The Political Economy of Innovation

PPPE 6365 **D.A. Hicks**
Fall 2020 **Exam 1**

Question 1

The answer to the question of whether innovation is related to economic growth and development has evolved over several hundred years. During early economic history, most countries in Europe saw themselves as isolated units in conflict with other nations in a type of economic war. This led to ideas of mercantilism where each country safeguarded its economy by establishing protectionist policies. During the 1760s, Francois Quesnay (1694-1774) furthered the idea of a state economy when he published the "tableau encomique" depicting the flow of income within the French economy as a great process (Warsh, 2006: 48). Adam Smith (1723-1790) also advanced the idea of a state economy when, in 1776, he published, "An Inquiry into the Nature of Causes of the Wealth of Nations" (Warsh, 2006: 48). Smith had several remarkable insights. He saw the economy as a system resembling a machine with interconnecting parts. An "invisible" chain of connecting processes (Warsh, 2006: 47). He saw that through the factors of scale, division of labor, and specialization, this economic machine could grow. These factors allowed for incremental improvements/innovations in the production processes making the machine more efficient (Warsh, 2006: 52). Another important insight was that wealth depended on the size of the market available (Warsh, 2006:53). This meant that nations should specialize, produce what they were best at, find international markets for those goods, and trade with other nations for other goods that they were not good at producing. That is, the machine could become bigger. Mercantilism was not necessary. However, a consequence of Smith's theories was that specialization would lead to lower and lower costs and diminishing returns. Smith saw nations only working with the technology they possessed. In other words, technology was exogenous to his system. Smith's results had more than one Cassandra. Thomas Robert Malthus (1766-1834) argued that Smith's capitalism would eventually lead to the population exceeding the food supply leading to mass starvation (Warsh, 2006: 63). David Ricardo (1772-1823) saw that less and less productive lands would be need for cultivation to feed the workers, resulting in workers spending all they had on food. Eventually society would stagnate (Warsh, 2006: 64). How could these results be explained? John Start Mill (1806–1873) recognized the importance of the principal of diminishing returns but said that this fact might be overcome "by whatever adds to the general power of mankind over nature" (Warsh, 2006: 76). The "whatever" was key. Its explanation, however, awaited further developments. Mostly mathematical developments. Karl Marx (1818-1883) had the insight that technology as endogenous (DAH, What Accounts for Economic Growth & Development?; 10) but it was not until Alfred Marshall (1842-1924) resolved the question of how prices are determined in the market by diagramming supply and demand (Warsh, 2006: 82) that the issue started to become crystalized. Underlying his diagrams was mathematics and it was mathematical evaluations that lead Marshall to discover that falling costs of production had two sources. The first, "internal economies" or those like Smith had described, and a second type called "external economies" (i.e. externalities) which resulted from general industry improvement (Warsh, 2006: 86). That was what Mill's had identified as "whatever." These externalities were "spillovers" and came from general innovations within the system (Warsh, 2006: 88). They somehow arose endogenously like Marx's had indicated. John Maynard Keynes (1883-1946), a student of Marshall, developed a mathematical model of an economy describing it as a combination of the value of consumption, government spending, investment, and import/export. Keynes developed the idea that governments could manipulate the economy through a toolbox of policies (DAH, What Accounts for Economic Growth & Development?; 13). Joseph Schumpter (1883-1950) published the idea that

innovation is a driving force in capitalism and economic progress. He said that profits increase because of the constant birth of new products and markets through innovation (DAH, What Accounts for Economic Growth & Development?; 15). However, Schumpter's insight was explored until new macroeconomic models in the Keynesian tradition began to appear. Roy Harrod (1900-1978) built a model that attempted to include "animal spirits." This model projected growth forever. Clearly not what was being observed in the real world. Evsey Domar's (1914-1997) macroeconomic model presented a troubling imagine of an economy that balanced on a knife's edge between explosive inflation and prolonged unemployment (Warsh, 2006: 143). Something was still wrong. The problem was solved by Robert Solow (1924-) when he allowed his model to function with labor and capital being substituted for one another. Solow included a parameter described as the rate of technical change (Warsh, 2006: 144-145). There it was, Mill's "whatever" had been "discovered." And it was endogenous as Marx's foretold. As study of this new model progressed it was found that nearly 85% of economic growth was from technical progress. That is, from innovation! Schumpeter was right! Technology was driving growth (Warsh, 2006: 149). Therefore, innovation is endogenously related to economic growth by providing the vast majority of the means to better utilize, develop, enhance, and create other productive factors within an economy.

Question 2

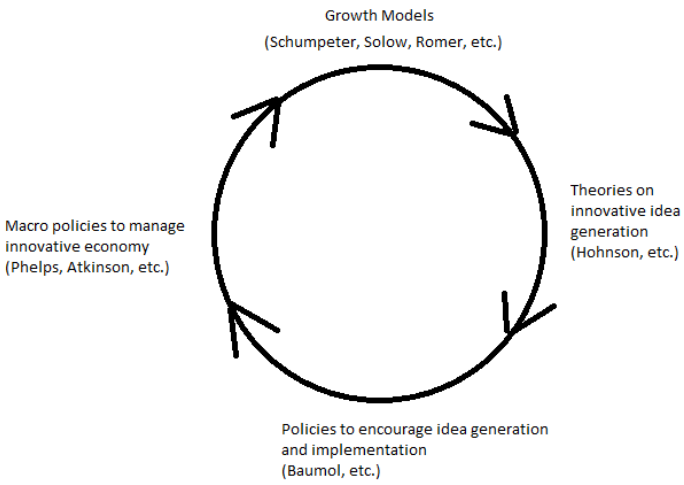
Neo-Keynesian and neoclassical economics saw the economy as an efficient machine that rarely underwent change, and which could only grow into a larger more efficient machine. Joseph Schumpeter (1883-1950) saw things differently. He said that the economy was constantly developing new industries, technologies, and ways of doing things while shedding the older ways (Atkinson, 2014: 6). Robert Solow (1924-) demonstrated mathematically that innovation, change, and technology are the important drivers of economic growth (Warsh, 2006: 149). Paul Romer (1955-) built upon this concept by including the idea that innovation could arise endogenously through purposeful decisions from within the system (Warsh, 2006: 196). This led to thoughts of the economy, not as a machine, but rather as an organism. As Schumpeter, in 1942, summed up evolutionary economics: "in dealing with capitalism we are dealing with an evolutionary process … [its] engine … comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates" (Atkinson, 2014: 11). Richard Nelson (1930-) and Sidney G. Winter (1935-) wrote again in 1982 about the economy as an evolution of long-term progressive change from which new, and quite different, futures will emerge from a set of dynamic processes (Atkinson, 2014: 12). Such ideas form the foundations of evolutionary economics. In summary, evolutionary economics generally postulates that growth and development of the economy are best achieved when the power of innovation is acknowledged and that innovation is at its best when it harnesses the resources around us and finds better and more efficient ways of using them (DAH, Dynamics Shaping the "2nd" Machine Age: 24). If true, this leads to questions of how innovation occurs and how it can be fostered.

Steven Johnson (1968-) writing in 2010, said markets are good for converting ideas into useful tools but not so helpful in generating new ideas. He said that new ideas come from the proximity of old ideas. When ideas from different people and even different fields are rapidly banging against one another they allow new and different ideas to generate. Thus, market forces are less important to innovation than openness and inspiration (McArde, 2010: 1-2). This is like Romer's observation that new innovation allows for new combinations. Progress doesn't run out it accumulates (Brynjolfsson & McAffee, 2014: 75).

William J. Baumol (1922-2017), Robert E. Litan (1950-) and Carl J. Schramm (1946-) began addressing the problem of how to sustain an evolutionary economy through government policies which might encourage individual entrepreneurial activities. They suggested that government policies should encourage "productive entrepreneurship" while discouraging "unproductive entrepreneurship." Policies encouraging "productive entrepreneurship" include: low legal barriers to business formation, strong property rights (including intellectual property rights), appropriate tax policies (e.g. consumption taxes are better than income tax because consumption tax encourages savings), effective patent systems (e.g. protect "novel" innovations), affordable health insurance (i.e. reduce risk associated with pursuant of entrepreneurial opportunities), optimize corporate governance and capital market regulations, create entrepreneurially favorable bankruptcy laws, open-boarders to enhance competitive pressures (i.e. exploit competitive advantage, encourage skilled labor immigration, transfer of foreign technology, etc), encourage commercialization of university research, and encourage innovation through corporate tax system. Policies should dis-incent "unproductive entrepreneurial" activities. Such policies might include: laws policing enterprise corruption and crime, discouraging enterprise political lobbying, limiting non-meritorious litigation, and avoiding inappropriate antitrust enforcement (Baumol, Litan, Schramm, 2007: 4-38).

Edmund Phelps (1933-) took a more macro view and felt that national dynamism (i.e. desire to innovate) resulted from national economic institutions and culture (Phelps, 2006: 2). Cultural values such as: opportunity for achievement, chances for initiative, interesting work, desire to take responsibility, etc. were of key importance for innovation (Phelps, 2006: 2). Robert D. Atkinson (1954-) also took a macro view when in 2014, he elaborated eight principles of evolutionary economic inspired macro policies. These principles were: 1) Allow global economic integration (namely, integration based on company/firm choices rather than government political decisions), 2) Slow industry sector loss rates (namely, understand why they are occurring, avoid foreign predation, and adjust to become competitive), 3) Not impede natural evolutionary forces (that is, allow Schumpeter's "creative destruction" to occur), 4) Limit government barriers to evolution, 5) Foster culture to embrace evolution (namely, no "Ludditism" or destroying technology to save jobs), 6) Spur organizations to drive evolution, 7) Speed technology innovations, and 8) Develop a deeper understanding of the process of economic evolutions targeting statistics and measurements (Atkinson, 2014: 2).

Together these ideas form a circle of reinforcing concepts where theorical economic modeling leads to ideas about the main source of economic growth, which in turn leads to the theories on how innovative ideas are generated, which in turn leads to policies regarding how to encourage individual efforts to innovate, which leads to governmental policies to manage and encourage growth, which finally leads to new/enhanced models of economic growth. See diagram below:



Extra Credit

The video from M. Schich, "Charting Culture", https://www.youtube.com/watch?v=4gIhRkCcD4U presented data from a Google owned catalogue of well known people and places. The video displays on a world map the birthplaces and the places of death of many famous people from 600 BCE to 2012 CE. Through this mapping cultural centers can be identified through the travels of each famous person. Migration patterns can also be discerned. This video is an example of how data can be organized using technology to see patterns and explore phenomenon that would otherwise be unavailable. Here cultural formation and migration were explored. Near the end of the video the narrator indicates that the team would like to explore how enlightenment thinking and religious landscapes overlap the cultural maps. This is an example of where new ideas are being generated using existing data and technologies. Likely at no or very little cost. There is no way to predict how this information may become valuable. Perhaps it can be used to predict future cultural centers and help countries direct expenditures on infrastructure. Or perhaps it might help religious groups distribute their message. In all cases, new knowledge is being generated with potentially innovative economic applications.

THE POLITICAL ECONOMY OF INNOVATION

PPPE 6365 **D.A. Hicks**
Fall 2020 **Exam 2**

Introduction: This exam is designed for broad coverage and to provide an opportunity to reveal to yourself all that you have learned. In each question I aim for you not simply recount what you've learned but to reach beyond and *use* this knowledge to come to some conclusion. Essay-style answers will be graded for clarity/ coherence, organization/ structure, and mastery of the materials read for -- and/or discussed -- in class. **A premium will be placed on answers that *explicitly* reference course readings, lecture materials and discussions**. The weight of each question is indicated in brackets. Extra points are available for unusually excellent answers. I have developed the questions in such a way that their answers should overlap minimally, if at all. If your answers have substantial overlap, you need to rethink your approach. First developing an outline and working from it would be a good strategy.

I have also included an Extra Credit question.

1. [50] So we ask: ***Drawing on our readings and session discussions, what have we learned about the origins of technology- and innovation-oriented fears? What special insights do economists, political economists and social scientists generally bring to the study of innovation and technological change that help take the fear out of anticipating the future?***

Response:

Like the opposite ends of a magnetic bar, humankind is attracted and repelled to change by two biologically programed responses. Pulled by curiosity and repelled by fear. Schumpeter developed the idea of "creative destruction." Within an economy, he said, new technology and innovations are developed which improve social wellbeing. In so doing new technology crowds out and replaces old technologies. This insight explains the opposition to innovation. The losers see their fate. Innovation may benefit society with the new, but those holding on to the old fear becoming victims, and those victims can fight back (Taylor, 2016). During the industrial revolution, for example, between 1811 and 1817, a group of English textile workers, known as the Luddites, whose jobs were threatened by the automated looms rallied around Ned Ludd and attacked and destroyed the loom machinery (Brynjolfsson & McAfee, 2014). Another example of this resistance occurred in 1829 when Dr. Goldworthy Gurney invented the first steam-powered automobile in Great Britain. By the end of 1832, Gurney was out of business killed by political opposition from the losers (e.g. horse breeders, buggy manufactures, etc.) from the new technology (Taylor, 2016). Taylor (2016) identified four sources of resistance to technological change: economic (e.g. holders of existing technology, and labor), social (e.g. those who might lose privilege), cultural (e.g. those that see technology as conflicting with their ethical values), and political (e.g. politicians that might lose favor with constituency). Although, these forces work together, often the strongest resistance comes from the fear of job lost; the Luddites. Theoretically, John Bates Clark wrote in 1915 that "In the actual [economy], which is highly dynamic, … unemployed labor is always at hand, and it is neither possible [nor] normal that it should be altogether absent. The well-being of workers requires that progress should go on, and it cannot do so without causing temporary displacement of laborers."

However, John Maynard Keynes was less confident that things would always work out so well for workers. Keynes was more concerned with short-term "maladjustments" but what if the short-term becomes the long-term? When technology eliminates one type of job those workers will have to develop new skills and find new jobs. In the meantime, they will be unemployed and what happens if by the time they learn a new job skill that job is replaced by yet a newer technology (Brynjolfsson & McAfee, 2014)?

Modernly, the advances in artificial intelligence and robotics have increased public concern over job loss. Headlines such as: "Robots Will Destroy Our Jobs—and We're Not Ready for It," "You Will Lose Your Job to a Robot—and Sooner Than You Think," and "Robots May Steal as Many as 800 Million Jobs in the Next 13 Years" do not help quell the publics concerns (DAH - Work, Workers & Life Disrupted; 46). Additionally, popular books such as "I, Robot" (Asimov, 2004) or movies as the "War games" (Badham, 1983) do not engender public embrace of technological change. While these type of sensationalistic mass media publications are widely consumed, a more realistic result is also publicly obvious - enormous wealth is being created, but a relatively small group of people earn most of it. Therefore, median income growth has been falling primarily because of this increasing inequality. That many Americans face stagnant and falling incomes is bad enough, however, this is combined with decreasing social mobility. The American Dream of upward mobility, which was real in earlier generations, is greatly diminished today. The spread between the rich and poor is not only large, but also self-perpetuating. Many people at the bottom and middle stay where they are over their careers and across generations. Additionally, economist Jared Bernstein, a senior fellow at the Center on Budget, noted that today the employment-to-population ratio is lower than any time in at least 20 years, and the real income of the median worker is lower today than in the 1990s (Brynjolfsson & McAfee, 2014).

These concerns sound dire, but economist do have some positive perspectives to shine on the modern state of technology and the economy. First, as Robert Atkinson and John Wu (2017) noted, we should all take a deep breath and calm down. They go on to say that in contrast to the popular view that technology today is destroying more jobs than ever, their findings suggest that from the period 2010 to 2015 they saw approximately 6 technology-related jobs created for every 10 lost, which was the highest ratio, that is the lowest share of jobs lost to technology, of any period since 1950 to 1960 (Atkinson & Wu, 2017). In addition to creating jobs, automation also complements labor, raises output in ways that lead to higher demand for labor, and interacts with adjustments in labor supply (Autor, 2015). Another study found that there is no correlation between adoption of robots and job losses in the manufacturing sector. Automation is actually creating jobs, however, they may be difficult to immediately identify. Those that are identified can be in entirely new industries (e.g. Airbnb, Uber) (Andes, 2016). Also, automation is leading to wage growth by reducing prices which raises purchasing power (Atkinson & Wu 2017, & Andes, 2016). A paper by James Bessen from Boston University found that computer use is increasing employment by 1.7% annually and that occupations that rely on automation are becoming more important not less (Andes, 2016). The movement to the digital sector is increasing wages. Analysis has shown that production and nonsupervisory workers earn higher pay in the digital sector. Workers earn higher pay in ecommerce compared to general retail Workers in mid-skill occupations such as office and administrative support; sales; and installation, maintenance, and repair get paid significantly more in the digital sector. Wage and

salary payments to ecommerce workers have increased by almost $18 billion since 2007. Thus, it appears that ecommerce has entered a virtuous circle (Mandel, 2017). In addition, technology may be making work more pleasant. By networking, reshaping practices, breaking down silos and hierarchies, (DAH - Work, Workers & Life Disrupted; 58) workers become more empowered likely leading to more job satisfaction.

All the good news does not mean that governmental policy cannot play a significant role in smoothing the transition to a more automated economy. In generally, governments should focus on the "five pillars" of innovation: correctly managing intellectual property rights, providing research subsidies to create positive externalities, encouraging education, funding research universities, and managing trade policies (Taylor, 2016). However, at the core of government policies should be people. Policymakers should do more to improve labor-market transitions for workers who lose their jobs. Such policies as lifelong-learning accounts akin to 401(k) accounts might be developed to help transitioning workers with retraining costs. Governments should reform higher-education systems to separate responsibility for education from the franchise of credentialing (Atkinson & Wu, 2017). Generally, investments in human capital should focus on producing skills that are complemented by rather than substituted for by technological change (Autor, 2015).

In addition to the focus on human capital, governments should consider that if there is any risk for the future, it is probably that technological change and productivity growth will be too slow. Therefore, governments should do all they can to speed up creative destruction, otherwise, it will be impossible to raise living standards faster than the current snail's pace of progress (Atkinson & Wu, 2017).

One unique concern for policymakers in this new age is the widening gap between the superstars (i.e. the very rich) and everyone else. This widening gap is known as the "spread." Spread, means there are large and growing differences among people in income, wealth, and other important circumstances of life (Brynjolfsson & McAfee, 2014). In addition to pure technology related factors leading to this large divide many cultural, legal and trade factors are contributing to growing spread (DAH-Work, Workers & Life Disrupted, slide 40). It is possible that if this divide becomes too great then too much economic and political power could be inappropriately concentrated and/or social discontent may emerge. Governments, policymakers, and academia should monitor this development carefully.

Finally, technology has allowed a vast new age of communication. The level of unfiltered communication leads to the dissemination of vast amounts of misinformation (i.e. like a worldwide water cooler rumor mill) leading to destructive mistrust in governments and scientific advice. Social leaders should work to counter misinformation about the economic consequences of technology advancement with publicly consumable factual information and seek to build trust in expert advice.

2. **[50]** In the study of economics there is perhaps no clearer distinction to be made than that between ***macro***economic and ***micro***economics. As we think about some of the scholarly work we sampled – from Taylor to Baumol among many others – we used both frameworks for gaining a deeper understanding of the idea of innovation. Then, perhaps pretentiously, I added a third lesser-acknowledged perspective on innovation which I labeled ***nano-***economics. Consider each of these three perspectives. ***Drawing on our course readings and discussions, what are the defining contributions each makes to the study of innovation? What specific concepts are used by each framework to test research hypotheses regarding innovation (or its proxies)? In your view, which of the three perspectives offers the more useful – or valuable – approach to the study of innovation? Justify your answer.***

Response:

Macroeconomics

Macroeconomics was the opening chapter for thought about the role of innovation in the economy. Francois Quesnay (1694-1774) developed the idea of a state economy with his publication of the "tableau encomique" depicting the flow of income within the French economy (Warsh, 2006). Adam Smith (1723-1790) published "An Inquiry into the Nature of Causes of the Wealth of Nations" in 1776 (Warsh, 2006) analyzing the economy as a system resembling a machine which could be made more efficient through process improvement. After these early pioneers, several other important contributors – namely, Karl Marx (1818-1883), Alfred Marshall (1842-1924), John Maynard Keynes (1883-1946), Joseph Schumpter (1883-1950) - developed the concepts and tools, especially mathematics, which ultimately culminated in Robert Solow's (1924-) econometric model of an economy that included a parameter for technical change. Solow's model demonstrated that nearly 85% of economic growth was from technical progress (Warsh, 2006). Building on this, Paul Romer (1955-) developed concept that innovation rose endogenously through purposeful decisions from within the system (Warsh, 2006). This led to thoughts of the economy, not as a machine, but rather as an organism. Therefore, as a discipline, macroeconomics gave researchers the large-scale models and explanations necessary to understand and depict how large-scale changes in the economy could be influenced by changes in technical/innovation progress. Perhaps more importantly, macroeconomics presented a birds eye perspective of the economy which allowed for the identification of those features of the political, legal, social, and cultural processes within the economy that might be modified to encourage the innovation process and promote growth.

Macroeconomics tests its hypotheses on innovation by matching mathematical models to national aggregated data. Two common data points are: Gross Domestic Product (GDP) and measures of Consumer Value. GDP is the total value of goods and services produced by a country. GDP can be coupled with other data points such as new business formations, research and development (R&D) expenditures, educational measures, etc. to help correlate macroeconomic innovation hypotheses. However, GDP has been challenged recently because, even if it is perfectly measured, it is becoming less relevant in quantifying social welfare. It has been suggested that trends in this official statistic not only underestimate increases in welfare but actually may be misleading (Brynjolfsson & McAfee, 2014). Consider how a GDP is lowered, say from being able to read the newspaper online for free rather than having to pay one dollar for a printed copy, but consumer welfare is increased (Brynjolfsson & McAfee, 2014). Macroeconomic models can

also be tested against measures of consumer value, such as changes in market prices or consumer surplus (Brynjolfsson & McAfee, 2014). These measures have also come under criticism because most value to consumers now comes from new goods not the fall in price from old goods. Or value from convenience and efficiency not consumer surplus (Brynjolfsson & McAfee, 2014). Therefore, as identified by the 1996 Boskin Commission (Turvey 1997) these older measures of macroeconomic value are likely in need of revision to truly measure the macroeconomic value of innovation (Brynjolfsson & McAfee, 2014) in the future.

Mircoeconomics

A macroeconomic understanding of the impact from innovation fortunately was not necessary for economic growth. Once capitalism was established and the free market had a sufficient level of institutional impediments removed, the economy just grew by itself and by itself became the machine that generates innovation and growth (Baumol, 2002). The mechanics of these activities came from the individual, firm, and industry levels. These are the levels studied by mircoeconomics. Microeconomic theory has historically been about price theory and little of growth theory has been incorporated into its concepts (Baumol, 2002). Therefore, its current contributions to innovation theory are not great. Mircoeconomics can be characterized as the unwritten chapter of innovation economics.

Notwithstanding its unwritten nature, in testing microeconomic theoretical concepts around profit seeking, price determination, capital investment decisions, and expense management, microeconomic research should be easily incorporated into innovation theory (Baumol, 2002). A firm's management is faced with an ordinary budget-allocation decision in which outlays are apportioned among competing uses (Baumol, 2002). An integrated theory of innovation that brings its position closer to microeconomics should advance several innovation issues. The analysis of innovation should provide an explanation of the amount spent on innovation, which products are developed, the pricing of those products, and should show how they fit into the determination of the other variables of microeconomic modeling. It should be capable of dealing with the role of innovation in the theory of resource allocation, income distribution, and welfare analysis, and in both dynamic as well as static models (Baumol, 2002). Especially as R&D and new product development becomes more and more a routine activity with competitive consequences it will be better captured by the accounting profession. That information can be used to evaluate how firms respond to innovation. For example, one unpublished research project, utilized the R&D; selling, general and administrative (SG&A), and capital expenditure (CAPEX) to evaluate which allocation was the greatest predictor of a firm’s economic performance (Hicks & Budiman, 2020). Eventually, microeconomic should be extendable and provide valuable insights into innovation theory.

Nano-economics

Nano-economics (also known as, population ecology) analyzes turnover and replacement dynamics (i.e. Schumpeter’s “creative destruction”) that occur beneath a microeconomic landscape and represents the motion that occurs within a capitalist economy. Specifically, nano-economics will examine such areas as the impact from entrepreneurial activity, interaction between newcomer firms and incumbent firms, industry evolutionary life cycle patterns, and the impact to/from regional environments on growth.

The impact on the economy from the radical innovations introduced by entrepreneurs was of particularly interest to Joseph Schumpeter (1883-1950) (Fritsch, 2013). Entrepreneurs have been studied for their individual behaviors and impact. For example, Baumol (1990) introduced a distinction between two types of entrepreneurship: "productive" entrepreneurs that have a positive effect on economic development and "destructive" entrepreneurs that have a negative effect. Fortunately, he found that the impact from the "destructive" entrepreneurs was insignificant when compared to the "productive" entrepreneurs (Fritsch, 2013). Minniti and L´evesque (2010) further distinguished entrepreneurs into those that were innovative and those that were imitative. Innovative entrepreneurs were new product research-based entrepreneurs while the imitative entrepreneurs created incentives for further innovation by threatening the rents of the innovators (Fritsch, 2013). Entrepreneurship has also been evaluated for its role in producing knowledge spillover (Acs et al., 2009). One study found that failed entrepreneurs produce important new knowledge about the economic viability of business concepts within a region (Kirzner, 1997, 2009 & Fritsch, 2013).

Generally, it has been found that the indirect spillover effects from new business formation on regional development are more important than the growth effects (Fritsch, 2013). From these studies it has been found that creative destruction may create new markets but also creates competitive pressure on incumbent firms to innovate (Fritsch, 2013). The ultimate impact from newcomers has been found to depend upon incumbent's reaction to business entry. The character of this interaction depends on the type of new business and the intensity of the challenge, incumbents' speed to react, industry stage of development, and regional environment (e.g. size of workforce, formal and informal institutions, etc) (Fritsch, 2013).

Another component of nano-economics is industry life cycle patterns. It has been found that the evolution of many industries, particularly in manufacturing, follows a life cycle pattern in which at least three stages can be distinguished: an early exploratory stage (characterized by high uncertainty), an intermediate stage (industry shakeout, with some firms exiting), and the mature stage (characterized by a routinized regime) (Klepper, 1997 & Fritsch, 2013).

Finally, nano-economics has studied the impact to and from regional environments on growth. In general, these studies show that new businesses do create employment, but their direct impact is small with a considerable time lag. However, indirect regional impact is higher. Indirect impacts can include increased employment, and greater variety of available goods, services, and problem-solving methods. In regards to how the regional environment influences the number of emerging businesses and regional development, it has been found that the level of regional population density, the number of universities, availability of airports, skill level of the regional labor pool, and overall regional standard of living have been important factors (Fritsch, 2013 & SBA report, 2002).

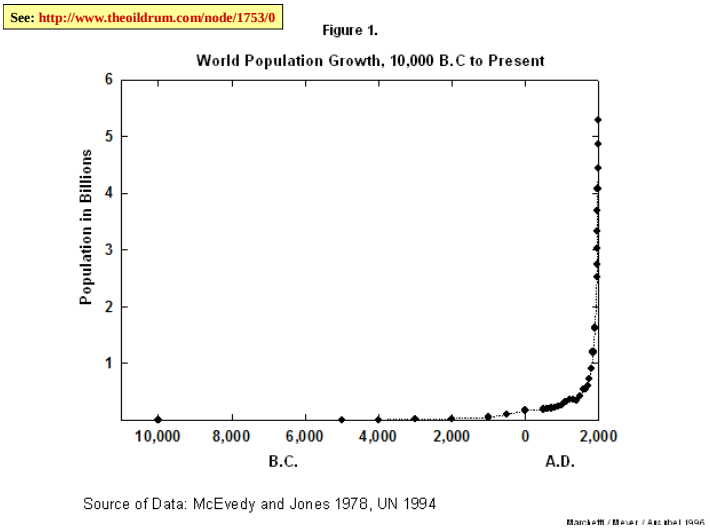
Macroeconomics vs. Mircoeconomics vs. Nano-economics

All three perspectives have their place in the evaluation of innovation economics. The macroeconomic view provides national policy makers with a general outline of how to organize their society for growth. It provides a view that allows that level of policy maker to say, "head in this direction!" Mircoeconomics, while not yet fully developed, will provide business firm leaders the tools to help organize their companies to better compete in an innovative economy

and, in that sense, can provide significant value. Nano-economics supports the regional leaders in how best to organize, develop, and promote growth. Because, economics is generally a self-organizing principal, one could argue that microeconomic theories might provide the optimal advantage to growth advancement. However, I think the better argument is that nano-economic theories are most likely to supercharge local economic development and energize firms to grow and innovate. Further, while national leadership is important, it is likely that regional growth, to the extent that it occurs, will generate more enthusiasm and garner more national recognition which will in turn point the way for further promotion at the national level. Therefore, nano-economics is most key.

Extra Credit

[15] Consider the graphic below. Is this data pattern relevant to our course? If so, discuss why; if not, discuss why not.



The above graphic is extremely relevant to our course. Average economic growth rates for about one and a half millennia before the Industrial Revolution, beginning around 1760, are estimated to have been approximately zero. As the Industrial Revolution began to impact economic progress a corresponding explosion of population growth, as seen in the graph, occurred (Baumol, 2002). Even the most well-off consumers in pre-Industrial Revolution society had virtually no goods at their disposal that had not been available in ancient Rome. In contrast, in the past 150 years, per capita incomes in a typical free-market economy have risen by amounts ranging from several hundred to several thousand percent! (Baumol, 2002). While it is possible to see the above graphic as alarming, Han Rosling points out that worldwide, the typical free-market economy's experience has been rippling through the globe. Today, the percentage of the world's population living outside extreme poverty (i.e. living on less than $1.90 / day) has fallen dramatically to under 10%, life spans have increased from around 50 years to 70 years, and child survival rates have allowed families to become smaller from 5.5 to 2.5 children. This has allowed for greater investment in a smaller number of children increasing everyone's welfare. Rosling also notes that as the family size is stabilizing so should population growth and, globally, we

should begin to see a replacement only growth rate (Rosling, 2013). Therefore, the above graphic partially demonstrates the positive impact that innovation economics has had on the wellbeing of the global community.

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