summarized Professor Helpman, the role of technology, particularly that of GPTs, is a relatively new area of study for economists. It provides potential explanations and a powerful tool to explore those aspects of economic growth that traditional approaches have been unable to elucidate.

GEORGE AKERLOF IDENTIFIES A WAY TO EXPAND TRADITIONAL ECONOMIC ANALYSIS

Economists have traditionally limited themselves to the quantifiable aspects of human behaviour and have skirted qualitative questions. Moreover, the profession is generally averse to looking across disciplinary boundaries and acknowledging the importance of other disciplines in explaining real-world events. However, real-world problems are multidisciplinary in character; that is, in addition to economics, problems may entail social, political, cultural, historical, and psychological aspects.

"The addition of identity alters standard economic analysis and affects economic outcomes," says George Akerlof, Professor of Economics at the University of California at Berkeley. In an April 1998 Distinguished Speakers in Economics lecture, Professor Akerlof argued that actual behaviour is likely to differ from that predicted by standard analysis because it is determined by many factors other than those usually accounted for in economics. Chief among these non-economic factors is the notion of identity.

People care about their identity, asserts Dr. Akerlof. In other words, they care about who they are and about how they see themselves. Taking account of identity means including a gamut of prescriptions about what actions are or are not appropriate. These prescriptions are powerful, conscious or unconscious motivations of behaviour. For example, consider the case of gender – specifically, the role of the male. There is a list of things a man should do and a list of things a man certainly should not do. With these prescriptions, actions have meanings, and following these prescriptions affirms one's manhood.

According to Professor Akerlof, traditional economic analysis can be expanded in three ways through the inclusion of identity. First, behaviour motivated by identity is prescriptive. Whereas most economic analysis concerns actions undertaken solely to obtain goods and services, actions in response to identity are prescriptive; they may either be rational and cognitive, or they may be triggered by emotions and may be aversive (in other words, behaviour may occur even when there is no incentive for the response to occur, and the behaviour may be contrary to the interests of the individual).

Second, identity involves prescriptive externalities. That is, an action may have meaning and evoke emotional responses in others. For example, a dress is a symbol of femininity and a man wearing a dress may affect other men in the sense that they feel their masculinity threatened. They may harass the "offender" in response.

Third, there may be incentives to manipulate prescriptions. With the exception of advertising, economists have generally not recognized that symbols and rhetoric can change preferences and prescriptions for behaviour. Incorporating the possibility of changing prescriptions into

a model of behaviour adds an important facet to decision making and policy, suggests Dr. Akerlof.

Adding identity to the economic model expands the choice set of both individuals and policy makers, declares Mr. Akerlof. To illustrate this result, he first developed the model and then applied it to five different situations: the economics of gender discrimination, of race and poverty, of education, and of violent crime, and the economic modelling of politics. In each case, he contrasted the results found in traditional economic methodology with those from his identity-augmented approach. And in each case, the identity-expanded model better explains the real-world event. For example, traditional approaches are not very good at modelling violent crime. The inclusion of identity in the behaviour response improves the analysis since much violent crime is a response to restore insulted honour and is thus triggered by identity. The implication here, says Mr. Akerlof, is that harsh penalties may be somewhat blunt instruments to prevent such crimes. Rather, policies that over the shorter run delay response, such as removing weapons from the streets, and over the longer run change prescriptions regarding human behaviour may be fruitful ways to decrease homicide and may be much more effective in dealing with violent crimes than harsh penalties.

- *People care about their identity.*
- *Including identity can expand traditional economic analysis in many ways because certain behaviour is motivated by identity (for example, externalities) and, over and above advertising, because there may be incentives to manipulate prescriptions.*
- *Adding identity helps explain why people do things that are economically not rationale.*
- *Adding identity to the economic model expands the choice set of both individuals and policy makers.*

In sum, identity is important: it helps to explain why people do things that are economically irrational. Moreover, the addition of identity adds multidisciplinary considerations to the standard economic approach. This can only help to strengthen the analysis.

ROBERT SUMMERS: ARE THE PENN WORLD TABLES CHUTZPAH OR PRAGMATIC?

Suppose you were asked to provide your conclusions about the economic condition of countries around the world over the past 30 or so years. What would you want to include in your analysis? Undoubtedly, the first step would be to compare each country's economic statistics over time. For example, how much have consumption, output, and standards of living grown? A second approach would be to make comparisons between countries. Have household incomes in one country risen or fallen relative to incomes elsewhere? In short, you would want to provide a set of intertemporal and international comparisons in support of your conclusions.

But where would you obtain the data necessary for such comparisons? That's easy, some would say: just get the national accounts data from the central statistical agency of each country! You could then make your comparisons and draw you conclusions, couldn't you?

Hold on, says Robert Summers, Professor Emeritus of Economics at the University of Pennsylvania, "the devil is in the details." At a recent Distinguished Speakers in Economics presentation, Professor Summers addressed the pitfalls and tribulations of making international and intertemporal comparisons of real product and its components. He introduced the Penn World Tables (PWTs), a system of national accounts for over 100 countries in which the data are expressed in a common currency unit, based on a set of average world prices in a partic-

The Penn World Tables are directly comparable across countries and across time.

ular year, so that they are directly comparable across countries and over time.

What's the big deal in developing a system of national accounts across time and space? Why can't we squeeze enough juice out of individual national accounts? Essentially, says Professor Summers, you wouldn't get the answers across space from the individual national accounts, even though you might think you did. To illustrate, consider the question whether richer countries engage in more investment than poorer ones. From the individual country data, the share of investment in gross domestic product (GDP) for developed countries is about 20 per cent while for developing countries it is about 21 per cent. But consider that in developed countries capital goods are cheap whereas in developing countries they are expensive. What would happen if the capital goods were evaluated at the same set of prices? By correcting for the differences in prices across countries, the share of investment in GDP rises from an average 20 per cent to around 22.4 per cent for the developed countries while it falls from 21 per cent to around 15 per cent for poor countries. The implications from the second set of numbers are very different from those provided by the simple comparison based on the individual national accounts.

- *Individual national accounts do not give answers across space because of differences in prices across countries.*
- *What is needed is the collection of prices and price surveys and the establishment of purchasing power parities, or PPPs.*
- *The shares of countires with higher prices are exagerated and only by using a common set of prices across all countries will that inflated share diminish.*

Moreover, what is needed is a basis for comparing what a unit of currency is worth in one country with the worth of another currency in a second country. For example, how does one compare the output of Japan, measured in yen, with our own output, measured in dollars? This involves more than just the exchange rate, says Professor Summers, because the exchange rate does not fully take into account differences in prices. One also needs to gather data about prices and price surveys, and to determine purchasing power parities, or PPPs. Not only does the exchange rate differ from the PPPs, but it does so in a systematic way, adds Professor Summers. In fact, he continues, using the exchange rate exagerates the notion of disparity between poor and rich countries because it overstates the shares of countries with the higher prices. Only by using a common set of prices across all countries will that inflated share diminish.

So, are the Penn World Tables the panacea for making intertemporal and international comparison? Not quite, reports Professor Summers. All of this work is on the expenditure side of the system of national accounts; considerably less work has been done on the production side. And the reason is simple, he adds: it is much harder to work on the production side, so we are doing the easy stuff first. He credits the latest version of the Penn World Tables with being more than just a rudimentary space/time comparison mechanism. Nevertheless, much work remains to be done, he concludes.

Distinguished Speakers in Economics Program

Schedule for 1998-99

September 11, 1998 -- ***OLIVER HART***, Harvard University, on *"The Theory of the Firm: Implications for Microeconomic Policy"*

October 2, 1998 -- ***PHOEBUS DHRYMES***, Columbia University, on *"The Economics of Productivity"*

October 29, 1998 -- ***ANNE O. KRUEGER***, Stanford University, on *"American Trade Policy and the East Asian Economies"*

November 13, 1998 -- ***JOHN McMILLAN***, University of California at San Diego, on *"Auctioning the Airwaves"*

November 20, 1998 -- ***DALE W. JORGENSON***, Harvard University, on *"Canadian Economic Growth in International Perspective"*

March 12, 1999 -- ***JOEL MOKYR***, Northwestern University, on *"Technical Advance and Economic Progress"*

March 19, 1999 -- ***DANI RODRIK***, Harvard University, on *"Making Openess Work"*

March 26, 1999 -- ***PETER B. KENEN***, Princeton University, on *"Reforming the International Financial System: Motion or Commotion?"*

April 9, 1999 -- ***JACK TRIPLETT***, Brookings Institution, on *"Quality Improvements and Productivity"*

April 30, 1999 -- ***FRANK S. LEVY***, Massachusetts Institute of Technology, on *"Computers and Work"*

May 21, 1999 -- ***FRANCO MODIGLIANI***, Massachusetts Institute of Technology, on *"Topic to be anounced"*