

THE ECONOMIC UNDERPINNINGS OF A KNOWLEDGE BASED ECONOMY

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Table of contents

1: What is a knowledge-based economy?

- *The Knowledge Content of Goods and Services*
- *The Knowledge-Based Economy*

2: How a knowledge based economy works

- *Human beings strive for knowledge and its value*
- *Commercialization*
- *Free Enterprise and Entrepreneurship*
- *The Austrian School of Economics*
- *The Resilience of a Knowledge-Based Economy*
- *How Globalization Fits In*
- *Creative Destruction and the Winner Take All Economy*
- *A High Return Usually Means a High Risk*

3: Why is the knowledge-based economy more relevant concept now than in the past?

4: Some hard questions

- *Do Advanced Economies Like Canada's Have Any Alternative Other Than Shifting Towards A More Knowledge-Based Economy?*
- *Do we have to abandon social fairness in a knowledge-based economy?*
- *Is government less relevant in a knowledge based economy?*

5: Conclusion

1: What is a knowledge-based economy?

The Knowledge Content of Goods and Services

As the 20th century draws to a close, the knowledge content of everyday goods and services is rising as never before. Accompanying this is an equally amazing explosion in the amount of information available to ordinary people.

Consider the letters on these pages. Only a couple of generations ago, a quill and a dark fluid were all a writer needed. Anyone of normal intelligence could pluck a bird's tail-feathers and set verse to paper. A generation ago, people used pens and pencils. Although virtually no-one, on his or her own, could have manufactured a ball point pen, or even a pencil, from metal ores, coal tar, or tree branches, the workings of these writing instruments were comprehensible to most of humanity. Now, to write these unworthy pages, we are using a PC vastly more powerful than the room-sized computer that guided men to the moon in 1969. We print hard copies with a laser printer – yet lasers were props of science fiction only a few years ago.

Each advance in writing tools was built on humanity's accumulating hoard of knowledge. Aeons ago, someone discovered how a quill feather could spread a coloured liquid across a flat surface. Others, watching, copied her. Over the ages, certain observant people found that some feathers and some liquids worked better than others. A store of knowledge grew, and new scribes had to learn it before they could practice their art. Yet until the current age, every scribe could, on his own, build the tools of his trade from scratch.

By the Renaissance, this was no longer true. Johannes Gutenberg, who built the first printing press, was a metal-smith, and knew nothing of smelting or mining. Yet knowledge of these trades was embedded in his printing press. The metal from which built his press was produced by a smelter with knowledge of metallurgy and furnaces. He, in turn, used ore that was mined by a miner, whose knowledge of ores and earths led him to dig his mine. Both relied on equipment produced by other craftsmen from materials produced by yet others. The knowledge embedded in the Gutenberg press in 1436 was already beyond the capacity of a single mind.

Today, the accumulated knowledge embedded in everyday goods and services is extraordinary. PCs are ultimately made of common things: sand (silicon), metal ores (circuits), coal tar residuals (plastics), and the like. Certainly, no human being could, alone, build a PC, or even a printer, from nature's provenance. Humanity's collective knowledge of metallurgy, electronics, petrochemicals, and other specialised fields is embedded in these common appliances that a free market economy provides to an average worker for a few dozen hours of his wages.

The Knowledge-Based Economy

The knowledge content of today's goods and services is vastly more important than it was even a few decades ago. To deal with this, successful companies must make the gathering, filtering, and processing of new information to produce useful knowledge a routine part of doing business.

The sharply rising knowledge intensity in 21st century production means that successful managers and employees need "information handling" skills. The need for these skills is clearly not restricted to companies' upper echelons. Modern cars contain advanced technology like computer chips that control fuel delivery and power distribution, that record gas mileage, and so on. Mechanics trained in the 1970s and even the 1980s are unable to service today's reliable and fuel efficient cars unless they have "upgraded" their car knowledge.

Knowledge is much more than technical training. Much of the knowledge intensity in today's goods and services is on the "soft" side. An individual who can, from scratch, optimally organise and manage production and marketing in today's world is about as rare as one who can build a PC from coal tar and sand. Generations of experience, ideas, failed experiments, and unexpected successes underlie the organisation of large business enterprises.

Moreover, technical knowledge and "soft" knowledge must be linked. Car manufacturers like Chrysler regularly link engineers, material scientists, service mechanics, advertising agents, car dealers, market analysts, and accountants together in designing new car models. The launch of a new model draws on much wider and deeper knowledge than that of engineers and computer scientists alone. Consumers and services groups play increasingly critical roles. The result is more appealing new cars that are easier to service when they (increasingly rarely) require it. These successes are due to more than new technology, though that is certainly important. They depend on the automaker's ability to co-ordinate the work of related and unrelated teams of specialists. Information sharing and simultaneous information processing are stages in the production of the knowledge that gets embedded in each new car model.

Even in the manufacturing of simple commodities like clothing, the process has fundamentally changed. Computers feed consumer purchase patterns (e.g. style, colour, material) directly to distributors, who use this knowledge to choose designs and place direct orders to manufacturers. They then deliver the clothes to stores "just in time." The consequence is much more rapid style cycles (twelve per year instead of only four) more satisfied customers, lower purchase prices, and yet higher profits. The cornerstone of this process is distributors' continuously updated information about consumers' demands, manufacturers' capabilities, raw material supplies, and their own delivery systems, and their use of this information to produce knowledge about what style of jeans should be shipped to each clothing store in Kitchener or Red Deer this afternoon.

Marketing techniques are also changing to reflect better knowledge of consumers' tastes. The selling of Saturns is based on a marketing concept previously used only for specialty items like Harley Motorcycles. GM created a Saturn Club that provides Saturn owners with activities ranging from get-togethers for swapping their experiences to reunion parties. A few Japanese Saturn users have actually shipped their Saturns from Japan to Texas to join reunion parties. The marketing technique that builds up such "consumption capital" and customer loyalty relies on "knowing consumers" and continuously updating this knowledge.

Such sophisticated knowledge-based marketing techniques have spread even to the marketing of toys. Any parent, grandparent, uncle or aunt to a pre-school or elementary school child is aware of the beanie baby phenomenon. Beanie babies are modestly priced animal-shaped bags stuffed with plastic beads. The beanie baby is not just a toy, however. It is part of a series of "issues" of different animal shapes, some of which become collector items valued hundreds of times higher than the original store price. There is a beanie-baby handbook, a beanie baby website, electronically connected user clubs, and so on. An active black market exists for rarer "issues" and for beanie babies from foreign countries. In 1998, the U.S. Customs Service was ordered to confiscate beanie babies crossing the border from Canada, presumably to raise the black market prices of issues that were rare in the U.S., but relatively common in Canada. The manufacturers sell not beanie babies, but some abstract consumption capital stemming from the beanie baby series.

Distribution in a knowledge-based economy is much more complicated than ordering, stocking, and selling. The success of distributors like Walmart and Toys R US is based on so-

phisticated logistic management systems. These firms collect detailed information about changes in their inventories, customers' purchase patterns, suppliers prices and capabilities, and their own transportation capabilities. They use this to know what stocks are "just right" to satisfy customers. They precisely co-ordinate their transportation system. Trucks are linked to docks and stores electronically, so loading and unloading time is economised, routes and movements of empty vehicles are minimised, and so on. The result is convenient shopping and lower prices for consumers, leading to a massive customer base and thus the distributor's bargaining power to bid manufacturers' prices yet further down. The system translates spending power into lower merchandise prices (thus higher consumer value), and higher distributors' profit. These companies have revolutionised the distribution process through their "knowledge" of customer needs, manufacturing supplies, transportation systems, and general logistic capabilities.

Financial services businesses like investment, consulting, accounting firms are serving their customers using the knowledge they build company-wide and globally. Firms that are leaders in these areas, like the Bank of Montreal with its "Mbanx" computer banking system, and the Toronto Dominion Bank with its computerised discount brokerage business are industry leaders. The gains they can make by making these knowledge intensive products available to more customers are cited as justification for their mergers with the Royal Bank and CIBC respectively.

The successes of such knowledgeable firms have left their former competitors with declining customer bases, unattractive merger proposals, and even bankruptcy filings. As traditional department stores' toy floors lost out to Toys 'R' US, their other floors simultaneously lost customers to "big box" specialty stores that used these same knowledge intensive distribution methods. Established department store chains like Woodward's and Eaton's filed for bankruptcy. Automakers like Jaguar, American Motors, and others that failed to keep pace with technology became subsidiaries or divisions of more successful companies.

These changes have certainly increased potential productivity throughout the economy. In recent years, much has been made in some quarters of a so-called "productivity puzzle". The basic allegation is that, all else equal, high investment in information technology is not clearly associated with increased productivity. These arguments have been shown to be faulty – mainly because the "all else equal" assumption is usually inappropriate. The first problem is the way the "productivity puzzle" economists tried to measure "productivity", as sales minus costs. Sales is price times units of output. Increased information content is reflected both in better quality units of output and in lower output prices, like the Henry Ford's model T cars and the various generations of powerful PCs. Consequently, sales minus cost figures can be grossly misleading if interpreted casually as measures of productivity. The second problem is that whole new markets and professions have been created around information flow and information processing. These are entirely missing from studies that find evidence of a "productivity puzzle"¹. In short, the world has changed so much that many of these studies are founded on fundamentally flawed assumptions about what has remained constant.²

¹ There are other problems. Measuring investment in knowledge is usually quite difficult. For example, R&D spending is very fungible so that it is hard to specify R&D spending by industry. The problem applies in measuring other inputs too. Another problem is that the timing of the benefits of investment in knowledge may be quite volatile, some come more immediately and some only after a long delay.

² In any case, studies based on macro data are quite supportive of the importance of technological progress. For examples, see "The Sources of and Prospects for East Asian Economic Growth," Lawrence Lau; and also "The Industrial Revolution: Past and Future," Robert E. Lucas, Jr. Both papers were presented at the Far Eastern Meeting of the Econometric Society, Hong Kong, 1997.

The world certainly has changed. The inevitable conclusion from these illustrations is that a vast amount of knowledge is embedded in everyday goods and services. This embedded knowledge raises their value to consumers. It is a crucial input in virtually every business. Knowledge has become the primary weapon in competition for profits and corporate survival. It is this central role of knowledge in competition that distinguishes our modern economy as a “knowledge-based economy”.

2: How A Knowledge Based Economy Works

Human beings strive for knowledge and its value

Human nature encapsulates both innate curiosity and the desire for consumer goods. Sociobiological studies of human behavior find clear and consistent evidence of spontaneous curiosity and hoarding, characteristics we share with most primate species.³ Philosophers and ethicists may question these aspects of human nature, but their arguments are unlikely to overturn traits that arise from deep within the human genome. The genius of a knowledge-based economy is that it lets us satisfy one of these primeval compulsions (wealth accumulation) by satisfying the other (curiosity).

Humans are fundamentally resourceful, and crave improvements on their lives. We value ideas that improve our well-being, and that help us overcome environment constraints and other adversities. Since our own bodies are relatively weak, some eight millennia ago we acquired knowledge about training oxen, and later horses, as beasts of burden. We supplemented this source of energy with waterpower, steam, and other steadily more knowledge-intensive sources of energy. We developed ways to use energy to give us light, heat, and so on.

Markets underlay the development and spread of all of these innovations. Even the first use of beasts of burden in the ancient Near East was contemporaneous with the first organized trade.⁴ Markets reward people who commercialize ideas and inventions that others value. They give others incentives to copy these ideas in other places, and to improve them if they can.

Thomas Edison’s laboratory in New Jersey produced innovations ranging from the light bulb to motion pictures. The same technology Edison used was known elsewhere in the world, including in Canada. The dynamic free market economy of the United States at the beginning of the 20th century meant that innovators there stood to make and keep more money than innovators elsewhere could. Edison argued that his work was “for the betterment of mankind”, but he was always careful to safeguard his patent rights. Indeed, the loss of his motion picture patents deeply embittered him in his later life, despite the fact that his loss created a whole new industry. Alexander Graham Bell actually invented the telephone in Canada, but famously took his invention to the United States when no financial backing was forthcoming for such an odd device in this land of woods and water.

Inventors themselves may not see the commercialization possibilities, but the profit incentive makes sure someone does. The hydraulic piston motor had been used, with water power, in China since c. 530 AD. Joseph Cugnot built a steam-powered horseless carriage in 1769; but his funding disappeared with the disgrace of his patron, the Duke de Choiseul, foreign minister

³ See *On Human Nature*, by Edward O. Wilson, Harvard University Press, Cambridge, 1978; and also *Consilience*, by Edward O. Wilson, Alfred A. Knopf, New York 1998.

⁴ See *Great Inventions Through History*, by Gerald Messadi9, Chambers, Toronto, 1988.

to Louis XV. Fuel oil predates recorded history in the ancient Near East, but the first gasoline-powered piston engine was not built until 1876, when Niklaus Otto put two and two together. Entrepreneurs, like Gottlieb Daimler, Carl Benz, Eli Olds and the Packard brothers, used old technology when they built the first, very expensive, commercial automobiles in the late 19th century. Henry Ford revolutionized auto making by introducing assembly line production in the 1920s, bringing affordable automobiles to the masses.

Ultimately, human beings have collectively overcome adversities and constraints. The awareness of what needs improvement, the ability to find solutions, and the ability to appropriate commercial value from these solutions, together give rise to the continuous introduction of ever more knowledge into goods and services. The result is the improvement of living standards, and huge fortunes to the successful innovators!

Commercialization

Commercializing knowledge means putting knowledge into a business. It means acquiring and assimilating knowledge, identifying the commercial opportunities that make the knowledge valuable, and having the ability to act on the new knowledge.

Again, notice here that advanced technology is just an ingredient leading to commercial success. It is neither necessary nor sufficient. When desktop copiers were introduced, Xerox probably had patents on virtually every aspect of copying technology. It had the rights, and the ability, to produce personal desk copiers. Yet, it took Canon, a little “David” with far less technological capability, to give consumers desktop copiers. Canon’s managers saw the need for inexpensive, reliable, small volume copiers that can fit into any corner of an office; and Canon delivered exactly that. Canon’s critical knowledge was not the technology of making small copiers, for that belonged to Xerox. Its “edge” was its knowledge of what buyers wanted. The moral of Xerox’s forfeit of this whole line of business is that technology is useful, but knowledge of consumer needs and production possibilities is essential to profitably commercializing that technology. It takes the full spectrum of knowledge to give the supplier and customers a win-win outcome.

Knowledge comes wrapped in people. People collect, store, and sort information, and their thoughts process this raw information into useful knowledge. Acquiring knowledge is an economic activity like any other, in that it has an economically meaningful cost. An individual must exert effort, first to acquire information and then to gain useful knowledge from it. We can attest, by personal experience earlier in our lives, that staring at a book, even for many hours, yields no information. You have to read, analyze, and ponder it. Then you have to re-package the book’s contents in your own words, and relate it to other information you possess. This “decoding” and “re-coding” process require labor (the time spent reading and thinking), capital (the book, a place to read it, and the background knowledge to understand it), and energy (the light to read by and the food to sustain the reader). Intense thought is every bit as draining as hard labor. But without going through this process, you gain no knowledge from your book.

Innate curiosity leads us to collect information, but acquiring valuable knowledge can be a draining job, and people need motivation to undertake it. We acquire knowledge of operas not just because we ourselves find them entertaining. Rather, knowing such things conveys implications about social status, wealth, intelligence, and other qualities that attract attention and praise – a real, albeit intangible, value.

People work hard to develop knowledge with commercial value if they can appropriate a considerable part of that commercial value. The Chinese inventor who built the world’s first pis-

ton engine lived in an economy where only the feudal aristocracy was entitled to an income above subsistence levels. Any wealth he accumulated would have rightfully belonged to his local warlord. The same conditions prevailed in most pre-industrial societies. Property rights were such that average people earned nothing from innovations – indeed, their value often accrued to hated overlords. Unsurprisingly, economically important innovations were few and far between. It is no coincidence that the pace of innovation only picked up in the last few centuries as modern concepts of property rights evolved. A large and increasingly influential school of economic historians argue that legal reform, especially the extension of effective property rights protection beyond the aristocracy, is the crucial difference between our age and earlier ones.⁵ By protecting their return from commercialized innovation, these reforms set the stage for the rapidly rising knowledge intensity of our contemporary economy.

In an organization, individuals work as a team. This makes economic sense because different individuals can distill different knowledge from the same information. In a team, employees independently and jointly acquire, process, and generate knowledge and then act to capture its commercial value. Creating successful knowledge-intensive products requires firms to have effective coordination mechanisms for fostering such interactions. That means management must understand employees' vantage points so as to create effective incentives to cooperate in these ways. When this is done well, the firm has vastly more knowledge capability than the sum of the individuals it employs. But, when its employees' incentives are in disarray, an organization's knowledge capability quickly falls to match the minimum competence level among its managers and employees.

The importance of the soft "institutional" side for inducing the creation and utilization of knowledge cannot be over-emphasized. Intensive thought is work, but it is hard to meter such work. This often makes standard hierarchical management structures liabilities rather than assets. As the Dilbert comic strip illustrates every day, it is harder to manage people paid to think than to manage people paid to work on assembly lines or dig for ore.

Employees in today's economy are about as willing to devise innovations that enrich only their employers as serfs were to devise innovations that enriched only their feudal lords. The only proven way to get people to create knowledge, work that is both hard and difficult to measure, is to give them clear monetary incentives based on results rather than effort. They must be empowered with both freedom from standard managerial oversight and with at least partial property rights over the proceeds of their knowledge. For a company to be knowledge-based, it has to give employees these incentives to create knowledge with commercial value.

It also has to encourage coordination and cooperation in work processes. The importance of information sharing and teamwork in knowledge creation seems self-evident, and no self-respecting company is without access to powerful communication technology. But, few companies burst at the seams with knowledge creation. A consulting company instructs its consultants to share insights and knowledge in company-wide email network. But, there is no return for the extra work. The result – no one uses the system other than for appearance's sake. Each individual employee still acts based on his/her own knowledge because that course is the most financially sensible. As a consequence, from an outsider's perspective, the company is at best as knowledgeable as that individual employee the outsider is dealing with.

Company politics can impose further constraints, so that the individual employee displays less intelligence than he actually has. A junior executive's idea threatens a senior execu-

⁵ See *How the West Grew Rich*, by Nathan Rosenberg and L.E. Birdzell, Jr., Basic Books, New York, 1986.

tive's power and remuneration if the idea reduces the company's dependence on the senior executive's knowledge, or if the senior executive should have thought of the idea herself. To protect their power bases, senior executives have been known to use their discretionary power to retard the development of knowledge that substitutes for their past ideas and to reward the development of knowledge and ideas that complement their own.⁶ Competing employees have also been known to feed one another misleading or deceptive information, and to deny one another access to information the company possesses.

Fortunately, examples exist of how to manage coordination and cooperation successfully. The analysts, consultants, and bank representatives of Citibank regularly write onto and read from "citimail", its bank-wide information network system. The reason – if an idea is used, its originator receives real cash bonuses. Citibank acts as if it has the sum of its employees' information, and can use this store to create knowledge. The result is a highly competitive market position and a good bottom line.

This discussion highlights three basic principles that govern the utilization of information and thus the creation and commercialization of knowledge within an organization – empowerment, incentives, and the appropriability of returns. The use of these principles to make an organization knowledge-based is a central concern in the fields of organizational economics, sociology, and management.⁷

Free Enterprise and Entrepreneurship

In five millennia of recorded history, humans have experimented with every conceivable approach to organizing their societies. Divine pharaohs, tribal chieftains, social idealists and cynical dictators have all had their turns. Feudalism, mercantilism, socialism and theocracy have all been tried in different combinations and permutations. One and only one mode of organizing society has proved amicable to the rapid creation and application of valuable knowledge. That mode of organization is free market capitalism. The market mechanism allows individuals or firms to capture the commercial value of the knowledge they create, thus it links effort to reward.

Capitalism and only capitalism has propelled the creation and commercialization of knowledge that have made modern society possible. Socialist, social democratic, communist, and theocratic economies have proven barely able to incorporate new knowledge developed in their capitalist neighbors, and totally inept at creating knowledge on their own.

The state-owned factories of post-socialist countries in Eastern Europe and the former Soviet Union are living museums to the technology that was current when those countries became socialist. Czech factories preserved the technology of the late 1940s and Russian factories preserved that of 1917. The only real exception to this was Soviet military technology, which was considered too important to be centrally planned. Instead a generous system of perks and privileges rewarded successful managers of military projects and top Soviet scientists in fields with military uses. In contrast, fields with no perceived military purpose, such as the biological sciences, were infused with Marxist theory. Soviet genetics lagged the West by decades because acknowledging that science meant disavowing the Party Line that human nature was infinitely

⁶ Exactly this behavior by IBM top management led to that company largely missing out on the PC market in the 1980s; see *Strategic Technology Management*, by Frederick Betz, McGraw Hill, New York, 1993. IBM's top researchers and managers had careers that were built around mainframe computers. Shifting to PCs meant running a nontrivial risk of marginalizing themselves.

⁷ See, e.g. Michael C. Jensen and William H. Meckling, "Specific and General Knowledge, and Organizational Structure," *Journal of Applied Corporate Finance*, vol. 8, 1995.

malleable to Marxist indoctrination. Even the liberal social democracies of Northern Europe are increasingly faced with the technological obsolescence of their key industries, and with stagnant real standards of living.

The reason for this general absence of innovation is easy to see. Why should a firm adopt a new production process that reduces its labor needs in a country with labor laws that ban dismissals without cause? Why should a firm implement cost cutting technology if most of its increased profit is absorbed by higher tax bills? In such an environment, innovation is a pointless nuisance. In 1945, the United Kingdom's Enigma project had given it a commanding lead over the rest of the world in computing technology. But the project's leader, Alan Turing, did nothing to commercialize his inventions. Nor did anyone else in Labour-ruled post-war Britain. Rather, Turing's ideas were developed and commercialized in the United States, where these enterprises could generate profits for the entrepreneurs who led them.

No one can deny the difficult ethical and human questions that free market economics stirs up. Capitalism is clearly an unsatisfactory way to run an economy in a host of dimensions. But arguments of this sort tend to obscure the fact that all the alternatives tried so far are worse. This is most blindingly apparent when we consider knowledge production and commercialization. First class minds are rare, and their owners understandably want to live in economies that give them the freest access to information and the most generous rewards for valuable knowledge. In this light, it is no surprise that the vast majority of Nobel laureates in the sciences have been American-born or naturalized Americans, and that almost all the important R&D in many key industries is done in that country.

If other parts of the world are to compete meaningfully in the 21st century's growth industries, they must find ways to attract and keep creative thinkers (other than imprisoning them as the Soviets did). The United States is justly and unjustly criticized on many fronts, but the rest of the world has no other model of such a thoroughgoing knowledge-based economy at this time. Other countries may have little to learn from the United States about gun control, wars on drugs, interracial harmony, convicting murderous football stars, or electing monogamous politicians. We do, however, clearly have much to learn from the Americans about how to organize a knowledge-based economy. The rest of us should not let misplaced nationalist sentiments blind us to this solid and indisputable fact.

The Austrian School of Economics

The textbook view of a free market economy sees many firms competing for each other's customers by cutting prices, for each other's workers by offering better salaries, and for each other's investors by offering higher returns. This competition discourages inefficiency by keeping prices as low as possible and wages and investment returns as high as possible. But this competition is, at the margin, a zero sum game. Ultimately, prices get as low as they can get while wages and returns to investors rise as high as they can. Profits disappear altogether and a competitive economy of this sort theoretically settles into a stable state where no one can be made better off without making someone else worse off. In the long run, textbook microeconomics theoretically must lead to a stagnant zero-sum game where my gain is your loss.

How does this square with the irrepressible dynamism of free market economies like the United States? The missing piece to this puzzle is the economics of knowledge. The first serious study of knowledge accumulation was undertaken by a group of economists in late 19th and

early 20th century Vienna called the Austrian School.⁸ This was at a time of accelerating technological change, as radical new high-tech industries like precision steel casting, railroads, and electricity found large-scale commercial application. The Austrian School sought to explain these phenomena, along with the wave of corporate mergers, opaque new financing techniques, and vast wealth creation they engendered. The school was neglected in the postwar era, mainly because it meshed poorly with the mathematical restatement of economics that was then the central project of academic economists. The recent integration of Austrian economics into the superstructure of economic theory, an undertaking called “endogenous growth theory”, has revived the intuitive arguments of the Austrians. This intuition forms our basic understanding of a knowledge-based economy.

The principles that govern the creation of a knowledge-based organization also govern the creation of a knowledge-based economy. A knowledge-based economy is one that grants its prospective entrepreneurs the right to capture a large portion of the profits their enterprises produce. A free enterprise economy that safeguards intellectual property rights is the only known form of economic organization that does this. The knowledge real world free enterprise economies create is the engine of their dynamism. It is the reason actual free market economies are positive sum games, rather than zero sum games.

In a knowledge-based economy, the primary competition between companies is not competition to cut prices, but competition to innovate first. Firms collect and digest information to create new knowledge, based on which they offer innovations. To be profitable, innovations must raise “consumer value”; that is, they must satisfy consumers’ desires that previously were unmet, or that could formerly be satisfied only at greater expense. A company with an innovation that no one else has can cut its prices, pay its employees more, give its investors a better return, and yet avoid an unhealthy fixation on simple cost cutting. The essence of innovation is getting more valuable outputs from the same old inputs. The consequence is the creation of genuinely new wealth – a positive sum economy.

This does not mean textbook economic competition is irrelevant. Competition to innovate does not replace more traditional sorts of competition. Instead, successful innovation makes it easier for firms to be competitive in the traditional arenas of prices, wages and investment returns. Because successful innovators have an “edge” that lets them push their rivals aside in these traditional arenas, the return to innovation can be vastly higher than the return to other economic activities.

The theme in a knowledge-based economy, like that in a knowledge-based company, is the empowerment of people. People must have access to information and markets, so that the chances of their generating valuable knowledge are as high as possible; and people who develop valuable knowledge must earn a substantial enough profit from their ideas to justify the enterprise in the first place. Their ability to appropriate these returns is the economically important meaning of “empowerment”.

This version of empowerment must extend not just to entrepreneurs, but to everyone. Consumers must be able to buy the new product if it better meets their needs. They must be unhindered by trade barriers, discriminatory taxes, or other distortions that artificially separate the entrepreneur from her customers. Workers must move freely from old firms to new, more knowledge intensive firms. This migration must not be impeded by migration restrictions, subsidies to old firms, taxes on new firms, or rigid labor laws. Savers must be able to invest their

⁸ See *A History of Economic Thought* by Josef Schumpeter, Oxford University Press, 1954.

money in knowledge-based firms. Their investment choices must not be curtailed or distorted by discriminatory tax rules, bureaucratic interference, or other artificial impediments. Finally, losers must be free to fail. Bankruptcy wrests control over productive assets from slow or unsuccessful innovators, as their creditors seize assets for sale to the highest bidder – who is often a successful innovator in the same industry and is able to use the same assets more profitably. Protection from failure leaves poor innovators in charge, and thus impedes knowledge creation and use. Anything short of full empowerment in all of these ways suppresses the returns to innovation, and consequently constricts knowledge creation.

Economies that deny their citizens these sorts of empowerment are less able, or in many cases unable, to create new, more knowledge-intensive products. Again, extreme examples are the communist economies whose institutions discouraged information accumulation (by private citizens) and made knowledge creation for private gain a felony. The Soviet economy famously produced more low quality steel pipe than any other country. Unfortunately, nobody wanted it. The Chinese “Red Flag” automobile, which was still produced in the early 1980s, used 1949 engine technology. It is tempting to laugh at such arrested development until we recall that, in the 1970s, the British automaker, Jaguar, was also making cars with 1940s technology engines - and with wooden parts to boot!

The Resilience of a Knowledge-Based Economy

Once the foundations of a knowledge-based economy are in place, the economic growth that results tends to be both self-sustaining and self-reinforcing. This is a phenomenon called “positive feedback”. Economic growth in a knowledge-based economy is a positive feedback process because knowledge breeds more knowledge. This happens in four basic ways.

First, in a society where firms compete to innovate, the general information flow is bound to be large and innovation skills plentiful. Potential innovators find easy access to information, skilled workers, and capital. Employees, including both the technical and management types, exchange information in social settings and sometimes in job exchanges. They are like bees cross-fertilizing ideas in different firms.

Second, ideas and innovations developed for one job often have applications in others. Lasers, first conceived of as laboratory tools, now print letters, play CDs, transmit data through fiberoptic networks, and tally the prices of doughnuts at supermarket cashiers. Henry Ford's concept of assembly line production found its way into almost all major US industries, and was probably responsible for the U.S. and Canada being able to supply all the their World War II allies.

Third, widespread knowledge makes investing in more knowledge less risky and therefore more attractive. Information processing tools like computers and data storage devices were quickly pressed into use as financial tools. Investors realistically fear entrusting their money to rascals and fools. Much of the growth in the finance industry over the past two decades has been due to well run firms’ ability to distinguish themselves more starkly from poorly governed firms. If investors are better able to assess their investment opportunities, their uncertainty is reduced. This reduction in perceived risk means sound business ventures have better access to capital than have unsound ventures. This improved capital allocation allows for faster commercialization of valuable ideas.

Fourth, innovation frees up society’s resources, its raw materials, labor and capital. Henry Ford’s assembly lines brought affordable cars to people. Trucks could carry raw materials from far away without the need for costly railroad construction. Cars let people travel to

work, making a wider pool of labor available to businesses. Innovators, raw material owners and workers all gained increased wealth, which made financing for other innovations easier. Increased wealth and faster travel also gave people more free time, increasing their demand for other goods and services.

It is because of this positive feedback that the self-perpetuating economic growth described by Austrian economics is now called “endogenous” growth, meaning “internally generated” growth⁹.

Precisely because of the way knowledge-based activities reinforce one another, government must take care that the institutional environment it provides induces vigorous knowledge creation - just as managers must ensure that their firms are organized to foster, rather than to inhibit, knowledge production. Impediments to knowledge creation, or just weakened incentives to implement innovations, do not merely impede immediate innovative activity. They also disrupt this self-reinforcing feedback, condemning the whole economy to reduced growth.

How Globalization Fits In

Knowledge is different from most other economic inputs in two critical ways. First, it is hard to trade knowledge as one trades copper, used cars, or pork bellies. This is because knowledge is relatively easy to steal. After sharing their knowledge of how to produce CDs cheaply with their Chinese joint venture partners in Shanghai, American CD makers were dismayed to find numerous new, 100% Chinese-owned factories mass producing CDs with that technology. Although intellectual property rights protection is getting stronger in many countries, the U.S. firms have been comically frustrated in their attempts to gain, let alone enforce, a court order against the pirate factory owners. Because of potential problems like this, many innovative firms jealously safeguard their proprietary knowledge, never letting key secrets go beyond the head office.

Unfortunately the second unique characteristic of knowledge as an economic input squarely confounds the first. Knowledge, unlike apple pie, potato chips, and possibly chicken curry, can be consumed more than once.

The technique for extracting residual oil from old reservoirs does not disappear when it is used at an oil field at Medicine Hat. It can be consumed again and again at oil fields all over the world. In contrast, an apple, once consumed, is gone. Since it can be used many times, knowledge generates more profit the more it can be used. In theory, this means the oil company with the new extraction technique should sell its knowledge to every other oil company so that old oil fields everywhere can come back on line. The knowledge is most useful when it is applied most universally.

⁹ In “The Industrial Revolution: Past and Future,” (paper presented at the Far Eastern Meeting of the Econometric Society, Hong Kong, 1997), Robert E. Lucas, Jr. says, “On this general view of economic growth, then, what began in England in the eighteenth century and is continuing to diffuse throughout the world up to the present day was something like this. Technological advances occurred that increased the wages of those with the skills needed to make economic use of these changes. These wage effects stimulated others to accumulate skills, and stimulated many families to decide against having a large number of unskilled children and in favor of fewer few children, with more time and resources invested in each. The presence of a higher skilled workforce increased still further the return to acquiring skills, keeping the process going.” Lucas later mentions that countries that have been kept out of this process are those suffering from socialist planning, or simply corruption and lawlessness. The ingredient of growth we emphasize is the empowerment of individuals and firms to establish and take advantage of the linkage between knowledge creation and reward.

But this is where the first unique property of economically valuable knowledge confounds the second. Once the proprietary knowledge is sold, the innovative oil company loses control over it. The buyer may resell it to others. Or, it may guard the knowledge less closely than the innovator did, allowing others to steal it. The universal application of the innovation virtually invites its theft.

How can an innovative firm both retain exclusive control over its proprietary knowledge and apply that knowledge on as wide a scale as possible? The answer is that the innovative firm must grow very large very quickly.¹⁰ This growth can be in both scope and scale.

An example of growth in scope is Honda, which developed unique knowledge about transferring power from engines to wheels. It applied the knowledge to lawnmowers, motorcycles, and cars. Accounting firms with knowledge of their customers and of the business climates in different cities, regions and countries, branch out to consulting. Similarly, software companies with knowledge of Internet technology expand into computer-based communication, entertainment, and banking.

McDonald's is an example of growth in scale. McDonald's proprietary knowledge is its marketing skills and its ability to manage franchising operations so that every McDonald's, whether in North America or in Korea, offers identical standards of cleanliness, food preparation, and so on. These advantages would have been valuable applied to a small chain of hamburger stands, but their full value came from applying them worldwide. McDonald's and other similarly skillfully managed chains essentially wiped out other hamburger stands, not just in the US and Canada, but almost anywhere its knowledge-based "edge" made it attractive to people who wanted a quick, salmonella-free meal. In the same way, business school professors with new unique knowledge no longer confine their teaching to localized classrooms. They can earn a higher return on their knowledge by reaching out to global audiences *via* teleconferencing, video tapes, Internet-based courses, and international book launches. Likewise, financial services firms with skills at distinguishing good investments from poor ones are expanding internationally. If their advantage is real and they are not hampered by discriminatory regulations, they will drive less knowledgeable domestic competitors out of business because their knowledge delivers higher returns for savers.

This need for rapid expansion is probably why periods of rapid technological advancement, like the beginning and end of the 20th century, the 1920s and the 1960s saw waves of corporate takeovers. Mergers and acquisitions are the most straightforward way for a firm to get very large very quickly.¹¹

Innovative firms based in the U.S. clearly create value by expanding abroad, whereas non-innovative U.S. firms that go global generally get into trouble.¹² Again, this expansion is often most easily accomplished through corporate takeovers. Moreover, the cycle of positive feedback applies here too. Empirical evidence suggests that firms with an international reach invest more heavily in knowledge creation than do purely domestic firms.¹³

¹⁰ See "Why Investors sometimes Value Diversification: Internalization vs. Agency Behavior," Randall Morck and Bernard Yeung, University of Alberta working paper. May, 1997.

¹¹ See "Internalization, An Event Study Test," Randall Morck and Bernard Yeung, *Journal of International Economics*, Vol. 33 (August) 1992, pp. 41-56.

¹² See "Why Investors Value Multinationality" by Randall Morck and Bernard Yeung, *Journal of Business*, 1990.

¹³ See "Causality between International Expansion and Investment in Intangibles, with Implications for Financial Performance and Firm Survival," Will Mitchell, Randall Morck, Myles Shaver, and Bernard Yeung, in *Global Competition and Market Entry Strategies*, J-F. Hennert (ed.) Elsevier, North-Holland, forthcoming, 1998.

If the innovative firm is based in a small country, this sort of expansion in scope or scale usually means expanding into other countries. This is why guaranteed access to foreign markets is so heavily stressed by innovative businesses in smaller countries.

Moreover, and contrary to conventional wisdom, small firms can reach global markets as readily as they can reach large multinational firms. Many small firms have knowledge-based assets with valuable opportunities for expanded application. While these firms may not have the resources to expand directly, they can be acquired by larger firms that do. More subtly, a small firm that produces inputs for other firms can effectively access global markets by selling to multinationals in its home market. The multinationals can then ship the inputs to their worldwide operations. This “intermediated expansion” yields roughly the same outcome as direct expansion: the innovation is applied worldwide and the innovator keeps a significant part of the return from her innovation. This is especially true if there are many multinationals in its home market, so no single firm has a monopoly on providing intermediated expansion.¹⁴

The critical implication of this for small economies like Canada’s is that better access to large global markets, either directly or *via* multinationals, makes specialized knowledge creation more profitable for local firms than it would be without that access. As a consequence, Canadians and Canadian businesses should, over time, come to devote fewer resources to basic production activities and more to knowledge creation. As Canada becomes a knowledge-based economy, innovative Canadian firms should be able to earn high returns as the brains (headquarters) of globe-spanning operations that utilize resources in non-knowledge-based economies. Since, their knowledge is the indispensable input, while traditional inputs like low skill labor and raw materials can be found in many places, knowledge-based companies can dictate the terms of this game, and capture the lion share of the profit produced.

This happens despite the fact that a knowledge-based economy is essentially a service economy. It provides knowledge to serve the global economy, and collects a hefty return. A knowledge-based economy’s wealth increases if it generates more ideas, and applies them on a wider scale and scope. Its people can earn more without putting in more hours or by saving more. On the other hand, non-knowledge-based economies collect only basic returns for commodities sold, hours worked and money saved.¹⁵

Creative Destruction and the Winner Take All Economy

Economists of the Austrian School call economic growth through knowledge creation “creative destruction”. This is because knowledge-based companies are fundamentally creative enterprises, and because of the sure and certain destruction of firms that fail to innovate. Because of this stark distinction between winners and losers, and because of the immense bargaining power a successful innovator has, a knowledge-based economy is rightly described as a “winner take all” economy. Winners at innovation can totally displace less innovative firms, disrupting entire industries. The personal computer essentially destroyed the typewriter industry, battering venerable names like Smith-Corona and Remington. Innovations are often hard for older firms to imitate, certainly at short notice. The result is sudden death for losers and immense profits for winners – at least until other innovators come along and displace them.

¹⁴ See “The Internationalization of Small and Medium Size Firms: A Policy Perspective,” Zoltan Acs, Randall Morck, Myles Shaver, and Bernard Yeung, *Small Business Economics*, Vol. 9, No. 1, February 1997, pp. 7-20.

¹⁵ See “Industry Location, Growth, and Government Activism: the Changing Economic Landscape,” by Joanne Oxley and Bernard Yeung, in *Structural Change, Industrial Location, and Competitiveness*, Joanne Oxley and Bernard Yeung (eds.), Edward Elgar Co. 1998, forthcoming.

A successful knowledge-based economy thus has a high bankruptcy rate and many corporate takeovers. Bankruptcy is a disruptive and high cost way to transfer productive assets from the hands of losers to the hands of winners. Corporate takeovers are less disruptive ways of making the same transfer.¹⁶ In a corporate takeover, the owners of the old firms get a competitive price for their assets and walk away to retirement. They are only ruined if they insist on continuing to fail until bankruptcy is inevitable. Indeed, sometimes the mere threat of a corporate takeover is enough to limber up ossified management.¹⁷ Regardless, flexibility in allowing the ready transfer of control over corporate assets is an important policy objective for a knowledge-based economy.

The “winner take all” phenomenon absolutely does not mean that everyone else is impoverished. The winner takes all the profits away from other firms, but it still has to pay competitive prices for what it buys. However, without unique knowledge, other parties in the economy are generally “price-takers”. That is, competition means they get only an ordinary return for their ordinary capabilities. In contrast, the winner’s unique knowledge gives her strong bargaining power and therefore extraordinary returns – at least until she, in turn, is displaced.

This logic applies to wages too. Imagine a restaurant chain with unique marketing and management knowledge that captures consumers *en mass*. Because of competition for jobs, the meat suppliers, food preparers, and so on earn ordinary returns, the same money they would get for the same work anywhere else. The owners, however, take all the surplus because of the unique knowledge and skills they own. That is the MacDonal’d’s phenomenon.

Simply put, knowledge-based firms earn extraordinary income while ordinary firms earn only ordinary income. Individuals with valuable knowledge earn extraordinary salaries while others earn only basic wages.

Moreover, as knowledge-based firms internationalize, their earnings further increase, and so does the pay their knowledge creators draw. This happens for two reasons. First, their knowledge is now applied to a larger scale of operations. Second, they become less dependent on ordinary inputs from any specific location. This increases the return to knowledge and thus encourages more investment in knowledge creation.

The social consequence of this is an uneven income distribution. Its political consequence is lobbying by non-innovators to capture innovators’ gains through redistributive taxes or other mechanisms. Some lobbyists are motivated by genuine concern for the displaced, others are exhibiting, either consciously or unconsciously, another primal human trait: envy. In dealing with this lobbying, the government of a knowledge-based economy must recognize that lowering the return to innovation reduces the amount of innovation in the economy. Radical redistribution can look good for a while, but ultimately it impoverishes the whole economy relative to more up-to-date knowledge-based economies.

A High Return Usually Means a High Risk

The essence of competition in a knowledge-based economy is creative destruction. New knowledge is often disruptive. And today’s winner can be next week’s loser. The fortunes of individuals and firms with specific knowledge can fluctuate wildly. Many modern high paying

¹⁶ See “Alternative Mechanisms for Corporate Control”, by Randall Morck, Andrei Shleifer and Robert Vishny, *American Economic Review*, 1989.

¹⁷ See “Managerial Ownership and Corporate Performance: An Empirical Analysis”, by Randall Morck, Andrei Shleifer and Robert Vishny, *Journal of Financial Economics*, 1988.

jobs in computers, finance, and other knowledge-intense fields are high-return high-risk propositions.¹⁸

PCs and networking systems, today's innovators, destroyed mainframe computer making, yesterday's innovator. Digital image presentation is threatening the old fashioned film and image development business. Advances in computing capability have virtually wiped out old fashioned book-keeping jobs and have forced accounting firms to radically upscale their services. The possible development of room temperature superconductors would lay waste firms and people in industries ranging from energy production to auto parts.

Just as globalization increases the return to people with unique knowledge, it also increases the risks they face. Because knowledgeable people are highly mobile within multinational firms, new substituting skills can arrive suddenly from the least expected corners. Even skilled workers can lose their jobs with little advance notice. Few would have expected Asian chipmakers to devastate DRAM chip production in almost all the advanced countries. But they did.

Because of these glowering risks, firms and individuals look for insurance. Some are keen on developing deep and generally applicable knowledge. Sony has focused on miniaturization, and is always searching for new applications of its skill in that area. Its latest project is a "knee-top" computer - a powerful notebook computer weighing less than 3 pounds, not much larger than a legal pad, and selling for less than C\$2,400. Other firms are keen on becoming big or diversified. Canada's banks have adopted this strategy. Yet others aim for continuous knowledge creation capability. To move in this direction, many firms pin their hopes on "chief information officers" while their senior managers and management researchers busy themselves studying how to become a "learning organization". Despite the unfortunate prevalence of buzzwords and bizarre acronyms, these are real issues.

It makes sense for individuals to follow the same sorts of strategies. The analogous buzzwords are "continuous learning", "learning to learn," and so on. This has created a booming business in executive training courses. However, the younger generation seems more prepared for high job turnover, not expecting to work for one company only. New knowledge-based businesses, like headhunting, are emerging to make greater job mobility easier and to find better job matches, and to accumulate knowledge about labor markets.

In this context, unions should change too. Their focus on protecting jobs must be a losing concern in a knowledge-based economy because it is ultimately a fight against innovation. Their concern should be how to increase union members' productivity and mobility, and to how to provide job and income insurance to their members. That is a more sustainable and socially constructive way to attract new members and address genuine social problems.

While such volatility in individuals' and firms' fortunes can be disconcerting, especially to those directly affected, the aggregate fortune of a knowledge-based economy can be relatively unaffected. This is because the basis of the micro-level volatility is creative destruction. The destruction of each one million dollar firm is offset by the creation of another firm worth more than that and the destruction of each \$40,000 job appears to be offset by the creation of a new one that pays more (albeit often for an employee with very different qualifications). The aggregate macroeconomic performance of a knowledge-based economy can be a smooth, upward climb, punctuated only by the same sorts of economic disturbances that afflict any economy.

¹⁸ See "*The High Risk Society*," by Michael Mandel, Times Business: Random House, 1996.

Finally, it makes sense for governments to follow the same sorts of strategies firms and individuals follow. From an international perspective, economies compete with each other just as firms do. A knowledge-based economy will win out against traditional economies because its innovative firms will continually win out against those of other countries. Though each winning innovator firm's victory may be short-lived, a succession of such winners will steadily add to knowledge-based economies' wealth. In contrast, firms and individuals in other economies will continue collecting their ordinary wages and returns.

Government policies that reduce the return to knowledge creation and application can disrupt the positive feedback process that fuels knowledge creation. In the 18th and 19th centuries, Britain's success was due to its innovators. Britain's industries were the envy of the world, and at the forefront of virtually every field. At the same time, the social injustice of Dickensian fame raised genuine questions about British capitalism. In the mid 20th century, Britain chose a socialist path to right such wrongs. Within a couple of decades, British industry had fallen far behind its chief foreign competitors, British innovators and academics had moved abroad in droves, and the British economy was stagnating. Once knowledge-based growth is disrupted, an economy quickly drifts back to providing ordinary returns for ordinary labor, and overall standards of living quickly fall behind those of more knowledge-intensive economies. Governments must take care to engineer social policies carefully so they do not stifle innovation.

3: Why Is The Knowledge-Based Economy More Relevant Concept Now Than In The Past?

Britain's economic success in previous centuries was due to its knowledge-based manufacturing industries. The basic principles of knowledge-based growth were worked out by economists in Vienna a century ago. Clearly, the concept of a knowledge-based economy is nothing new. Why is the topic gaining so much attention now? The answer is that all economies, even primitive hunter-gatherer cultures that use bird feathers for drawing, are knowledge-based. The differences are of degree, not of kind.

Knowledge has always been the driving force for social and economic progress. The difference between a knowledge-based economy and an ordinary one is that in the former, the main competition between individuals, firms, and countries is competition to innovate. Other forms of competition, like price-cutting, become secondary. The result is increasingly knowledge-intensive goods and services and disproportionately rapid economic growth in knowledge-intensive sectors and economies. Why is knowledge-based commercial activity more prevalent now than in the past? We believe that there are several reasons.

First, radical developments have changed the technology of handling information itself. Information processing power has followed an exponential growth path. This has lowered the cost of gathering information and thus made knowledge production easier.

Second, public education and relatively equal access to university education have greatly increased the number of people qualified for knowledge-intensive jobs. In a normal industry, an abundance of employees depresses wages, but knowledge-based activities are different because they are subject to positive feedback. Any depression in the return to knowledge due to an abundance of knowledge workers is likely to be temporary. The self-reinforcing growth of a knowledge-based economy creates a revised version of the venerable Saye's Law: the supply of knowledge creates its own demand.

Third capital mobility has increased substantially in recent years, due to new technologies, better developed capital markets, and liberalisation of cross border investment. Higher capital mobility leads to more competitive capital costs. Sound knowledge-based commercial activities can find financing from anywhere in the world, driving down capital costs in formerly closed economies. Knowledge-based economies attract capital while other economies export their savings.

Fourth, foreign goods and services themselves and foreign direct investment can be the origins of domestic creative destruction. Globalisation makes it harder for entrenched, established firms to maintain the *status quo*. In the past, they could do this by starving domestic innovative firms of financing and by erecting other market entry barriers. In the era of more liberalised cross border trade and investment, their grip is challenged by strong foreign firms' exports and by foreign direct investment. Foreign competition weakens large, entrenched domestic firms financially and politically. This opens the door to local innovators. Foreign direct investment can provide financial backing to these local innovators.¹⁹

Fifth, our world has become richer. As people get richer, they seek more sophisticated goods and services - even if these are more costly. To satisfy these more sophisticated demands, suppliers need knowledge. We prefer more sophisticated cars and household appliances; and we search and compare models on the Internet before we visit show rooms. We demand more comprehensive banking that goes beyond savings accounts with minimal interest rates. We are informed book buyers and want bookstores that can instantaneously locate our choices, offer user-friendly information services, and give us a cultural experience in each visit. The owners of dingy bookstores in strip malls face disaster without state intervention to save them.

Finally, the world has become more like economics textbooks always made it out to be. Globalization means that cosy local monopolies have been broken up, sweetheart deals between local bigwigs and corrupt politicians are harder to pull off, and people in one country no longer meekly accept paying more for groceries, books, or automobiles than people in other countries pay. This heightened "ordinary" competition has paved the way for heightened competition to innovate by giving entrepreneurs more secure access to wider markets and more secure property rights over the returns from their innovations.

4: Some Hard Questions

Do Advanced Economies Like Canada's Have Any Alternative Other Than Shifting Towards A More Knowledge-Based Economy?

The options are limited and unattractive. Canadian firms are competing with U.S. firms and other countries' firms for both domestic customers and foreign customers. Knowledge-based firms will win because they are successful innovators, producing goods or services that consumers want and at lower prices than their competitors. At the same time, since they earn superior returns, innovators can attract the best employees by paying higher wages than their competitors can pay. Finally, innovators can attract new capital to finance their expansion by offering investors higher and more certain returns. These competitive "edges" let innovators quickly gain large market shares through higher capital spending or acquisitions, and equally

¹⁹ See "Inherited Wealth, Corporate Control, and Economic Growth, the Canadian Disease", by Randall Morck, David Stangeland and Bernard Yeung, 1998, NBER working paper # xxxx.

quickly push their less innovative competitors out to the fringes of the economy, or into bankruptcy.

Canadian firms that survive this competition will also have to be knowledge-based firms with continuous learning and innovative capabilities. Skilled Canadians will work for knowledge-based firms, Canadian-owned or foreign-owned. Clearly, the worry is Canadian firms that cannot compete and Canadian individuals who lack the skills to join knowledge-based firms.

It would be dangerously misguided to artificially halt Canada's transformation into a more knowledge-based economy on this account. There are, however, real concerns that some Canadian firms will not survive and that some Canadians will suffer permanent declines in their living standards. This is the standard trade-off we face when discussing trade liberalization. Is some level of protection acceptable?

We need to be very sensitive to the extremely high costs of even some mitigated form of "protection" for non-innovators in a knowledge-based world. First, as we pointed out earlier, knowledge-creation, and thus innovation, is subject to positive feedback - it breeds itself. Determinants to knowledge creation that disrupt this self-sustaining economic growth are extraordinarily costly. Second, as we pointed out in the previous section, protection or subsidies for entrenched Canadian firms undercuts potential Canadian entrepreneurs. Subsidizing my rivals is equivalent to taxing me. When Canada's entrenched behemoths eventually do fail, as they must, the only buyers for their assets will be foreigners. Finally, we must accept the logic of international trade economics that paying unemployment insurance to displaced workers is far cheaper than artificially protecting their jobs.

The United States, largely by accidents of history, demography, and politics, has developed laws, regulations, and customs that make innovation relatively easy and rewarding there. This means successful (i.e. innovative) American businesses are increasingly out-competing their rivals in other countries. Unless other countries find ways to accelerate innovation in their economies, they are likely to experience steadily worsening terms of trade with the United States, steadily stronger competition from the United States in third country markets, and steadily eroding living standards. We can choose not to become a knowledge-based economy, but our children are unlikely to forgive us.

Do we have to abandon social fairness in a knowledge-based economy?

A knowledge-based society is a society with legal, regulatory and informal codes of behavior that support a knowledge-based economy by encouraging innovation and discouraging an unhealthy fixation on the *status quo*. In this very basic sense, a knowledge-based society is a "liberal" society. It is resolved to overcome the vested interests that defend old capital, old jobs, and other dimensions of the *status quo*. In this same fundamental sense, the interests that oppose the growth of a knowledge-based society are "conservative", even though many of these interests regard themselves as leftist or progressive.

In a knowledge-based economy, uneven and volatile income distribution is expected. This violates our usual sense of equity. Creative destruction inevitably hits some Canadians with substantial losses in their earnings, and this happens periodically. This is a serious concern!

To deal with it, we first need to develop a concept of fairness that makes sense in a knowledge-based economy. Fairness has traditionally meant income equality. Certainly, the ease with which innovators can dislodge, and even impoverish, old money in a knowledge-based economy must count as another sort of fairness. The philosophical basis of this concept of fair-

ness is that every individual, even an innovator, should be able to improve her lot in life as much possible.

Second, the high returns to knowledge-based activities come with high risks. Egalitarian judgements should not focus on the returns and ignore the risks. Their high earnings compensate innovators for the risks they have undertaken.

Third, all change is not bad. The sharp contrasts in income should not lead us to overlook the fact that innovators' high earnings are due to their abilities to fuel creative destruction. This raises the overall wealth level and improves the lives of workers, customers and investors across the economy. In contrast, the wealth of the rich in a non-knowledge-intensive economy is usually inherited. This is harder to justify on egalitarian grounds.

Fourth, individuals and firms can conduct their own hedging of earning risks in a knowledge-based economy. Government provided security can cause a moral hazard problem – certain individuals and firms always try to scam the system. This can be expensive to the system, expensive to detect, and can undermine support for other government redistribution programs. In contrast, private insurance, for example learning new skills, is free of such problems.

Social fairness remains a legitimate concern in a knowledge-based economy, but we do need to think more carefully about what we really mean by the term. Socio-economic mobility and “risk management” have to become more important, and ex-post income equality less important.

Is government less relevant in a knowledge based economy?

Absolutely not. Good government is critical in a knowledge-based economy. There are several tasks before it that call for deep thought.

First, government needs to provide the institutional structural that lets knowledge-based activities take place. It must remove artificial entry barriers and prevent new one from rising. It must provide the laws that let markets function well. It must provide public goods, like public health, information and education. It must protect property rights, especially those of innovators.

Second, government must promote economic openness. Though it is among the largest in the world, Canada's economy is small relative to that of the world's most important knowledge-based economy, the United States. If Canadian innovators are to generate knowledge as intensively as their US counterparts, they must be able to make returns just as high. That means they must have clear access to markets at least as large as those their US rivals can reach.

Finally, government should explicitly recognise that social programs should promote socio-economic mobility and “income risk management”, not provide long-term “income support”. Government can open doors for young people from low income families with good public education and university scholarships. The current federal scholarship initiative is a commendable step in this direction. Government can also aid Canadians in managing their earning risks while undermining neither people's own efforts at risk management nor overall knowledge production and application. Examples of how to do this include risk-based unemployment insurance, tax smoothing arrangements, and many other things. Examples of what not to do include ubiquitous universal transfer programs funded by high income taxes on innovators profits and knowledge workers' pay.

Canadians accept that government must look after those who are truly desperate. They also recognise that their taxes support many worthwhile public goods - universal health care and quality public education, to name the two most popular. But many other government expendi-

tures have questionable returns. Runaway taxes to cover pointless government programs can quash creative destruction, killing the Canada goose that lays the golden eggs.

5: Conclusion

Curiosity and the desire for a better life are two of the most basic human instincts. A knowledge-based economy uses the satisfaction of one of these primal instincts, curiosity, to satisfy the other, longing for a better material life. So far, one and only one economic system, free enterprise, has proven able to combine these basic human motivations in a self-sustaining way.

Unlike most other economic inputs, knowledge is not destroyed when it is used. This means it can be used simultaneously in many places. One piece of knowledge can improve productivity all over the economy. This increased productivity can fund more knowledge creation. This effect, called positive feedback or increasing returns to scale for knowledge, appears to underlie the rapid growth of the Western World over the past three centuries.

The work of commercialising an idea is often hard and expensive. All our experience so far shows that only a free-market economy that gives innovators' high returns for their work can become and remain a knowledge-based economy. Under all other economic systems, from feudalism to communism, those in power are able to wrest all (or most) of the return to innovation away from the innovators. Even social democracy tends to impose the views of "wise men" on the rest of us, often in ways that render innovation economically pointless for innovators. Without a clear link between creativity and economic reward, nothing in any of these systems steered innovation towards satisfying common people's wants and needs. Consequently, technological innovations that improved living standards in such economies were rare.

In a very profound sense, a knowledge-based economy is a marvellous manifestation of human transcendence. By harnessing instincts from deep in our evolutionary past, we can build an economic order based on both knowledge and on satisfying people's wants and needs. In the democratic world, the business of government is also to serve the people. The care and feeding of our knowledge-based economy is therefore the government's duty.

The most important thing government can do to nourish a knowledge-based economy is to let successful innovators become very wealthy. Egalitarian leanings to tax inherited wealth, casino winnings, land holdings, luxury consumption goods, and the like may well be more beneficial than harmful. But government must take great care not to tax overly hard the returns to knowledge. Discouraging knowledge creation and use by taxing it too heavily undermines the growth through increasing returns to scale that makes a knowledge-based economy so attractive in the first place.

In the global economy, countries are "clubs", whose members are their citizens. When a club is not well run, its members begin to explore other clubs. People move their savings abroad, or buy goods made elsewhere. A declining club loses its most productive members first, for they are the ones the other clubs most gladly take in. Whether an economy is attracting or losing skilled people, their savings, and their consumption, are therefore direct measures of how well a government manages its "club". The winning "club" these days is unquestionably a knowledge-based economy that empowers people to become wealthy when they create knowledge that improves other people's lives. Social programs and other traditional public goods must be popular not only with those who benefit from them, but must also be popular with those who might most easily leave the "club". This means we need Peter's OK before we can tax him to pay Paul. Democratic governments therefore confront a binding constraint on the power of political majorities to redistribute wealth and income.

Because of this, we need a serious rethinking of the meaning of good economic governance. Part of our government's current burden is to reverse well meaning past policies that now hinder knowledge creation and application. High income taxes unquestionably cause people with economically useful knowledge to flee this country in droves. Others arrive from Hong Kong, India and elsewhere to take their places, but Canada would be much better off if we could attract skilled immigrants and hold onto our own best and brightest. Our government must empower its people. It must provide the educational opportunities that its people need to participate in a knowledge-based economy, and then it must protect their rights to keep most of the fruits of their knowledge. If it does not, some other government surely will, and it can probably provide a better climate too.