

**MY BRAINS AND YOUR LOOKS:
CANADA IN AN INNOVATIVE WORLD**

(A Business Agenda with Heart)

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Daniel Trefler

Canadian Institute for Advanced Research (CIAR)

and

University of Toronto

In the hopes of producing a child of exceptional beauty and intelligence, an attractive woman once asked George Bernard Shaw whether he would father her child. To which Shaw replied: “But Madam, what if the child has my looks and your intelligence?” I fear that Canada is falling into the same hapless error. Think of brains as the U.S. innovation powerhouse and beauty, not in any pejorative sense, but as Canada’s distinctive core values of community and caring. In the 1980s, Canadians watched from the sidelines as Americans took the high road of growth through innovation. We are now afraid that unless drastic action is taken, Canada is condemned to fall farther and farther behind. Integration with the United States through NAFTA and the WTO was supposed to prevent this. By tying ourselves onto U.S. coat tails, we would not be left behind. Yet this has not worked as well as hoped. U.S. productivity growth in key sectors continues to far outstrip Canadian growth.

At the same time, Canadian social services have steadily eroded. Not only are we missing out on the brains of growth through innovation, we are losing the beauty of our social programs. In the willy-nilly race to emulate U.S. economic performance, fiscal

restraints have forced us to abandon or downsize many of our social programs. This has created a tension between the social agenda and the business-driven innovation agenda.

The bulk of this report documents Canada’s innovation gap and its sources. The report ends with a vision statement that explains to Canadians how innovation is linked to their daily bread and how a caring and healthy population can contribute to innovation. In so doing, I focus on the multiple touchstones between what is mistakenly thought of as Canada’s *competing* business and social agendas.

INTERNATIONAL COMPETITION: DOES IT PROMOTE INNOVATION AND PRODUCTIVITY?

The general public is tired of hearing about international trade policy initiatives. Free Trade Fatigue is a pervasive fact that constrains policy decisions. I am sympathetic to many of these concerns, less sympathetic to others. For example, I cannot fathom what is meant by the popular slogan: “No Globalization Without Representation.” See

figure 1. I thought I elected the officials who negotiate trade agreements. This is not the place to outline the numerous legitimate sources of Free Trade Fatigue. I simply want to point out that the galvanization of public resistance to further trade initiatives and the growing political effectiveness of transnational civil society has altered the set of available policy instruments.¹ This said, we cannot allow ourselves the luxury of burying our collective head in the sand: international trade is central to innovation and growth. We have no choice but to maintain a high level of integration with the most dynamic elements of the world economy.

There are a large number of links between international competition on the one hand and innovation and productivity on the other. Inward FDI brings high-productivity firms to Canada which in turn leads to valuable demonstration effects for domestically owned firms. Outward FDI provides a channel for exploiting scale economies that are larger than the domestic market. R&D conducted in the U.S. not only raises U.S. productivity, but also spills over into rising Canadian productivity. Access to the U.S. patent base provides us with otherwise difficult-to-obtain information. These and other channels at the productivity-innovation interface are created by liberal trade policies.²

Against this, it is often argued that the trade-productivity link is a sham. After all, the Canada-U.S. Free Trade Agreement (FTA) did not close the Canada-U.S. productivity gap. This argument is patently false. My own detailed work points out that while the FTA was costly in terms of worker adjustment, it definitely delivered the goods on productivity.³

The productivity point can be seen from figure 2. The figure lists annual productivity growth rates by industry over the

1990-95 period for both the United States and Canada. At the top of the figure are those industries for which U.S. productivity growth exceeded Canadian productivity growth. The U.S. domination comes from two industries: "Electrical and electronic products" and "Industrial and commercial machinery." The first is primarily computers, one of the most technologically innovative sectors. The second, machinery, is the link between innovative activity and commercialized final products. In these industries we are dealing with *product innovation*, that is with the introduction of new products. For most of the industries at the top of figure 2, Canadian productivity growth has not kept abreast of U.S. developments. That is, Canada is not as competitive in industries where product innovation is central. *Process innovation* involves the reduction of the cost of producing existing products. At the bottom of figure 2 are the low-end manufacturing industries such as leather goods and clothing. Such industries tend to be process innovators. For most of the industries, Canada has been able to cut costs more effectively than the United States. *Canadian firms know how to cut costs, but we are not as good as U.S. firms at developing and marketing new products.*

I will come back to this point shortly. Here my main point is simple. The set of industries that experienced the largest FTA-mandated tariff cuts were *exactly* the same set of industries that are grouped at the bottom of figure 2. This makes it crystal clear that increased international competition has raised productivity by increasing process innovation.

DOMESTIC COMPETITION

No one should be surprised that competition increases innovation and productivity. Indeed,

the most important source of such competition typically originates domestically. We must thus ensure that we do everything possible to promote domestic competition. Putting aside several heavily regulated industries such as banking, transportation, and pharmaceuticals, government's role in promoting innovation through competition comes under the purview of the Patent Act and the Competitions Act. There has been enormous and detailed discussion of how best to fine tune these Acts in order to promote more competition. In my view, Canadian innovative and productivity failures cannot primarily be attributed to a failure of such fine tuning. By and large, we have the microeconomic climate in place.⁴

One explanation for the innovation-productivity gap is low levels of R&D in this country. But this only takes one so far in terms of policy responses. First, Canada has very generous R&D subsidies and tax credits to both large firms and SMEs.⁵ Second, Canada does have a number of exceptionally innovative firms e.g., Nortel and Bombardier to cite just two. Thus, low levels of R&D cannot be a complete story of the innovation and productivity gaps.

ECONOMIC GEOGRAPHY

I have argued that domestic and international competition are not the smoking guns in the mystery of Canada's lagging productivity and innovation. A very important piece of evidence starts with the observation that economic activity takes place in physical space rather than on a pinhead from some Smithian factory. Figure 3 describes the relationship between the cost of doing business internationally and the degree of geographic concentration in an industry. The revolution in transportation and information technologies

together with substantial reductions in legislated trade barriers have meant that many industries are far out on the figure 3 curve. The image most of us carry around is exemplified by autos. At very high costs of doing business internationally (the left side of the figure), every country has a domestic auto industry so that autos are geographically diffuse. At moderate costs, autos are shipped from just a handful of production locations. At very low costs of doing business internationally (the right side of the figure), manufacturing fragments. That is, auto seats are made in Mexico, engine blocks are made in Ohio, and assembly is done in Ontario.

Unfortunately, dynamic knowledge-based industries are not at a comparable stage of fragmentation. In most knowledge-based industries (the ones doing product innovation and associated with the new-goods economy), geographic clustering remains a key feature of economic geography. New York financial services, Boston venture capital, Houston oil-extraction services, San Jose computers, and Vancouver-Washington software are the most prominent of these clusters, but hardly the only ones.

Why do these clusters exist? There are two reasons. The first is that by promoting competition, the clusters promote innovation. I recall reading about a New York computer firm that was going to relocate to a new cluster in Austin, Texas. The CEO stated that he was moving because there was *more* competition in Austin.⁶ The idea that one moves to where competition is greatest makes little sense in most economic models, but makes perfect sense from an economic geography perspective. The second reason for the existence of clusters, and the reason I wish to harp on, is that clustering enables firms to develop tighter upstream and downstream

relationships. This in turn promotes “learning-by-using” innovation.

LEARNING BY USING

The typical image of an innovator is that of a white-coated technician whirling around a laboratory that is equipped with all the most recent and expensive machinery. But this paints an inadequate picture of the innovative process. Most innovation involves incremental changes made by users. It is *not* the initial idea that makes the product profitable: it is the follow-up patents and developments that bring the new product into the black. This point has been hammered at for years by the two greatest students of technology, Eric Von Hippel at MIT and Nathan Rosenberg at Stanford. Unfortunately, it has not overturned our lab-technician image of innovation. More importantly, it has not percolated into mainstream policy thinking.

Some examples may help make the point about learning by using. The turbojet was a revolutionary engine design, but one that had distinct cost disadvantages because of its high maintenance costs. Yet a decade of observation and tinkering with design defects led to a 70% fall in maintenance costs as the engine was overhauled to accommodate a simpler and less frequent maintenance schedule. This type of innovation or learning-by-using is so pervasive in the aircraft industry that most passenger aircraft are initially designed flexibly to allow for incremental user innovation. This is especially important with “stretching”. In its first 15 years, corrections to initial design flaws allowed the DC9 to double its passenger capacity.⁷ More generally, Von Hippel finds that most high-technology equipment goes through numerous major design changes during its lifetime.

Further, most of these design changes (as much as 77%) are done by users.

CANADA’S LEARNING-BY-USING GAP

The key question, then, is whether Canada takes advantage of learning by using? The answer is not a positive one. In this section I will document our learning-by-using deficit. At each stage I will offer a policy solution for this deficit. There are many such solutions. Here I focus on education because it is an excellent example of the touchstones between the social and innovation agendas.

First, from figure 4, our technology uptake rates are very modest relative to the United States. We are not giving ourselves the opportunity to learn by using. Further, evidence over the last decade makes it clear that firm technology strategies are not just about buying fancy machines: they are about aggressively hiring skilled workers and re-training existing workers.⁸ *They are about building an educated workforce with strong secondary school and first-degree post-secondary training.*

Second, incremental innovation is encouraged by good technical staff and by management who keep open lines of communication and recognize how to tailor products to production. The success of the Japanese economy even as recently as 1990 was in designing, and then redesigning products so that production costs could be lessened without affecting product performance as perceived by consumers.⁹ *This type of learning by using is premised on the availability of executives with strong management training, strong engineering backgrounds, and/or strong human resource backgrounds: in short strong professional-school training.*

Third, basic science may seem like the last place to find learning by using or clustering. On the learning-by-using side, one need only recognize that the United States pioneered the development of the technical schools that offered Ph.D. programs in industry-oriented fields. Not only did this involve prominent schools in major urban centres (Harvard's 1847 professorships of geology and engineering), but also schools located close to the source of the industrial activity (the famous Colorado School of Mines established in 1873).¹⁰ More recently, we have seen the development of a Southern California bio-tech industry centred on academic stars who have linked up with commercial enterprises. Five articles coauthored by academic stars and firm scientists imply about five more products in development.¹¹ A recent report by the City of Toronto ties the emergence of Toronto's bio-tech industry to the hospital complex associated with the University of Toronto.¹² Basic research leads to product use which in turn feeds back into more basic research.

I have often heard it said that Canada does not need basic research. We can free-ride on U.S. developments. This is a case of too little, too late. By the time we hear of the innovation, it is already being developed commercially. And without the research capacity here it is difficult to know if the innovation is truly significant or how one would commercialize it. *All this points to the need for advanced graduate degrees.*

I believe this helps explain a Canadian paradox. We have liberalized trade, granted large R&D subsidies, and even invented some pretty important stuff. Yet we do not seem to be getting the big productivity kick we were expecting. The resolution is that we are short on clusters and in particular, short on the users

one finds in those clusters. There are not enough people with the education, training, experience, motivation, and conceptualization needed to do incremental user innovation.

MY LOOKS AND YOUR BRAINS

I have focussed on education as a partial solution to developing user-innovating clusters. I will not claim it as a universal panacea, but it does have two nice features. First, if one is thinking about geographic clusters then one starts thinking about government interventions that target specific locales. Educational facilities from primary school through to the most advanced research facilities all share the common feature that they anchor the community and provide a footing for economic clusters. More generally, a Conference Board of Canada survey concludes that the dominant factors in influencing the development of clusters of knowledge-based industries were: (i) a skilled labour force, (ii) the reputation of local universities, and (iii) quality of life. In contrast, lower taxes did not make the list.¹³

I have a second, more insidious reason for stressing education. I see it as a touchstone with those interested in children, in less-educated youth looking for work (a group with the highest poverty rates in Canada, higher even than single moms), in inequality, and in urban decay. We have all heard from the CIAR Human Development and Population Health groups about the importance of the early years. There are the neglected rats who perform poorly under stress, nurture-deprived monkeys who react impulsively (destructively) rather than curiously (constructively) to new situations, animals who respond aggressively to being low on the pecking order, and orphans whose lack

of early-year stimulation leads to substantial IQ deficits. It is natural to ask yourself who you would prefer to work with. Is it a co-worker who performs poorly in the stressful world of high-tech innovations, who shows little curiosity, reacts aggressively, and is not particularly bright? If your answer is no, then you are in synch with company recruiting surveys. These surveys point out that what employers are looking for is attitudinal factors. They look for workers that our healthier (fewer sick days), display commitment to staying with the job for a long period (which allows for greater investment in worker training), and are flexible in the sense of being able to respond to top-down instructions *as well as* to communicate bottom-up observations about user innovation.¹⁴ *This is all about early childhood education and secondary schools (good school-to-work transitions).*

Further, in his blueprint for a more productive Canada, the Dean of University of Toronto's Business School stresses the importance of how Canadian aspirations are formed as well as how these aspirations are translated into action.¹⁵ Both of these are core concerns in the human development literature.

You should be thinking that I am overstating the link between the interventions advocated by those who emphasize human development and more generally, the core importance of social programs that target children, unemployed youth, the poor, and urban decay. I would whole-heartedly agree. It is not that there is no link, but that the links are just beginning to be explored, as for example, by Murnane and Levy in *Teaching the New Basic Skills*.

In thinking about these issues, one should not discount the importance of finding touchstones between a business agenda of

cluster-based innovation and a social agenda of community and caring. I recently read of a business group advocating that primary schools should include risk assessment strategies in their curriculum. My immediate reaction was, probably like yours, "what next?" In fact, an important issue in early childhood outcomes is the importance of developing a healthy curiosity that is tempered by a sense that extreme actions can have extreme consequences. ("Take chances, make mistakes," Ms. Frizzle of the Magic School Bus enjoins us each week.) While educators will not think of risk assessment in terms of portfolio positions, they do understand its immediate developmental significance.

To return to the title of this talk, Canadians fear that unless they are able to emulate U.S. brains or ability to grow through innovation, they will be left behind. At the same time, there is a real concern that willy-nilly adoption of a U.S. model will degrade our beauty and our capacity to maintain core Canadian values of community and caring. Canadians need to have the business agenda of innovation on their radar screen. Without more innovation we will be unable to afford our social programs. To put innovation on the radar, we must demonstrate to Canadians that policies which induce innovation also benefit our children, our youth, our poor, and our cities.

ENDNOTES

1. See Saskia Sassen, *Globalization and Its Discontents*, New York: The New York Press, 1998. Cited by Margaret Atwood in "Blind Faith and Free Trade" in *The Case Against Free Trade*, Earth Island Press: San Francisco, 1993.
2. See Daniel Trefler, "Does Canada Need a Productivity Budget?" *Policy Options*, 20 (July-August 1999): 66-71.
3. Daniel Trefler, "The Long and Short of the Canada-U.S. Free Trade Agreement." Mimeo, University of Toronto.
4. Michael E. Porter and the Monitor Group, *Canada at the Crossroads: the Reality of a New Competitive Environment*. Ministry of Supply and Services, 1991.
5. *Report of the Technical Committee on Business Taxation* (Mintz Report), April 6, 1998, chapter 5.
6. Citation.
7. Nathan Rosenberg. *Inside the Black Box: Technology and Economics*. New York: Cambridge University Press, 1982.
8. Mark Doms, Timothy Dunne, and Kenneth R. Troske, "Workers, Wages, and Technology," *Quarterly Journal of Economics*, 1997, pages 253-290.
9. See Martin Baily and Hans Gersbach, "Efficiency in Manufacturing and the Need for Global Competition." *Brookings Papers: Microeconomics*, 1995, pp.307-347.
10. Paul A. David and Gavin Wright. "Increasing Returns and the Genesis of American Resource Abundance." *Center for Economic Policy Research*, Discussion Paper No. 472, 1996
11. Lynne G. Zucker, Michael R. Darby, and Jeff Armstrong, "Geographically Localized Knowledge: Spillovers or Markets?" *Economic Inquiry*, 36, January 1998.
12. "Toronto Competes: An Assessment of Toronto's Global Competitiveness," Toronto Economic Development Office, February 2000.
13. Januzs Zieminski and Jacek Warda, "What Makes Technopoles Tick? A Corporate Perspective." Conference Board of Canada, September 1997.
14. Baily and Gersbach, *op. cite*.
15. Roger L. Martin and Michael E. Porter, "Canadian Competitiveness: Nine Years after the Crossroads," mimeo, January 2000.

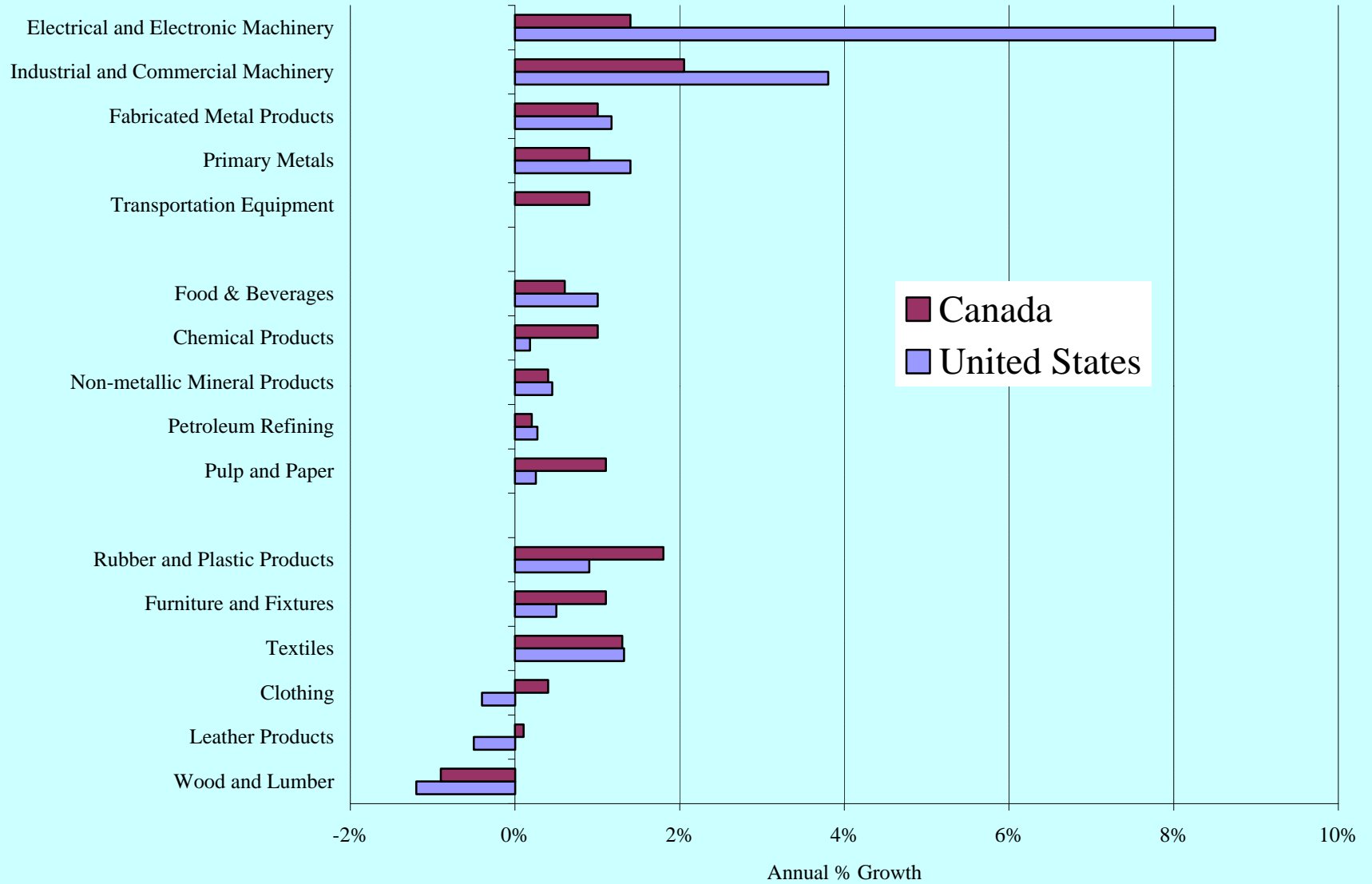
**No Globalization
without
Representation!**



**Make Trade
Clean, Green, and Fair**

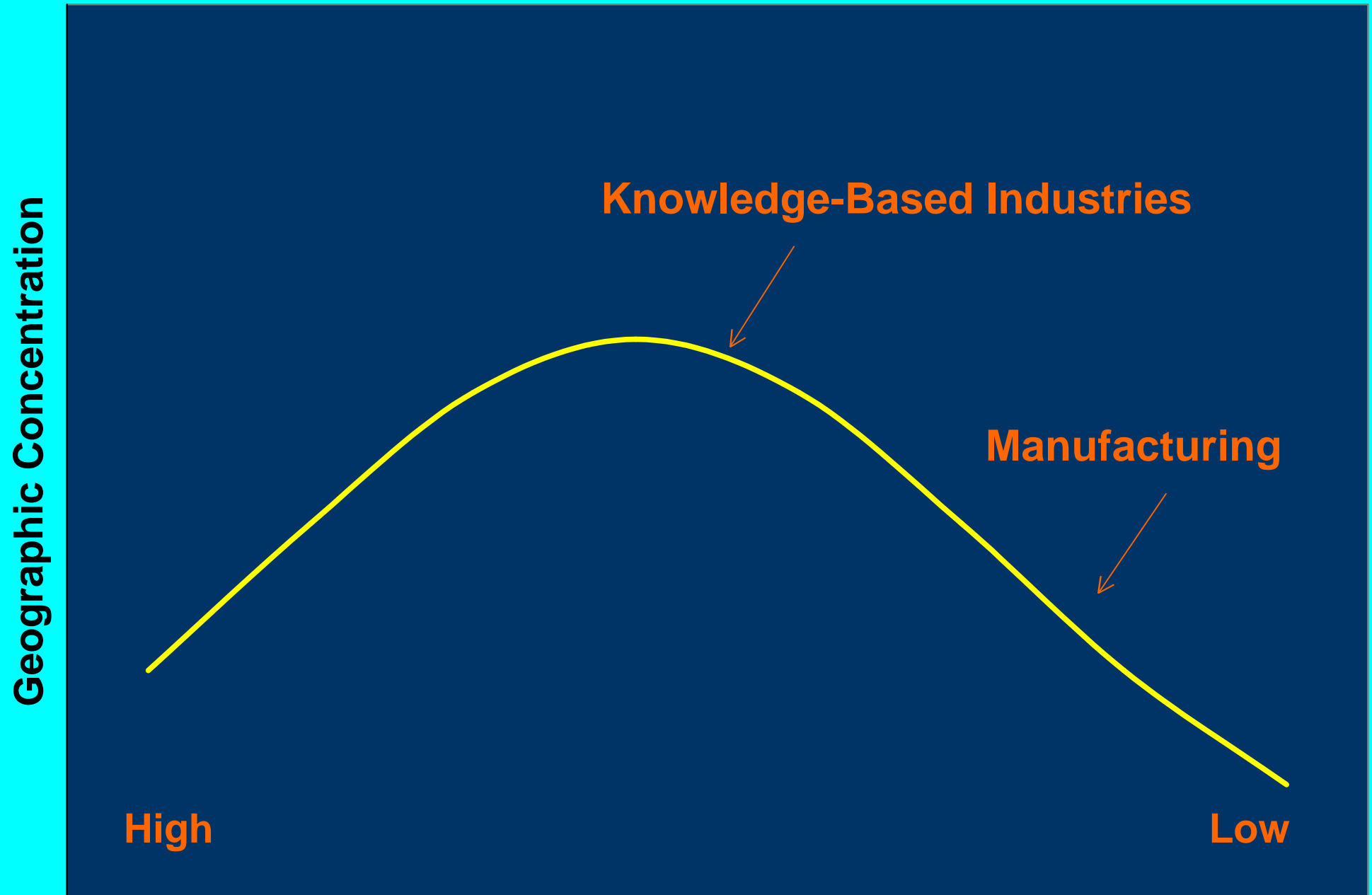
Figure 1. No Globalization without Representation

Figure 2. Annual Productivity Growth Rates by Industry, 1990-95



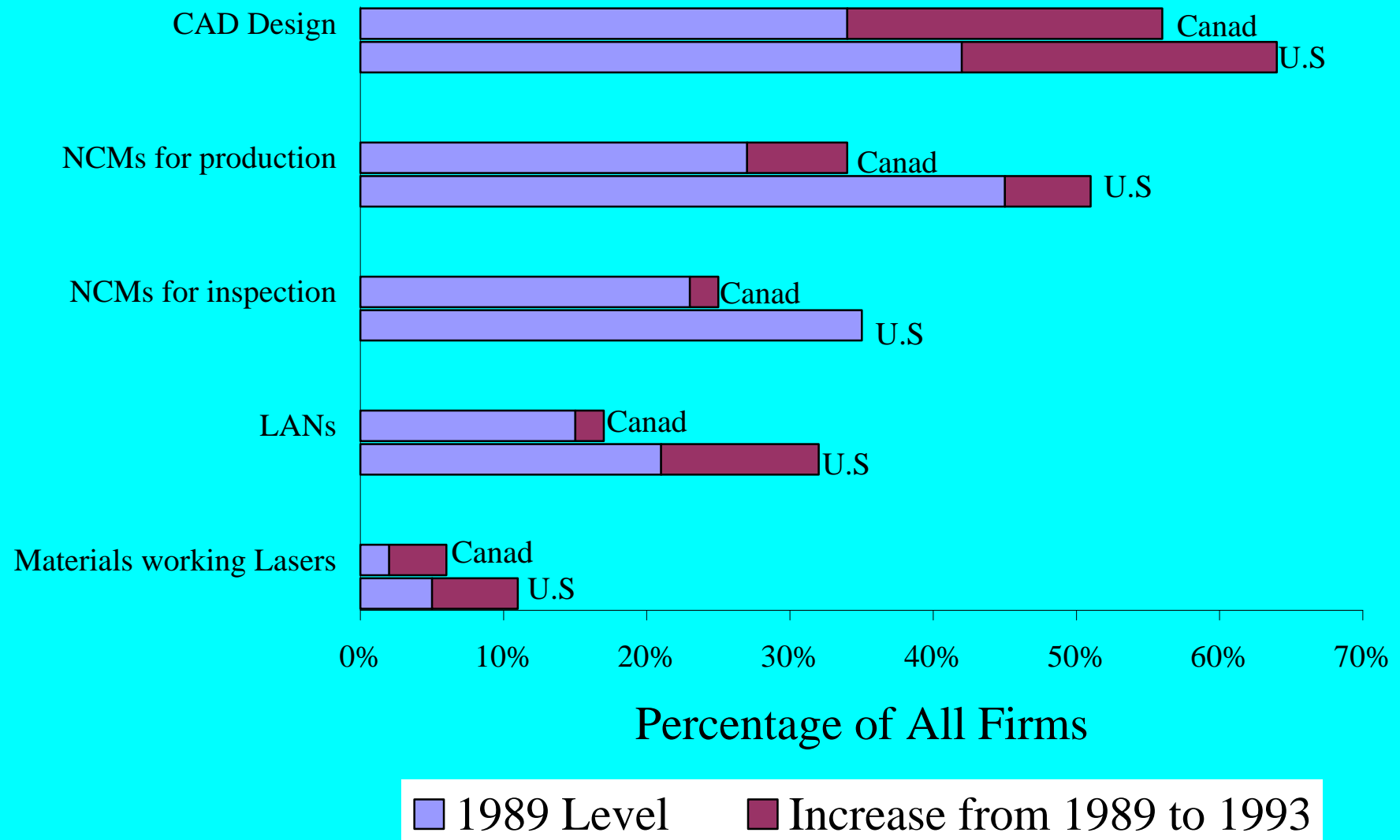
Source: *The Daily*, March 23, 1999, Statistics Canada

Fig. 3 The Geography of International Trade



Falling Costs of Doing Business Internationally

Figure 4. Technology Adoption



Source: Baldwin and Sabourin, "Technology and Competitiveness in Canadian Manufacturing Establishments" *Canadian Economic Observer*, May 1996, Statistics Canada Cat. No. 11-010-XPB