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By

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THE AUTOMATION - ECONOMIC WELFARE PARADOX IN AMERICA

A DISSERTATION

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[1] Adedeji B. Badiru, *Project Management for Research*, (London: Chapman and Hall, 1996)

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TABLE OF CONTENTS

PART III - The Paradox (Econometric Analysis and Data Sets)

LIST OF TABLES

LIST OF FIGURES

THE AUTOMATION-ECONOMIC WELFARE PARADOX IN AMERICA

Abstract

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In socio-economic research it is often hypothesized that technological change leads to greater economic growth, and subsequently to greater economic welfare. Many observers would argue, perhaps intuitively, that we live in an age of stagnant or diminished economic welfare. Few would, however, argue against a proposition that automation is the greatest technological change ever. We thus have a paradox between traditional business and economics pedagogy regarding automation impact and the popular belief of non-increasing economic welfare.

The focus of this research is the scholarly affirmation or rebuttal of the popular assertion of stunted economic welfare in spite of the increase in technological change.

The research methodology includes economic analysis, historical analysis, evidence by contradiction, affirmation by formal or informal logic, graphical analysis, and statistical inference. The nature of automation, technological change, utility, classical and Keynesian economics, rational expectations and supply-side economics, and the philosophies of Pigou and Pareto are all reviewed to provide an evaluative perspective for an assessment of the level of economic welfare.

Five key economic welfare indicators are identified, defended as centrally appropriate, and quantitatively assessed. The indicators are economic growth, income and distribution of income, inflation and the price level, unemployment, and hours of work.

The findings of the study indicate a higher level of expected but not realized economic welfare given the state of automation. A conclusion of this study is that increased automation has not led to the expected increase in economic welfare. Pursuant to this conclusion, remedial policies including economic growth enhancement and workweek modification should be investigated as stimulus for increased economic welfare. Another conclusion is the need for the identification of the precise causation for non-increasing economic welfare. The conclusions form content for further research.

PART I

INTRODUCTION

INTRODUCTION

...there are no useful propositions in economics that cannot be stated accurately in clear, unembellished and generally agreeable English.

John Kenneth Galbraith[1]

What are technology and technological change? Which is older, man or technology? What is Economic Growth? How are Economic Growth and Technological Change related? What is the history of technological change? When was the first Industrial Revolution? How many Industrial Revolutions have there been? Why do we expect accelerated technological change to lead to greater economic welfare?

What is Automation? Does Automation represent an Economic blessing or an Economic Hazard or both? What part does Automation play in our society? How is the computer related to Automation? What is the history of the computer?

What is Economic Welfare? What is the difference between Pareto and Pigou versions of Economic Welfare? What is the difference between positive and normative economics? Why did classical economics not solve the Great

[1] John Kenneth Galbraith, *Economics in Perspective* (Boston: Houghton Mifflin, 1987), 4.

Depression problems? Why were Keynesian policies needed to solve the Great Depression and finance America's participation in World War II? How are cardinal and ordinal utility related to economic welfare?

What is the Welfare State? What is the history of the Welfare State? How do the principles of the Welfare State compare with Pareto Optimality? Which welfare concept dominates American philosophy? How have economists contributed to the decline of the welfare state? What is the decreasing marginal utility of money? Who believes in the decreasing marginal utility of money? How does the American insurance industry prove that most Americans believe in the decreasing marginal utility of money?

How are Rational Expectations theories and Supply-side economics related to Economic Welfare? What is the difference between regressive, proportional and progressive taxation? Which form of taxation is best for America? What is Democratic Capitalism and what are the powers of the voters in such a system? How do the Arrow Possibility Theorem and Pareto Optimality threaten the Welfare State philosophy?

Why are: 1) Economic Growth, 2) Hours of Work, 3) Inflation and the Price Level, 4) Income and the Distribution of Income, and 5) Unemployment justified as Economic Welfare Indicators?

Why does an evaluation of justified economic welfare indicators in the Age of Automation lead to a conclusion of a diminution of economic welfare rather than improvement? What is the **Automation-Economic Welfare Paradox in America?**

PART II

AUTOMATION AND ECONOMIC WELFARE

part two
Chapter I

Automation in the Context of Technological Change

Andrew Carnegie, the greatest steel manufacturer of the era, had come to dominate the industry on the basis of the Bessemer converter. Sir Henry Bessemer himself had convinced the young Carnegie that "Bessemer's volcano" could work with American iron, and Carnegie had come back to Pittsburgh to install his first great Bessemer works in the early 1870s.

In a competitive market, output expands and prices fall, the gain going mainly to the most efficient. Steel rails sold at $120.00 a ton in 1873 and had fallen as low as $17.00 a ton in 1898. During that period, Andrew Carnegie had entered the steel industry as a novice and surpassed every steel producer in the world. He had done it by ruthless use of the market, telling his salesmen to accept the market price and his managers to meet it profitably. **Every time his furnaces were rebuilt, Carnegie demanded improvements in their design.**

. . .

Carnegie freely scrapped his massive Bessemer plants to install the Siemens open-hearth furnaces and in the process was reported to have opened a board meeting with, "Well, what shall we throw away this year?"[19] **Technological change produced rapid obsolescence, and a competitive economy forced new innovation to be adopted.**[20] Those who fell behind the pace had to give up. Andrew Carnegie was the classical nineteenth-century American tycoon, the Schumpterian entrepreneur, whose competitive methods the great economist, Joseph Schumpeter, called "creative destruction." **If new inventions are to be introduced into the stream of economic life, less efficient processes must be retired. The innovative economy necessarily leaves a trail of obsolescent junk.** In a competitive market, the measure of need is profit. It can be increased by cutting costs, and that is what the new technologies did in the nineteenth century. Steel was perhaps the most dramatic example. Vast quantities of money were involved--thousands of workers, coal, coke, railroads, lake steamers, barge lines--whole communities and cities appeared as the industry grew. Great fortunes were made (and lost) from it. Dramatic confrontations in social relations (the famous and violent Homestead strike of 1892, in which the company used the Pinkerton agency and then the National Guard to protect "scab" workers and break the strike, was against Carnegie Steel.)

In the 1890s, production of special alloy steels increased, then electric furnaces were introduced. The constant pressure was to reduce the time (and need for reheating) between ingot production, rolling, shaping, and drawing. Progress was steady, competition intense, and the industry continued its cost-reducing expansion.

. . .

[19]Jonathan Hughes, *The Vital Few* (New York: Oxford University Press), p.259
[20]Americans also took a different view of the purpose of blast-furnace linings. By raising air pressure in the blast, the amount of pig iron per change could be increased. But the blast furnace linings were worn out more rapidly. The American iron masters raised the pressure, called "hard driving," and their profits too. British observers were critical of the new technique, but the Americans could sell iron cheaper, even at the expense of new blast-furnace linings. Peter Berk, "Hard Driving and Efficiency: Iron Production in 1890." Journal of Economic History, vol. XXXVIII, no. 4, December, 1978.

From: **American Economic History**
by: **Jonathan Hughes**[1]

TECHNOLOGICAL CHANGE

Introduction

This Chapter will examine Automation in the context of the evolution of Technological Change.

What rational man is not concerned and interested in technological change. It is through technological change that work is made simpler and time is freed for doing other things that can advance the quality of life. There is no doubt that America is considered a leading nation in the world due to its high level of invention and innovation. So firmly ingrained in society's mentality is this concept that Americans feel a strong sense of dissatisfaction if it appears that other countries might have a technological advantage that America does not have.

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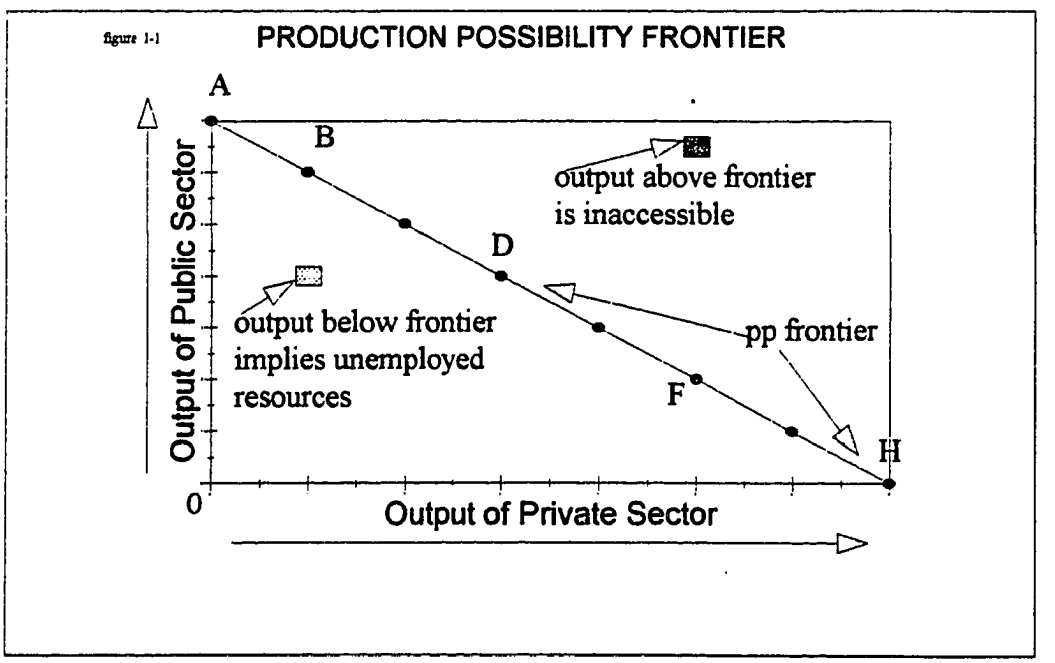
[1]Jonathan Hughes, *American Economic History*, (Glenview, Illinois: Scott, Foresman and Company 1983), 348-49. Bold has been added.

Relationship of Technological Change to Economic Growth

Let us begin our discussion of technological change by analyzing economic growth. With an understanding of economic growth, the overwhelming importance of technological change becomes apparent.

Consider an economy that produces goods in the private sector through privately owned businesses and corporations and produces goods in the public sector, financed by the taxes collected from citizens and private sector corporations. Limiting ourselves to this two dimensional view of the economy we are able to conceptualize a two dimensional production possibility frontier as illustrated in figure I-1.

figure I-1



The output of the public sector is represented on the vertical axis and the output of the private sector is represented on the horizontal axis. The production possibility frontier in this diagram extends from point A to point H. If all of society's resources are devoted to public sector production (virtually a slave society), we achieve point A on the graph. Alternately, if all of society's resources are devoted to the private sector (there are no government ,i.e. "public" goods) we achieve point H on the graph. Points B through G reflect mixes of both public and private production. Points below the pp frontier are inefficient in that unemployment of labor, machines, land, and/or other resources is indicated in this area. Points above the frontier are inaccessible given society's present resources and know how (assume no international trade).

Economic growth implies a shift in the production possibility frontier in the northeast direction. More maximal output from the public sector and/or the private sector becomes possible. Intuitively, believing that more output is better than less, a logical question becomes: "How can such a shift be initiated?"

Indeed there are several methods. The simplest is an increase in the size of the workforce, with a new member being as productive as an existing member. However, while this will increase national output, we probably would not

expect output *per capita* to increase simply due to an increase in population, ceterius paribus.

Another source of a northeast shift might be more capital. Capital broadly defined is the land and machines that are part of the economic production process. Capital has the ability to amplify the work effort of people. Digging a hole with a shovel is quite different from digging a hole with one's bare hands. The shovel amplifies the work effort of human beings. More generally, with more capital this year than last, it is quite conceivable that the national product would increase (with or without a labor force increase) causing an outward shift in the Production Possibility Frontier.

Diminishing returns is an often used concept in Economics. It becomes quite important in our discussion of Economic Growth. Consider a production process that is built upon several inputs that are combined to produce a specified output. If we hold all inputs constant except one and measure the additional output that occurs as a result of increasing the one variable input, we see that each additional unit of the variable input will eventually begin to produce a diminishing increment of the output.

More concretely consider a man with a standard shovel assigned with the task of digging a 6 cubic foot hole in the ground. Output here might be measured by the cubic feet of dirt that are removed from the hole. If we add

a second man (with manual dexterity skills equal to those of the first man) with a standard shovel we might observe that the additional amount of output (per unit of time) from the second shoveler is approximately equal to the output of the first shoveler.

However, as we add more and more shovelers, we begin to observe that the additional output resulting for each additional worker is not as great as it was for earlier added shovelers. That is, maybe one to four shovelers need not be overly concerned with each other's behavior, eight to twenty shovelers will certainly have a problem with optimal coordination. We could logically argue that at some point an additional shoveler would actually cause output to decrease (i.e., negative additional output). This, therefore, is an example of diminishing (marginal) returns.[2]

We therefore are led to expect diminishing returns in our total national output configuration. Labor grows much more slowly than does capital.[3] As an approximation, we can consider labor to be fixed (in the short-run) as we add additional units of capital. We therefore may expect that the most recent

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[2]Diminishing (marginal) returns is discussed in any standard Introductory Economics text including Paul Samuelson, *Economics: 8th Edition* (New York: McGraw-Hill, 1970), 22-25. In our example work space is the fixed input.

[3]Paul Samuelson, *Economics: 8th Edition* (New York: McGraw-Hill, 1970), 722. During first 70 years of this century labor has doubled while capital has increased eight-fold.

additions to capital will yield diminishing returns. Yet, this is not the case at all.

Since the share of national product that goes to capital is relatively constant through time, we assume that the recent additions to the national capital stock are at least as productive as the existing capital stock. How can this be so? The answer is technological change, the third and most important source of increases in national output.

The greatest source of increase in the production possibility curve is undoubtedly technological change. Technological change is an improvement in society's knowledge about how to produce goods or services. This improved knowledge will be embodied in superior production techniques or in improved capital goods.[4]

As we better know how to achieve productive goals of a useful nature, we are better off, at least materially speaking.

Evolution Summary

In this section we briefly discuss the evolution of technological change. Part of the perspective we wish to convey is the relatively few years (approximately 300 years) that rapid technological change has been in existence. The

[4]Paul Samuelson. *Economics: 8th Edition* (New York: McGraw-Hill, 1970). Chapter 37 plus appendix discusses growth.

American economy and its growth are very closely associated with rapid technological change. Putting technological change in its proper historical perspective is designed to convey that rapid technological change is not a law of nature existing through perpetuity, but rather a shorter time of continuous discovery of how better to achieve labor magnifying results. Being convinced that modern technological change has not been around forever, we will begin to realize that a state of rapid changes in technology may not last forever. We may reach limits such that improvements in technology are minor and occur at a diminished rate. Such a situation could have dire consequences for technology driven economies. We are therefore interested in putting technological change in its proper historical perspective.

> It is generally agreed that "Man is a toolmaking animal." In a sense the history of technology is the history of "man," or all human kind. One of the major determining characteristics of human behavior is the fashioning of tools. This is a pattern of innovation requiring thought rather than a pattern of instinctive behavior characteristic of other animal species. It is this ability to apply technological methods that separate humans from animals. Humans have technology, while other animals do not. Since toolmaking is an important aspect of human nature, the history of technology is the history of humans.[5]

Thus to study technology origins is to study the origin of people distinct from the rest of the animal kingdom. Find the oldest tools and you have found the oldest man? We turn to the archaeologists and find that the oldest known

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[5]*Baron's Student's Concise Encyclopedia*, 1988 ed., s.v. "Technology."

tools are approximately 2,600,000 years old. According to the above definition we have the beginning of technology and an official beginning of mankind.

> The tools found in 1969 at the Koobi Fora site, near lake Rudolph in northern Kenya, consisted of five choppers, a number of flakes, and a couple of battered stones. The tools lay on the surface; the flakes were found three feet below them in tuff (volcanic rock) datable to about 2,600,000 years ago. ... [6]

People are just other members of the animal kingdom struggling to exist, until they differentiate themselves by tool making. While other animals have created very simple tools, people alone have created tools of continually increasing sophistication. Gathering and hunting for sustenance were the economy forms of this most ancient time period.

Neither the hands (claws) nor the teeth of people are suited for tearing the skins of animals with edible meat. If people want to be carnivorous, as are many of the other animals they observed, then people must produce tools to substitute for strong teeth (and strong predator bodies).

In 1969 in Kenya Africa, remnants of people with people made stone tools were found. This site was dated as being between 2 and 3 million years old. No older tool bearing site has been discovered on the planet. Judging by the abundance and precision of the tools, scientists believe that a tool making

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[6] *Encyclopedia Britannica 1990 ed.*,s.v. "Tools." by R.S.H, et al.

people must have preceded the people found at this site. But since no direct physical evidence of such exists, the age of mankind is dated by this site.

Perhaps people developed extensive language systems prior to this time. Or, perhaps people catalogued the plant kingdom in terms of food, medicine, poison, and other. These pursuits are difficult if not impossible to chronicle. But bones, trees (wood), stone (natural and people modified) and metal do survive time and it is therefore not surprising that the origin of people is associated with tool making.

If people were simply vegetarian, then surely a non-carnivorous life style would have been sufficient for survival, but how would such an existence be separated from that of the monkey. The monkey undoubtedly is able to distinguish between nonpoisonous and poisonous foodstuffs. Monkeys have a communication system. And the monkey is able to form very primitive tools (to fish ants out of a hole in the ground or log, for instance).

However, the capture of an animal in a trap, the skinning of that animal, the preparation of the meat for eating and/or the preparation of the skin for clothing must all be activities associated with people.

Even if we chose to associate other activities with the origin of people, the origin of technology and thus technological change must surely be associated

with tool making. It is therefore at circa 2,600,000 years ago that our conception of technological change begins.

[Digression: Quite frankly, it appears to this author that fire must have been known long before this time. If lightning strikes and starts a fire, it takes one only a short time to note that animals trapped by the fire taste better than those eaten raw. Ancient People would no doubt desire to duplicate that recipe and the essential ingredient would be fire.

Touch fire directly and get burned. However touch it with a very long branch and the end of the branch ignites and you have portable fire. Some materials burn, but others don't. Exactly how long do you believe it took to master fire, at least in a rudimentary manner? Why not date the beginning of mankind on the date of fire mastery? What member of the animal kingdom (not man) can manipulate fire? Indeed, the Firemaster is probably the original man and probably predates the stone master by many, many, many years. However, what tangible evidence does the Firemaster leave for verification?]

Writing dates back to only about 3000 b.c.[7] Therefore, all existence before that date is "prehistoric" by definition. However, due to the relatively rapid deterioration of many materials that might have been used for tools, the tools

[7]Earliest writing forms are Hieroglyphics (Egyptians) and Cuneiform (Sumerians). Both are dated to circa 3000 b.c., *The New American Desk Encyclopedia*, 1984 ed., s.v. "Hieroglyphics" and "Cuneiform".

used for marking prehistoric time are made from the more durable materials of stone, bronze and iron.

> The idea of relating human history to the material from which tools were made dates from 1836 when Christian Jurgensen Thomsen, a Danish archaeologist, was faced with the task of exhibiting an undocumented collection of clearly ancient tools and implements. Thomsen used three categories of materials--stone, bronze, and iron--to represent what he felt had been the ordered succession of technological development. The idea has since been formalized in the designation of a Stone Age, Bronze Age, and Iron Age.[8]

We will utilize Thomasen's methodology in our milestones historical approach that follows. The uncertain nature of history increases the farther back in time we journey. However, our current objective is to put the modern industrial revolutions in proper historical perspective, particularly the most recent Automation revolution. The fact that ancient history is approximate and uncertain is therefore of minor consequence. Indeed, we will concentrate on selected major "milestones", rather than all inclusive historical detail, to emphasize the evolutionary environment from which these "revolutions" emerged.

Milestones in Technological Change

[8] *Encyclopedia Britannica*, 1990 ed., s.v. "Tools", by W. J. McC. and J. A. Mc.

Stone Age - Paleolithic Culture - 2,600,000 to 9000 b.c.: [Hunters and gatherers, crude tools "man"ufactured from stone by flaking using a hammerstone (e.g. choppers, hand axes and scrapers), root grubbing, bone marrow eating, skinning and butchering hunted animals, etc. The basic tool set remained without major (technological) changes for more than 2,000,000 years. Flint was the stone of choice for many tools. Wood, bone, horn and animal skins fashioned into useful items using stone tools. Use of fire in tool making (100,000 b.c.). Cro-Magnon man (35,000 b.c.). More specialized tools allowing bones to be made into awls, needles, pins, hooks. Throwing spears and spear throwers. Hafting (fitting a handle to a tool e.g. tipped spears) (33,000 b.c.). Bow and arrow (30,000 to 15,000 b.c.).][9]

Middle Stone Age - Mesolithic Culture - 10000 b.c. - 3000 b.c.: [period officially recognizes the evolution of well organized collective hunting techniques and collective living arrangements that imply increased civilization; primitive huts with bark covered floors; flint tools, tools of chiseled bone and antlers; wooden implements include bows, arrow shafts, ax handles, dugout canoes, fishnets made of bark fibre, etc.; food included vegetables, zebras, wildebeest, hartebeest, wild pigs. deer, fish and water fowl].[10]

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[9]*Encyclopedia Britannica*, 1990 ed., s.v. "Tools."

[10]*Encyclopedia Britannica*, 1990 ed., s.v. "Prehistoric Peoples and Cultures."

New Stone - Neolithic Culture - 8000 b.c. to 2000 b.c.: [Polishing of tools is indicative of this age. Agriculture and animal domestication. Use of harder stones than flint for tool making. Harder stones included jadeite, diorite and schist. Ground and polished tools. Some hunters became herdsmen. Pottery making with the potters kiln which when modified probably led to metal working. Polished Neolithic hand ax allowed land clearing for agricultural endeavors. Stone Tool modified wood became widely used. Housing, furniture, boats, skis, utensils, etc. represent the advance in woodworking. One of the earliest large scale industries specializing in mining and manufacturing flint ax heads that were traded with consumers who did grinding and polishing.][11]

[Invention of the wheel. Spinning and Weaving (5000-4000 b.c.). Sailing Ships, lamps and dyes (3000-2500 b.c.). Irrigation, alphabet, calendar (2500-1500 b.c.). Glass (1000 b.c.)].[12]

Bronze Age - 3000 b.c. to 1000 b.c.: [Gold and Silver were known, but too soft for making tools. The beginning of the metal ages. Hammering and elementary heat processes used in metal work. Natural Copper and Meteoric Iron used in tool making and mark the beginning of this age. Casting metals

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[11] *Encyclopedia Britannica*, 1990 ed., s.v. "Tools."

[12] Hall. A. and A..F. Smith _____ *Encyclopedia*, s.v. "Inventions."

in clay or stone forms. Smelting (using heat to extract a metal from its ore) of copper and iron occurred, therefore metal no longer limited to native sources. Discovery that copper and tin ores smelted together produced a metal superior to copper; this metal was Bronze. Metal chisel used to form building stones. Metal pins, fishhooks, awls replaced bone models. Stone tools continued in use due to widespread availability and ease of technology when compared to metal work.][13] Earliest writing forms are Hieroglyphics (Egyptians) and Cuneiform (Sumerians); both are dated to circa 3000 b.c.[14] [2500 b.c. Great Pyramids are built in Egypt.

Iron Age - 1000 b.c. to present: Iron Technology derived from bronze technology allowed the introduction of the Iron Age. Iron replaced Bronze as the choice in metal work because of the much wider abundance of Iron ores; Iron 5% of earth's crust vs. 0.01% for copper. Man made iron replaces copper and bronze in the Hittite Empire circa 1500 b.c. Iron has the advantage of easier joining of two or more separate pieces. Iron twice as flexible and stronger than bronze. Wrought iron and steel surfacing circa 1200 b.c. in Middle East. The age of specialized metal content, tools expanded in number and types of tools and included: hammers, axes, knifes, drilling and boring tools, bow drill,

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[13]*Encyclopedia Britannica*, 1990 ed., s.v. "Tools."

[14]*The New American Desk Encyclopedia*, 1984 ed., s.v. "Hieroglyphics" and "Cuneiform".

saws, chisels, planes, vise, tongs, pliers, screw, screwdrivers, wrenches, levels, compasses.][15]

Middle Ages 300-500 a.d. to 1500 a.d. (European): [Inventions include (in temporal order: soap, heavy plow, three field crop rotation, horseshoe and collar, distillation of alcohol, table fork, windmill. 1200 to 1300 waterpower systems for hammers, bellows, mills, etc. Firearms, mechanical clock, blast furnace, suction pump.

1500 to 1700 - Prelude to the Industrial Revolution: Coal replaced wood burning and used for brick making, brewing, etc. (1550-1600). Knitting machine, high dams, telescope, microscope, windpowered sawmill, Machine assisted underwater diving (1550-1600). Slide rule, submarine, wagon railroad, micrometer, adding machine (1600-1650). Air pump, reflecting telescope, plate glass (1650-1700)].[16]

1701 to 1900 - The First Industrial Revolution: Human labor replaced with machine labor (e.g. steam power), labor specialization[17], [Steam Engine (1712)and improved versions(1769, 1800), spinning machine, iron bridges, power loom, cotton gin, optical glass, electric battery (1800), gas light.

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[15]*Encyclopedia Britannica*, 1990 ed., s.v. "Tools."

[16]Hall, A. and A..F. Smith _____ *Encyclopedia*, s.v. "Inventions."

[17]Daniel A. Wren, *The Evolution of Management Thought* (New York: John Wiley & Sons, Inc, 1979), 274 & 522

Railroad locomotive (1805), Steamboat (1807),water turbine, dynamo, revolver (1835), electric telegraph (1825-39), photography (1840), pneumatic tire (1845), sewing machine (1846), portland cement(1850). Internal Combustion Gas Engine (1859), dynamite (1866), typewriter (1867), telephone (1876), phonograph, filament lamp, electric streetcar, steam turbine, AC electric motor (1887), Automobile (1884-1890), glider (1891), reinforced concrete building, radio (1896), motion picture camera, diesel engine (1896)].[18] [Electricity became widely used: 1831 Faraday invented d.c. generator, improved by Werner (1866) and Zenobe (1870), Edison-Swan invent incandescent lamp(1880). Edison Company built d.c. generating stations to light New York, London and Milan (1882). Telsa demonstrated advantage of a.c. generators and first a.c. hydroelectric plant opened at Niagara Falls, N.Y. (1895)][19]

1900 to 1948 - The Second Industrial Revolution: Mass production via the assembly line. Widespread use of electricity. Henry Ford uses assembly line methods to manufacture affordable Fords (circa 1910-1925).[20] [Airplane (1903), triode electron tube, helicopter, plastic, liquid propelled rocket, nylon,

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[18]Hall, A. and A..F. Smith _____ *Encyclopedia*, s.v. "Inventions."

[19]*Encyclopedia Americana*, 1982 ed., s.v. "Generator, Electric."

[20]Daniel A. Wren. *The Evolution of Management Thought* (New York: John Wiley & Sons, Inc, 1979), 274 & 522.

electron microscope, radar (1935), television (1935), turbojet engine (1937-40), Xerography (1938), Electronic Computer (1942), transistor (1948)].[21]

> The computer made possible a Third Industrial Revolution based on cybernetics. The first had replaced human labor with machine labor, the second brought forth mass production through the assembly line, and the third replaced human control of production processes with machine control.
>
> Daniel Wren[22]

1948 - present - The Third Industrial Revolution: - Automation (human control of production processes replaced with machine control)[23]. [Space travel (beginning 1950), lasers (beginning 1960), plastics in daily use (beginning 1945), atomic energy (beginning 1945), gas turbine (1945+), jet propulsion growth, growth in television, major increase in agricultural yields, genetic research, major success in human organ transplants].[24] See also "Selected Current Instances of Automation" below.

As stated earlier, a primary objective of this section to put the modern industrial revolutions in proper historical perspective. That is, it is important

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[21] Hall, A. and A..F. Smith _____ *Encyclopedia*, s.v. "Inventions."

[22]Daniel A. Wren, *The Evolution of Management Thought* (New York: John Wiley & Sons, Inc, 1979),522.

[23]Daniel A. Wren, *The Evolution of Management Thought* (New York: John Wiley & Sons, Inc, 1979),522.

[24]*Barron's Student's Concise Encyclopedia*, 1988, s.v. "Technology".

to see rapid technological change as an infinitesimally small slice in the history of Mankind. The following quote from Wallis eloquently makes this point, although this statement is obviously made before the 1969 Kenyan discovery that modified the origin date for Mankind.

> Anthropologists are not able to agree on the dates of the first coming of Man on earth, but the range generally accepted as between a quarter of a million and a million years ago.[14] If the first estimate, 250 thousand years is taken and reduced to a scale of one hour, some sense of the relative time spent on the several phases of technical progress can be obtained. Making the scale an even 240 thousand for mathematical convenience, man then spends 55 minutes, or 11/12ths of the whole period in the Paleolithic (old stone) culture. Five minutes ago, he embarked upon the Neolithic culture, the cultivation of plants, the domestication of animals, the making of pottery, weaving, and the use of the bow and arrow; 3 1/2 minutes ago he began the working of copper; 2 1/2 minutes ago he began to mold bronze; 2 minutes ago he learned to smelt iron; 1/4 of a minute ago he learned printing; 5 seconds ago the Industrial Revolution began; 3 1/2 seconds he learned to apply electricity; and the time he has had automobiles is less than the intervals between the ticks of a watch, that is less than 1 second.[15]

[14]Fredrick E. Zeuner, "The Chronology of Early Man and his Cultures," *Dating the Past* (London: Methuen and Co, Ltd., 1958).
[15]Wilson D. Wallis, *Culture and Progress* (New York: McGraw-Hill Book Co., Inc., 1939).[25]

Fundamental Concepts of Technological Change

Let us become more precise about the nature of technological change by consulting a leading expert in the field of Technological Change. Edwin

[25]J. James Miller, "Automation, Job Creation, and Unemployment," *Journal of the Academy of Management* (December 1964),306.

Mansfield in his *Technological Change* provides the following relevant definitions:

> **Pure Science** is directed towards understanding, whereas **technology** is directed towards use. **Technology** is society's pool of knowledge regarding the industrial arts. **(Technology)** consists of knowledge used by industry regarding the principles of physical and social phenomena, ... knowledge regarding the application of these principles to production, ... and knowledge regarding the day-to-day operations of production... .
>
> ...An **invention** is a prescription for a new product or process that was not obvious to one skilled in the relevant art at the time the idea was generated. ... The product or process must have utility as well as novelty. An **invention**, when applied for the first time is called an **innovation**.
>
> **Technological change** is the advance of technology, such advance often taking the form of new methods of producing existing products, new designs which enable the production of products with important new characteristics, and new techniques of organization, e.g. marketing, and management.
>
> . . .
>
> A **technique** is a utilized method of production. ... Whereas **a technological change** is an advance in knowledge, a **change in technique** is an alteration of the character of the equipment, products, and organization which are actually being used.
>
> A new piece of knowledge is **technological change** when it is first discovered; but it is not counted as a **technological change** when it is subsequently passed from one person to another **(diffusion of technology)**.
>
> Technological change can take various forms: For one thing, it can be **labor-saving, capital saving, or neutral**. If technological change results in a greater percentage reduction in capital input than labor input, it is **capital saving**; if it results in a greater percentage reduction in labor input than capital input, it is **labor saving**; if it results in an equal percentage reduction in capital and labor it is **neutral**. ...
>
> Technological change can also be classified as **capital-embodied** or **disembodied**. Many changes in technology must be embodied in new equipment if they are to be utilized.
>
> . . .
>
> **Basic research** is aimed purely at the creation of new knowledge; **applied research** is expected to have a practical payoff, and **development** is aimed at the reduction of research findings to practice. ...[26]

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[26]Edwin Mansfield, *Technological Change: An introduction to a vital area of modern Economics* (New York: W. W. Norton and Company, Inc. 1971, 1968),Chapters 2-3 passim.

[Digression: The above discussion by Mansfield occurred before diffusion and acceptance of the work by Gary Becker and others in the field of Human Capital. With human capital we are concerned with the skills acquired through education inside and/or outside of the employing organization. The analogy between human and physical capital is emphasized to highlight the similarity of making an investment in both that is expected to generate positive monetary returns in the future. According to Ehrenberg and Smith:

> Human capital, (is) a term that conceptualizes workers as embodying a set of skills that can be "rented out" to employers. The knowledge and skills a worker has--which come from education and training, including the training that experience yields--generate a certain stock of productive capital. However, the *value* of this amount of productive capital is derived from how much these skills can earn in the labor market. Job search and migration are activities that increase the value of one's human capital by increasing the price (wage) received for a given stock of skills.[27]

With the advent of human capital, capital and capital embodied technological change have broader definitions. Post human capital discussions of "embodied technical progress" therefore include embodiment in capital machinery and embodiment in better trained and better educated labor. Disembodied technical progress becomes a more abstract term implying,

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[27]R. G. Ehrenberg and R. S. Smith, *Modern Labor Economics: Theory and Public Policy* (Glenview Illinois: Scott Foresman and Company, 1988), 292. This quote appears at the beginning of a chapter that is an excellent summary of the current state of Human Capital Theory.

according to Reynolds, "improvements in management which do not change the characteristics of labor or capital, but simply allow these factors to be used more effectively."[28]]

The above definitions provide a good introduction for our analysis of technological change. However, a mini case study should be more illustrative. Let's consider the development of the transistor as an example of technological change.

The Transistor - An Example of Technological Change

The transistor is "a small device that transfers electric signals across a resistor. (The name transistor began as a trademark concocted from *transfer* plus *resistor.*)"[29] Generally speaking transistors replaced vacuum tubes in electronic circuitry. Vacuum tubes were developed as an outgrowth of the work Edison did at the turn of the century with the electric light bulb. Vacuum tubes preform(ed) many useful functions including switches, rectifiers, signal detectors, amplifiers, etc.

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[28]Lloyd G. Reynolds, *Macroeconomics: Analysis and Policy* (Homewood, Illinois: Irwin, 1988), 355.

[29]H. I. Capron and John D. Perron, *Computers and Information Systems: Tools for an Information Age* (Redwood City, CA: Cummings Publishing Company, 1993),552.

Problems with the vacuum tube include: excessive heat production, short life, space requirements, fragile enclosure, filament warm up time, excessive power consumption, etc. The ability to replace the vacuum tube with superior technology certainly advanced the state of the art for electronics.

A distant cousin of today's transistor was used circa the turn of the century to detect radio signals. This device was called the "cat's whisker rectifier" and was the only useful device capable of detecting radio signals at the time. This device was built with very thin wires and crystals of lead sulfide. However, due to its low reliability, the cat's whisker rectifier was replaced by vacuum tubes in most radios.

World War II provided pressure for accelerating development of electronic technology. The military needed technology that could detect super high frequency signals that could not accurately be detected by vacuum tube devices and research into cat's whiskers technology was revived. This time silicon and germanium were used in place of lead sulfide, producing a superior rectifier.

> By the late 1930s, investigators had demonstrated that semiconductors, like vacuum tubes, could act as rectifiers. But until the intensive radar-related research during the war, no one understood how to control semiconductors well enough to make them predictable and practical as switches or amplifiers.[30]

[30]R. Adams and D. D. Cantlay, eds., *Understanding Computers: Computer Basics* (Alexandria, VA., 1989), 69.

Prompted by the WW II related success in semiconductors, many scientists continued research in this area as a post war project. Prominent among involved scientists were those associated with Bell labs. The incentive for Bell was great. The nation's telephone service required the use of many vacuum tubes and relays. To be able to replace these devices with semiconductor units could reduce costs and improve the quality of Bell service, precisely the goals of **technological change**.

If the original development of the cat's whisker rectifier was a result of a general search for increased general knowledge, then such research would be correctly labeled as **basic research** in **pure science.** However, the post WW II research by Bell labs into the development of the transistor was **applied research**, because the objective of replacing tube technology with semiconductor technology was quite clear. This was not simply a general excursion into better understanding of electronics, but rather specifically directed at replacing tube technology with semiconductor technology.

Bell initially invested $1,000,000 from 1945-48 in **applied research**. The result was a semiconductor based sound amplifier that allowed massive improvement in our national telephone system. Bell's research team was headed by William Shockley and included Walter Brattain and John Bardeen.

At the time the Bell semiconductor amplifier had a definite design formulation, that amplifier was a new **invention**. Therefore, when Shockley created the design for a new amplifier that was theoretically valid, we have the **invention** of an amplifier. The Shockley design worked in theory but not in practice. Therefore the Shockley amplifier while a valid **invention**, never became an **innovation** (the first time an **invention** is actually applied in a real application).

Brattain and Bardeen investigated the reasons for the failure of the Shockley amplifier and created a new design. This new design worked in theory and in practice and therefore was both an **invention** and an **innovation**. The B & B amplifier was an **invention** when correctly specified and an **innovation** on December 23, 1947, the date the B & B amplifier first worked in practice in Bell's laboratory.

> On July 1, 1948--two and a half years after the public unveiling of the ENIAC, the world's first large-scale digital computer--a brief news story appeared on page 46 of *The New York Times*. The item reported the **invention** of a new gadget, "a device called a transistor, which has several applications in radio where a vacuum tube is ordinarily employed."[31]

We are definitely in the realm of **technology** as opposed to **science** because of the **use** objective of the research. With such a monumental change in technology (**technological change**), shouldn't we expect almost instantaneous

[31]R. Adams and D. D. Cantlay, eds., 67

changes in **techniques** (*utilized* methods of production)? After all, "the transistor could do everything the tube could do, but in a fraction of the space and with none of the tube's disadvantages: no fragile glass container, no filament that had to warm up, no overheating, no voracious consumption of power".[32]

The answer is no! While the transistor was a great **technological change**, there were barriers to the associated **diffusion of technology** throughout the electronics industry. Barriers included: 1) the high cost of the transistor ($8/unit as opposed to $0.75/unit for the equivalent vacuum tube), and 2) the lack of education about the nature and potential of the transistor.

The **diffusion of technology** associated with the transistor received a tremendous boost from Gordon Teal (first with Bell Labs and later with Texas Instruments). Teal discovered how to replace the germanium in the original transistor with silicon, a much cheaper and more abundant material. The Teal **invention/innovation** allowed for improvement of the original transistor and greatly accelerated the **diffusion of technology** associated with the transistor.

Since the transistor is a component of capital instruments, this technological change is **capital embodied.** (Taylor's Scientific Management is probably a

---

[32]R. Adams and D. D. Cantlay, eds., 72.

good example of a **capital disembodied technological change.**[33]) Whether transistor technology is **labor saving, capital saving** or **neutral** requires more study and probably varies from application to application. What might appear to be **capital savings** due to the longer life and greater durability of the transistor, might actually have greater **labor savings** due to the decreased need for product maintenance and an improved ability of related products to replace human functions.

The transistor went through many more modifications, including integrated circuits and miniaturization, making possible a myriad of related products that are in existence today including the famous *Microchip*. (The reader is hopefully not led to believe that vacuum tubes are extinct. Television tubes and tubes for most computer display terminals continue to be vacuum tubes and are two of the continuing uses of vacuum tubes.)[34]

Measurement of Technological Change

Assume we have an unlimited demand for rebuilt auto alternators. Also assume that the person who rebuilds the alternators can do so at the rate of 1 rebuilt alternator per hour, or 8 rebuilt alternators in a typical work day. This

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[33] Daniel A. Wren, *The Evolution of Management Thought* (New York: John Wiley & Sons, Inc, 1979), Chapter 6 ,offers a good discussion of Scientific Management.

[34] R. Adams and D. D. Cantlay, eds., *Understanding Computers: Computer Basics* (Alexandria, VA.,The Time Inc. Book Company 1989), Chapter 4 is the source for all of the preceding historical information about the transistor.

continues to be the rebuild rate for the entirety of year one. However, during the holiday period prior to the beginning of year two, the rebuilder learns a new technique that allows a rebuild rate of two alternators per hour. This new technique involves no new capital, only a new labor technique. Perhaps similar components of the 16 alternators are worked on at the same time instead of completing a single alternator before beginning another.

Output for this entrepreneur has doubled in year two when compared to the output of year one. This increase is completely attributable to technological change. Labor has adopted a technique that provides greater efficiency and thus improves productivity.

As previously stated, most of the increase in national product is attributable to technological change. The increase in the size of the labor force and the size of the capital stock play secondary roles in productivity increases.

At the philosophical level, it is difficult to separate technological change from labor and capital. It is in labor and capital that most technological change eventually resides. Production with greater efficiency and lower cost necessarily involves labor and capital. If one develops a new technique, it must inevitably involve new versions of capital goods and/or new labor/management techniques. It is instructive to look more analytically at labor, capital, and technological change, the three sources of economic growth. We will "prove"

that, in America, technological change is the most important component of economic growth. Our proof will follow logic of Edward Dennison, John Kendrick and Robert Solow, distinguished American economists. The proof has additional merit in that it will simultaneously reveal the technique used in measurement of technological change.

National Income can be separated into: a) the part the goes to labor in the various forms of compensation, and b) the part that goes to capital in the form of rent, interest and profits before taxes. Some analysts frequently attribute 1/4 of national income to capital and 3/4 of national income to labor, following historical trends. Thus:

$$3/4 * NI = \text{Labor Income}$$

$$1/4 * NI = \text{Capital income}$$

Therefore if National Income increases by 8% we would expect about 3/4 of the increase to be paid to labor and 1/4 of that increase to be paid to capital.

Alternately, if the labor force increases by 8% at the same time that the capital stock increases by 8%, we would expect National Income to increase by 8%. 3/4*8% + 1/4*8% = 8%.

However, in a particular year, assume that: a) the labor force increases by 4%, b) the capital stock increases by 2% and c) national income increases by 6%. We have an apparent incongruity; 4%*3/4 + 2%*1/4 equals 3.5%, not

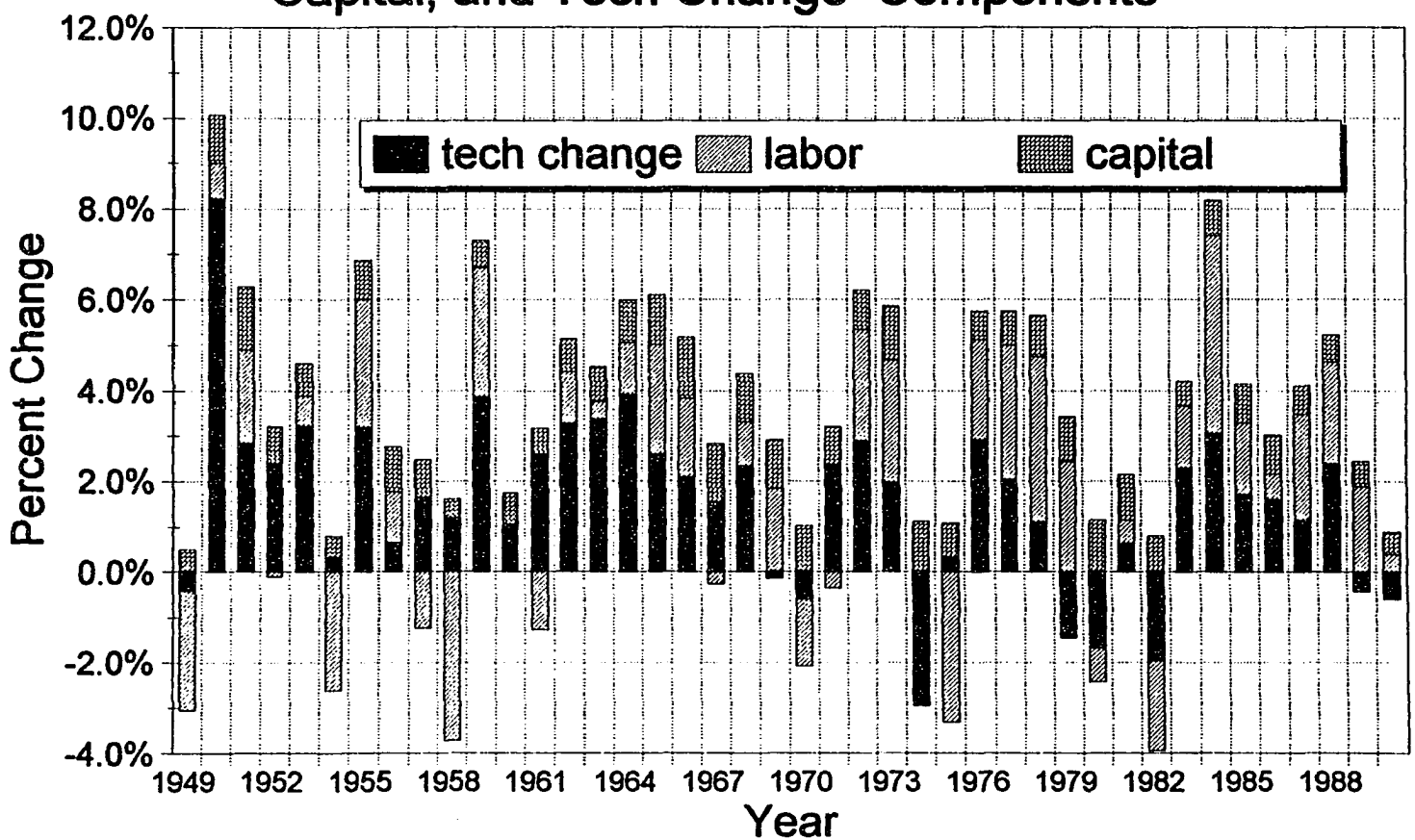
the 6% actually observed. What is the source of the "extra" 2.5% growth? The source must be technological change, the third source of economic growth. We have therefore developed a technique for measuring the annual growth attributable to technological change: 1) measure the annual increase in National Income 2) measure the annual increase in the Labor Force and 3) measure the annual increase in the Capital Stock 4) weight the Labor Force increase and the Capital Stock increase by 3/4 and 1/4 respectively and then sum. 5) The difference between the answers from #4 and #1 (the "residual") must be the annual percent change in growth attributable to technological change.

The results of a similar but more sophisticated approach are included in figure I-2. The data is from 1949 thru 1990 and is compiled and refined by the U.S. Bureau of Labor Statistics.

Rather than use the 3/4 and 1/4 weights for the labor and capital contributions, an elasticity approach was used.

In the general model $\ln(Y) = \ln(a) + b*\ln(X)$, applying a derivative with respect to ln(X) yields $d[\ln(Y)]/d[\ln(X)]=b$, but this is the general elasticity formula. Therefore if we perform simple natural logrithmetic regression the derived coefficient will yield elasticity. Using this technique on the indicated BLS data set yielded the following results: $\%\Delta GDP/\%\Delta Labor = 2.7814$ and

figure: 1-2



source: data from News: U.S. Department of Labor, Bureau of Labor Statistics, 8-29-91, p. 11.

%ΔGDP/%ΔCapital= .8313. That is, the weight for labor input should be 2.7814/.8313 = 3.3458 times the weight for capital. Using .7699 for labor and .2301 for capital yields the 3.3458 ratio required and satisfies the additional condition of summing to 1. These ratios are surprisingly close to the 3/4 and 1/4 longer term weights and avoid the problem of computing Labor and Capital's share of GDP (a problem made difficult by the structure of the national income accounts).

The total length of a bar indicates the annual change in Gross Domestic Product. The technological change, labor and capital components are as indicated. The long term dominance of technological change should be evident. Therefore we corroborate the theory asserting that technological change is the most important factor in economic growth in America (see Econometric Analysis II for a more precise *proof* of this assertion).[35]

Extremely powerful economic insight (at least for this student) is provided by looking at a single year from figure I-2 in which the technological change growth component is negative.

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[35]Paul Samuelson, *Economics: 8th Edition* (New York, McGraw-Hill Book company, 1970, Chapter 37 including the appendix is the source for a discussion of this view of growth theory. See figure I-2 for BLS data source.

Take for instance the year 1979, -1.45% is the TC growth component, 2.43% is the labor component and .99% is the capital component, thus total economic growth is 1.97% for 1979.

From a philosophical point of view, how do we conceptualize "negative" technological change. Don't we always know more this year about the industrial arts than we knew last year? How can the American Economy have a year of "negative" increase in technology? A seeming impossibility! Perhaps a person can become senile in old age and perhaps forget some of what was previously known, but how can society as a whole do this? Negative technological change is virtually unconscionable.

Perhaps if we s-t-r-e-t-c-h our imagination, we might approximate negative technological change by looking at the energy industry. In a certain era, it appeared that nuclear energy would be quite pervasive and plans were made to build many nuclear power plants to meet increased demand, decrease dependence on fossil fuels, and decrease the unit cost of electricity. However, due to dangerous risks in nuclear energy there was public rebellion of sufficient magnitude to render additional nuclear power plants infeasible. Many power plants on the drawing boards or in the process of being built were abandoned at great expense to their potential builders.

Can we not call this negative technological change? Perhaps, that which was thought to be an increase in technology was eventually judged to be a decrease in technology and is therefore "negative" technological change.

However, this is **not** the phenomenon observed during 1979 as indicated above. In 1979 capital and labor grew enough to justify growth in NI equal to 3.42%. However, since observed NI increased by only 1.97%, there must be a negative adjustment = -1.45% to explain the **underutilization of state of the art technology**. This negative adjustment is negative technological change. Now the technological change growth component is sometimes negative. In our 1949-90 series, technological change is negative 9 times (22%), with four of those 9 times since 1979. Such an indication of underutilization stands in stark contrast to theories (rational expectations, supply-side, etc.) that assert that recent inflation and unemployment can be traced to the fact that the economy is functioning at capacity and is therefore unable to respond to expansionary policies. Using technological change as an indicator, it appears that America is frequently operating below capacity and not taking full economic advantage of state-of-the-art technology. Even if economic growth attributable to technological change is positive, who's to say it couldn't be more positive? As economic resources and technology are all used to their economic maximum, what is the value of economic growth attributable

to technological change? Whenever, the **actual** technological change component is **less** than its maximal **potential**, there is underutilizaton of economic resources. To judge a positive technological change component as less than capacity is difficult. However, a negative technological change component seems to be an unambiguous indicator of underutilizaton (as perhaps do small positive components adjacent to the negative). There therefore appears to be technological underutilizaton in the Age of Automation, particularly since 1979, the age of the Microcomputer and Micro-chip, and Supply-side Economics.

In sum what must be realized is the potential for confusion regarding the term "technological change". On the one hand, we have changes in technology that represent new, better, and more efficient methods of producing output. On the other hand we have that portion of economic growth that is attributable to technological change; this might be called an actual technological change component of economic growth. In that the actual t.c. component might not fully use the economic growth potential provided by the latest t.c., we are able to conceptualize a potential technological change component of economic growth that would represent using technological change at the maximal capacity, just as operating at economic capacity means using labor, capital, and technology at their maximal rates.

We now have a partial explanation of how we can live in the greatest age of technology and technological change and yet have less than maximal economic growth. The technology may be underutilized leading to less than optimal economic growth. The "greatest age of technology" is logical if we assume no major "mistakes" in technological advance (as with the energy industry above). This year will always reflect greater technological knowledge than last year. Add to that the following example attestation to the automation era:

> We have made major investments in computers and in other information-processing equipment. The share of information equipment, in current prices, has more than doubled, from about 17 percent in 1960 to 36 percent in 1992. Computers alone went up from less than 1 percent to 11 percent of the total; and that does not allow for improvements in the quality of this equipment which has been happening at a very fast rate--on the order of 15-30 percent per year. ...[36]

Having established that technological change is the most important component of economic growth in America, we realize that when we look at productivity results, we are, to a large extent, looking at the results of applied technological change. Two measures of productivity are: a) output per manhour index and b)the total productivity index.

Output per manhour is considered the oldest measure of productivity. To a novice, increases in output per manhour may evoke images of greater effort

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[36]Ziv Grilliches, "Productivity, R&D, and the Data Constraint," *The American Economic Review* (March 1994), 11.

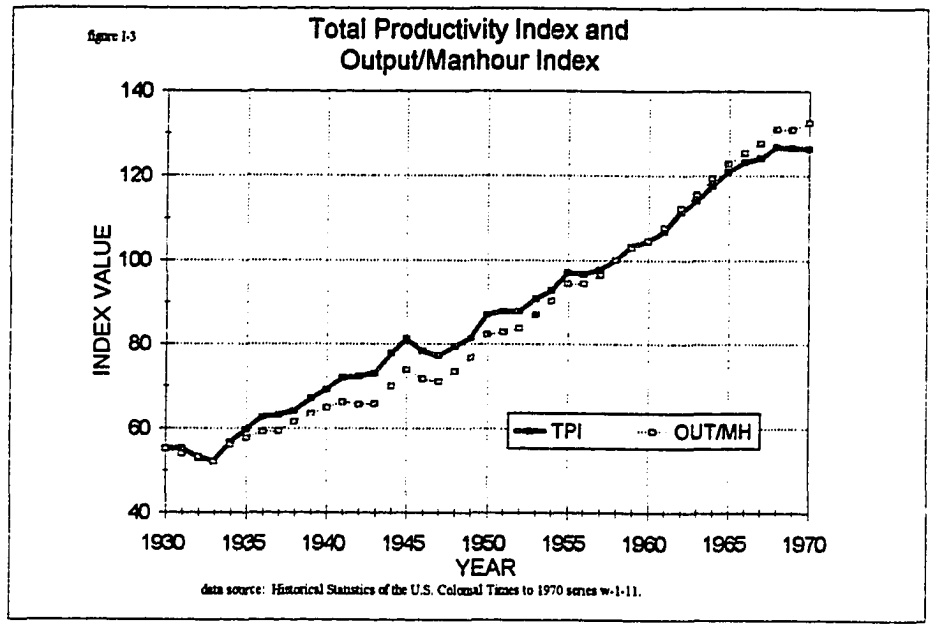
on the part of the laborers. While it is possible that such additional effort could increase output, it is far more likely that more efficient capital goods or other manifestations of technological change are responsible for the increased output. Consider the alternator rebuilder mentioned above. The doubling of output per hour is not the result of a faster working laborer, but rather the result of technological change that makes the same amount of work effort result in more output. So it is with the economy in general. The long term increase in productivity is primarily the result of technological change and resultant quality changes in human and physical capital. Output per manhour views total output divided by hours of work.

The total productivity index is a measure of productivity considered more accurate than output per manhour. The output is now per the combination of labor and capital. In this instance the productivity increase comes very close to being a measure of technological change.

If the same level of labor force and of capital stock are more productive, there is only one source for increased productivity and that source is technological change. Thus, the productivity index is a measure of growth attributable to technological change. The productivity index is constructed using data similar to the technological section of the growth bars discussed above. The data is refined using a base year with TPI equal 100. Years with

greater output per unit of capital and labor will have TPI values greater than 100. Those years with less productivity will have TPI values less than 100.

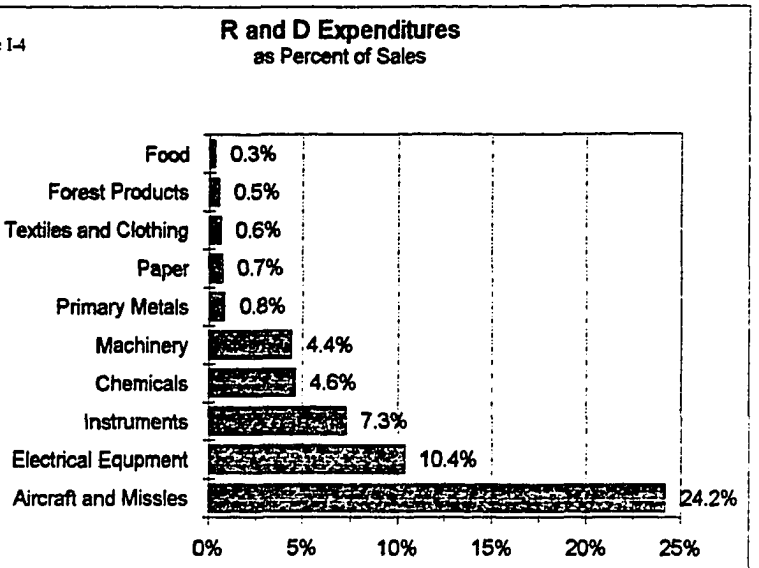
The TPI series and Output/man-hour index series are reflected in figure I-3.



Two indicators of forthcoming technological change are patents and expenditures on research and development. All patents do not reflect goods that will have great success in the market place. All research and development does not result in success. However, in the absence of better data, patents and R&D expenditures are good indicators of upcoming technological change.

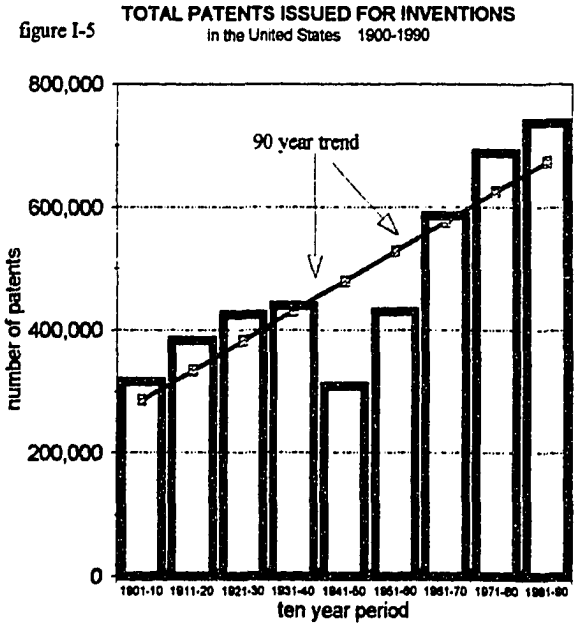
Figures I-4 and I-5 reflect selected R&D expenditures and patents issued during this century, respectively.

figure I-4



Source: Edwin Mansfield, The Economics of Technological Change (New

figure I-5



Data Sources: U. S. Department of Commerce, Highlights in Patent Activity, Patent and Trademark Office, October 1992 and U. S. Department of Commerce, Historical Statistics of the United States Colonial Times to 1970

Automation

> The impulse behind the postwar push for automatic control was not entirely new or modern. ... In addition to the ideological, technical, economic, military, political, and psychological forces at work was a primitive human enchantment with automaticity and remote control. As historian Silvio Bedini has pointed out, "the first complex machines produced by man were automata, by means of which he attempted to simulate nature and domesticate natural forces." Such automata, which dates back to ancient Egypt and which reached an extraordinary level of ingenuity and craftmanship in the seventeenth century, "constituted the first stem in the realization of his dream to fly through the air like a bird, swim the sea like a fish, and to become ruler of all nature." And this will-to-power, this god-like effort to "imitate life by mechanical means," this delight in automaticity as an extension of human control, resulted in the development of mechanical principles and devices which were subsequently used to reduce or simplify human labor.[37]

Definition and Origin of Automation

Webster defines *automation* as "automatically controlled operation of an apparatus, process, or system by mechanical or electronic devices that take the place of human organs of observation, effort, and decision" and dates the origin at 1948.[38]

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[37]Silvio A. Bedini, "The Role of Automata in the History of Technology," in Kranzberg and Pursell, *Technology in Western Civilization*, II; Derek J. DeSolla Price, "Automat and the Origins of Mechanism and Mechanistic Philosophy," *Technology and Culture* 5 (1964); see also Mumford, *Technics and Civilization* (Harcourt, Brace, 1934) and his two-volume, *Myth of the Machine*. Quoted in David F. Noble, *Forces of Production: A Social History of Industrial Automation* (New York: Knopf, 1984),57-58.

[38]Webster's Ninth New Collegiate Dictionary (1987), s. v. "automation."

We consult Management and Economic Literature in search of more detail about the origin of the term. According to Samuelson:

> The word "automation" was coined in 1947 by Del Harder, vice-president of Ford Motor Company to apply to "automatic handling of parts between progressive production processes." At about the same time John Diebold, a management engineer, shortened the word "automatization" into automation. Diebold stressed the use of control devices that operate by means of "feedback."[39]

The Webster definition yields a concise sense of the evolved nature of automation while the Harder-Diebold definition gives us automation "roots".

A classic tractor certainly meets the test of "taking the place of human organs of... effort...", but fails the test "automatic control" and is therefore not automation. However, a thermostat used to control home heat does "take the place of human organs of observation, effort, and decision" and also "automatically controls operation of an apparatus, process, or system by mechanical or electronic devices" and therefore qualifies as automation and ties to Diebold's original definition. Examples of Automation are not limited to the post-definition date of 1947. Culbertson provides us with the following 8 examples of pre-1947 automation.

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[39] Paul Samuelson, *Economics: 8th Edition* (New York: McGraw-Hill, 1970), 318.

1. In 1713 Humphrey Porter discovered an automatic valve control. Mr. Porter's job had been the manual opening and closing of valves on a Newcomen steam engine. By fastening valve handles to piston rods with wires, Mr. Porter's manual job became automated.

2. In 1784 Evans builds a completely automated water powered flour mill requiring no human labor or guidance.

3. The first thermostat receives a patent in 1830.

4. Jacquard's weaving loom was invented in 1801 and revolutionized textile production by using punched cards to specify complex cloth patterns.

5-8.

Selecting just a few highlights of automation we have automatic controls in bakeries about 1850 with the loaves passing slowly and continuously through ovens on endless belts, automatic telegraph recorders (1854), automatic bottle-making machines (1907), and A. O. Smith's factory for automatic production of auto chassis (1920).[40]

In 1955 congressional hearings were conducted on Automation before the Subcommittee on Economic Stabilization of the Joint Economic Committee. At those hearings more than 25 definitions of automation were presented by experts. Apparently the terms *technological change, mechanization, automation and*

[40]James Culbertson, "Automation-Its Evolution and Future Direction," *Computers and Automation* (November-December 1960): parts 1 & 2 *passim*.

cybernation were sometimes interchanged and confused one with another. As we have discovered, technological change implies a fundamental change in the way work is achieved, e.g. new production techniques, new designs and/or techniques of organization. Mechanization implies the replacement of human or animal labor with machines. All mechanization is therefore technological change but all technological change is not mechanization. Automation extends mechanization by replacing human controllers with automatic electro-mechanical devises. Cybernation, a term not in wide current use, focuses specifically on computer usage in the factory or office workplace. Therefore all cybernation is potentially automation but not the reverse. While these terms are generally clear today, such evidently was not the case in the 1955 subcommittee hearings.[41]

In the early discussions of automation in the 1950s and 1960s, two divergent viewpoints developed. One argued that automation's nature required government intervention to assure proper economy wide application while the other viewpoint argued that automation as the latest manifestation of technological change posed no economic threat and therefore is best left alone. These two view points continue today and deserve analysis in some detail. We

[41]Julius Rezler, *Automation & Industrial Labor* (New York: Random House, Inc., 1969), 5-6.

will therefore in turn look at Automation as Potential Economic Hazard and Unrestricted Automation as Certain Economic Benefit.

Automation as Potential Economic Hazard

> The industrial revolution has . . . displaced man and the beast as a source of power. . . .The Factory of the future. . . will be controlled by something like a modern high-speed computing machine. . . . We can expect an abrupt and final cessation of the demand for the type of factory labor performing repetitive tasks . . . an intermediate transitional period of disastrous confusion. . . . Industry will be flooded with the new tools to the extent that they appear to yield immediate profits, irrespective of what long-time damage they can do. . . . It is perfectly clear that this will produce an unemployment situation, in comparison with which the present recession and even the depression of the thirties will seem a pleasant joke.
>
> 1950 Norbert Wiener, MIT Mathematician[42]

Introduction

Many "educated" observers are of the opinion that the conceptualization of automation as a potential economic hazard is an "uneducated" conclusion. However, this is not accurate. Many brilliant observers see danger in Automation. In 1962, President John F. Kennedy called the reaching of full employment, at a time when machines are replacing men, the major economic challenge of the sixties.[43]

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[42]N. Wiener, *The Human Use of Human Beings* (Houghton Mifflin, Boston, 1950), 180-189 as quoted in P. Samuelson, *Economics* (McGraw-Hill, 1970),319.

[43]Leon C. Megginson, "Automation: Our Greatest Asset-Our Greatest Problem?" *Academy of Management Journal*, September 1963, 232.

Rezler believes that support for this position is comprised "mainly, but not exclusively, of labor leaders, liberals, and institutional economists."[44]

Proponents of this position propose a direct causal relationship between increased automation and national unemployment.[45] If increasing automation occurs contemporaneously with increasing unemployment then this position receives more credibility. Such was the case from 1956-1963.[46]

Keynesian economists have often argued that expansionary monetary-fiscal policy could cure unemployment, almost regardless of origin. The increase in government spending associated with the 1964 tax cut, the Viet Nam War and the Kennedy-Johnson Great Society caused a general decrease in unemployment and therefore concern about automation caused unemployment waned. However, living in the Age of Automation as we do, and realizing the large number of persons who believe that automation is responsible for their unemployment, the possibility of causality must not be discarded. We therefore are lead to seriously consider the arguments of automation caused unemployment.

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[44]Julius Rezler, *Automation & Industrial Labor* (New York: Random House, Inc., 1969), 21.

[45]Julius Rezler, *Automation & Industrial Labor* (New York: Random House, Inc., 1969), 21.

[46]Julius Rezler, *Automation & Industrial Labor* (New York: Random House, Inc., 1969), 41.

J. J. Miller

A very logical and convincing argument of automation as a potential economic hazard is provided by J. Miller of Duquesne University, writing in the *Academy of Management Journal* in December 1964.

J. Miller contends that don't worry type arguments about mechanization (automation) receive momentum by having been correct in earlier American history. However, modern automation is quite a different phenomenon.

According to J. Miller the usage of capital can be divided into four evolutionary stages: a) earliest stage - capital upgraded labor's skill and productivity, b) second stage - labor is partially displaced by capital, c) third stage - capital goods are able to replace manpower in its entirety, and d) fourth stage - the probable final stage of technological development in which complete automation reigns in the production of goods and services. While such a list required some imagination in 1964, in 1995 very little imagination is required to confirm feasibility.

Much of the momentum for the "don't worry" attitude about automation is derived from America's agricultural mechanization experience. Agriculture employment was diminished quite rapidly due to the greater efficiency of new farm machinery. However, mass unemployment did not result from this episode because of the simultaneity of the great expansion of the

manufacturing sector and the massive need for labor in that sector. J. Miller argues that such simultaneity is rare.

> ...But whereas the displaced farmers had the opportunity to move into an expanding industrial operation, the displaced factory worker finds himself stymied as to finding employment for his available talents.[47]

J. Miller argues that certain pre-conditions must attain in order for additional mechanization (automation) to lead to additional employment. 1) demand for the product must be sufficiently sensitive to an automation caused cost/price reduction such that large increases in demand will occur requiring not only the maintenance of all existing labor units, but perhaps also require additional labor units. **or** 2) the automation must create markets for new products that do not exist before its introduction. Should these very specific pre-conditions not be met, we may expect automation to cause a reduction in the use of labor.

For instance, if I can hire a machine for $15/hour that will replace a person receiving $20/hour, then there is a strong likelihood that such a switch will be made. If such a cost reducing switch results in a decrease in price such that more units of my product are demanded, then I can expand my output which may require more workers, which may cause me to continue the employment

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[47]J. James Miller, "Automation, Job Creation, and Unemployment," *Academy of Management Journal* (December 1964), 302.

of all current employees. (However, if I don't pass cost savings to consumers or if I meet additional demand with additional automation rather than additional labor, automation may not lead to more employment, but rather lead to less employment).

J. Miller cites several concrete mechanization cases for consideration:

1. Steel Industry: In the beginning technology was such that steel could not be produced at low prices or efficiently in large quantities. Technological change and innovation in the form of the Bessemer Process and the Open Hearth technique allowed low cost steel to efficiently be produced in large quantities. In this instance we have increased employment and sales.

Latter in the history of steel, we have new mechanization (automation) without increases in employment. While there may be an (lower cost inspired) increase in demand, the increased demand is not sufficient to prevent reduction in employment. The result was increased production with decreased employment.

2. Coal Industry: In the beginning mechanization caused a cost reduction that generated additional demand sufficient to require additional employment. Later mechanization in the form of borers and cutters cut cost but did not greatly increase demand for the

product. The result was increased production with decreased employment.

3. Rail Industry: Technological change in the form of diesels and remote controlled yard operations, etc. reduced costs but did not affect demand enough to prevent decrease in rail employment. The result was increased production with decreased employment.

J. Miller believes that many other examples of mechanization and automation follow this same pattern of cost and employment reduction.

Devey and S. M. Miller

We don't necessarily need to consult 60s literature to find suspicion of automation. In a 1983 *Challenge* article, Donald Tomaskovic-Devey and S. M. Miller, sociologists, argue against high employment expectations from the highly automated high tech sector. Their study was inspired by the 1983 Reagan State of the Union message. According to Devey and Miller, Reagan stated his expectation that an increasing percentage of the labor force would be absorbed into high technology industries. Devey and Miller's study of data preceding the Reagan speech contradict the Reagan assertion.

Part of the Devey and Miller analysis included defining high-tech. Three definitions emerged: a)a Sci-Tech definition, b) a R&D definition and c)a Mass definition. The Sci-tech definition included industries that employed high percentages of scientists, engineers and technicians. The R&D definition used industries with above average levels of research and development. The Mass (i.e. Massachusetts) definition required high percent of scientists and technicians in the work force, plus a highly skilled labor force. Given these definitions Devey and Miller were able to use Standard Industrial Classification numbers to identify 25 "High- Tech" industries for study.

We are not implying a natural congruence between high tech and automated industries. However, Devey and Miller's findings included data that confirmed that High-Tech industries had a production workers/total workers ratio much lower than the overall average for manufacturing (50% vs. 72%) which implies a higher degree of automation (or in general a higher capital/labor ratio).

Devey and Miller looked at employment changes between 1969 and 1979. During the 70s U.S. employment growth was 27.6% while growth directly attributable to High-Tech was only 2% in the 24 industry definition. In fact, using 24 high-tech industries, Devey and Miller report a net decline in employment (some due to decreased military spending and some due to losses

to foreign competitors). High-Tech value added during the same period almost doubled for the 24 industries. Thus, high-tech output is increasing while its workforce is decreasing.

Devey and Miller allow that many High-Tech representatives will argue that much of the High-Tech employment will be indirect and exist in other industries. Devey and Miller counter by stating:

> ...There is some truth in the suggestion that new employment, particularly software employment, has been generated by high technology. The occupations of computer programmer and systems analyst are growing, spawned by the advent of computers. But as these fields grow, more traditional occupational fields diminish. Programmers often replace bookkeepers and accountants. Increased secretarial efficiency through the use of word processors reduces the need for secretaries. Certainly, robotics on the assembly line and "intelligent cash registers" reduce both the skill and number of required workers. Individual employers selectively reduce their labor forces by using high-tech equipment. The general point is that the loss of positions in firms purchasing high technology more than offsets the employment gain in firms producing high-tech equipment.[48]

Levitan and Johnson

One of the leading centers for the development of automation and robotics is at Carnegie-Mellon University in Pittsburgh. Engineers for a number of years have stated that any job that can be done manually can eventually be performed through automation. Given this premise, we can expect engineers to be able to forecast the actual displacement potential of newly developed

[48] Donald Tomaskovic-Devey and S. M. Miller, "Can High-Tech Provide the Jobs?", *Challenge*, May-June 1983, 57-63. This is reference for quote and the entire Devey-S.M. Miller section.

technology and indeed such forecasts have been made. However, the reading of these "projections" must be tempered with the realization that the diffusion of innovation is subject not simply to availability of new technology but also to socio-economic constraints as well. That is, it must be economically feasible to replace human labor with automation and social pressure opposing automation must be overcome. Given this background, we can better interpret the following as indicating what is theoretically possible but not necessarily what will (has) actually occur(ed).

> . . . a study conducted at Carnegie-Mellon University asserts that the current generation of robots has the technical capability to perform nearly 7 million existing factory jobs-one third of all manufacturing employment-and that sometime after 1990, it will become technically possible to replace all manufacturing operatives in the automotive, electrical-equipment, machinery and fabricated metals industries.[5] Yet these theoretical estimates of the potential for automation, which reach as high as 65 to 75 percent of the factory work force, do not reflect the rate at which the new technology will actually be introduced.
>
> . . .
>
> Auto manufacturers already find it possible to operate robots for $6 per hour, well below the $20 per hour required for the pay and benefits of a skilled worker in 1981.[6]
>
> . . .
>
> The Carnegie-Mellon study argued that 38 million of 50 million existing white-collar jobs would eventually be affected by automation, while a vice president for strategic planning for Xerox Corp. preferred the more conservative guess of 20 to 30 million jobs affected by 1990.[9] . . .

[5]Lublin, "As Robot Age Arrives. . .,"and "The Speedup in Automation," *Business Week*, Aug. 3, 1981, p. 62.
[6]Congressional Record (daily edition), Dec. 10, 1981, p. S14908.
[9]"The Speedup in Automation."[49]

[49]Sar A. Levitan and Clifford M. Johnson, "The future of work: does it belong to us or to the robots?", *Monthly Labor Review* (September 1982), 11-12.

Wassily W. Leontief

This distinguished Economist was actually born in St. Petersburg, Russia in 1906. (St. Petersburg was later called Leningrad after Communist leader Lenin led Bolsheviks to power in 1917). Leontief's Russian family was anti-communist, which led Leontief to seek a self-imposed exile in the United States. In America Leontief became a distinguished Harvard Economist. His signature research project was the development of modern input-output tables that showed "what each industry received from and sold to every other, and therewith the flow of income through the system and its effects...".[50] This work revived foundational analysis of the same type conducted in the mid-18th century by French Economist François Quesnay (a contemporary of Adam Smith, often mentioned as a co-founder of modern Economic thought). In fact both tables were called (Quesnay's or Leontief's) Tableau Èconomique.

It so happens that Input-Output tables are well suited for analyzing any type of economy, capitalistic, planned, or an intermediate combination. This feature led Leontief to become an international Economist, celebrated by both Western and Soviet scholars. In 1973 Leontief was awarded the Nobel Prize for his Economic scholarship.

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[50]John Kenneth Galbraith, *Economics in Perspective: A Critical History* (Boston: Houghton Mifflin Company, 1987), pp. 55 & 260-61. This is also the source for the biographical information about Leontief.

With this background, we can begin to appreciate the concern expressed by Leontief for the potential negative impact of technological change if not accompanied by serious structural changes in the impacted economies. The Leontief view is expressed in two articles appearing in 1982-83: 1) *The Distribution of Work and Income*[51] and 2) *Technological Advance, Economic Growth and the Distribution of Income.*[52]

Leontief is well aware of the erroneous foundation of the Luddite protest against the installation of automatic knitting machines in early 19th century England. Of course the protesters were wrong because the demand for now cheaper cloth would increase and demand many more skilled laborers to operate the machines. The machines replaced elementary physical labor but required trained individuals to operate them successfully. Current Technological Change in many instances is replacing high and low level physical and **mental labor** and has the ability to eliminate labor as the most important factor of production. For the past 200 years, the length of the workweek adjusted downward to help compensate for the increasing power of technology. However the downward trend in the workweek ceased in the mid 1940s. Post World War II legislation first considered full-employment to

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[51]Wassily Leontief, "The Distribution of Work and Income," *Scientific American* (September 1982).

[52]Wassily Leontief, "Technological Advance, Economic Growth, and the Distribution of Income", *Population and Development Review 9, No. 3* (September 1983), 403-10.

mean 2% unemployment, which over time has changed to 4% and circa 1982 was 9%.

The growth in technological unemployment can be addressed in several unacceptable ways:

1) **don't have technological change** - this was the Luddite recommendation and of course is unacceptable because this cure presents more social and economic ill than it cures.

2) **workers could accept lower wages** - proposed by pure laissez-faire proponents but rejected by Leontief because wages tending to zero could displace some capital in the short-run but not in the long run because some technologies simply don't need much of a labor complement. If wage cuts are not accompanied by constraints on labor saving technological change (which of course would cause more harm than good), even cheaper labor would begin to be replaced and the original problem would return.

Leontief believes that current automation, robotization, etc. may be compared to the introduction of farm tractors that overtime eventually eliminated the horse as a component of farm production:

> Even if horses were ready to accept smaller rations of oats or hay per working day, the process of their gradual elimination would slow down only temporarily; more and more efficient tractors would come along, and finally, unable to compete with the superior performance of machines, horses would lose their jobs. That outcome would, moreover, be brought about by the perfect operation of the free competitive price system that would automatically compare the costs

> of different technologies competing with each other. If horses had controlled the government, this would have been a quite different story. But this brings us back to the problem of human technological unemployment and income distribution.[53]

3) **reduce the growth in population** - if the labor force should shrink, the reduced need for labor would be automatically met. While there are economic forces that suggest the logic of smaller families, how could such a policy be imposed?

or 4) **use more labor intensive technologies** (as opposed to capital intensive technologies) - this is contradicted by the profit motive of the firm which dictates that the lowest cost technique should be utilized.

Two techniques that do have Leontief merit are:

1) **Increased Investment** - as the economy grows more investment is required and most capital investment requires a labor complement. However Leontief warns that one job 20 years ago may have required an investment of $50,000 but today will require $500,000.

> The latest copper smelter to go into service in the U.S. cost $450 million and employees fewer than 50 men per shift.[54]

and 2) **reduction in the workweek and incomes policies** - for the 200 years prior to 1940, the reduction in the workweek was a natural response to

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[53]Wassily Leontief, "Technological Advance, Economic Growth, and the Distribution of Income", *Population and Development Review 9, No. 3* (September 1983), 405-6.

[54]Wassily Leontief, "The Distribution of Work and Income," *Scientific American* (September 1982)., 102-3.

advancing technological change. Leontief ponders why this trend stopped. Perhaps real wages did not rise fast enough. It is unlikely that a sufficient real wage increase is now possible that would induce a **voluntary** decrease in the work week. This leaves us with government imposed reductions in the workweek.

Simply reducing the workweek will not solve the problem completely, Leontief sees the distribution of income question as being concomitantly important:

> Adam and Eve enjoyed, before they were expelled from Paradise, a high standard of living without working. After their expulsion they and their successors were condemned to eke out a miserable existence, working from dawn to dusk. The history of technological progress over the past 200 years is essentially the story of the human species working its way slowly and steadily back into Paradise. What would happen, however, if we suddenly found ourselves in it? With all goods and services provided without work, no one would be gainfully employed. Being unemployed means receiving no wages. As a result until appropriate new incomes polices were formulated to fit the changed technological conditions everyone would starve in Paradise.[55]

According to Leontief, different economies handle the distribution of income in various ways. The government of Singapore has government directed high wages, that in turn encourage the very latest technology in capital goods. Of course such a policy requires strict immigration laws and the encouragement of birth control.

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[55]Wassily Leontief, "The Distribution of Work and Income," *Scientific American* (September 1982).. 103.

West Germany has a policy of codetermination in which half of the board of directors of major corporations are from labor and half are from management. This helps tremendously in curbing inflation.

Austria is a third example. Austria uses a system similar to Germany's, but Austria also has an effective input-output analysis mechanism that allows it to predict what the impact of a new technology will have on various sectors of the economy. The government is therefore able to "plan" an economy that is free of many of the inflationary pressures of the more laissez-faire economies of Britain and the U.S.

Leontief indicates that although most advanced economies are concerned with automation and robotics, only a few countries (including Austria, Japan and Norway) are using input-output analysis to project future impacts.

This brings us to a feature that separates Leontief's analysis from that of other scholars. Leontief's input-output tables are well suited for analyzing the impact of impending technological change under varying scenarios, allowing the economy to smoothly adjust to change in an optimal fashion.

In input-output technological change simulation, different sets of input-output coefficients are generated for all affected sectors and for each scenario version. This can be an expensive undertaking.

> Information for construction of the new coefficients was procured by comprehensive questionnaires circulated to technologists in each field and

interviews with responsible technical directors of major industrial and service enterprises.[56]

An excerpt from an input-output analysis of the Austrian economy (about 3% of the size of the American economy) is instructive:

Table I-1 Austrian Economy Input-Output Excerpt

	1976 (actual)	1990 (projections)				
		unchanged work week		shortened work week		
		no mechan-ization	full mechan-ization	no mechan-ization	partial mechan-ization	full mechan-ization
GDP/employed	229	366	390	326	340	341
per capita wages	101	150	159	131	136	137
avg. work hrs/wk	42.1	39.6	39.9	35.2	35.3	35.3
unemp in 1000s	55	220	386	29	165	76
employ in 1000s	3,222	3,221	3,056	3,413	3,277	3,336

source: Wassily Leontief, "The Distribution of Work and Income," *Scientific American* (September 1982).. 107.

Unrestricted Automation as Certain Economic Benefit

Rezler believes that the persons supporting this position are "representatives of management, conservatives, and economists of the neoclassical brand."[57] The following statement by Yale Brozen of the University of Chicago made in 1964 is a good summary of the belief that automation should not be restricted:

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[56]Wassily Leontief, "The Distribution of Work and Income," *Scientific American* (September 1982).. 105.

[57]Julius Rezler, *Automation & Industrial Labor* (New York: Random House, Inc., 1969). 21.

> The indictment of automation for causing unemployment adds another to the long list of economic propositions which many believe but are, nevertheless, the exact opposite of the truth.[58]

While we use only three references below in defense of non-interference with automation, the list could go on and on. The three listed references are typical.

Economists are trained in skepticism with a long list of theories that defy simple common sense. Keynes' Paradox of Thrift in which increased national savings leads to diminished national income is just one example. A perhaps dominate view of the Economics profession asserts that students who believe automation is counter to a healthy economy are using deficient, incomplete reasoning. Let's look at three representative sources.

Samuelson - Fundamental Principles of Keynesian "New" Economics

Samuelson has published a Principles of Economics text since 1948. In a good principles text we expect to find economic theory that is widely accepted. Samuelson's text is no exception. The text referred to in this section is written in 1970, a good year for the "New" Keynesian economics that inspired a great deal of professional confidence at the time. Rational expectations, high

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[58]Yale Brozen. "Putting Economics and Automation in Perspective," *Automation*, 11 (April 1964), 30 as quoted by Julius Rezler, *Automation & Industrial Labor* (New York: Random House, Inc., 1969), 22.

government deficits and a runaway national debt were not part of political-economic thought at the time. The New Economics was a cure-all for many conceivable economic problems. We look at economics under three conditions: 1) automation leads to short-term unemployment, 2) automation leads to the exact amount of new investment needed to employ any automation displaced workers (assuming existence of efficient retraining as needed), and 3) automation leads to excessive new investment that is potentially inflationary.

Automation leads to short-term unemployment: In this scenario the automation causes X% greater productivity. That is, the same labor force can now produce X% greater real national income. The assumptions in this scenario include no change in government spending, no net investment (depreciation allowances are sufficient to fund the new automation), and no change in the propensities to consume and save (lower manufacturing costs did not translate into lower prices). Under such circumstances, less labor is required and we can expect technological unemployment.

New Keynesian Economics to the rescue! Proper monetary-fiscal polices are enacted to stimulate demand. Government expenditures might be increased, taxes might be decreased, the money supply might be increased, or some combination of these might occur. The idea is to generate sufficient additional

demand to absorb the technological unemployment. Some retraining may be required so that the skills of the labor force match the skills requested by the additional demand. Mobility may be required to insure re-employment. But in a world of New Keynesian Economics, there is no fear of technological unemployment.

Automation inspires Full-employment Increases in Investment: Rather than no net investment, this scenario has precisely the right amount of net investment that generates the exact amount of new demand needed to absorb anyone displaced by the new automation. A new product may be implied by the automation (e.g. computer chips) or more of an existing product (e.g. molded plastic), with the additional demand precisely sufficient to use any technologically displaced workers.

Automation Inspires Excessive Inflationary Investment: In this scenario, new net investment may be so great as to demand more output than a fully employed economy can produce. The economy response in this instance might be inflation, unless the government intervenes with contractionary monetary-fiscal policy.

The commonality of the three scenarios is that New Keynesian Economics is sufficient to solve any automation caused unemployment problem that

might arise. Thus, New Economics allayed many of the automation inspired fears of unemployment.[59]

Cyert and Mowery - Orthodoxed View of Economics Profession

In the present times of Rational Expectations, high government debt and deficits, many doubt the efficacy of Keynesian Economics. However, Cyert and Mowery present a pro-automation argument that is not predicated upon Keynesian remediation. the Cyert and Mowery article "Technology, Employment and U. S. Competitiveness" provides logic that is quite current and quite mainstream economics.

Reasons Why Technological Change (Automation) Creates and Not Destroy Jobs:

1. Immediate effect of technological innovations may be the displacement of workers. Introduction of technological innovations is usually to reduce cost of producing output. If technological innovation is cheaper than current labor configuration, labor will be displaced. Stopping at this step in the analysis is premature because of the following 3 implications of technological innovation.

2. A fall in the cost of output may be translated into a price reduction. If demand is sensitive to fall in price, increased product

[59]Paul Samuelson, *Economics* (New York: McGraw Hill, 1970), 318-321 is the source for this section.

demand can be expected. The increased product demand may require more rather than less labor.

3. National employment may rise even if price reductions don't significantly increase product demand. Consumers can be expected to use the cost savings to increase demand of other goods and services. As such the cost savings function much like a tax cut.

4. The new process required by the technological innovation may require "new machine tools, materials and supplies". Such additional demand may increase employment in those industries that supply goods and services needed by the innovation.

Model Components for Determining Employment Impact of Technological Innovations: 1) diffusion rate of innovation (how long does it take to be distributed throughout the economy), 2) sensitivity of demand to a lower cost caused price reduction (price elasticity of demand), 3) change in demand for labor due to increased demand (function of price reduction) for product, and 4) how consumers use additional income that results from price reductions. Cyert and Mowery argue that data of sufficient quality do not exist that will allow adequate or precise analysis of employment impacts of new technology. If the innovation results in new products, analysis is even more complex.

International Competition: Consider two competing countries A and B. If both have access to new technology, yet country B utilizes the technology first, we can expect country B to have a competitive advantage over country A. Country B will be first to reduce prices and therefore can be expected to increase market share in Country A, by supplying lower cost high quality units. Employment in Country A can be expected to decrease because Country A is slow in implementing new technology, not because it has implemented too much new technology. If Country B continuously is first in new technology, we can expect international balance of payments to favor Country B in the long run.

Thus we have compelling logic in support of no constraints on automation.

The Economist - International Confirmation of Orthodoxy

As we discuss automation implications in an American context, we are bound to have more confidence in our conclusions, if those conclusions match conclusions of other industrialized nations of the world. A summary article, "Towards Fuller Employment: We have been here before", appearing in the London publication, *The Economist*, in 1984 provides such a perspective:

> Automation. robotisation and informatics are likely in the long term to create many more jobs than they will destroy. This statement brings waves of disbelief, but this is at least the fifth time in the past century when it has been predicted that a technological or social revolution is about to bring a huge rise in unemployment.

> The five occasions have been: (1) the post 1880 agricultural revolution (the mechanisation of farming); then (2)the industrial revolution (the mechanisation of manufacturing); then (3) the entry of many more women into the labour force; then (4) the energy price rises in the 1970s; and now (5) the information revolution.
>
> All the previous predictions about massive net losses of jobs proved wrong. Since 1880 employment in the rich industrial democracies (hereafter called OECD) has more than tripled, even though mechanisation has displaced more than two thirds of pre-1880 OECD jobs. Throughout the past century, employment has increased most in those countries which installed labour-saving machinery most quickly.[60]

Brief History of the Computer

While it is possible to have automation without a computer, so much of current day automation involves the computer or computer type components, it is instructive to briefly review the history and evolution of the computer.

The abacus, a counting device using beads strung on wires or wire-like sticks is an older counting device from ancient times (and still in use today). Pascal and Liebniz invented metal mechanical calculators in the 1600s. Jacquard, a French inventor developed a weaving loom controlled by punched cards (defining patterns and colors and similar to punched cards used in computers today) that revolutionized the textile industry in the early 1800s.

Babbage's Difference and Analytical "engines" were developed circa 1822. While pre-electricity, the Babbage engines are admired for being much like modern computers in style. The Babbage Analytical engine was programmable

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[60]"Towards Fuller Employment: We have been here before." *The Economist*, July 28, 1984, 19.

and had a "store" where instructions were kept (similar to modern computer memory) and a mill where arithmetic operations occurred (similar to modern arithmetic-logic unit). Input into the Babbage engine was via cards similar to Jacquard's.

In the post-electricity age we have Herman Hollerith who was responsible for accelerating computation of the national census. Hollerith used punched cards and invented tabulating machines that could "sort, reproduce, and merge punched cards and perform limited arithmetic and printing operations." Hollertith's Tabulating Machine Company became a major foundational component of IBM.

World War II and its need for high speed computing accelerated the development of automatic computing devices. Aiken (Harvard 1939-44), Stibitz (Bell Labs) and Zuse (Germany 1936-39) all invented electromechanical relay computers. Of course a fully electronic computer that had no major mechanical parts would compute much faster. Atanasoff (Iowa State University circa 1941) inspired Eckert and Mauchly of the University of Pennsylvania who with government help invented the fully electronic ENIAC with about 18,000 vacuum tubes from 1943-46.

After World War II von Neumann (Princeton) assisted in development of a new generation ENIAC computer with stored memory (eliminating continual re-programming).

Shockly, Brattain and Bardeen of Bell Labs developed the transistor which replaced the vacuum tube in many applications. Teal (Bell Labs and Texas Instruments) improved the design of the transistor and made it more affordable. After perfecting the transistor the next move was to miniaturize electrical circuits facilitating the development of many new products plus smaller more efficient computers.

Altair (1975), Radio Shack (1976), Commodore (1977) and Apple (1976) were all pioneers in the "micro" computer arena. Apple was a larger commercial success than the others and its success preceded IBM's entry into the microcomputer market in 1981. Since 1981 computers have gotten smaller, more powerful, and less expensive.[61]

Selected Current Instances of Automation

Our definition of Automation has two primary qualifying conditions: 1)automatic control and 2) replace human observation, effort or decision. An

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[61]R. Adams and D. D. Cantlay, eds., *Understanding Computers: Computer Basics* (Alexandria, VA..The Time Inc. Book Company 1989), passim. R. Stern & N. Stern, *An Introduction to Computers and Information Processing* (New York: Wiley and Sons, 1985), Chapter 3.

instructive exercise is to examine each of the following instances to confirm that both qualifying conditions attain. For instance, a TV with remote control replaces human effort and is automatically controlled and is therefore automation.

Automation is so pervasive in our society today, that any list is bound to leave out some important instances. The list below, while not exhaustive, does attempt to record some of the major instances of automation in society today (explanations have been added for less familiar terms).

Computer Types: Personal/Desktop, Portable, Workstations (a supermicro computer or a terminal for a large mainframe; allows the power of mainframe on desk top; used for CAD, CAM, CAE, graphic design, science applications, etc.)[62], Mid-range, Minis. Mainframes, Super. Computers are listed in general order of size and power. However, clear delineations no longer exist due to wide range of options.

Automation in the Home: home computers, home security systems, garage door openers, VCRs with auto timing devices, TVs with and without remote, telephones, controls and auto timing devices, stereo systems with automatic and remote controls, thermostats. Fax Machine, telephone answering

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[62]H. L. Capron and John D. Perron, *Computers and Information Systems* (Redwood City, CA: Benjamin/Cummings Publishing Company, 1993), 34 & 587.

machines, calculators, aid for physically handicapped, cable TV, electronic musical instruments, computer type toys.[63]

Automation in the School: Home devices are generally available for the school as well. Computers in **network** configurations allowing inter-computer communications and computer based group work. Computer Assisted Instruction (CAI).

Automation in the Office: Home and School devices are generally available for the office. Expected trend includes more computer based education and work in the home. Greater emphasis on networks and electronic mail exist in many office settings.

Automation in Industry: Artificial Intelligence: CAD (computer assisted design), **CAM** (computer assisted manufacturing), **CAE** (computer assisted engineering). Preliminary drawing may be developed using CAD forwarded to CAE for engineering specifics and to CAM for manufacture.[64] **Robotics** (computerized hands), **Machine Vision** (shape, pattern, material recognition by machine), **Materials Handling** (e.g. movement from one workstation to another). **FMS** (flexible manufacturing systems)- systems that can be easily and automatically modified to accommodate the manufacture of

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[63] *1991 Edition Electronic Market Data Book*,(Washington D.C., Electronic Industries Association, 1991), v-ix.

[64]H. L. Capron and John D. Perron, *Computers and Information Systems* (Redwood City, CA: Benjamin/Cummings Publishing Company, 1993), 448-Gallery 3.

related goods with varying specifications. **ES** (Expert Systems) - software systems that uses set of if-then conditions and a knowledge base to reach decisions equal to those of a human expert. **MRP-**{Material Requirements Planning. American software system inspired by Japanese Just in Time. Minimizes excess inventory (increasing funds for other operations), schedules inventory delivery to arrive "just in time".} **MRP II-**(Manufacturing Resources Planning. The evolutionary version of MRP. Integrates Finance, Marketing, Production and Engineering into single interactive system.)[65] **CIM** (Computer Integrated Manufacturing; synthesis and evolutionary system more general than MRP II designed to optimize overall factory system to minimize cost, time, etc. Interacts with CAD, CAE, CAM, etc.).

Automation in Medicine: diagnostic equipment, therapeutic equipment, surgical and medical instruments, doctor/nurse instructional, patient monitoring equipment, consumer medical electronics.[66]

Automation in the Military: personnel management, strategic defense including simulations, surveillance devices, missiles, drones, procurement management, etc.

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[65]John Teresko, "MRP II: A Strategic Tool for Survival," *Industry Week*, September 30 ,1985.

[66] *1991 Edition Electronic Market Data Book*,(Washington D.C., Electronic Industries Association, 1991), v-ix. is the source for most of this section.

Testing the Economic Welfare Implications of Automation

We have reviewed economic theory that supports the idea that Technological Change is the primary force leading to increased economic growth. Economic growth is strategically associated with Economic Welfare (a point made clearer in chapter II). Automation is a quantum leap in Technological Change. Few would argue otherwise. We therefore logically expect a quantum leap in economic growth and associated welfare. The title of this work implies a contradiction of this causality. To support the proposition of a paradox we must demonstrate that a quantum leap in technological change, i.e. Automation, has not lead to a quantum leap in economic welfare.

We have reviewed theories that indicate that Automation is a potential economic hazard. Many in the Economics profession appear to believe that unrestricted automation implies certain economic benefit. We can adopt the "mainstream" economics position as our hypothesis. Let us therefore test the hypothesis that Automation has produced a quantum leap in economic welfare. Rather than keep the reader in suspense, the title *The Automation - Economic Welfare Paradox in America* implies our conclusion of a rejected hypothesis. However, the rejection of the hypothesis that Automation has produced a quantum leap in economic welfare is predicated upon a very

specific definition of economic welfare and very specific tests of welfare changes during the Age of Automation. The reader therefore must accept the proposed welfare indicators as indicative of general economic welfare in the Age of Automation and must accept the data analysis techniques as valid. There is therefore a *degree* of mystery in our analysis. However, if we agree that our chosen set of welfare indicators are valid indicators of general economic welfare and if we agree that the statistical analysis is valid, we have indeed identified an important economic problem demanding further analysis and remedial public policy measures. We therefore look at Economic Welfare in chapter II and we conduct statistical analysis in Part III.

part two
Chapter II

Economic Welfare

> We the people of the United States, in Order to form a more perfect Union, establish Justice, insure domestic Tranquility, provide for the common defence, **promote the General Welfare**, and secure the Blessings of Liberty to ourselves and our Posterity, do ordain and establish this Constitution for the United States of America.
>
> Preamble of the U. S. Constitution (bold added)

Introduction

Definition

Self preservation is commonly offered as a first law of nature. We expect one to treat one's personal welfare as a priority concern. Additionally, quite common greetings (often offered almost unconsciously) include: a) "How are you doing?" or b) "How are you today?" That is, it is quite common for members of society to be concerned about the general welfare of their neighbors.

Our concern in this chapter is an exploration of economic welfare, a subset of the general welfare mentioned above as a directive of the U.S. Constitution. A primary concern then becomes the separation of economic welfare from general welfare. In this matter reference is directed towards the late A.C. Pigou (Emeritus Professor of Political Economy at the University of Cambridge) and

his original work *The Economics of Welfare.* This book by Pigou was first written in 1920 and had a fourth edition in 1952.

John Kenneth Galbraith calls Pigou "the successor to Alfred Marshall in both prestige and professional position at the University of Cambridge."[1] Galbraith gives Pigou considerable credit as a chief architect of the modern "Welfare State." Pigou is indeed the expert we seek for the definition of economic welfare. This is Pigou's definition:

> . . . Hence, the range of our inquiry becomes restricted to that part of social welfare that can be brought directly or indirectly into relation with the measuring rod of money.[2]

Our range of inquiry is considerably narrowed. If social welfare is not directly or indirectly associated with money, then that segment of social welfare is not part of economic welfare. At first glance, this delimiter appears fairly precise. One simply inquires as to whether or not money is associated with the welfare. If the answer is yes we have economic welfare; if not, we don't. One's income is therefore a primary determinate of one's economic welfare.

Alternately, a teenager's learning to do the latest dance may improve said teenager's social welfare, yet have no impact on one's economic welfare.

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[1]John Kenneth Galbraith, *Economics in Perspective: A Critical History* (Boston: Houghton Mifflin Company, 1987), 212-13.

[2]A. C. Pigou, *The Economics of Welfare* (London: Macmillan and Co., 1952), 11.

Now consider a person's health. At first glance we might argue that health is not a component of economic welfare. However, if we found that one's long-term health was directly related to one's ability to pay for health services, we would recant and admit that health is a function of money income and therefore component of economic welfare.

Economic Welfare becomes a complex concept, particularly if we seriously consider Pigou's "directly or indirectly" phrase. We therefore won't consider every facet of economic welfare in this chapter. Indeed, this is certainly not our objective.

In this chapter we will review the theory of Economic Welfare and justify the use of 5 major indicators of Economic Welfare: 1)economic growth 2) hours of work 3) income and distribution of income 4) unemployment. 5) inflation and the price level.

Economics is the study of the optimal use of scarce resources. Without scarcity, there is no need to economize in the use of a resource. Air was once thought to be an example of a non-scarce resource. However, recent history involving air pollution and the Ozone problem have focused economic attention even in the direction of air, indicative of the greater value of "clean air" and the need to study those factors that contribute to clean air. Manufacturing firms must be particularly sensitive to the choice of technique utilized to manufacture

goods and the potential air (and other) pollutants produced by that technique. Indeed, many techniques that were previously profitable, are no longer profitable after a consideration of the cost of government required anti-pollution technology. Air (of good quality) has become a scarce resource.

Positive vs. Normative Economics

Economic Welfare is concerned with welfare that can be altered via alternative distributions of scarce resources directly or through the use of money. Economists differentiate between positive and normative economics. With positive economics the goal is primarily description and prediction of economic phenomena. In fact, the better the job of description, the easier the job of prediction (usually).

With normative economics the goal is direct prescription. Normative economics may involve analysis of various possible economic prescriptions to solve what has been perceived to be an economic "ill".

Adam Smith is perceived by many to be the father of "modern" economic thought. Smith's famous book *The Wealth of Nations*, was written circa 1776, concurrent with the birth of America as an independent nation. Also concurrent and possessing great economic importance was the beginning of the First Industrial Revolution that we have discussed in the previous chapter.

In Smith's opinion, members of society should pursue their self-interest and in so doing, the general good would also be realized. Smith's "Invisible Hand" would thus guide the economy.

> ... ~~As~~ every individual~~, therefore,~~ endeavors ~~as much as he can both~~ to employ his capital ~~in the support of domestic industry, and~~ so ~~to direct that industry~~ that its produce may be of the greatest value; ~~every individual necessarily labours to render the annual revenue of the society as great as he can.~~ He generally~~, indeed,~~ neither intends to promote the public interest, nor knows how much he is promoting it. ~~By preferring the support of domestic to that of foreign industry,~~ he intends only his own security~~, and by directing that industry in such a manner as its produce may be of the greatest value, he intends~~ only his own gain, and he is in this~~, as in many other cases,~~ led by an **invisible hand** to promote an end which was no part of his intention. ~~Nor is it always the worse for society that it was no part of it.~~ By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it.
>
> Adam Smith[3]

Because of the naturally good effect of this natural competition, there was little need for government interference in the economy. Governmental affairs could primarily be limited to: 1) national and societal defense, 2) justice, 3) public works, and 4) education.[4]

This originating view of the economy as naturally tending toward correct behavior has led many economists to believe that the only two proper functions of economics are description and prediction. The objective was (is) to see

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[3] The version including strikeouts is Adam Smith, *The Wealth of Nations*, (Chicago: University of Chicago Press, 1976),477-478. The edited version (minus all strikeouts) appears in Paul Samuelson, *Economics-8th Edition*, (New York: McGraw-Hill, 1970), 37.

[4] Adam Smith, *The Wealth of Nations*, (Chicago: University of Chicago Press, 1976), ix.

Economics as a science much like Physics. Consider the thoughts of Milton Friedman on this dichotomy as he wrote *during* the great depression.

> Confusion between positive and normative economics is to some extent inevitable. ... Positive economics is in principle independent of any particular ethical position or normative judgements. As Keynes[5] says, it deals with "what is" not with "what ought to be." Its task is to provide a system of generalizations that can be used to make correct predictions about the consequences of any change in circumstances. Its performance is to be judged by the precision, scope and conformity with experience of the predictions it yields. In short, positive economics is, or can be an "objective" science, in precisely the same sense as any of the physical sciences. ...
>
> Normative economics and the art of economics, on the other hand, cannot be independent of positive economics. Any policy conclusion necessarily rests on a prediction about the consequences of doing one thing rather than another, a prediction that must be based-implicitly or explicitly-on positive economics. There is not of course, a one-to-one relation between policy conclusions and the conclusions of positive economics; if there were there would be no separate normative science. ...
>
> I venture the judgment, however, that currently in the Western world, and especially in the United States, differences about economic policy among disinterested citizens derive predominantly from different predictions about the economic consequences of taking action-differences that in principle can be eliminated by the progress of positive economics-rather than from fundamental differences in basic values, differences about which men can ultimately only fight.[6]

The scientist develops refutable hypotheses and then gathers data (through observation and experimentation). The hypotheses are either verified or denied. The economic scientist differed from the physical scientist only in subject matter and not in the modus operandi.

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[5]The reference here is to John Neville Keynes and not to his son John Maynard Keynes..

[6]William Breit and Harold M. Hochman, eds.,*Readings in Microeconomics* (New York: Holt, Rinehart and Winston, Inc., 1968)citing Milton Friedman, "The Methodology of Positive Economics", *Essays in Positive Economics* (Chicago: The University of Chicago Press, 1935), 3-43.

When we look at fundamental Physics we see universal physical laws that don't change over time; but Mankind's understanding of those laws increases over time. The physical laws that Newton derived are extended and enhanced by the physical laws derived by Einstein. However, the Universe operated by those laws long before the Newton-Einstein (et. al.) "discoveries" and will continue to do so indefinitely.

Many economists (both old and new) want to view Economics in a similar fashion. That is, these economists believe that economic "laws" are virtually a part of nature (human nature) and that the job of the economist is primarily to discover these laws by creating refutable hypotheses, then denying or confirming those hypotheses.

Many economists believe that attempting to intervene in the natural laws of economics is tantamount to a sacrilege. What self-respecting physicist would propose "man"-ually changing the laws of gravitational attraction? This is simply beyond the ability of the scientist.

So we find classical and neoclassical economists arguing for the dominance of "natural" economic forces and the minimization of government interference in that process. On the other hand we find Keynesian economists in favor of monetary and fiscal policies by the government to correct and improve the economic path of the nation. The economic dichotomy between classical and

Keynesian economics is reflected in the dichotomy between Microeconomics and Macroeconomics respectively.

Microeconomics vs. Macroeconomics

Webster defines the Micro prefix as "very small" or "involving minute quantities or variations"[7]. Webster defines the Macro prefix as "of, involving, or intended for use with relatively large quantities or on a large scale."[8]

It so happens that these Webster oriented prefixes are misleading in an Economic context. While Microeconomics does discuss individual producers and consumers, the discussion of General Equilibrium and Welfare Economics have traditionally also been included in Microeconomic Theory. Yet, these topics discuss the larger economy as opposed to its individual components. Granted these "Macro" pictures are composed by considering the interactions of the individual parts. Nonetheless, these are Macro views of the economy, not solely Micro.

{Digression: Is the whole not the sum of its component parts? Current economic literature has a new trend that is concerned with the Microfoundational theory underlying Macroeconomic theory. While "New

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[7]*Webster's Ninth New Collegiate Dictionary*, (1987), s.v. "Micro"

[8]*Webster's Ninth New Collegiate Dictionary*, (1987), s.v. "Macro"

Classicals" are responsible for starting this trend, it is increasingly being recommended for all serious Macroeconomic students.[9]}

Intermediate courses of Economics are often where most Economics majors begin studies that separate them from those who take the prerequisite Principles of Economics series simply as a general education requirement. With intermediate courses we are introduced to professional level "mainstream" Economic theory that reflects foundational and generally accepted theory and methodology. It is at this intermediate level that the student seriously considers Welfare Economics, typically as a topic near the end of the Intermediate Microeconomics course. The content of Microeconomic Welfare Economics (pareto optimality, social welfare functions, production possibility frontiers, etc.) is presented as the extent of accepted theory according to the detached scientific mind that the objective economist should use in evaluating proposed economic policy alternatives.

Much of classical Welfare Economics (the Microeconomic viewpoint) states that pareto optimality is the only welfare statement that the economist can make and still remain objective and scientific. To make a greater statement is to go beyond the bounds of economics. Indeed, Arrow's Impossibility Theory[10]

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[9]For an introductory discussion of Microfoundations see William M. Scarth, *Macroeconomics: An Introduction to Advanced Methods* (Toronto: Harcourt Brace Jovanovich, 1985), 1-21.

[10]Kenneth Arrow, *Social Choice and Individual Values*, 2d. ed.(New York, Wiley, 1963).

implies that serious contemplation of a social (economic) welfare function that attempts to use rules for society that economists have agreed are quite logical for a "rational" individual economic thinker, potentially leads to the impossibility of reaching a "rational" social conclusion.

A major conclusion of (micro-oriented) Welfare Economics therefore becomes that decisions on the distribution of income are beyond scientific economic purview and decisions about income distribution must come from other disciplines (Political Science, etc.).

A logical progression is for the Economics major to move from Intermediate Microeconomics to Intermediate Macroeconomics (sometimes vice versa). Here again is a potential confusion. Macroeconomics purports to look at the economy as a whole and indeed it does. However, what is not explicitly stated is the overwhelming Economic Welfare foundation and content of Macroeconomics.

Macroeconomics (as we know it today) was "created" by J. M. Keynes. In his "General Theory of Employment: Summary." Keynes clearly states:

> This that I offer is, therefore, a theory of why output and employment are so liable to fluctuation. It does not offer a ready-made remedy as to how to avoid these fluctuations and to maintain output at a steady optimum level. But it is properly speaking, a Theory of Employment because it explains why in any given circumstances, employment is what it is. Naturally I am interested **not only in**

> **the diagnosis, but also in the cure;** and many pages of my book are devoted to the latter. ... (bold has been added)[11]

The "cure" that Keynes mentions is prescriptive and therefore normative and therefore content of Welfare Economics. The fact that Welfare Economics transcends the Microeconomic-Macroeconomic dichotomy needs to be emphasized. First, this fact is not readily apparent given traditional economic pedagogy. Secondly, as we develop Economic Welfare Indicators it will be important to see the Microeconomics and the Macroeconomic "roots" .

Utility

Professor J. R. Turner of the Alexander Hamilton Institute writing in a 1937 version of an Economics text offers the following discussion of the concept of economic utility:

> ...In economics the words *utility* and *value* are given exact, definite meaning which must be clearly understood, since in everyday speech they are used in different senses. Briefly, utility is want-satisfying power. Anything which men want is said to possess utility. If only one man desires it, then it possess utility to him, but not to others. If a thing is intensely desired it is said to possess great utility; the less intense the desire, the less the utility. Potatoes, for example, are greatly desired for food and thus possess great utility. Diamonds are greatly desired because of their scarcity and beauty and on that account possess utility. Utility and usefulness are not synonyms. American Beauty roses can scarcely be said to be useful yet they are greatly desired and therefore possess great utility. No one doubts that the potato is a useful vegetable. Yet a peck of comparatively useless diamonds could possess greater utility than several million bushels of

[11] John Maynard Keynes, "The General Theory of Employment: Summary", *The Quarterly Journal of Economics* (February 1937), 221.

> potatoes, since men are willing to give much more for a single diamond than they are for many bushels of potatoes. The word usefulness implies the attainment of some practical and desired end. A crutch under the arm of a lame man is properly called useful; to him it also possesses utility. The slender canes which young men sometimes carry nobody would call useful, yet to the young man they may possess perhaps as much utility as the crutch does to the lame man.
>
> Sometimes economists use the word to express the thing itself as well as its attribute. For example, if a thing possesses utility they sometimes speak of it as being a utility, by which they merely mean that it is something desired by man, something capable of gratifying a human want.
>
> . . .[12]

Cardinal Utility is measurable for the individual consumer and comparable to cardinal utility of other members of society. Ordinal Utility is only measured in levels according to the order of the levels. With ordinal utility, how much better one level is than another is seen as an unnecessary question. Interpersonal comparisons in an ordinal utility system are therefore impossible.

Utility Evolution

Adam Smith in his 1776 *The Wealth of Nation's* describes an "Invisible Hand" that will attend to the needs of the larger economy if each individual simply pursues individual self-interest.[13] Jeremy Bentham in his 1789 *An Introduction to the Principles of Morals and Legislation* indicates that legislators should use "the

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[12]John Roscoe Turner, *Economics: The Science of Business* (New York: Alexander Hamilton Institute, 1937), 10-11.

[13]Adam Smith, 477-478.

greatest happiness for the greatest number" (utilitarianism)[14] as the guiding principle in developing social legislation. Smith recommends a minimalist role for Government, while Bentham recommends an active government utilizing utilitarian principles. (Utilitarianism receives a more formal definition in J.S. Mill's 1861 *Utilitarianism*.) This Smith-Bentham dichotomy beginning during the foundation of modern Economics continues even through the present time. The dichotomy today might be called the ordinal utility-cardinal utility dichotomy.

Ferguson indicates a three stage development of the concept of Utility in Economics.[15] The first two stages involve cardinal utility. The third stage involves ordinal utility.

Cardinal Utility

The first development in utility theory (attributed to Gossen, Jevons and Walrus) assumes that utility is measurable and additive. Utility in the consumption of one good is assumed independent of the consumption of other goods. Total utility is found by simply adding up the individual utilities associated with each good.

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[14]*The New American Desk Encyclopedia*, 1984 ed., s.v. "Bentham, Jeremy"

[15]C. E. Ferguson, *Microeconomic Theory*, (Homewood, Illinois: Richard D. Irwin, 1969), 14-21.

Later scholars {Edgeworth (1881), Antonelli (1886), Fisher(1892) and Marshall(1920)}, reject the independence and addition of individual good utility assumptions. Independence is dispensed with quite logically; the utility of a television must be related to the utility of electricity, the utility of a homesite must be related to the utility of a water supply, etc.

Additivity of the utilities of individual goods is seen as unnecessary. Utility is derived through consumption of baskets, (i.e. collections) of goods. Utility may remain constant if the reduction in the consumption of one good is replaced by an increase in the consumption of another. The whole basket of goods has a utility value; the individual good utilities are unnecessary. Thus, it becomes unnecessary to add the utilities of individual goods. The utility value of the basket of goods is all that is needed. The baskets of goods when compared one to another, are either of equal utility or of greater or lesser value. Baskets of equal value have the same utility value. However, this value is still measured in a cardinal manner, thus allowing interpersonal comparisons of utility which is the cornerstone of modern income tax policy and the cornerstone of the modern "Welfare State".

Ordinal Utility

The majority of microeconomic textbooks present cardinal utility as a passé concept to be replaced by the more robust concept of ordinal utility. Ordinal

utility makes no interpersonal comparisons of utility. The student of ordinal utility and of Arrow's Impossibility Theory is led to believe that ordinal utility is more modern and more correct than cardinal utility and led to believe that national welfare functions can lead to irrational thought. In a democracy (i.e. democratic capitalism) ruled by the majority, this textbook view is not accurate at all. The poorer 3/5ths of the population always out number the richer upper 2/5ths of the population and therefore always possess the ability to tax the upper 2/5ths to a level of income similar to the lower 3/5ths. It is through the economic leadership of the top 2/5ths and the accompanying promise of a larger national income for all, that such a vote is put in abeyance. For the economics profession to support the preeminence of ordinal utility to the exclusion of cardinal utility, is to undermine the democratic environment in which American economy exists. It would perhaps be better to label Economics as "Political Economy" as it was in the past. This label would emphasize the importance of the political environment in the study of Economics. Our analysis will indicate that ordinal utility does contain truth; it simply doesn't contain the whole truth.

Pareto Optimality

Pareto Optimality is the social welfare criteria that grows from the non-comparability of individual utilities. An allocation of production and

distribution is pareto optimal if and only if production and distribution cannot be reorganized to yield a configuration such that at least 1 individual is better off while no one is made worse off. Pareto Optimality has Microeconomic roots in that "Perfect" Competition will yield pareto optimality under reasonable assumptions.[16]

Arrow Impossibility Theorem - Paradox of Voting

> . . . In fact, many economists, well within the academic fold, would separate economics from sociology upon the basis of rational or irrational behavior, where these terms are defined in the penumbra of utility theory. It would seem extremely important therefore, to know clearly what is contained in the conventional utility analysis, if only to understand the consequences of denying its validity.
>
> Paul Samuelson[17]

Rationality is defined very precisely in Economics. A consumer is assumed to behave according to the following rules of rationality:

1. Given any two groupings (i.e. baskets) of goods and services, the consumer is capable of deciding that one grouping is preferred (has greater utility i. e. personal usefulness) or indifferent to the other grouping.

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[16] James Henderson and Richard Quandt, *Microeconomic Theory: A Mathematical Approach* (McGraw-Hill: New York, 1971), chapter 7.

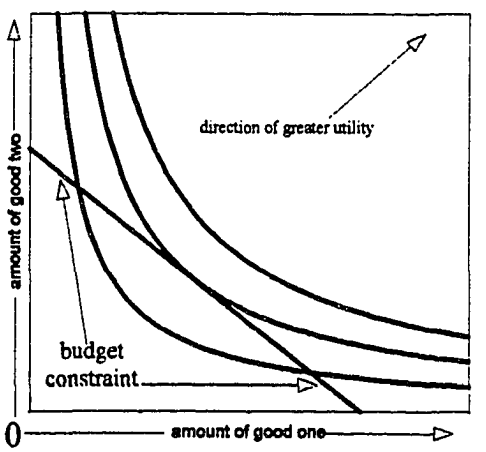
[17] Paul Samuelson, *Foundations of Economic Analysis*, (Atheneum: New York, 1972), 90.

2. Preferences are assumed to be transitive. If grouping A is preferred to grouping B and grouping B is preferred to grouping C then grouping A must be preferred to grouping C. (The word "preferred" can be replaced with "indifferent" or with "indifferent or preferred".)

3. More of a particular good or service is assumed preferred to less.

A graphical representation of choice is found in the standard indifference map.

Figure II-1 **Generic Indifference Curves two good analysis**



On the X axis we measure the quantity of good one and on the Y axis we measure the quantity of good two. (Limiting this discussion to two goods will yield conclusions similar to a discussion of a many goods economy and avoid unneeded complexity that accompany multiple goods economies.)

Mark a point on the Y axis to indicate that amount of good two that will be purchased if a person's entire income is spent on good Y. Mark a point on the X axis to indicate the amount of good one that can be purchased if a person's entire income is spent on good X. Join those two points with a straight line and this is the budget constraint for the consumer. Only those groupings that are on or below the budget line are accessible by the consumer.

There are three indifference curves represented in the diagram (bow shape). The points on any indifference curve represent groupings that are indifferent for the consumer. That is, the consumer judges all of the groupings on a curve to yield equal utility.

The illustrated indifference curves are only example curves from an infinite number of indifference curves that extend from the origin outward toward the "northeast". However, indifference curves cannot intersect for to do so would indicate that one grouping was simultaneously indifferent to and preferred to another grouping which is of course a logical contradiction.

Indifference curves also have a negative slope. As we move along an indifference curve, the amount of the good on one axis must increase as the amount of the good on the other axis decreases because a grouping of more of both goods must lie on a higher indifference curve.

Indifference curves are usually assumed to be convex to the origin. This means that if any two points on the indifference curve are joined by a straight line, the straight line will be further from the origin than the curve segment defined by those same two points. The economic meaning of this convexity is that as one has greater quantities of a good, equal additional amounts of that good becomes worth less (has less utility) the more of that good the consumer possesses.

Given the above assumptions, the consumer maximizes his utility subject to his budget constraint by purchasing the grouping represented by the point of tangency between the indifference curve and the budget line. It is that grouping that will give the consumer the maximum possible utility given the consumer's budget.

Additional assumptions often include **divisibility of goods** into infinitely small amounts (in contradiction to the real world, but insuring smooth and

differential indifference curves) and **perfect information** by the consumer (about prices in the market, etc.).[18]

The above concepts of consumer behavior are fundamental in Microeconomic analysis. Because of the power of the logic behind these concepts there is a natural tendency to want to extend these concepts to a Societal Welfare Function that will reflect the logical summation of individual preference functions. Arrow in a highly recognized work proves that using "rational" individual indifference orderings can yield "irrational" societal choices. Arrow's conclusions are base on the 200+ year old **Paradox of Voting**.

Assume that there are three competing alternatives for changes in society and we would like to choose the preferred alternative using majority voting as our choice rule. Assume further that we have three voters X, Y and Z who will choose among the three alternatives a, b, and c. It is possible that the greater to least preference order for the three voters might be:

X --> a,b,c

Y --> b,c,a

---

[18]This is a fairly standard discussion of rationality found in most standard Microeconomic textbooks. For example see Edwin Mansfield, *Microeconomics: Theory and Applications* (Norton and Company: New York, 1970), chapters 2-3.

Z --> c,a,b

Note that 2 of 3 voter's prefer a to b, 2 of 3 voters prefer b to c and 2 of 3 voter's prefer c to a, such that using majority voting we have this societal ordering a,b,c,a. How can we justify "a" being preferred to "c" and "c" also preferred to "a"? If we cannot, then *irrationality* is a potential component of a majority based democracy.

Arrow has extended the above paradox into his famous (Im)Possibility Theorem which states that given the conditions and axioms listed below it is impossible to assure that social outcome will not be paradoxical ((i.e. "irrational")

The axioms of Arrow's theorem are as follows:

Complete ordering As in the case of the individual, social preferences must be completely ordered by the relation "is at least as well liked socially as" and therefore must satisfy the conditions of completeness, reflexivity, and transitivity (see discussion above for individual). The Pareto ranking, which states that allocation A is socially preferred to allocation B if at least one person's utility is higher in A and no one's utility is lower, is not complete and therefore does not satisfy this axiom.

Responsiveness to individual preferences Assume that A is socially preferred to B for a given set of individual preferences. if individual rankings change so that one or more individuals raise A to a higher rank and no one lowers A in rank, A must remain socially preferred to B. This axiom would be violated if there were some individuals against whom society discriminates in the sense that, when their desire for some alternative increases relative to other alternatives, the social desirability of that alternative is reduced.

Nonimposition Social preference must not be imposed independently of individual preferences. If no individual prefers B to A and a least one individual prefers A to B, society must prefer A to B. This axiom ensures that social preferences satisfy the Pareto ranking. Let A be an allocation such that no

member of society has a lower utility than at B and one or more member have higher levels. The nonimposition axiom requires that society prefer A to B.

Nondictatorship Social preferences must not totally reflect the preferences of s single individual; i.e., it must not be true that society prefers A to B if and only if the *i*th individual prefers A to B. If this axiom were violated the *i*th individual would be a dictator.

Independence of irrelevant alternatives The most preferred state in a set of alternatives must be independent of the existence of the other alternatives. Assume that when alternatives A, B, and C are available, society prefers A to B to C. If C were no longer available, it must not be true that society then prefers B to A.[19]

Thus conditions that are quite logical and natural outgrowths of our assumptions about rational individual behavior, lead to potential "irrational" majorities. This conclusion has caused trauma among Economics and Political Science academics such that Arrow's possibility theorem is considered a very important contribution to the literature.

Economic Growth as Welfare Indicator via Pareto Criteria

If we look for a national economic welfare criteria, it is difficult to find one with greater acceptability than economic growth. It is the only welfare indicator that is unambigiously supported by the Pareto criteria (At least one person must be better off and no one worse off in order to have a Pareto improvement.). If real GNP is greater this year than it was last year, we can be certain that a

[19] James Henderson and Richard Quandt, *Microeconomic Theory: A Mathematical Approach* (McGraw-Hill: New York, 1971), p. 285.

Pareto improvement can occur. That is, everyone can enjoy at least the same amount of GNP enjoyed last year and the GNP increase can be evenly divided among all or accrue to a single individual. In either case at least one person is better off and no one is worse off.

It is possible for GNP growth to occur and for Pareto improvement not to attain. If taxes on any group of individuals are increased at a rate sufficient to make this year worse than last and if the increase in GNP does not accrue to this group, we have economic growth with a simultaneous violation of the Pareto improvement. However, such a Pareto violation is completely separate from economic growth. Economic growth allows for Pareto improvement, but does not require it.

Now Keynesian policy is capable of generating economic growth. However, Keynesian economic growth may be caused by increased government debt and such debt is seen as having the potential of engendering a non-Pareto optimal growth pattern. As American government currently struggles to reduce deficits and debt levels, yet continues to be interested in Keynesian type induced economic growth, it is instructive to review a "classic" argument in favor of Keynesian growth constructed by Klein (Nobel Prize winning economist) in 1947 (revised 1966), long before our current deficit/debt crisis.

> Mechanically the debt problem operates as follows: Given a certain debt, we must pay the annual interest charge. From the national income we extract a tax

> as government revenue, which we then pay out in the form of interest. The debt is held largely by the richer classes; the taxes come largely from the richer classes; the interest is paid largely to the richer classes. We merely extract from the right-hand pocket of the rich and pay to the left-hand pocket of the rich. But if this transfer enables us to command enough resources to achieve full employment, then both the rich and the poor are better off. The poor are better off because they have jobs instead of hunger pains and the nervous frustration of idleness. The rich are better off because they have lost nothing on the transfer and they get larger profits out of the full-employment income than would otherwise be the case.
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> . . . . . .
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> . . .During . . .prosperous times, it will be advantageous to fight the danger of inflation by raising taxes and retiring debt. It is possible, though, that some of the debt may fall due at a moment when it is not propitious to raise taxes. If this be the case, then the government merely needs to borrow funds to pay off the debt that is falling due and incur a new debt that exactly replaces the old debt. The government is a continuous institution that does not die when single constituents die. It can keep replacing old debts with new debts of the same size as long as it lives, by transferring a claim from one constituent to another with the same interest charge. This process, from the point of view of the government, is equivalent to the issuance of long-term debts, say perpetuities. But from the point of view of the claimant, who is a constituent, the risk is periodically transferred to new shoulders, which is certainly not undesirable.[20]

While the above quote may engender some doubt as to the Pareto optimality of all economic growth (particularly given rational expectation theories and concern for high debt/deficits), economic growth will nonetheless be one of our welfare indicators. It has great potential as a Pareto optimal criteria and it is generally accepted by economists of differing philosophies as generally and unambiguously being a good economic welfare indicator.

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[20]Lawrence R. Klien, *The Keynesian Revolution* (New York: The Macmillan Company, 1966).182-3.

The Welfare State

Introduction

> . . .
> From this line of classical thought Pigou provided release. He held that so long as total production was not reduced by the action, economic welfare--the sum total of satisfaction from the system--was enhanced by the transfer of spendable resources from the rich to the poor. The marginal utility of money did, he held, decline with increasing amount, accordingly, the poor man or family did get more enjoyment than the rich from an increment of income and the goods so obtained. J.K. Galbraith[21]

Macroeconomic Welfare is more clearly seen in what is often referred to as the "Welfare State" (Usually not *explicitly* content of "Macro-economics"!). According to Galbraith the Welfare State in America was largely a response to the Great Depression.[22]

An elementary description of the Welfare State would involve income redistribution to the indigent, elderly, unemployed, etc. In this work however, Welfare State Indicators will be more broadly conceived to include all income redistribution that (potentially) may be non-Pareto optimal, yet meet the Pigou criteria as mentioned in the Galbraith quote above. Mainstream Economics allows the Pareto Criteria as the only valid and "rational" welfare criteria acceptable to Economists. Macroeconomics does not explicitly mention welfare

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[21] John Kenneth Galbraith, *Economics in Perspective: A Critical History*, (Boston: Houghton Mifflin Company, 1987), 213.

[22] John Kenneth Galbraith, Chapter 16..

consideration. However, since modern Macroeconomics is rooted in Keynes' *General Theory* and since a major goal of the *General Theory* was the restoration of full employment, the welfare implication is clear. If the Pareto optimal nature of Keynesian Macro policy as presented by Klein above is not (always) believed, the Keynesian policy becomes a Welfare State policy adhering to the Pigou principle. Since we are using both Pareto criteria and Welfare State criteria, there is no doubt that policy directed at reducing unemployment is simultaneously directed towards Welfare improvement. If the Pareto criteria is not meet, the Welfare State (Pigou) Criteria certainly will attain. What we want to avoid in our consideration of Economic Welfare is the myopic view of Economic Welfare that is typically presented in most collegiate curricula in which Pareto Optimality is the **only** valid welfare criteria. The Welfare State perspective is well developed and is certainly a valid economic standard. Indeed, much of modern Macroeconomics is rooted in a Welfare State perspective (e.g. cure unemployment) without ever explicitly stating such. The reader must not be tempted to believe that a non-Pareto perspective is beyond the scope of serious Economic analysis. Such a view while fostered by the structure of much of present day Economics is far from complete Economic reality. (As an exercise we might review each American government program to see whether it is Pareto optimal or Welfare State in nature and then count the dollars in each category.

Which category is the largest and therefore what criteria has American Democratic Capitalism judged to be most important?)

Brief History of the American Welfare State

Welfare State philosophical roots can be seen in Bernoulli's St. Petersburg paradox (1730-31) and in the progressive income tax (Edgeworth 1897), both discussed below in this section. These topics are discussed in considerable detail below due to their theoretical relevance.

However, Galbraith traces the origin of the modern welfare state to Germany, 1884-7 and Count Otto von Bismark. Accident, old age, sickness and disability insurance were established. Evidently Bismark was interested in curing potential Capitalistic ills in order to insure against large scale societal revolution. The German example was later replicated in other European locations.

Having previously enacted an old-age pension, in 1911 Britain enacted legislation that provided sickness and invalidism insurance and also originated unemployment insurance.[23]

Missouri (U.S.A.) initiated aid to families with dependent children in 1911 and was followed by 39 other states within 10 years. Assistance was provided

[23]John Kenneth Galbraith, p. 210-11.

originally for widows but later extended to other needy single head of household women.[24]

Progressive federal taxation became fully legalized in 1913 via the 16th Amendment to the Consititution (see discussion this section below). Pigou first published his influential *The Economics of Welfare* in 1920.

Robert La Follette, governor of Wisconsin from 1901-1906, initiated a "think tank" relationship between Wisconsin politicians and economists whose collective efforts resulted in the "Wisconsin Plan". The Wisconsin Plan (a model plan for all states) included: a) regulation of public utility rates b) limits on usurious interest c) support of trade unionism d) progressive state income taxes and e) in 1932, a state unemployment compensation (federal legislation followed 3 years later).[25]

Beyond progressive taxation, social welfare programs were centered at the state level until the severity of the Great Depression compelled Federal participation.

Great Depression Brief History

Hoover became president in January 1929, having predicted the coming of an end to poverty in the United States. His prediction was seen as consistent

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[24]Kenneth Jost, "Welfare Reform", *Congressional Quarterly Researcher*, April 10, 1992, 321.

[25] John Kenneth Galbraith, p. 215-19.

with prevailing American economic and social reality since the turn of the century that included: increased life expectantcies; population increase from 76 million to more than 121 million; 1500 new cities; increase in farm structures, industrial equipment and private homes exceeding $100 billion; steady increases in GNP and GNP per capita; an unemployment rate of only 3.2%; and consistent increases in real wages with concurrent increases in leisure time.[26]

The Great Depression hit quickly in October 1929 with the Stock Market Crash and the prosperity bubble alluded to by Hoover quickly burst. Hoover's response to the Depression included: business community agreements to maintain high wages, stimulation of railroad and public utility improvements, and the creation of the Reconstruction Finance Corporation to make loans to "banks, railroads, agriculture credit institutions and insurance companies".[27] Hoover's response was constrained by a desire to balance the national budget, believing that much of the cause of the depression was related to public psychological fears.[28]

The Hoover belief in a balanced federal budget may have manifested itself in Hoover's response to the Bonus Marchers' Incident. Some veterans of World

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[26]Robert L. Heilbroner, *The Making of Economic Society: Third Edition*, (New York: Prentice Hall,___). 127.

[27]J. R. Turner, *Economics: The Science of Business* (New York, Alexander Hamilton Institute, 1937). 350-51.

[28]*The New American Desk Encyclopedia: 1984 Edition*, s.v. "Herbert Clark Hoover"

War I had been granted a $1000 bonus payable 20 years after the War. Due to the unemployment of the Great Depression, Congress passed (over Hoover's veto) a bill that paid half of the bonus early. At least 10,000 WW I veterans marched on Washington, D.C. in 1931 demanding the other half of the bonus. Hoover, was not supportive of their request and ordered General Douglas MacArthur and Dwight Eisenhower to disperse the veterans and they did so using "tear gas, tanks and some gun fire".[29]

Hoover, due to his inability to deal with the growing Depression, suffered a crushing defeat from F.D. Roosevelt in 1932.[30] Roosevelt's campaign promised a "New Deal" that would allow America to escape the Great Depression.

Roosevelt assumed office in March 1933 (and served through 1945, more years than any other American president). In the first 100 days of his administration, FDR's administration saw 15 congressional measures passed. Among other goals, these 15 measures: established government supervision of banks and guaranteed bank deposits, responded to youth unemployment, supplemented relief efforts of the states, tremendously increased farm loans, established the Tennessee Valley Authority, and curbed stock speculation.

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[29]*Barron's Student's Concise Encyclopedia: 1988 Edition*, s.v. "Bonus Marchers"

[30]*The New American Desk Encyclopedia: 1984 Edition*, s.v. "Herbert Clark Hoover"

Keynes famous "Open Letter to the President" was published in the *New York Times*, December 31, 1933. In this letter Keynes emphasized the importance of government expenditures in excess of revenues and financed by loans as key in the cure for the woes of the Depression. This publication preceded the publication of *The General Theory* by 2 years.[31]

Additional New Deal legislation included the Social Security Act of 1935, establishment of the Federal Housing Authority, The Wagner Act (increasing Labor's bargaining power) and the Fair Labor Standards Act of 1938 (minimum wages and maximum hours).[32] The Social Security Act provided for: federal old-age assistance, a state-federal system of unemployment compensation, and a state-federal system of Aid to Dependent Children.[33]

Despite Federal participation to increase economic welfare, in 1936 after 4 years of the New Deal, the Great Depression continued, marked by 17% unemployment and GNP still struggling to approach the 1929 pre-Depression level. Some speculate that the Federal Government's deficit spending "frightened business into a condition of economic paralysis" that froze investment spending.[34] Formal economics (and most economists) was (were) still

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[31] John Kenneth Galbraith, p. 227

[32]Robert L. Heilbroner, p. 141.

[33]Kenneth Jost, 321.

[34]Robert L. Heilbroner, 146.

laissez-faire in nature, calling for free markets and minimum government interference. Leading economists Joseph Schumpter of Harvard and Lionel Robbins of The London School of Economics were recommending that the best policy was to let the Depression simply run it course without interference.[35] However GNP dropped by 46% between 1929 and 1933. Also in 1933, one of every 4 persons in the labor force was unemployed, residential construction was down 90% (compared to 1929), 9 million savings accounts were lost due to bank closings and 85,000 businesses failed.[36]

For economists who recommend (or recommended) that a reduction of wage demands by 1930's workers would have solved the Depression, in 1932, we have wages reduced to 5¢ an hour in sawmills, 6¢ an hour in brick and tile manufacturing and 7.5¢ an hour in general contracting. Women in mills were paid less than 5¢ an hour for a 50 hour week. Compare these numbers to the 56¢ an hour average American pay in 1929.[37] Surely economic science was in need of revolutionary change that could maintain the essence of democratic capitalism yet restore full employment and business confidence in investment.

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[35]John Kenneth Galbraith, 195.

[36]Robert L. Heilbroner, 129.

[37]Robert L. Heilbroner, 129 & 127.

Enter John Maynard Keynes and his "revolutionary" ideas including "the underemployment equilibrium, the repeal of Say's Law, (and) the call for government spending uncovered by revenues to sustain demand."[38] It is at this point that the "welfare" content of Keynesian policies should become more visible. The nation was in shambles and the (classical) economic theory of the day recommended doing nothing!

Great Depression Causation: Turner in 1937 states: "The world-wide maladjustments in industry brought about by World War I resulted in the crisis of 1929 which was followed by the severest depression in history".[39]

Heilbroner with considerably more years of hindsight lists 7 major causes of the Great Depression: 1) The Stock Market Crash (more than 16 million shares dumped in a single day), 2) Pyramid business structures, 3) Agricultural disequilibrium due to feeding other nations during World War I only to have those nations become more self-sufficient after that war and a resulting fall in demand for America agriculture. The decreased demand for American agriculture resulted in a multiplier effect as less farm machinery was demanded (perhaps this ties with Turner's point above). 4) Technological change that resulted in displacement of some workers jobs, 5) Increased productivity that

[38]John Kenneth Galbraith, 221-222.

[39]J. R. Turner, 350.

did not result in increased wages, 6) Maldistribution of income such that higher income groups were getting more of the income, yet were less likely to spend it. Lower income groups who were more likely to spend their income were receiving less National Income. And, 7) Cessation of capital growth due to lack of confidence, etc. (Many of the Heilbroner reasons are related to the welfare indicators of this document.)[40]

World War II Impact

While the nature of the Great Depression seemed to mandate Keynesian type policies, the nation briefly experienced classical economic recidivism in 1937-38 in the form of the Temporary National Economic Committee (TNEC). This committee was composed of a classical school executive-legislative coalition. Their attempt was to explain the Depression as failures of proper application of classical principles (i.e. the allowance of Monopoly and other forms of imperfect competition) and not a failure of the classical system as a whole. Their major recommendations included vigorous enforcement of anti-trust legislation. However, the tremendous financial needs of World War II rendered the TNEC

[40]Robert L. Heilbroner, 128-138.

position mute. Anti-trust action was suspended during WW II and Keynesian economics could be used to justify huge war expense.[41]

By the time of World War II, there was an "army" of Keynesians in Washington D.C. One of the more important figures was Simon Kuznets, who speciality was the compilation of the National Accounts which facilitated quantitative analysis of National level (Macroeconomic) data. It was one thing to embrace the philosophy of Keynes, it was quite another to use quantitative methods to verify Keynesian propositions. One of the more important contributions of the development of the National Accounts was to quantify the extent of underutilized labor and capital at the outset of the war and thereby precisely define the War-time production capability of America.[42]

Federal purchases increased from $22.8 billion in 1939 to $269.7 billion in 1944.[43] The National debt was $40 billion in 1939 and more than $250 billion in 1944. Federal expense beyond revenue was a timid experiment in 1939 with still 17% (9.5 million persons) unemployment. By 1944, unemployment was a mere 1.2%.[44] Keynesian policy was funding the War effort to again make the

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[41]John Kenneth Galbraith, 242-243.

[42]John Kenneth Galbraith, 243-246.

[43]*Economic Report of the President*, 1985, p. 235 as quoted by Galbraith, 248.

[44] Heilbroner 145-148 and Galbraith 248.

world safe for Democracy and simultaneously restore America to vigorous economic growth and full employment.

Post World War II Resolve: The Employment Act of 1946

F.D. Roosevelt died April 1945 having been President throughout the Great Depression and World War II and having seen the end to both. Keynes died in April 1946 with a similar vision.[45] During their watch, two of the greatest challenges to democratic capitalism had been met and overcome. Who knows what the outcome would have been without them?

The Employment Act of 1946 was passed by Congress and in America has been the "cornerstone of economic policymaking" ever since. The Act established the Council of Economic Advisors to advise the president and caused economic matters to have an increased Federal priority. Specifically the Act stated:

> It is the continuing policy and responsibility of the Federal Government to use all practical means consistent with its needs and obligations and other essential considerations of national policy-to coordinated and utilize all its plans, functions, and resources for the purpose of creating and maintaining, in a manner calculated to foster and promote free competitive enterprise and the general conditions under which there will be afforded useful employment opportunities, including self-employment for those able, willing and seeking work, and to **promote maximum employment, production and purchasing power**.[46]

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[45] More precisely, the atomic bomb was dropped on Japan in August of 1945 causing a Japanese surrender and formally ending WW II..

[46] William J. Boyes, *Macroeconomics: The Dynamics of Theory and Policy* (Cincinnati: Southwestern Publishing Company, 1984), 361. Bold has been added.

With this act, the pursuit and maintenance of Macroeconomic welfare becomes specific national policy. The bold highlight is virtually synonymous with our selected Economic Welfare indicators. Our quest therefore is not in the direction of a politically biased set of Indicators, but rather Economic Welfare Indicators that are specifically consistent with the directives of American National law. The New Deal and World War II established the foundation of a new economic order of strategic government interference to assure Economic optimality and the Employment Act of 1946 codified the new philosophy.[47]

Other Post World War II Welfare State Modifications

There have been many additional Welfare State modifications since 1946. Indeed there are many more modifications than we shall review here. Galbraith, speaking of post Social Security Act legislation, states:

> Health insurance, fully established aid to families with dependent children, housing for lower-income and housing subsidies, job training and other welfare supplements to the needful, were all to come. And as in the United States, so in all the industrial countries. [48]

It appears that post-WWII prosperity with its Welfare State content inspired an air of general affluence. "The 1950s seemed at the time to be an era of peace

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[47]See Jonathan Hughes, *American Economic History*, (Illinois: Scott, Foresman and Company, 1983), 544-46 for an alternate explanation of the origin of this act.

[48]Galbraith, 218.

and prosperity."[49] Trattner and Jost mention J.K. Galbraith's 1958 book *The Affluent Society* and Galbraith's belief that poverty was "no longer a massive affliction [but] more nearly an afterthought."[50] However, welfare rolls were growing to such an extent that President Kennedy identified poverty as a major national problem, and developed remedial programs aimed at Appalachian poor whites and inner city Black youth.

In the Kennedy administration, Social Security amendments allowed welfare benefits to families with an unemployed parent. The Social Service Amendments of 1962 provided social service matching funds aimed at financial independence and a reduction in the welfare rolls.

After the assassination of Kennedy (and perhaps in his honor), President Johnson declared "War on Poverty". The Head Start education program for poor youth and the Job Corps manpower training programs were established.

Other Johnson legislation included an expansion of the Food Stamp program in 1964 and the establishment of Medicaid in 1965. The development of a welfare rights movement increased participation in welfare programs.

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[49]Jost, 321.

[50]Jost, 321.

The Nixon administration made the food stamp program mandatory for all states in 1972, concurrently easing eligibility. Earned Income Tax credit provided assistance to the working poor.

The Nixon and Carter administrations both saw increases in expenditures for "means-tested programs".

Reagan entered the White House with a reputation for being critical of welfare expenditures, having developed this attitude as governor of California. He also embodied a growing national sentiment against welfare program expenditures. Reagan fought for and won cuts in AFDC estimated at S4 billion in 3 years. Many indicated that the Reagan cuts acted to diminish work incentives for the poor.

The Reagan administration emphasized "workfare" incentives at the state level in an attempt to reduce welfare participation.

[Digression: In this discussion of Economic Welfare we should emphasize that the Pigou position has national economic welfare increasing through income transfers from the rich to the poor as long as national production is not reduced. Thus the Pigou position is completely consistent with movement from so-called "welfare rolls" to the labor force. Such a (permanent!) move would increase national economic welfare. It is perhaps unfortunate that those in receipt of income transfers are said to be "on welfare".]

While work incentive programs for the poor have been emphasized since 1967, a growing problem seems to be a lack of jobs or training slots or both for those in need. This implies that unemployment rates are inaccurately low and also implies that technology-automation may indeed constrain the available number of jobs. Yet the states continue to experiment with welfare-to-work programs, with varying degrees of success.

The Family Support Act was passed in 1988 in response to a call by Reagan, and the National Governors' Association for Welfare reform. Senator Moynihan of New York was a principal author. The Act featured the JOBS (Jobs Opportunities and Basic Skills Training Program) program. JOBS mandated states to institute education, training and placement programs and supplemental programs of child care and transportation by October 1990. 60% of the cost was provided by the federal government. 1) Increase child support, 2) required aid to needy two parent families, 3) transitional child-care and Medicaid for parents leaving welfare rolls, were also parts of this act.

The 1989 recession reduced job opportunities and increased AFDC cases by 20%. The desire for effective welfare reform continues with the current Clinton administration.[51]

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[51]Most of the factual content of this section is found in Jost, 319-326.

In fiscal year 1990, 210 billion federal and state dollars were spent on means tested welfare programs as follows:

Table II-1 FY 90 Programs for Needy	Percent of Total
Cash Aid	26.2%
AFDC	10.1%
Supplemental Security Income	8.2%
Pensions for Needy Veterans	1.9%
General Assistance	1.5%
Earned Income Tax Credit	2.8%
Other Cash Aid	1.7%
Medical Benefits	41.0%
Food Benefits	12.0%
Housing Benefits	8.3%
Education Aid	6.8%
Other	5.6%
TOTAL source: derived from Jost, 319	100%

Given the current Welfare "backlash", it should be emphasized that:

> Currently, federal spending on AFDC constitutes less than 1 percent of the total federal budget; state and local spending on the program amounts to about 1 percent of total state and local revenues.[52]

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[52] Jost, 320.

Health insurance is currently the center of much controversy. One of the reasons this controversy is the increasing percent of employee compensation that must be paid for health insurance. For instance, in 1948 pensions and insurance were 3.7% of employee compensation. In 1984 this percentage had become 9.9%. In 1977 21.9% of workers did not have health insurance available through their employment (alternately 78.1% had health insurance available).[53] In 1975 8.3% of GNP was spent on health care. In 1989, this percentage had become 12 percent. America spends more per capita for health care than any other country, yet does not have the best per capita health in the world. For instance, America spends 50% more than Canada for health care, yet ranks behind Canada in per capita Health.[54] It is therefore easy to appreciate the current concern for national health care and the emphasis on the importance of health as an economic welfare component in America.

Of course this section does not mention every post- WW II economic welfare program. However, the intent was to present major and representative programs.

Three Post Depression Challenges to Keynesian Economics

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[53]R.G. Ehrenberg and R.S. Smith. *Modern Labor Economics: Theory and Public Policy*, 3rd Edition. (Illinois: Scott, Foresman and Company, 1987), 394-95.

[54]J.V. Henderson and W. Poole, *Principles of Microeconomics* (Massachusetts: D.C. Heath and Co., 1991), 230.

The Friedman-Phelps Accelerationists Theorem: In the Post World War II era there have been many challenges to the "new" economics established by Keynes. One serious challenge to Keynesian theory is the Accelerationist theory of Milton Freeman and Edmund Phelps[55].

Keynes saw deflation as a more serious threat to employment than inflation:

> There is perhaps, something a little perplexing in the apparent asymmetry between Inflation and Deflation. For whilst a deflation of effective demand below the level required for full employment will diminish employment as well as prices, an inflation of it above the level will merely affect prices. This asymmetry is, however, merely a reflection of the fact that, whilst labor is always in a position to refuse to work on a scale involving a real wage which is less than the marginal disutility of that amount of employment, it is not in a position to insist on being offered work on a scale involving a real wage which is not greater than the marginal disutility of that amount of employment.[56]

The Great Depression was characterized by decreasing prices and wages. It may be that increasing wages and prices therefore signal to many a movement away from depression tendencies. The Great Depression may therefore have created a bias against deflation. Or, consider labor vs. management inflationary spirals in which equal percentage income and price increases are said to leave no one better or worse off. In any event, inflation was not a symptom of the Great Depression and therefore not a primary Keynesian depression concern.

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[55]Standard references: Milton Friedman, "The Role of Monetary Policy." *American Economic Review* (March, 1968), 1-17 and Edmund S. Phelps, "Money Wage Dynamics and Labor Market Equilibrium," *Journal of Political Economy* (July/August, 1968), 687-711.

[56]John Maynard Keynes, *The General Theory of Employment, Interest, and Money*, (New York: Harcourt Brace Jovanovich, 1953), 291.

However, during post WW II analysis (e.g. with the non-price-controlled Koren and Vietnam Conflicts), inflation became more important particularly as A.W. Phillips developed the famous Phillips curve that indicated a trade off between unemployment and wage inflation.[57] This analysis was later expanded to include price inflation and applied to American data by Samuelson and Solow.[58] This theory became an accepted part of Macroeconomics as economists believed that they could exchange a decrease in inflation for an increase in unemployment or exchange an increase in inflation for a decrease in unemployment. In dramatic contrast, Friedman and Phelps argued the instability of the Phillips "Curve" analysis.

Let's here define the natural rate of unemployment as that rate that does not accelerate inflation (admittedly there is some controversy here). The natural rate of unemployment corresponds to a full employment level. That is, if unemployment is at the natural rate, by definition we have full employment. The accelerationists argue that the Phillips curve indicated trade-off between unemployment and inflation is a short-run phenomenon. Starting at full

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[57]A.W. Phillips, "The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957." *Economica* (November, 1958), 283-300.

[58]Paul Samuelson and Robert Solow, "Analytical Aspects of Anti-Inflation Policy." *American Economic Review* (May, 1960) 177-194.

employment, with unemployment at its "natural rate" and inflation at some corresponding initial level, the accelerationist argument precedes as follows:

> Now suppose policymakers decide that the unemployment rate . . . is much too high and that they implement expansionary monetary and fiscal policies . . . Initially, individuals and firms experience an increased demand for their products and services. Increased wages are offered to attract additional workers or to induce workers to put in overtime hours. As a result, production increases and measured unemployment falls. But at the same time, the increased demand for goods means that prices rise. Then, as workers realize that their extra hours of work and pay are not getting them the additional purchasing power they thought they would have, they cut back on their hours. Very simply, if you are paid less to do some task, it is likely that you will have less of an incentive to carry out that task and will probably devote fewer hours to it.
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> The realization that the rate of inflation has increased causes the Phillips curve to shift to the right . . . The end result is that the economy returns to the original unemployment rate, but now it is saddled with a higher rate of inflation . . . The expansionary monetary and fiscal policies had only temporary effects on output and unemployment.[59]

According to the accelerationists, the trade-off between unemployment and inflation is an illusion and therefore the long-term Phillips "curve" is actually a vertical line at the natural rate of unemployment.[60]

Again, the environment in which the Keynesian logic was developed was an unemployment, deflationary one. In the post WW II era, there may be occasions in which full employment does exists and therefore the accelerationist argument may have great merit. What must be closely examined are the

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[59]William J. Boyes, *Macroeconomics: The Dynamics of Theory and Policy* (Texas: South-Western Publishing Co., 1984), 187.

[60]The above information in this section relies heavily on Boyes, 184-189 and 241-247.

concepts of full employment and the natural rate of employment. If one is arguing accelerationist's arguments while not really at full employment, it may be that one is simply excusing faulty corrective policies.

While the Phillips curve was developed after Keynes death, and deflation and unemployment were the primary depression problems, the interested student might be shocked to learn that Keynes did have very precise opinions about inflation and employment (national output) and that these opinions cannot be contained in a simplistic traditional Phillips curve. In Keynes' famous 1933 *N.Y. Times* open letter to President Roosevelt we have the following:

> ..Rising prices are to be welcomed because they are usually a symptom of rising output and employment. When more purchasing power is spent, one expects rising output at rising prices. Since there cannot be rising output without rising prices it is essential to insure that the recovery shall not be held back by the insufficiency of the supply of money to support the increased monetary turnover.[61]
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> ...
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> But there is much less to be said in favor of rising prices if they are brought about at the expense of rising output. Some debtors may be helped, but the national recovery as a whole will be retarded. Thus rising prices caused by deliberately increasing prime costs or by restricting output have a vastly inferior value to rising prices which are the natural result of an increase in the nation's purchasing power.
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> ...too much emphasis on the remedial value of a higher price-level as an object in itself may lead to serious misapprehension of the part prices can play in the technique of recovery. **The stimulation of output by increasing aggregate purchasing power is the right way to get prices up; and not the other way around.**
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> Thus, as the prime mover in the first stage of the technique of recovery, I lay overwhelming emphasis on the increase of national purchasing power resulting from governmental expenditure which is financed by loans and is not merely a

[61] Contrast this statement to the current policy of money supply constraint given the least hint of inflation.

transfer through taxation, from existing incomes. Nothing else counts in comparison with this.

Many scholars have stated that according to Keynesian Phillips Curve logic, a rising price level should imply more employment and decreased employment should imply decreased inflation. Since this (Phillips Curve) theory was violated many scholars have concluded the demise of the Keynesian policy making. However, consulting Keynes himself (and not those who simply call themselves "Keynesians"!), we find that Keynes' view of rising prices was more complex than the simple Phillips Curve. According to the above excerpt, if rising prices are part of a rising output dynamic, we can expect rising prices to imply increased employment. Keynes believes that fundamental Economic dynamics implies rising prices with rising output.

However, there is a second type of price increase that comes about with increases in prime costs or through output restrictions. These type of price increases are vastly inferior to the first type in that they don't signal increased output and employment.

Now if we look carefully at price increases due to the energy crisis and the paranoid reaction of American businesses, we clearly see price increases of the second type. Therefore the Phillips curve paradox of increasing price levels simultaneous with increased unemployment is resolved by reference to Keynes

(and not to Keynesians). Thus calling the Phillips Curve truly "Keynesian" is dubious; as dubious as calling the failure of the Phillips Curve a failure of the (true) Keynesian system.

Rational Expectations: Adaptive expectations is a price theory that predicts that workers are fooled into believing that their real wages have increased as a result of expansionary policies. This illusion continues long enough for the expansionary policies to be effective in reducing unemployment. Thus in an adaptive expectations environment, policy making can be effective, albeit for a limited time period. The accelerationist theory mentioned above allows for an adaptive expectations explanation of expansionary policy.

The more recent Rational Expectations Theory is foundational work for a "New Classical" movement. Rational Expectations Theory assumes that economic agents use all available information to reach their economic decisions (vs. adaptive expectations built solely on historical prices). The term New Classical is appropriate because it embraces logic of (neo)classical pre-depression thought.

There are two versions of Rational Expectations. One assumes that economic agents have perfect information and the other assumes that economic agents have imperfect information due to information collection costs (information collection stops when marginal benefits equals the marginal cost of attainment).

Under the perfect information assumption, the principle of **policy ineffectiveness** applies. That is, no government oriented full employment expansionary policy can be effective because workers will not be fooled by expansionary policies into believing that their real wages have increased. With the imperfect information assumption, full employment monetary/fiscal policy is effective in the short run only (as with adaptive expectations).

Imperfect information is the norm for the real world. In which case, the policy implications of rational expectations equal those of the accelerationists.[62]

There is research that indicates the policy ineffectiveness argued by the accelerationist and rational expectations arguments is simply not true. Reynolds refers the interested reader to the research of Michael C. Lowell.[63]

Supply-side Economics:

> Thus, **supply-side economics**, which appeared in the literature around 1980, is considerably tarnished and may well have passed out of the literature by 1990.[64]
>
> Lloyd G. Reynolds

[62]The above information in this section relies heavily on Boyes. 247-254.

[63]Michael C. Lowell, "Test of the Rational Expectations Hypothesis," *American Economic Review*, March 1986, 110-24 quoted by Lloyd G. Reynolds, *Macroeconomics: Analysis and Policy 6th Edition*, (Illinois: Irwin.1988). 299-300, another reference for this section.

[64] Lloyd G. Reynolds, *Macroeconomics: Analysis and Policy 6th Edition*, (Illinois: Irwin.1988). 301.

Some schools and professors invite vigorous challenges to prevailing theories while other schools and professors do not. These other schools and professors advocate what might be called a "Xerox plus Epsilon" approach. In the Xerox plus Epsilon approach, the student is trained to 1) simply paraphrase (i.e. "put it in your own words") reflecting the Xerox component and 2) add details of minor significance to the literature that amounts to crossing an uncrossed " t " or dotting an undotted " i ", reflecting the Epsilon component. While knowledge attainment is confirmed by such an exercise, the student may be falsely led to believe that prevailing theories are absolutely correct, when the exact opposite may actually be the case. Not training students to vigorously challenge existing theories can therefore be quite dangerous for science and society. This is particularly important at the graduate level, the completion of which often leads to policy making. Perhaps there should be entire classes devoted to the creation of opposing theories. If only one opposing theory in a hundred had real merit, the course would none the less be worthwhile.

In this section we explore the possible pitfalls of a Xerox plus Epsilon approach to education as we look at the evolution of "supply-side" economics.

In the above two sections we looked at the Accelerationist and the Rational Expectation theories, both of which argue the long-term impotence of demand oriented government stabilization policies. With the acceptance of these

theories and phraseology such as "the Demise of Keynesian Policymaking"[65], economists therefore begin to look for alternative means of inducing economic growth.

Enter Arthur Laffer of USC and Robert Mundell of Columbia. These economists argued that increasing tax rates would increase tax collections by the government until the increase in taxes becomes so great that it diminishes the desire to work or participate in money making activities. If tax rates are so high that people are deciding to decrease their involvement in economic activity, then a reduction in tax rates will generate more economic growth. Rather than stimulate economic growth through increased demand as in Keynesian thought, dramatic cutting of taxes would stimulate an increase in aggregate supply. Reduced taxation could induced the overtaxed back into increased economic activity and thereby induce dramatic growth in GNP, with a larger GNP, tax collections would also increase and government could collect more taxes after the tax cut than before.

This Laffer-Mundell inspired "supply-side economics" was amplified by members of the press and some leading politicians. Supply-side Economics became a cornerstone of the Reagan Administration economic policy. In 1981

[65]Boyes, Chapter 6.

the Reagan Administration generated the largest tax cuts in American history! However, the expected tremendous growth in GNP was not realized.

Some of the proposed components of the 1981 Reagan Economic Recovery Tax Act included:

- An across-the board Kemp-Roth style 10 percent annual personal income tax reduction for 3 years beginning in July, 1981.
- A reduction, over a 3-year period, in the maximum marginal tax rate on investment income (unearned income) from 70 percent to 50 percent to make it equal to the maximum rate on wage and salary income.
- An increase in the income level at which the maximum tax rates take effect.[66]

Prior to the 1981 ERTA legislation, important tax measures include: 1) In 1977 Social Security Taxes were increased to accommodate the forecasted increased need of baby boomers because the generation after the baby boomers was smaller. 2) In 1978 capital gains tax was reduced from 39 to 18 percent, corporate tax rates were reduced from 48 to 46 percent and the investment tax credit was 10 percent rather than the scheduled 4-7 percent. The 1978 legislation was opposed by President Carter. These changes were labeled by Greider as the most regressive since the 1920s; however, the 1981 legislation was even more regressive. While supply-side economics began as an official policy in the Reagan administration, it can clearly be seen that tax changes of the Carter administration also qualify as supply-side. The argument against

[66]Boyes, 435.

supply-side-ism is therefore not a political party argument, but rather an argument against a specific economic policy.

Realizing the regressive nature of the 1981 legislation, the 1982 Tax Equity and Fiscal Responsibility Act was designed partially as a corrective measure. Some corporate tax breaks were repealed (e.g. the buying and selling of excess tax credits). However, other measures included an increased gas tax and excise taxes.

In 1983 a second modification of Social Security occurred. This increase in Social Security taxes, rendered federal taxation changes since 1977 regressive for all except the top 10% of wage earners (i.e. the poor are taxed by a greater percent and the rich are taxed by a diminished percent).

The 1986 Tax Reform Act eliminated $500 billion in tax shelters over 5 years, and repealed the investment tax credit and the capital gains exclusion. Corporate tax rate was reduced from 46 to 34 percent. Minimum tax rules were initiated insuring that high income individuals and corporations would pay tax. With personal income taxes, standard and personal deductions were increased and personal income taxes gave most families some tax relief.

In 1990 the Deficit-Reduction Act was passed increasing gas, cigarette and alcohol taxes. High personal incomes saw slightly increased tax rates including

social security taxes. Earned income tax credits for the working poor were increased for a second time.[67]

While all of these changes from 1977-1990 are difficult for the average individual to evaluate, The Citizens for Tax Justice of Washington D.C. estimate the impact of all the supply-side tax cuts during this time period to be as follows:

[67]The source for the mentioned tax changes and other related information is: John K. Manos, "The Great American Tax Fraud," *Consumer's Digest*, September/October 1992, 67-74.

Table II-2 Federal Tax Changes, 1977 vs. 1992 by Family Income (adjusted for income changes)				
Income Group	'77 vs. '92 change as a % of Income	'77 vs. '92 change as a % of Tax	Average 1992 Change - $	1992 change in billions of $
Lowest 20%	-0.5%	-5%	-38	-0.8
Second 20%	+1.2%	+8%	+241	+5.0
Middle 20%	+0.9%	+5%	+280	+5.8
Fourth 20%	+0.2%	+1%	+119	+2.4
TOP 20% Next 10%	+0.2%	+1%	+152	+1.6
TOP 20% Next 5%	+0.2%	+1%	+210	+1.2
TOP 20% Next 4%	-1.2%	-4%	-1,545	-7.0
TOP 20% Top 1%	-12.3%	-30%	-83,457	-83.7
Average/Total	-1.6%	-7%	-724	-75.5

NOTE: Figures compare the current federal tax code (including all federal taxes) to the level of progressivity of the 1977 federal tax system (adjusted for inflation and changes in incomes).
SOURCES: Based on data from the Congressional Budget Office, in Committee on Ways and Means, U.S. House of Representatives, 1991 Green Book (1991). Calculations by Citizens for Tax Justice, July 1991[68]

By combining tax effects for the entire period, the CTJ analysis allows us to see the overall impacts from 1977-1992. The changes are clearly regressive except for the top 5% and lowest 20% of taxpayers.

[68]Robert S. McIntyre, *Inequality and the Federal Budget Deficit* (Washington D.C.: Citizens for Tax Justice, 1991), 20.

Attention is directed at the top 20% of income earners. In 1977 the top 20% earned 46.6% of all income, in 1992 this became 52.6%, an increase of 13%.

We should also look at the top 1% of income earners. In 1977 the top 1% earned 8.7% of all income. In 1992 this became 14.6%, an increase of 67%. The top 1 percent in 1992 earned more than the lowest 40% of earners.

Even this analysis is misleading because between 1977 and 1992 only the top 5% of all income earners had an increase in pre-tax income. All below the top 5% suffered a loss of real income between 1 and 26%. The lower the income group, the greater was the loss. One wonders how such a reallocation of income is possible. 4/5ths of the population can out vote 1/5ths in any democratic configuration (e.g. 4/5ths is greater than 2/3rds). How is this consistent with a **rational expectations** when economic agents use all available information to reach their decision? (Or, traditional economic rationality in which more is preferred to less?) Have these economic agents forgotten that the majority rules in democracies? Or, given the high cost of being elected, are our elected officials torn between allegiance to those who finance election campaigns and those who actually vote? The top 20% earn slightly more than half the annual American income. Elected officials need a majority of the votes to be reelected, but convincing those voters costs money. Does the elected official vote in favor of

their contributors or in favor of a majority of their constituents? This balancing act is performed by every major elected official in America. However, a majority of constituents can always out-vote the high income 20% in a democracy. Although 15 years is a long time to have a non-democratic result, we do find some progressive remediation with the current Clinton administration (remembering all the while that politically, supply-side economics was a bi-partisan result). However, a great deal of harm has been done in the 15 years of regressive taxation.

Let's again focus our attention on the top 1% of all income earners. Robert McIntyre attributes all of the increase in deficits and national debt to the tax decreases for this group (the national debt was less than 30% of GNP in 1978 and steadily grew to more then 60% of GNP after 1992). McIntyre states:

> . . .the tax cuts for the richest one percent can explain the entire increase in the size of the federal budget deficit.
>
> . . . . . .
>
> . . .From fiscal '82-83 to fiscal '90-91, the average budget deficit was 1.7% of the GNP larger than in fiscal '77-78. Over that same period, the cost of tax cuts for the richest 1% since 1977 (including interest) averaged 1.9% of the GNP. Of course, the correspondence is not perfect in every year. In the early '80s, with defense build-up, deficit growth outpaced the rich's tax cuts. In the late '80s, after defense had passed its peak as a share of the GNP, the opposite occurred; the cost of tax cuts for the rich exceeded the increase in the deficit since fiscal '77-78. In the '91-93 period, however, the relationship is almost exact: the deficit is up by 2.6% of the GNP and tax cuts for the wealthy cost 2.6% of the GNP.[69]

[69]McIntyre, 8 and 29.

Regressive taxation and the resulting national debt problem are seemingly a crime against democratic capitalism. However, we can find economists with varying points of view. For instance, R. Amacher and H. Ulbrich of Clemson University publish the following table.

Table II-3 **Economic Performance and Reaganomics**

	1980	1987
Unemployment Rate	7.1%	6.1%
Inflation Rate	13.5%	4.4%
Saving/GNP	17.5%	15.0%
Investment/GNP	16.0%	15.9%
Growth Rate	1.9%	2.9%
Productivity Increase	-0.3%	0.9%
Federal Income Tax Revenues/GNP	15.6%	10.6%

Source:
Economic Report of the President 1988

According to this data except for the 4th and the 7th category, supply-side economics shows an economic improvement when 1987 is compared to 1980.

Supply-side economics has done considerable damage to democratic capitalism. However, if one is a New Classical and believes that the role of the government in the economy should be minimized, then supply-side economics is right on target. Big government must get smaller because in allowing the top

1% of income earners to pay less tax, we have created huge deficits which are scheduled to be repaid by program cuts and taxes on the lower income majority. To state that in the 1990s the top 1/5 of income earners control the Congress and the economists who fashion the leading economic theories and are able to effectuate a New Classicalism with a decreased government impact is perhaps a true statement of reality, but not a true statement of the essence of democratic capitalism. If the 4/5ths majority is not aware of its political power and does not rationally act in its economic self interest (more is preferred to less, etc.), the blame must rest in part with economic and political education that does not clearly indicate the impact of policies such as supply-side economics and does not vigorously seek and dispense alternative theory.

The federal government and what it represents for the less wealthy majority has been seriously crippled by supply-side economics.[70]

Conclusion: While the Accelerationist and Rational Expectations theories do provide serious challenges to Keynesian policy effect at unemployment levels labeled "natural", these theories do not release the Government from the Employment Act of 1946 (and related subsequent legislation) or the Constitutional charge to **promote the general welfare.** Alternative policies

[70]The source for most of the anti-supply-side viewpoint and most of the data is: McIntyre, 1-32. One is also referred to Boyes, Chapter 14. Boyes writing circa 1984 offers an additional perspective on supply side economics.

must be developed as necessary to achieve National optimal economic welfare objectives. Supply-side Economics is perhaps an example of how not to go about this process. The CORE philosophy, summarized in the **Conclusion** section below is another attempt at an effective remedial policy.

Again we must continue to scrutinize the definition of a natural rate of unemployment. Is this rate a voluntary rate of unemployment or the rate that doesn't accelerated inflation? Can we effectively argue that the two are the same? Or, is it the case that Automation is so effective and pervasive that labor in many contexts is becoming obsolete (i.e. with or without dramatic decreases in wage demands)?

The analysis is not simplistic. However, in this work, our primary objective is the establishment of several logical welfare indicators and measurement of those indicators to see if America is getting better, getting worse or remaining the same vis a vis these welfare indicators.

Can we argue that management is in the habit of increasing price as a short-run and perhaps long-term response to cost increases? If today unions are successful in increasing wages, then tomorrow management can respond with a price increase to regain lost profit. Union workers discovering the systematic nature of the management adjustment incorporate permanent Cost of Living Adjustments in their contracts. Imperfect Competitor Managers realize that

more of a price increase will be required in order to maintain expected profit with the newly imposed COLAs and the Phillips curves shifts to the right.

Later perhaps foreign oil suppliers organize into a cartel and effect an energy price increase that is nation wide in effect. Imperfect Competitor Managers faced with another long-term threat to profits increase prices again and again shift the Phillips curve to the right. Since these managers are Imperfect Competitor Managers there is no great incentive to shift the Phillips curve back to the left after energy price fall or after COLAs are no longer enforceable by the unions.

Alternately, assume for a moment that 90% of the labor force is capable of producing a GNP that has no "excessive" inflation tendencies. This 90% labor force has the ability to produce annual increases in GNP that satisfy the major national power brokers. The 10% unemployed would rather be employed but the immediate impact of adding larger numbers of the unemployed to the ranks of the employed is an increase in the price level signaling the inability to respond (in the short run) to this added demand with actual real output. The 90% employed have public relations economists that argue that the 90% employment represents full employment. These PR economists further argue that it is impossible to increase employment because the 10% unemployed choose to be unemployed at the current real wage rate. The PR economists

argue that the Government should not undertake expansionary policies because the economy, already at capacity, will simply respond with an unacceptable increase in inflation. In the long run the 90% coalition will replace any added output from the 10% group with automation therefore the government's expansionary policies have only short-term effects. Later when the 10% members are re-unemployed, the 90% employed can reduce the use of the newly acquired automation with little negative impact on profit. Does this scenario not support the same historical data that the accelerationist and rational expectations data support? The student must be clearly warned that alternate credible social science theories can fit the same historical data. A theory is simply a *logical* scenario that is not contradicted by the facts.

The shift in the Phillips Curve (in the two above scenarios) has nothing to do with the full employment inflation argued by the Accelerationists or the Rational Expectationers. In fact to argue that the economy is at capacity **in the long run** is nonsense and ignores economic growth. Is it not true that the economy grows every year (some years more than others)? If so, should we not acknowledge that the capacity of the economy is ever increasing in the long run. How can we logically speak of the aggregate supply of the economy being fixed in the long run in the face of ever increasing GNP? (See Econometric Analysis II and discussion of technological change.) It is just as logical to argue that

prevailing inflation is of the cost-push variety and that economic capacity is simply an illusion as the long run gets longer. Enormous numbers of labor force participants with diminishing real income therefore become a result of improper policy management and not a result of excuse oriented accelerationist, rational expectations dogma.

Keynesian policies rescued America from the Great Depression and saw America through World War II. If Keynesian policies did no more than this, the judgement of these policies must be a resounding success. Keynes established that novel techniques must be sought in order to insure the continued success of democratic capitalism. The fact that modern day economists have not discovered new effective techniques, is not an indictment of Keynes, but rather a criticism of modern economic achievement.

History of Progressive Income Tax - An Application of Cardinal Utility

> Mark 12:41-44
> 41 Jesus sat down opposite the place where the offerings were put and watched the crowd putting their money into the temple treasury. Many rich people threw in large amounts.
> 42 But a poor widow came and put in two very small copper coins, worth only a fraction of a penny.
> 43 Calling his disciples to him, Jesus said, "I tell you the truth, this poor widow has put more into the treasury than all the others.
> 44 They all gave out of their wealth; but she, out of her poverty, put in everything-- all she had to live on."
> (New International Version of the *Holy Bible*)

A review of the early federal income tax history of the United States is instructive. In general a tax may be classified as regressive, proportional or progressive. If a tax represents a higher percent of income for lower income groups, it is regressive. If all income groups are taxed the same percent of income we have a proportional tax and if higher incomes are taxed a greater percent than lower incomes, we have a progressive tax.

Hughes in his *American Economic History* reports the following:

> In response to the Civil War emergency, a desperate federal government imposed a progressive income tax. It needed immediate revenues and could worry about lawsuits later on. In 1872, the tax was abolished by Congress. A subsequent Supreme Court ruling in 1881, Springer v. U.S. actually held that the income tax was not a direct tax; therefore, it had been constitutional. But in 1894 Congress passed an income tax, and the U.S. Supreme Court threw it out on constitutional grounds. In Pollock v Farmers' Loan and Trust Company (1895), the Court reversed the Springer decision and held that an income tax was a direct tax upon land and its products and must be apportioned equally. The only way out for those who wanted incomes taxed would be a constitutional amendment that allowed unequal taxation.[71]

F. Y. Edgeworth writing in his 1897 "The Pure Theory of Taxation" established a foundation for progressive income taxation using cardinal utility as the basis. Utilitarianism via Bentham was seen as having the power to invoke equality of incomes through taxation. Such was seen as consistent with delivering the greatest good for the greatest number.

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[71]Jonathan Hughes, *American Economic History* (Glenview, Illinois: Scott, Foresman and Company 1983), 453.

Edgeworth receives relief from Benthamian "Socialism" through Sedgwick who indicates that such a(n) (equal income) scheme could result in a diminution of the total to be divided because workers might use the increased wage to enjoy more leisure and/or to have more children. Either resultant could engender a lower total output and/or a lower total output per worker.[72] Also, the monetary incentive for economic growth is diminished.

Thus we have two forces, one towards equal individual incomes and the other towards the maximization of society's total output. The former justifies taxation and the later place a limit on the extent of the "progressiveness" of taxation.

In 1913 the United States established the sixteenth amendment to the Constitution:

> The Congress shall have power to lay and collect taxes on incomes from whatever source derived, without apportionment among the several States, and without regard to any census or enumeration.[73]

It was this income tax that funded the largest fraction of the World War I effort. Thus began the long tradition of progressive taxation that has prevailed until recent times.

Traditional taxation in the United States is built upon a cardinal conceptualization of utility. Progressive taxation implicitly implies that

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[72]F. Y. Edgeworth, "The Pure Theory of Taxation", *Economic Journal* VII (1897), 550-571.

[73]*Barron's Student's Concise Encyclopedia*, 1988 ed, s. v. "The Constitution of the United States"

interpersonal comparisons of utility are possible and that an extra five dollars given to a man near starvation has greater utility than an extra five dollars given to a man who has recently won a 40 million dollar lottery. Therefore in order for a tax system to be fair it must be progressive. The rich should, on a percentage basis, be taxed more than the poor in order for taxes to represent equal sacrifice. Our discussion of the St. Petersburg paradox will prove the decreasing marginal utility of money, i.e. an extra dollar has greater utility for the poor than it does for the rich.

St. Petersburg Paradox[74] - Proving Decreasing Marginal Utility of Money

Expected value is a statistical term usually found in Introductory Statistics. We can create a lottery and use the lottery as a vehicle to study expected value. Assume that the only prize in a fair lottery is worth $10,000. If I purchase one of the 20,000 lottery tickets, my chances of winning are 1/20,000 or .00005 . If the .00005 probability of winning is multiplied times the value of the lottery prize, we have the expected value of my gamble. The expected value in this instance is .00005 * $10,000 or $0.50.

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[74] Daniel Bernoulli's original 1730-31 Latin article, "Specimen theoriae novae de mensura sortis" was translated into English ("Exposition of a New Theory on the Measurement of Risk") by Sommer and appears in *Econometrica* 22 (1954), pp. 23-36. This paradox is also discussed in by R.D. Luce and H. Raiffa, *Games and Decisions* (New York: John Wiley & Sons. 1957),19-23 as well as by L.L.Lapin, *Quantitative Methods for Business Decisions* (New York: Harcourt, Brace, Jovanovich,1991), 785-87.

Of course it is impossible to win fifty cents in this lottery. I will win exactly nothing or exactly $10,000. What then is the interpretation of the *expected value?*

If the lottery occurs daily and if I should buy 52 lottery tickets each day for 50 years (about 949,000 tickets) I can expect an average return of $0.50 for each ticket or about $474,500 for a 50 year total. If each ticket costs $0.50, I can expect to win exactly what I spend for tickets. If each ticket costs $0.25 I will win (on average) twice what I spend for tickets. And if each ticket costs $1.00, I will spend twice as much for tickets as I expect to win.

Repeated trials are the key ingredient necessary to achieve the expected value. In fact, as the number of trials (lottery tickets) approaches infinity, our expected winnings should be exactly the expected value.

The expected value is more formally the sum (discrete or continuous) of each outcome multiplied times the probability of each outcome. The concept of expected value is so essential in Statistics that it can be considered fundamental. Having developed the concept, let's consider a somewhat different gambling proposition.

A fair coin (when tossed, the probability of a head equals the probability of a tail equals exactly 1/2) will be tossed. If a head appears for the first time on the first toss you win $2. If a head appears for the first time on the second toss

you receive $4. If a head appears for the first time on the *n*th toss you receive 2^n (i.e. 2*2*2*...*2 , n times).

How much will you be willing to pay to play this game? $5, $500, $5000, $5,000,000? A good starting place is expected value. The probability of winning on the first toss is 1/2; of winning on the second toss is 1/4; of winning on the third toss 1/8; of winning on the nth toss is $1/2^n$.

[Digression: Experienced users of Statistics might wonder if this is really a bona fide probability distribution. The major requirement being that the probabilities must sum to one. That is, does $1/2 + 1/4 + 1/8 + \ldots + 1/2^n$ actually equal 1? Call this sum S such that $S = 1/2 + 1/4 + 1/8 + 1/16 + \ldots + 1/2^n$. This sum multiplied times 1/2 is $1/2*S = 1/4 + 1/8 + 1/16 + \ldots + 1/(2^{n+1})$. Now if we subtract 1/2*S from S we get $1/2 + 1/(2^{n+1}) = 1/2*S$. If n is truly infinite then $1/(2^{n+1})$ is essentially 0 therefore $1/2*S = 1/2$ and $S = 1$.[75]]

Expected winnings for each occurrence of this game is the probability of winning multiplied times the expected winnings. Expected winnings are therefore: $(1/2 * 2) + (1/4 * 4) + (1/8 * 8) + \ldots + (1/2^n * 2^n)$. Thus, ($1 + $1 + $1 + ... + $1) is the expected value *each time* we play this game. This sum

[75]Of course we are finding the sum of a geometric series here. This technique is discussed in many economic math texts including Taro Yamane, *Mathematics for Economists: An Elementary Survey* (New Jersey: Prentice Hall, 1968), 279.

however is infinite. Under such circumstances shouldn't you be willing to pay your total fortune to play this game? The expected value of the winnings will always exceed the finite amount paid to play.

The paradox is that few people are willing to pay a large sum to play this game. In fact few are willing to pay more than $20 to play this game.

This paradox is attributed to Nicolas and Daniel Bernoulli, members of the famous Swiss family of mathematicians of the 18th century. Nicolas sent a copy of this paradox (unsolved) to his cousin Daniel. Daniel suggested that "any increase in wealth, no matter how insignificant, will always result in an increase in utility which is inversely proportionate to the quantity of goods already possessed"[76].

A Bernoulli type utility function exhibiting diminishing marginal utility (risk aversion) is illustrated in figure II-2A below (utility is simply the log of the certain amount of money). Note that equal increments of money yield diminishing increments of utility as money amounts increase in value.

[76]Sommer, 25.

figure II-2A

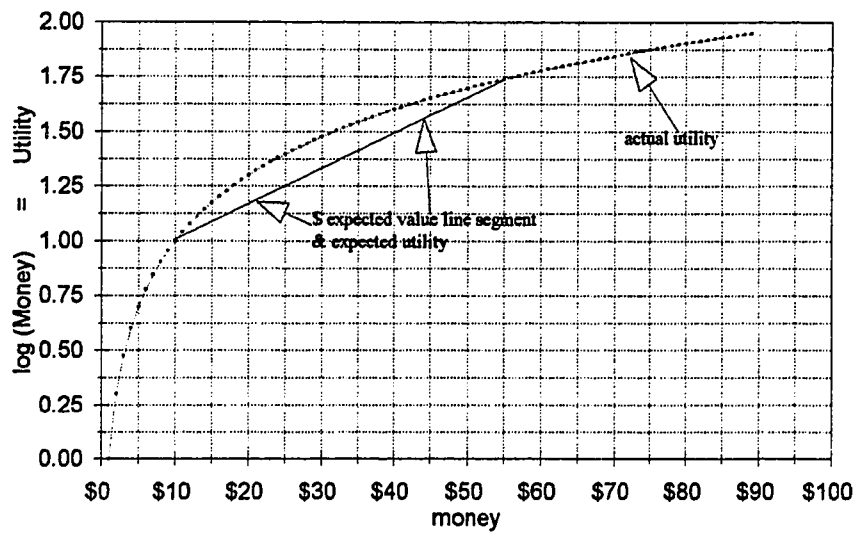
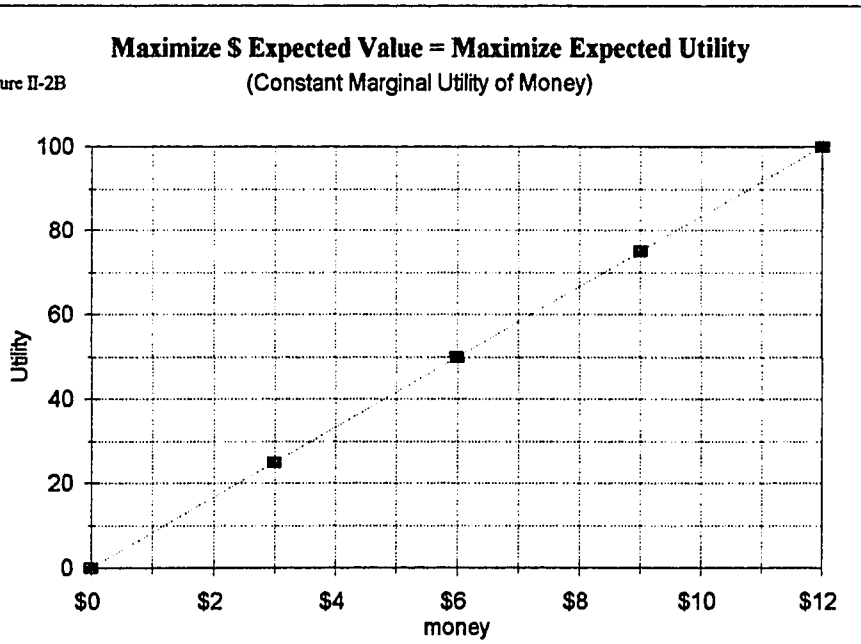


figure II-2B



A utility function reflecting constant marginal utility is exhibited in figure II-2B. In this diagram the utility axis measure both the utility of gambles (expected money values) and the utility of certain dollar amounts. The utility of X certain dollars is exactly equal to the utility of X dollars expected in an uncertain situation. This utility function corresponds to that of a risk neutral individual and may therefore yield an infinite utility corresponding to an infinite expected value.

Return to the figure II-2A model of diminishing marginal utility and observe the straight line segment connecting $10 and $55 on the actual utility curve. $10 yields about 1 unit of utility, while $55 dollars yields about 1.75 units of utility. But the curve is actual utility for certain dollar amounts. What about gambles for this risk averse individual? That is, what about expected utility corresponding to expected dollar amounts? Well, we already know the utility values for certain $10 and $55 amounts. We also know that a risk neutral person has a straight line expected utility-expected income line. If we connect the $10 and $55 dollar points on the utility curve [log(M)] we have a straight line yielding the utilities of money values resulting from gambles (expected values). Note that all points on this line (excluding the end-points) lie below the utility curve for certain amounts reflecting less utility associated with gambles with expected dollar value X when compared to the utility of certain X

dollars. For instance $40 resulting from a gamble yields a utility value of approximately 1.5 while a certain $40 yields a utility value of approximately 1.625. Thus, we see risk aversion.

The diminish utility form recommended by Bernoulli is:

$\log_{10}$(Expected Utility Sum + W) = $1/2*\log_{10}(W+2) + 1/4*\log_{10}(W+4) + 1/8*\log_{10}(W+8) + 1/16*\log_{10}(W+16)+... + 1/(2^n)*\log_{10}(W+2^n) +...$

W stands for the dollar amount of the player's wealth. Therefore the anti-log of the above sum minus one's initial wealth equals the expected utility sum which will yield more reasonable values for the expected value of the gamble.

For instance, if we assume that the player has wealth equal to zero (except for human capital), the above sum becomes:

$\log_{10}$(Expected Utility Sum)

$= 1/2*\log_{10}(2) + 1/4*\log_{10}(4) + 1/8*\log_{10}(8) + 1/16*\log_{10}(16)+... + 1/(2^n)*\log_{10}(2^n) +...$

This sum equals 4 (dollars or other units of money) exactly. This sum is much closer to the common sense valuation of what the St. Petersburg's Gamble is actually worth. Thus, the Petersburg Paradox is solved by Bernoulli.

Modern criticism of the Bernoulli approach center on the fact that the particular utility function chosen by Bernoulli is not unique. That is, there are

an infinite number of utility functions that will yield increasing utility at an decreasing rate.[77]

However, a similar argument can be constructed against the price indexes that are used everyday. When we hear that the cost of living has increased by 10%, we realize that this is an approximation and that some citizens are affected more or less than this approximation, yet we continue to use the CPI as a measure of economic welfare because it does a good job of general estimation in the absence of a better measure. If we give the same kind of consideration to Utility that we give to price indexes we begin to envision a national utility function that *generally* measures the marginal utility value of an increase or decrease in wealth.

Edgeworth in reviewing the Bernoulli function as a possible National Utility Function concludes that the Bernoulli utility function requires a proportional tax to reflect equal sacrifice. Edgeworth further indicates that the Bernoulli function may be too conservative:

> Upon the assumption that the diminution of marginal utility with income is (throughout) in excess of Bernoulli's law, the principle of equal sacrifice and that of proportional sacrifice both give progressive taxation, the latter in a higher degree than the former (i.e. higher for any assigned form of the utility-curve, and amount of taxation).[78]

Bernoulli's Petersburg Paradox clearly demonstrates the reasonableness of diminishing marginal utility. If our national utility function ranges from

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[77]L.L. Lapin, 787.

[78]F.Y. Edgeworth, "The Pure Theory of Taxation", *Economic Journal* VII (1897), 560.

Bernoulli configuration to the position of Edgeworth, we range from proportional taxation to progressive taxation **but never to regressive taxation.**

As we have previously demonstrated, in a majority rule democracy, it is quite easy for the lower 3/5ths income group to vote an income tax reducing the average income of the higher 2/5ths to that of the lower 3/5ths. The reason this is not done is due to the desire to promote greater national wealth with the expectation that this will make both rich and poor better off. (That is. the upper 2/5ths with high income incentive are expected to provide economic leadership that will cause a higher national income making all better off.)

The above logic is not interpreted to indicate that the less wealthy majority will allow themselves to be more highly taxed than the wealthy minority. Regressive taxation is therefore not a viable alternative and we thus trace the origin of such a concept to 1738 and a scholar named Daniel Bernoulli.

Diminishing Marginal Utility and Insurance: How widely believed is this concept of diminishing marginal utility of money? The answer is of course quite widely! The concept of diminishing marginal utility is the cornerstone of the modern insurance industry!

Consider a person whose only yearly income is determined by a single yearly toss of a fair coin. If the coin shows heads, the person (Mr. 50/50) gets $50,000 for the year. If the coin shows tails, Mr. 50/50 gets $100,000. Since the

probability of getting $50,000 is 50% and the probability of getting $100,000 is 50%, the expected value of yearly income is .5*100,000 + .5*50,000 or $75,000.

A person in such a situation who is indifferent between: a) a certain $75,000 and b) a 50% chance of getting $100,000 and a 50% chance of getting $50,000, is called risk neutral. If the person prefers the gamble to the certain amount, the person is known as a risk lover. If the person prefers the certain amount to the gamble the person is risk averse. Risk aversion is another name for a belief in decreasing marginal utility of money.

The greater the number of people that are risk averse, the greater the demand for the purchase of insurance. Consider the following:

> We spend close to 15 percent of our income, on the average, on insurance. That's as much as we spend on housing and more than we spend on cars and food. . . .
> . . .Life insurance reduces the risk of financial loss in the event of death. More than 80 percent of households in the United States have life insurance, and the average amount of coverage is $110,000 per household. More than 2,400 companies supply life insurance, and the total premiums paid in a year are around $300 billion. . . .[79]

Evidently, risk aversion is the philosophy of the majority in America. Consider again the gamble mentioned above. How much would Mr. 50/50 be willing to pay in order to assure a certain amount as opposed to the gamble?

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[79] Michael Parkin, *Microeconomics: Second Edition*, (Massachusetts: Addison-Wesley Publishing Company, 1993), 463-64.

Since Mr.50/50 is risk averse, a certain $75,000 is preferred to the 50% chance of $100,000 and 50% chance of $50,000. However, there must be some certain amount that will make the gambler exactly indifferent between the certain amount and the 50-50 gamble mentioned above. That amount will vary from individual to individual. However, in this instance assume that Mr. 50/50 considers a certain amount of $70,000 indifferent to the 50-50 gamble mentioned above. The difference between $75,000 actual expected value and $70,000 value that will make Mr. 50/50 indifferent is the area for insurance negotiation. If the insurance company can find many risk averse customers with an insurance problem similar to Mr. 50/50, the company can expect that $75,000 will be the average expected income value. If the customers are willing to accept the $70,000 certain amount in lieu of the 50-50 gamble, then the $5,000 differential is a potential insurance premium.

Assume that due to competitive market forces the actual insurance premium is $3,000. The employment contract will yield an average of $75,000 each year, per customer. The insurance company will pay $72,000 each year to each customer similar to Mr. 50/50. The insurance company is paid $3,000/year from the employment contract. The entire arrangement is summarized:

Table II-4 Insurance Example (in thousands of dollars)				
year# or person #	contract income	insurance payment	net income	payment to insured
1	50	3	47	72
2	100	3	97	72
3	50	3	47	72
4	100	3	97	72
5	50	3	47	72
6	100	3	97	72
	75 avg.	3 constant	72 avg.	72 const.

While the assumption of high and low income exactly alternating is contrived, over the long run the $75k average will attain. In a single year if there are many insurance customers similar to Mr. 50/50, we can expect the insurance company to average $75k each from the income contracts. Therefore the above table is a good approximation to expected reality.[80]

Overcoming Arrow's Impossibility Theorem

Using our prior discussion of the voter's paradox as a prelude, let us consider the following scenario:

[80]Similar discussions of risk and insurance are created by Michael Parkin, *Microeconomics: Second Edition* (Massachusetts: Addison-Wesley Publishing Company, 1993), 459-466 and by J.V. Henderson and W. Poole, *Principles of Microeconomics* (Massachusetts: D.C. Heath and Company, 1991), 182-86.

Assume that in "Arrowville" we have a programmable robot (i.e. "Arrowbot"). We wish to program the Arrowbot in decision making according to the logic given above for individual consumers. The Arrowbot will need a basis for making choices among pairs of goods. As a test project we will program the Arrowbot to choose among three different sedan automobiles. A logical basis of choice will be the (equally important) qualities of the sedans. Whatever sedan ranks highest using a majority of the qualities will be the preferred sedan of the Arrowbot.

According to Quality 1 Arrowbot ranks: Sedan1, Sedan2, Sedan3

According to Quality 2 Arrowbot ranks: Sedan2, Sedan3, Sedan1

According to Quality 3 Arrowbot ranks: Sedan3, Sedan1, Sedan2

In order for the Arrowbot to prefer one sedan to the others, that sedan must be preferred according to a majority of the programmed selection qualities. For 2 out of 3 qualities Sedan1 is preferred to Sedan2. For 2 out of 3 qualities Sedan3 is preferred to Sedan1. For 2 out of 3 qualities Sedan2 is preferred to Sedan3. Thus the Arrowbot prefers Sedan1 to Sedan2 to Sedan3 to Sedan1. The Arrowbot is therefore incapable of making a decision. Notice also if a so called "rational consumer" uses a similar scheme the possibility of irrationality also exist not at the Societal level but at the individual level as well. The

programmers must extend the Arrowbot's program into greater complexity in order to assure that a logical conclusion can always be made.

Now assume that the Arrowbots are responsible for making group (Societal) decisions. It's easy to see that a voting paradox is possible and that more complex programming will be required to assure that decisions are reached in a potentially paradoxical situation.

The human brain is far more complex than any existing computer and capable of making far more complex decisions according to very complex algorithms. American democracy works and has worked quite well for some time. The failure is not in Democracy but rather in the simplistic rules that economic rationality uses to make a decision. (Simplistic rules are good for model building but can lead to contradictions when examined in detail.)

Our major concern with the Arrow theorem at this point is that it tends to undermine the (traditional) rationality of democratic processes. Riker and Odershook state:

> 1. Unlike individual decisions, which are always ordered arrangements of preference, social choices are not. In that sense, social outcomes may lack coherence.
> 2. To the degree they lack coherence, social outcomes can appear arbitrary.[81]

Silberberg states:

[81] W.H. Riker and P.C. Ordershook, *An Introduction to Positive Political Theory* (New Jersey: Prentice Hall, 1973), 84.

> . . .
>
> Another interpretation of the possibility theorem is that interpersonal comparisons of social utility are ruled out. It is impossible to say that taking a dollar away from a rich person and giving it to a poor person will make society better off, in some nondictatorial or imposed sense. The problem of interpersonal comparisons of utility was a vehicle by which ordinal utility replaced the older cardinal utility idea.
>
> On a less rigorous but more intuitive basis, the reason sensible social welfare functions cannot exist is that they conflict in a fundamental way with the notion that more is preferred to less. At any given moment there is a frontier of possibilities for the consumers in any society. Any movement *along* this frontier involves gains for some individuals and losses for others. Without a measure for comparing these gains and losses between individuals, there is no sense to the phrase social welfare.
>
> . . . . . .
>
> Faced with the impossibility of constructing a meaningful social welfare function, economists have opted for a weaker criterion by which to evaluated alternative situations. This criterion, known as the Pareto condition, . . .[82]

This extremely dangerous dogma is standard in many economics and political theory text books in America and has been for many years. Such dogma undermines national policy reached through the democratic process. Assuming that Americans are limited mental Arrowbots is an insult to even the general level of intelligence expected in the latter half of the 20th century. The push of less government, abolishment of progressive taxation and minimization of income redistribution are counter to the Constitutional charge to maximize the

[82] Eugene Silberberg, *The Structure of Economics: A Mathematical Analysis* (New York: McGraw-Hill Book Company, 1978),470.

general welfare. The student must be made aware of the fact that such a view is ultimately not steeped in logic but rather in a quite biased ideology.[83]

Interpersonal Comparisons of Utility

Once the Arrow (Im)Possibility Theorem is overcome, the validity of a voting model (and democracy) is restored. The rationality of the voting model implies the validity of interpersonal comparisons of utility. In a one person-one vote political economy we are at once in the territory of interpersonal comparisons of utility. If the majority believes in the validity of diminishing marginal utility of money and fifty dollars is more valuable to a pauper than to a millionaire, the majority may vote for income redistribution through progressive taxation. Thus utility is comparable between income classes.

However, if the rich control research grants for Economists, and political contributions to elect politicians it is possible that a regressive tax structure could be installed. Economists could be paid to propagandize the irrationality

[83] James Henderson and Richard Quandt, *Microeconomic Theory* (New York: McGraw-Hill Book Company,1971), 284-86 offer an interpretation of the Arrow theorem somewhat different from that of Silberberg, but the Silberberg conclusion is considered fairly pervasive.

of majority voting while politicians could be paid to reduce taxes on the rich causing huge federal deficits and the demise of the Welfare State as we know it. The test of course is whether the "equilibrium" expressed in the previous paragraph is short-term or long-term.

> You can fool all of the people some of the time and some of the people all of the time, but you can't fool all of the people all of the time.
>
> Abraham Lincoln[84]

Selected Economic Welfare Indicators

Introduction

Having established Economic Growth as a Welfare Indicator and having described the Welfare State, at considerable length, we are now concerned with additional select Macroeconomic variables that will do a good job at measuring economic welfare. The measurement we now seek is not Economic Welfare in a strict Pareto sense, but rather Economic Welfare consistent with the philosophy of the Welfare State which allows a redistribution of income as long as total national income is not diminished. Such a redistribution increases national welfare in the Pigou sense. Our additional select Macroeconomic Welfare Indicators are: 1) Hours of Work, 2) Inflation and the Price Level, 3) Income and the Distribution of Income, and 4) Unemployment .

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[84] William J. Boyes, *Macroeconomics: The Dynamics of Theory and Policy* (Cincinatti: Southwestern Publishing Company, 1984), 232 as a preface to his expectations chapter.

These indicators will not be defended as being a "best" set of Indicators. However, these Indicators are defended as being a "reasonable" set of Indicators upon which a reasonable estimate of Automation Era Welfare can be based. The conclusions of our statistical tests vis à vis these Indicators will thus yield a reasonable view of Economic Welfare in the age of Automation.

A researcher with an alternative set of Indicators may reach a conflicting conclusion. However, researchers who seriously contemplate the set of Indicators presented in this work should be hard pressed to reach conflicting conclusions.

Below we discuss each chosen Welfare State Indicator from a theoretical perspective. Each should be evaluated according to its ability to measure distribution of National Welfare without diminishing National Product. However, the reader should already sense the income distributive potential of each of these indicators.

If the standard workweek is 60 hours, yet is suddenly forced to 40 hour/week by legislation, chronically unemployed persons can expect secure employment. We have an income transfer from the employed to the unemployed via **Hours of Work.**

Consider a price increase. If one group of workers receives an automatic wage increase that is indexed to price increase and another group of workers has no

such increase, the first group has constant real income while the second group has had its real income reduced. With federal taxes not indexed to price increases inflation has the ability to move one into a higher tax bracket without an accompanying increase in real income. **Price increases** have the ability to redistribute income.

When **Income and the Distribution of Income** are studied we can discern movements in income distribution among groups without regard to the causality.

If one had a job last year but not this year and total national income does not diminish, then income is transferred from the unemployed to someone else in the economy. The key economic feature of the Great Depression was unemployment. Although in the depression instance we had simultaneous diminution of national income and national employment, this unemployment may still be envisioned as a redistribution of income if we can logically purport a feasible potential economy that would have had higher national product and national employment levels (as did Keynes). Therefore, **Unemployment** measures income redistribution.

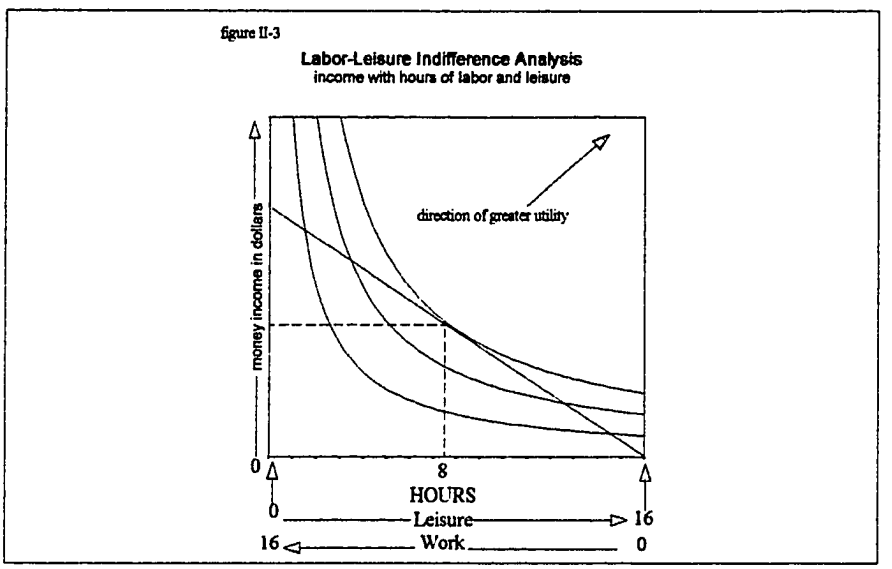
Hours of Work

We have briefly discussed indifference curve theory above in the Introduction to this chapter. Such analysis can also be applied to Leisure and Hours of Work.

Webster defines an economic good as "something that has economic utility or satisfies an economic want."[85] Thus leisure is also an economic good and therefore subject to our indifference curve analysis. Leisure time is defined as awake hours not spent earning income (16 hour maximum?). Therefore leisure and hours of work can be represented on the same axis. If we measure from left to right we have measured leisure. If we measure from right to left we have measured hours of work. If all of our material wants were met without any work whatsoever then our leisure time would be continuous and we would therefore be subject to a Garden of Eden effect (before the Apple?) However, if we look at Mankind after the Apple we find man working almost continuously in order to provide material wants. We might therefore look at an increase in leisure (assuming that the typical individual prefers leisure to work) time as indicative of an increase in individual economic welfare. Therefore, an increase in general economic welfare is indicated by a decreasing average work week. Accordingly,

[85] *Webster's Ninth New Collegiate Dictionary*, (1987), s.v. "good".

and with importance to this study, the consumer's graph becomes more complicated and looks like the following:



Be aware that consumers of different tastes will be represented by indifference curves of different shapes for: 1) the consumer who prefers work to leisure, 2) the consumer who is more balanced between preference of work and leisure (shown above) and 3) the consumer who, prefers leisure to work.

Who will deny that a nation that works an average of 60 hours a week is worse off when compared to a nation that works an average of 40 hours a week and enjoys a better living standard? America prior to the turn of the century was a nation with a 60 average work week. Hours of Work is our first chosen

economic welfare indicator. In Part Three, we will examine statistics concerning average Hours of Work to help analyze the Economic Welfare of America.

Inflation and the Price Level

Introduction

Barter involves the direct exchange of goods for goods. I specialize in the production of certain goods, perhaps eggs and chickens. You specialize in the production of vegetables. We meet in a market place (physical or abstract) and exchange goods for goods and we therefore are involved in barter economics.

The difficulty with Barter economics is that you may not have something I want when it's time for you to get your eggs and chickens. You now must find someone else who has something I want, make a trade with that party, and come back to me for your chicken and eggs. One can easily visualize how complex the Barter Economy can become. Of course it helps if we meet in a physical market place on a regular basis; but still barter can be very cumbersome.

Enter money as a medium of exchange. Perhaps gold has been collected for its unusual properties as a metal and because of its scarcity. The community now decides to use gold a medium of exchange. That is, instead of paying me with vegetables, which I may or may not have use for, you may now pay me with gold, which I definitely have a use for since it is a medium of exchange.

A medium of exchange is generally accepted by anyone possessing a good with utility. One need not be concerned with the probability of matching supply and demand of goods in the market place. With money (medium of exchange) commerce is facilitated.

However, consider one recluse type who has been missing from the market place for quite some time. When recluse returns, he returns with quite a quantity of medium of exchange, i.e. gold. What is the impact on our community?

Well, if gold continues as a medium of exchange, recluse becomes quite wealthy. However, with more money chasing roughly the same amount of desired goods, a normal response will be an increase in prices. With demand greater than supply, this is a legitimate response at least in the short run.

If all incomes and prices rise by the same percent simultaneously, it is difficult to say that anyone is better off or worse off in this isolated theoretical community. However, if one does not participate (or participate fully) in this "inflation", then that person is worse off. For instance, if one has been selling horse manure, it could be that an increase in the price of this manure would cause a dramatic decrease in the demand for manure. The horse manure seller, therefore, may be worse off as a result of inflation.

Inflation (or its opposite - deflation), is therefore an important welfare indicator in our economy. Is the price increase from your supplier indicative of a local effect specific to the supplier's market? Or, is the price increase by your supplier indicative of a general price increase throughout the economy? Correct knowledge in this situation will optimize your reaction to the price change. In short, knowledge of price level changes (i.e. inflation) is very important.

As an example, consider Turner's report:

> In the United States the great rise of prices took place as a result of rapid and unprecedented increase in the gold supply, one billion dollars of gold having been imported in 1913 and 1916. As a result of this great increase in the gold supply of the United States, the average of price in 1918 was nearly 100% higher than in 1913.[86]

It is therefore no surprise that most modern economies have abandoned gold as a monetary standard.

However, there are still changes in the general level of prices (for instance as a result of fiscal and monetary policy) and these changes need to be measured and reported. Price index numbers are the tools of choice for economists and statisticians.

The history of index numbers is not our primary objective. However, Samuelson and Turner have provided notes for those concerned with this history. Samuelson reports:

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[86] Turner, p. 198.

Economists such as Jevons, Edgeworth, Marshall, Allyn Young, Warren Persons, Irving Fisher, Edwin Frickey and others have made contributions to what may be called the statistical theory of index numbers. But what has come to be called the economic theory of index numbers is concerned with quite distinct matters. To this theory many economists have made contributions. A partial list would include the names of Wicksell, Konus, Bortkiewicz, Bowley, Haberler, Pigou, Keynes, Staehle, Leontief, Allen Lerner, Frisch and Wald.[25]

[25]Reference may be made to the survey article by R. Frisch, "Annual Survey of General Economic Theory: The Problems of Index Numbers," *Econometrica*, IV (1936), 1-38; also to the article by W. Leontief in the same issue. The early volumes of the *Review of Economic Studies* may be consulted for other discussions."

Turner provides a different, earlier, historical reference:

The oldest of these (price index) calculations are those of the London journal, *The Economist*. Another English computation of wide repute, that of Augustus Sauerbeck, has been continued by Sir George Paish in the *Statist*.

The first computations of this character in the United States were made under the direction of Dr. R. P. Falkner, later Director of Research for the Alexander Hamilton Institute, for the Senate Committee on Finance in 1891. The computations went back to 1860 for a base, and for a large number of articles, prices were obtained from 1840. Though not continued directly, this investigation was the basis for subsequent official publications of this nature. A few years later Dr. Falkner persuaded the Bureau of Labor Statistics to take up the matter again and, after an effort to complete the earlier figures under his direction, the Bureau established its own index number on the basis of the price of years 1890-99. Later, the Bureau of Labor Statistics used 1913 as the basis for its index number. ...[88]

We will utilize two price indexes for our economic welfare evaluation, The Consumer Price Index (CPI) and the Gross National Product Implicit Price Deflator (GNP IPD).

[87] P. A. Samuelson, *Foundations of Economic Analysis* ,(New York: Atheneum, 1972), 146.

[88]Turner, p. 197.

Consumer Price Index (CPI)

The CPI is built using a typical basket of goods that would be purchased by a typical consumer unit. The consumer price index is classified as a Laspeyres index and is calculated according to the following formula:

$$CPI = (p_t^1 \cdot q_0^1 + p_t^2 \cdot q_0^2 + p_t^3 \cdot q_0^3 + \ldots + p_t^n \cdot q_0^n) \div (p_0^1 \cdot q_0^1 + p_0^2 \cdot q_0^2 + p_0^3 \cdot q_0^3 + \ldots + p_0^n \cdot q_0^n) * 100$$

The subscripts indicate years. A subscript of "0" indicates the base year. A subscript of "t" indicates a chosen year. The superscript identifies each good in the typical consumer basket. "n" is the identifier for the last good in the basket. As can be seen, the contents of the basket of goods is being held constant and the prices change from year to year. If in the chosen year prices were higher than in the base year, the CPI would be higher and inflation would have occurred. If in the chosen year prices are lower than in the base year, the CPI would be lower and deflation would have occurred.

GNP Implicit Price Deflator

With the GNP IPD (or IPD for short), we begin with nominal GNP or GNP in current dollars. GNP equals the value of final goods and services for an economy, which essentially is the sum of the price of a final good or service multiplied by the quantity of the good or service for every final good or service in the economy. The IPD's computation is perhaps best described with an

example. Consider the following actual data for the U.S. Economy from 1978 to 1984.

table II-5 **U.S. GNP Data - 1978-1984**

Year	GNP in Nominal Dollars (billions of $)	Real GNP in (1982) dollars (billions of $)	GNP Implicit Price Deflator
1978	2,249.7	3,115.2	72.2
1979	2,508.2	3,192.4	78.6
1980	2,732.0	3,187.1	85.7
1981	3,052.6	3,248.8	94.0
1982	3,166.7	3,166.7	100.0
1983	3,405.7	3,279.1	103.9
1984	3,772.2	3,501.4	107.7

source: Henderson and Poole, *Principles of Macroeconomics* (Lexington, Mass.: D.C. Heath and Company, 1991), inside front cover.

We choose a year to serve as the base year; in this instance, 1982. Use the prices of final goods and services in 1982 to compute the value of final goods and services in the chosen year. If more goods and services formed GNP in the chosen year, then *real* GNP will be greater than base year GNP. This was the case for 1984, 1983, 1981 1980 and 1979. (1982 was a recession year.) If fewer goods and services formed GNP in the chosen year, then real GNP would be lower than the chosen year. This was the case in 1978. As can be seen, by

valuing yearly output with a single set of prices we can observe quantity movements (more or less real output?) separate from price movements. Prices are essentially being held constant.

The GNP Implicit Price Deflators are simply the ratio of nominal GNP (i.e. GNP in current dollars) divided by real GNP (GNP valued in base year prices). Percentage changes in IPDs are a measure of inflation. If an IPD increases from one year to the next, inflation has occurred. If an IPD decreases from one year to the next, deflation has occurred. In our example data set above, inflation has occurred every single year.[89]

Some Criticism of Price Indexes

The CPI is criticized for its choice of a typical basket of goods which may not reflect everyone's definition of "typical". What if consumers change their spending habits, what then of the typical basket. For instance, if thin is in, shouldn't the typical basket change towards lower fat food and towards exercise machinery? Many economists preferred the GNP IPD because it includes all final goods and services and not just the typical basket of the CPI.

A criticism of both indices is their failure to respond to changes in quality. If autos in the base year don't contain air bags but autos in the chosen year do,

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[89] The data for this section is U.S. Department of Commerce Data and was found in: R.C. Amacher and H.H. Ulbrich, *Principles of Economics: Fourth Edition*, (Cincinnati: Southwestern Publishing Co., 1989), inside front cover. A discussion of index numbers can be found in: W.J. Boyes, *Macroeconomics: The Dynamics of Theory and Policy* (Cincinnati: Southwestern Publishing Co.,1984), p. 32-37.

does that justify a price increase and if so, isn't it true that price increase is not a part of inflation?

Income and Distribution of Income

Introduction

Adam Smith states:

> It is in the age of shepherds, in the second period of society, that the inequality of fortune first begins to take place, and introduces among men a degree of authority and subordination which couldn't possibly exist before. It thereby introduces some degree of that civil government which is indispensably necessary for its own preservation: and it seems to do this naturally, and even independent of the consideration of that necessity. The consideration of that necessity comes no doubt afterwards to contribute very much to maintain and secure them in the possession of their own advantages. Men of inferior wealth combine to defend those of superior wealth in the possession of their property, in order that men of superior wealth may combine to defend them in the possession of theirs. All the inferior shepherds and herdsmen feel that the security of their own herds and flocks depends upon the security of those of the great shepherd or herdsman; that the maintenance of their lesser authority depends upon that of his greater authority, and that upon their subordination to him depends his power of keeping their inferiors in subordination to them. They constitute a sort of little nobility, who feel themselves interested to defend the property and to support the authority of their own little sovereign, in order that he may be able to defend their property and to support their authority. Civil government, so far as it is instituted for the security of property, is in reality instituted for the defence of the rich against the poor, or of those who have some property against those who have none at all. [1]

[1] [*Lectures*, p.15: 'Till there be property there can be no government, the very end of which is to secure wealth and to defend the rich from the poor.' Cp. Locke, *Civil Government*, §94, 'government has no other end but the preservation of property'.][90]

Given Smith's discussion of why a majority of voter's in democratic capitalism might be inclined to allow an economically irrational distribution of income

[90] Adam Smith, 236.

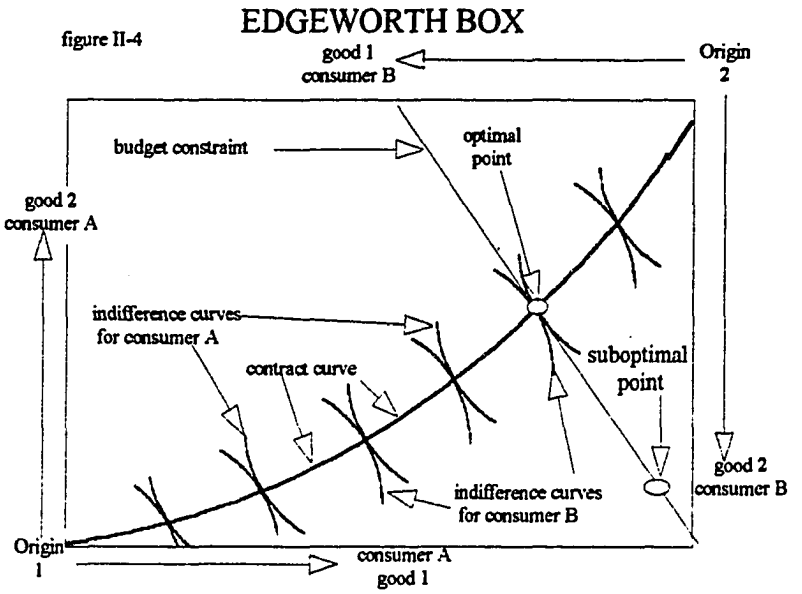
(regressive taxation), let's now consider distribution of income as an indicator of economic welfare.

Divide society into any logical set of groups and observe the income of those groups through time. Such an exercise yields a view of the distribution of income.

Classical and Micro-economics indicates that the strongest statement that one can make concerning the distribution of income is summarized in what is called the Pareto criteria. The Pareto criteria states that economists should limit their improvement recommendations to changes that can leave at least one person better off and no one worse off. To do more than this is to exceed the limits of classical economic thought. One comes into the economic "game" with whatever endowment of economic resources was previously possessed. The classical economist will direct individuals in the pursuit of economic well being to the extent that it does not violate the Pareto criteria.

The Pareto criteria is quite powerful in the economic conclusions it supports. We will consider the Pareto criteria in greater depth by looking at the Edgeworth box diagram (also known as the Edgeworth - Bowley diagram).

figure II-4



The Edgeworth box is a combination of the indifference space for consumer A combined with the indifference space for consumer B. Consumer A uses the SW corner as the origin and Consumer B uses the NE corner as the origin. Indifference curves for both are provided. As in our discussion of leisure, there are an infinite number of indifference curves with just a few examples actually illustrated. However, our examples for each consumer are selected such that we have a tangency point between pairs of indifference curves. The line (probably not straight) that connects all of the tangency points is called the contract curve. (Let consumer A represent low and middle income people and let consumer B represent upper middle and upper income people.)

The contract curve is of particular importance because this is the curve the indicates all the points that are **Pareto Optimal.** That is, if you select a point that is not on the contract curve, a point on the contract curve can always be found that will make one consumer better off without making the other consumer worse off.

These points of tangency also have other important properties. A tangent line is a straight line that touches (not intersects) a curve at a single point. The slope of the straight line defines the slope of the curve at the point of tangency. Now we have defined the point of tangency between the indifference curves of the two consumers as a point of Pareto Optimality and indeed it is. However, we can superimpose a tangent line over the same point that the two consumers' indifference curves share at their point of tangency. We can extend that tangency line to the borders of the Edgeworth Box. This tangency line now defines the budget constraints of the two consumers as well as the price ratio of the two goods in question (See our discussion above in our discussion of a single consumer).

If we look at the sum of the two budget spaces as total community (or National) income, we see that the Edgeworth box is a good indicator of the distribution of income. If the budget constraint moves closer to the SW corner, then consumer A has less income and Consumer B has more. If the budget

constraint moves closer to the NW corner, then Consumer B has less income and Consumer A has more income.

The Pareto criteria makes absolutely no judgement as to where this budget line should be placed, i.e. where on the contract curve is "best" for society (and is therefore perfectly consistent with a situation of nationwide depression and massive unemployment).

Before this year's (day's, month's, century's etc.) economic "game" begins people are assumed to have an initial endowment of economic resources (wealth, education, etc.). It is assumed that this endowment defines the budget that the consumer will enter the "game" with. The classical view is that a decision by the government to redistribute income in favor of one consumer or the other is an unwarranted imposition.[91]

Who exactly was Vilfredo Pareto whose philosophy is the foundation of Microeconomic Welfare theory? The Reader's Encyclopedia reports:

> ...Pareto's contempt for democratic institutions being well known, Moussolini and his followers claimed him as the creator of fascist ideology.[92]
>
> [Fascism: Doctrine; collection of concepts; and dictatorship by government of a country, often involving hostile nationalistic attitudes, racism, and private

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[91] see Francis M. Bator, "The Simple Analytics of Welfare Maximization", *American Economic Review* (March 1957), 22-59 for a more detailed analysis of the Edgeworth Box...

[92] *The Reader's Encyclopedia*, 2nd ed, 1965, s. v. "Vilfredo Pareto"

economic ownership under rigid government control. A fascist regime is often militarily belligerent.[93]]

Is it shocking that a criteria derived from the "creator of fascist ideology" is the cornerstone of modern (Microeconomic) Welfare Theory?

Klein in his *The Keynesian Revolution* interprets Keynes' view of fascism:

> The demagogue thrives on mass unemployment. The psychology of the unemployed worker is such that he is willing to listen to many dangerous arguments if they hold promise of a job. There are not many social conditions that are more depressing than forced idleness and forced abstinence from consumption. If **fascistic** demagogues can promise jobs, the unemployed workers may follow even if the job is one of producing bullets. It is no accident that Nazis grew powerful in Germany during times of unemployment and economic dislocation. It is also no accident that native **fascists** in the United States gained great followings during the decade of the thirties through promises of improved economic conditions. Thus there is one type of solution to the unemployment problem in a capitalistic economy which will be brought about by natural forces if we adopt a do-nothing attitude. There will appear on the scene the **fascists**, who will bring about full employment by producing armaments in preparation for war. The need to avoid such a solution shows clearly the importance of understanding the problem and of solving it by democratic methods.
>
> ...
>
> **Fascism** ... represents the worst stage of capitalism. It is the form that our capitalist society will acquire unless we are successful in bringing about Keynesian reforms ... .[94]

How attractive the call to arms, drug trafficking, car-jacking, etc. and a general disregard for traditional society and its legal institutions are today for a ever increasing segment of our society. How important are new theories that

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[93] *Barron's Student's Concise Encyclopedia*, 1988 ed, s.v., "Fascism".

[94] Lawrence R. Klein, *The Keynesian Revolution*, 2nd ed. (New York: The Macmillan Company, 1966). 166-167.

will take us to full employment and provide a greater attraction for *potential* law breakers to become a part of mainstream society and not yield to the temptation of general fascist illegality.

Galbraith examines the personality of Vilfredo Pareto (1848-1923) and has this conclusion:

> ...His (Pareto's) defense of the classical system, was its view of the distribution of income. Looking at elementary statistical data, including those from early income tax returns, he concluded that in all countries at all times income was distributed in much the same way. The curve showing the shares accruing to the rich and the poor remained basically unchanged. This distribution was far from equal; yet it reflected, in his opinion, the distribution of ability and talent in the social order. Those deserving of wealth were few as compared with the multitude deserving of poverty, and those deserving of great wealth were very few indeed. This was Pareto's law of income distribution. Like Social Darwinism, it was perhaps, too convenient--or flagrant; as a defense of the classical system, its authority has now largely gone. Among other things there is evidence that the distribution of income can be made more equitable. But again there are still echoes; there remains the sense that there is a normal inequality in the system that is justified by initiative and talent.[95]

The echoes that Galbraith speaks of have gotten louder and louder in the past 10-15 years or so. The contrast between classical economic views and post-Keynesian economic views to a large extent define the difference between what might be called "political" views of income distribution.

The Political Economy is therefore not absolute in its judgement about income distribution. But we will review empirical evidence of income

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[95] John Kenneth Galbraith, *Economics in Perspective*, (Boston: Houghton Mifflin Company, 1987), 124.

distribution during the age of Automation to see what descriptive conclusions can be reached. However, as a prelude consider the following exercise I have used with my Introductory Macroeconomics students. The students are presented with the following income distribution data found in their textbooks:

Table II-6 **U. S. Income Distribution by Quintiles, 1988**

Quintiles (lowest income in quintile)	% of National Income Commanded by each Quintile
First.....$0	4.6%
Second..... $15,100	10.7%
Third.....$26,200	16.7%
Fourth.....$38,500	24.0%
Highest.....$55,900	44%

Source: Henderson and Poole, Principles of Microeconomics (Lexington, Massachusetts: D.C. Heath and Company, 1991) p. 413

The students are then asked "What is the lowest income coalition of quintiles that represent a voting majority?" The answer of course is the first three. The next question is "Why don't the first three quintiles (who are the majority) vote to tax the highest two quintiles such that no one will have very high incomes?" The answer in the Introductory Class is understandable silence. Unfortunately, the answer in many advanced circles is also silence. The automatic stabilizer provided by the political majority of low income groups is often overlooked. Economic leadership is expected from the upper two fifths that will increase

national income so that not only are the rich getting richer but the poor are getting richer as well. Failing good leadership by the top two-fifths, we can expect rebellious behavior from the first three quintiles, as indeed should be the case in a capitalistic democracy.

A Rational Expectations View of the Distribution of Income

As students of economic philosophy, we are very interested in "new" theories of economic behavior. Rational Expectations as one of the newest of these theories is therefore a subject of central focus.

The Rational Expectations hypothesis is:

> The idea that people form their expectations regarding future values of economic variables by using all information that is available to them. This means that individuals will not systematically err in forming expectations.[96]

The wisdom of the most sophisticated econometric modeling economist is assumed to attain to less sophisticated economic agents(workers, managers, etc.). If the agent does not develop good information independently, the agent can buy good information from the sophisticated econometrician.[97] "Private

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[96]William J. Boyes. *Macroeconomics: The Dynamics of Theory and Policy* (Cincinnati, Ohio: Southwestern Publishing Co. 1984), 525.

[97] R. Maddock and M. Carter, "A Child's Guide to Rational Expectations", *Journal of Economic Literature* vol. XX (March 1982),p. 45 note 30.

economic agents are intelligent decision makers and can be expected to take the effects of government policy changes into account in deciding their behavior."[98]

This assumed agent economic intelligence is used to explain government stabilization policy impotence. If the agents are sophisticated and realized that the economy is already at maximal output, government policies designed to increase demand, output and employment will simply be seen as sources of inflation. Increases in government spending or in the money supply increase nominal income that if believed to be real income will call forth increased employment and produce output greater than the normal capacity of the economy. Excess demand will call forth higher prices and this inflation will lower the value of the increased income. While originally consumers might be fooled into participating in such a plan, eventually agents will no longer be fooled and demonstrate this by perhaps adopting Cost of Living Adjustments to respond to the inflation.[99]

What an interesting theory! However, we must assume that the economic sophistication is not limited to monetary and fiscal policy. If the government should try to fool economic agents in other facets of economic thought, this should be identified and responded to in a similar "rational" manner.

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[98] Maddock and Carter, 48.

[99] R. Maddock and M. Carter, "A Child's Guide to Rational Expectations", *Journal of Economic Literature* vol. XX (March 1982),42-43.

But what if the deception is not simply due to government "deception" but also to concurrent "deception" by sophisticated economists as well. We have previously pointed to: 1) the logic behind the progressive income tax, 2) the ability of the lower 3/5ths of income recipients to vote any tax increase they see fit on the top 2/5ths of income recipients in a democracy such as America's. 3) the logical reluctance of the electorate to undertake the policy of #2 if the top 2/5ths are providing proper economic leadership that provides increased real incomes for all. Now however, assume that economics courses begin to teach the potential irrationality of social welfare functions. That is, you can't be certain the income redistribution will increase total welfare in the Pigou sense. This indoctrination continues for a generation and then the government tests the success of the new doctrine by attempting to impose a "regressive" tax. If agents have accepted the "sophisticated judgement of economists" then they will accept regressive taxation.

> The government's policy of cutting taxes on the rich even as their income skyrocketed has made the shift in inflation adjusted *after-tax* incomes especially striking. For middle- and lower-income families in the first three fifths of the income scale, after-tax incomes actually declined since 1977.[8] The after-tax incomes of families in the fourth 20 percent grew by only one percent over 15 years. *But the after-tax income of the richest 1 percent of the population jumped by a staggering 136%*

[8]Families in the middle fifth of the income scale, for example, will see their pretax income (in 1992 dollars) fall from $34,505 in 1977 to $31,970 in 1992-a decline of 7%. After-tax income for this

group is expected to fall by 8% from 1977 to 1992 (a reflection of their highest effective tax rate).[100]

For a 15 year period the American public has accepted regressive taxation. It is only in the early 1990s that the regressive trend has been moderately reversed.

What does this say of rational expectations? Can the American public be fooled about matters of economics? Via the above quote, it appears so.

Using similar logic, Wessels concludes:

> *Expectations may not be rationally formed.* For example, stock market prices (which are in effect forecasts of how firms will do in the future) appear to vary much more than any underlying changes in the economy seem to justify. If so, it may be a reasonable government policy to act to offset unreasonable expectations on the part of the public.[101]

The distribution of income is thus our second measure of economic welfare. In Part Three we will examine distribution of income data to help ascertain the economic welfare of our great country in the age of automation.

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[100]Robert S. McIntyre, *Inequality and the Federal Budget Deficit*,(Washington D.C.: Citizens for Tax Justice, 1991), 6.

[101]W.J. Wessels, *Economics*,(New York: Barron's, 1987). 206.

Unemployment

Classical View of (Un)employment

When we use the term "classical", we are referring to Macroeconomic thought prior to Keynes. A major part of Classical thought can be summarized in what is known as Say's Law (named for Jean Baptiste Say [1767-1832])

Say's Law claimed that overproduction was impossible in an economy since production was a response to what could actually be purchased. A person or firm produces a product and gets paid for that product. All of the receipts from the sale of product will be expended somewhere in the economy. The amount demanded by an entity will exactly equal the compensation that entity received for the goods or services produced. Inadequate aggregate demand was as impossible as overproduction.

If a person is unemployed, that unemployment must be the result of a) refusal of labor to accept a reduction in wages due to a reduced demand or b) demanding a wage in excess of the value of the worker's marginal product.[102]

Keynesian View of Unemployment

It is unfortunate that fallacious economic theories are not dismissed in academic circles before they cause irreparable damage to an economy and its inhabitants. Say's Law is indeed a case in point. The continued belief in

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[102] John Kenneth Galbraith, p. 74-77.

fallacious logic led us into the Great Depression. Were it not for Keynes, where would America be today?

Keynes writing in his 1935 classic *The General Theory* clearly indicates his disapproval of standard classical economic thought regarding unemployment (i.e. Say's Law):

> Moreover, the contention that the unemployment which characterises a depression is due to a refusal by labour to accept a reduction of money-wages is not clearly supported by the facts. It is not very plausible to assert that unemployment in the United States in 1932 was due either to labor obstinately refusing to accept a reduction of money-wages or to it obstinately demanding a real wage beyond what the productivity of the economic machine was capable of furnishing. Wide variations are experienced in the volume of employment without an apparent change either in the minimum real demands of labour or in its productivity. Labour is not more truculent in the depression than in the boom--far from it. Nor is its physical productivity less. These facts from experience are a *prima facie* ground for questioning the adequacy of the classical analysis.[103]

The Vocabulary of Modern Employment Theory

The terminology of employment is fairly standardized, yet subject to misinterpretation by a novice. Let's review the major terms.

The labor force has two major components: 1) the *employed* - those who are actually have wage compensated employment and 2) the *unemployed* those who are actively seeking a job and who have not exhausted their unemployment

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[103] John Maynard Keynes, *The General Theory of Employment, Interest and Money*, (New York: Harvest/Harcourt Brace Jovanovich, 1964), p. 9

benefits. If a person is in neither of these two categories, then that person is consider to be *not in the labor force.*

At times the above definitions are considered inadequate descriptions of reality. Certain additional definitions have been developed. 1) *underemployed* - a person is underemployed if one cannot find employment that matches or exceeds one's education and/or skill level. 2) a *discouraged worker* has exhausted all unemployment benefits, yet is still ready, willing and able to work. To say that this person is not in the labor force is of course not in fact entirely accurate, but officially this is the case.

The discouraged worker classification undoubtedly goes a long way towards better describing reality. A major criticism of the unemployment statistics has been the removal of people from the labor force if they are unable to find a job during the period of unemployment compensation, when they may genuinely desire work but cannot find it. If a person is ready, willing and able to work but unemployed, should he not be considered in the labor force?

The primary published employment statistic is the unemployment rate which is the percentage equivalent of the ratio of the number of unemployed/total labor force. The lower this number, the better the evaluation of those in charge of public administration. However, if half of those receiving unemployment benefits are scheduled for benefit exhaustion in 1 week, then the unemployment

rate may fall by 50% in one week without any additional employment. The unemployment rate may therefore be an inadequate measure of unemployment as a national economic welfare indicator. We will look more closely at this economic welfare indicator in Part Three and investigate methods that can be utilized to make the measure a more accurate welfare measure.

In policy analysis there is often the need to characterize types of unemployment. Frictional, structural, seasonal, cyclical and demand deficient are frequently used terms; 1) *Frictional Unemployment* results when one is searching for a job that does exist and the search is expected to be a short one. If the job match occurred instantaneously, of course there would be no "friction" at all. Because it takes time and effort for job search even when the job search will shortly be successful, this type of unemployment is expected in a market economy that has computer technology, yet does not fully utilize that technology to help minimize job search time and effort (friction). 2) *Structural unemployment* results when jobs are available, but the jobs do not match the skills and/or location of the labor force. 3) *Seasonal Unemployment* is a direct result of seasonal employment opportunities that occur during the same season every year (Summer, Winter, Ski, Football, etc.). When the employment season is not occurring, of course there is the possibility of seasonal unemployment. 4) *Cyclical Unemployment* results as a function of the long-term business cycle.

There are cycles in market economies such that at the peek of those cycles aggregate demand is greater and in the low points of the cycles demand is decreased. 5) *Demand Deficient* unemployment results when a decrease in the demand for a product or service decreases and management's response is to decrease employment.[104]

Natural Rate of Unemployment or the NAIRU?

Summers and Clark credit Friedman ("The Role of Monetary Policy", 1968) as publishing the most well-known statement supporting the argument that "reducing the unemployment below some 'natural' rate would be a step away from economic efficiency."[105]

In the referenced Friedman article, Wicksell's term 'natural rate of interest' is discussed. Friedman indicates:

> The monetary authority can make the market rate less than the natural rate only by inflation. It can make the market rate higher than the natural rate only by deflation.[106]

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[104] The types and classifications of unemployment are more fully discussed by; R.G. Ehrenberg and R.S. Smith. *Modern Labor Economics*, (Glenwood Ill.: Scott Foresman and Company, 1988), p. 584-605 and F.R. Marshall and V.M. Briggs, Jr., *Labor Economics*; Sixth Edition, (Homewood, Ill.: Irwin, 1989), Chapter 4.

[105] K.M. Clark and L.H. Summers, "Labor Market Dynamics and Unemployment: A Reconsideration", *Brookings Papers on Economic Activity*, 1:1979: 15.

[106] M. Friedman, "The Role of Monetary Policy" in *Reading in Money, National Income and Stabilization Policy: Revised Edition, 1970* (Homewood, Ill., 1970), W.L. Smith and R.L. Teigen, eds.,p.481.

Friedman suggests that the 'natural rate of interest' is analogous to the 'natural rate of unemployment': "...As in the interest rate case the 'market' rate (of unemployment) can be kept below the 'natural' rate only by inflation".[107]

Friedman argues that the exclusion of the Fisher distinction between nominal and real rates of interest are a weakness of both Wicksell's discussion of natural rates of interest and Phillips' discussion of the tradeoff between inflation and unemployment.

Reynolds presents the term 'natural' rate of unemployment as a misnomer:

> ...but this label does not seem useful. It is no more 'natural' than other rates corresponding to other levels of aggregate demand. it may or may not be regarded as a desirable policy target. ...[108]

In its stead, he supports the use of the term NAIRU, i.e. the Non-Accelerating Inflation Rate of Unemployment. NAIRU = the unemployment rate below which the inflation rate will begin to rise.

Okun's Law - Unemployment is More Costly Than You Might Think

Okun's article "Potential GNP: Its Measurement and Significance"[109] is a popular reference when discussing the costs of unemployment. Potential GNP

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[107]Friedman, p. 483.

[108] L.G. Reynolds, *Macroeconomics: Analysis and Policy - Sixth Edition*, (Homewood, Ill., Irwin, 1988),p. 192-3.

[109] A.M. Okun, "Potential GNP: Its Measurement and Significance" in *Readings in Money, National Income and Stabilization Policy: Revised Edition: 1970* (Homewood, Ill., 1970) W.L. Smith and R.L. Teigen, eds., p. 313-322.

is compared to Actual GNP. Potential GNP reflects the economy efficiently using all of the economic resources at its disposal in order to maximize output. To the extent that the economy has unemployed or underemployed resources, we have a gap between the economy's potential GNP and actual GNP.

According to Okun:

> Potential GNP is a supply concept, a measure of productive capacity. But it is not a measure of how much output could be generated by unlimited amounts of aggregate demand. ... In estimating Potential GNP, most of the facts about the economy are taken as they exists: technological knowledge, the capital stock, natural resources, the skill and education of the labor force are all data, rather than variables. ...[110]

Okun predicts (by three separate methods and confirmed by Solow in 1962) that GNP and unemployment are inversely related and a 1 percent change in unemployment implies a 3 percent change in GNP. This relationship is popularly known as **Okun's Law**. (Wessels reports a 1 percent change in unemployment implying a 2 percent change in GNP.[111] This evidently reflects the assumption of a weakening of Okun's Law through time.) Okun thus encourages us not to view a 4% vs. 5.5% unemployment rates as economic grades of 96.5% vs. 94.5%, which might appear as a slight difference. Instead we are encouraged to be cognizant of the full impact of Okun's Law.

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[110]A. M. Okun, p. 314

[111]W.J. Wessels, *Economics* (New York: Barrons), p. 187.

For example, 3% of 1984 real GNP of $1,639 billion = $49.17 billion dollars and this would be the loss GNP associated with 1% of labor unemployment below its fully capacity level (using Okun's original law).

Unemployment is listed by many as the number 1 symptom of the Economic sickness known as the U. S. Great Depression. In the 1990s it continues to be one of the major Economic concerns and certainly qualifies as an economic welfare indicator.

PART III

THE PARADOX

(ECONOMETRIC ANALYSIS AND DATA SETS)

Econometric Analysis

Number: EA-I.
Title: **Analysis of GNP and GDP magnitudes and growth rates**

In this analysis we look at Gross National Product and Gross Domestic Product. Gross Product has been previously discussed in this work, but a review of some key concepts is beneficial.

> GDP measures the value of all goods and services produced in America. GNP measures the total income of American residents, regardless of where it comes from; profits from a firm's overseas subsidiary as well as the earnings in America are included. This means that GNP is equal to GDP plus net income from abroad; profits, dividends and interest earned overseas minus income payable to foreigners (the profits of Japanese car factory in America, for instance.) ...
>
> ... America's GNP is only about 1% bigger than its GDP. ... [1]

The Gross Product is closely tied to economic welfare since an increase in Gross Product has the ability to marginally increase everyone's economic welfare without decreasing anyone's welfare. That is, we have potential economic welfare increase consistent with Pareto Optimality when we have economic growth.

Growth in Gross Product is very important in our age of high technology. If we assume that technological advance can eliminate some employment opportunities, it is reassuring to know that simultaneously, the level of Gross Product is increasing and potentially creating new employment opportunities. As technological change has a greater potential for employment reduction, economic growth is a welcomed potential counterbalance. Analogously, decrements in economic growth rates are conceivably more harmful in the presence of technological unemployment. Thus the growth of Gross Product is very important in the Automation Age.

Let's begin with a graphic view of GNP and GDP. Figures EA-I-1, EA-I-2 are our references. Time is expressed in years while GNP and GDP are expressed in log form.[2] With this format, the slopes of the lines connecting data points are reflective of the growth rate

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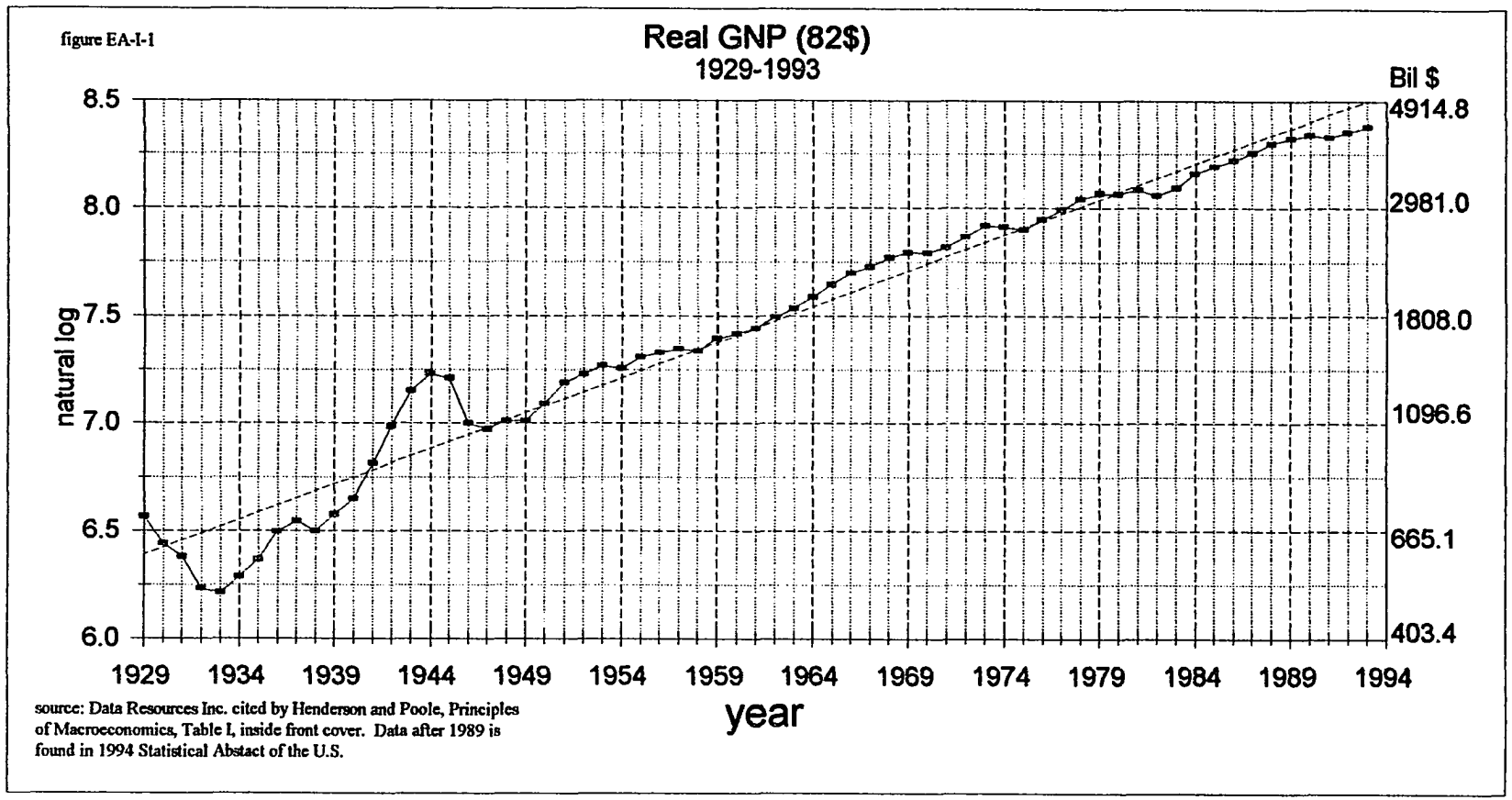
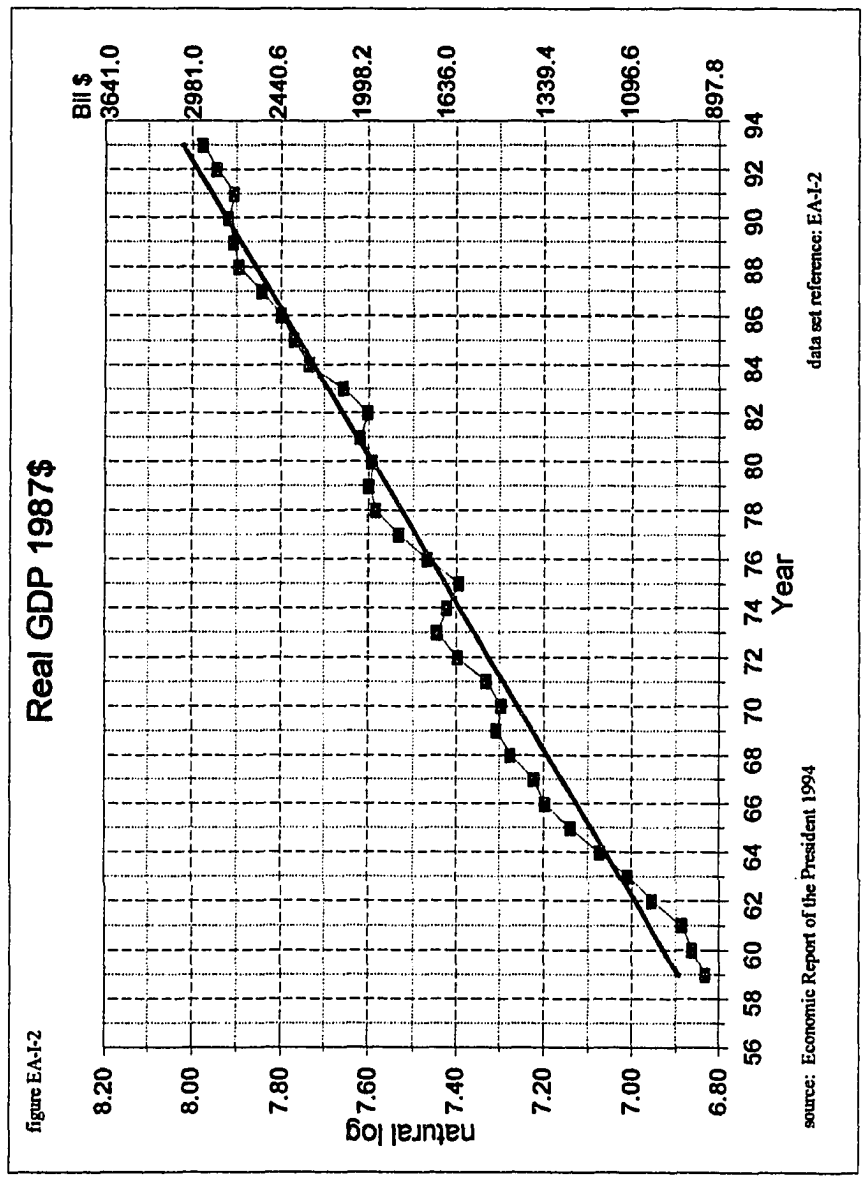
[1] *The Economist*, September 21-27, 1991 cited by: Michael Parkin, *Macroeconomics: Second Edition*, (Reading, MA: Addison-Wesley Publishing Company, 1993), p.142.

[2] This format is discussed by: Morris Hamburg, *Statistical Analysis for Decision Making*, (New York: Harcourt, Brace, Jovanovich, 1977), pp 461-3.

figure EA-I-1



source: Data Resources Inc. cited by Henderson and Poole, Principles of Macroeconomics, Table I, inside front cover. Data after 1989 is found in 1994 Statistical Abstact of the U.S.



occurring between data points. The steeper the slope, the greater the growth rate. A negative slope implies a negative growth rate. Data points emanating from lines with approximately equal slopes imply approximately equal growth rates.

Regarding long term growth rate, we have used the least squares technique to develop trend lines for both GDP and GNP. The resulting equations are:

Model One: Developing GNP Least Squares Trend Growth Rate

Data Set Reference: EA-I-1

Model One MINITAB® REGRESS Results:

The regression equation is
lnGNP = 6.35 + 0.0331 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Constant	6.35361	0.02996	212.08	0.000
YRINDX	0.0330635	0.0007892	41.89	0.000

s = 0.1194 R-sq = 96.5% R-sq(adj) = 96.5%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	25.012	25.012	1755.18	0.000
Error	63	0.898	0.014		
Total	64	25.910			

Durbin-Watson statistic = 0.27

Model One Serial Correlation Correction

Full Maximum Likelihood Estimated Rho = 0.8700

The regression equation is
lnGNP = 6.42 + 0.0311 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Noconstant				
Intercept	6.42459	0.09315	68.97	0.000
YRINDX	0.031053	0.002330	13.33	0.000

s = 0.06050
Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	2	74.162	37.081	10131.89	0.000
Error	63	0.231	0.004		
Total	65	74.392			

Durbin-Watson statistic = 1.00

Model One Variable Dictionary

lnGNP= natural log of Gross National Product
YRINDX=year index with 1929=1 and 1993=65

Model Two: Developing GDP Trend Growth Rate

Data Set Reference: EA-I-2

Model Two MINITAB® REGRESS Results:

The regression equation is
lnGDP = 6.88 + 0.0327 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Constant	6.87862	0.01628	422.52	0.000
YRINDX	0.0327387	0.0007888	41.51	0.000

s = 0.04713 R-sq = 98.1% R-sq(adj) = 98.1%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	3.8264	3.8264	1722.76	0.000
Error	33	0.0733	0.0022		
Total	34	3.8997			

Durbin-Watson statistic = 0.39

Model Two Serial Correlation Correction

Full Maximum Likelihood Estimated Rho = 0.8151

The regression equation is
lnGDP = 6.86 + 0.0332 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Noconstant				
Intercept	6.85843	0.04078	168.20	0.000
YRINDX	0.033157	0.001857	17.86	0.000

s = 0.02858

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	2	83.521	41.761	51122.26	0.000
Error	33	0.027	0.001		
Total	35	83.548			

Durbin-Watson statistic = 1.37

Model Two Variable Dictionary

lnGDP= natural log of Gross Domestic Product
YRINDX=year index with 1959=1 and 1993=35

The year index coefficients in the above regressions are the long-term trend estimates of annual percentage growth. Thus we estimate least squares trend growth of GNP from 1929-93 as 3.11% and we estimate least squares trend growth of GDP from 1959-93 as 3.32%. These least squares trends can be used as reference values. Growth below the reference value implies less potential economic welfare, while growth above the reference value implies more potential economic welfare. Least squares trend growth results from the minimization of the sum of squared errors about a regression line, while arithmetic averages simply sum all annual growth rates and divides by the number of observations. Both measures are used in economic literature. In the remainder of this analysis we will look at arithmetic growth averages. We will demonstrate how analysis of the variances of arithmetic growth averages can lead to different conclusions when longer term results are compared to shorter term results.

Also, we will see that arithmetic averages that seem significantly different, may not be *statistically* significantly different. This result causes a questioning of the veracity of statistical significance. Yet, we conclude by showing that statistical significance applied to shorter time horizons can and do confirm the suspicion of a "productivity slowdown".

A review of arithmetic growth averages for selected time periods is instructive.

table EA-I-1 time period	real GNP growth	real GDP growth
1930-93	2.84%	N/A
1960-93	2.89%	3.36%
1950-73	3.77%	N/A
1960-73	3.72%	4.35%
1974-93	2.31%	2.67%

1960s	3.97%	4.74%
1970s	2.76%	2.91%
1980s	2.55%	3.09%
1990s	1.42%	1.71%
Source: Data Sets EA-I-1 and EA-I-2		

At this point, we have sufficient evidence to announce (among other things) a slowdown in productivity since the 1970s compared to the 1960s.

However, many Econometricians say: "Ah, but are the mean differences 'statistically significant'?" The apparent implication being that if the differences are not statistically significant, we cannot unequivocally proclaim a "productivity slowdown".

Now, 2.23% GNP mean growth for the 80s & 90s is less than 3.97% mean GNP growth for the 1960s. Are we compelled to demonstrate 'statistical significance' to claim that such a difference is "important", "meaningful", "substantial", "consequential", and so forth? I think not. However, we are nonetheless compelled to seriously address the concept of "statistical significance", if for no other reason than to seriously respond to the Econometricians whose influence in contemporary economics is quite *significant*.

If the observations that contribute to the mean have large average deviations from the mean, then the corresponding "confidence interval" will be wider. If confidence intervals for different means are wide enough to overlap, then we cannot say that the differences in the means are statistically significant. The greater the level of confidence we seek, the wider the confidence intervals will be.

Let's analyze and compare the variances for the above means.

Model Three: Analyzing the Variances in Mean GNP Growth Rates

Data Set Reference: EA-I-1

Model Three MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE ON GNP Growth Rates

SOURCE	DF	SS	MS	F	p
Between Samples	8	0.00406	0.00051	0.32	0.957
Within Samples	201	0.31744	0.00158		
TOTAL	209	0.32150			

LEVEL	N	MEAN	STDEV
1930-93	64	0.02835	0.06213
1960-93	34	0.02892	0.02231
1950-73	44	0.03108	0.02589
1960-73	14	0.03724	0.01710
1974-93	20	0.02309	0.02403
1960s	10	0.03971	0.01387
1970s	10	0.02756	0.02566
1980s	10	0.02545	0.02487
1990s	4	0.01397	0.01824

Tukey's pairwise comparisons

Family error rate = 0.0500
Individual error rate = 0.00197

Critical value = 4.44

Intervals for (column level mean) - (row level mean)

	1930-93	1960-93	1950-73	1960-73	1974-93	1960s	1970s
1960-93	-0.02705 0.02591						
1950-73	-0.02717 0.02170	-0.03066 0.02632					
1960-73	-0.04571 0.02791	-0.04795 0.03129	-0.04445 0.03212				
1974-93	-0.02670 0.03722	-0.02933 0.04099	-0.02565 0.04165	-0.02932 0.05764			
1960s	-0.05379 0.03106	-0.05568 0.03409	-0.05234 0.03508	-0.05412 0.04919	-0.06495 0.03170		
1970s	-0.04164 0.04321	-0.04353 0.04624	-0.04019 0.04723	-0.04198 0.06134	-0.05280 0.04384	-0.04365 0.06794	
1980s	-0.03953 0.04532	-0.04142 0.04835	-0.03808 0.04934	-0.03987 0.06345	-0.05069 0.04596	-0.04154 0.07006	-0.05369 0.05791
1990s	-0.04992 0.07868	-0.05100 0.08090	-0.04804 0.08228	-0.04746 0.09401	-0.05922 0.07746	-0.04807 0.09956	-0.06022 0.08741

	1980s
1990s	-0.06233 0.08530

Model Four: Analyzing the Variances in Mean GDP Growth Rates

Data Set Reference: EA-I-2

Model Four MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE ON **GDP Growth 1960-93**

SOURCE	DF	SS	MS	F	p
Between Samples	6	0.005608	0.000935	1.10	0.368
Within Samples	95	0.080718	0.000850		
TOTAL	101	0.086325			

LEVEL	N	MEAN	STDEV
1960-93	34	0.03360	0.02953
1960-73	10	0.04744	0.01853
1974-93	10	0.02905	0.03825
1960s	10	0.03092	0.02886
1970s	4	0.01707	0.02407
1980s	14	0.04347	0.02320
1990s	20	0.02669	0.03200

Tukey's pairwise comparisons

Family error rate = 0.0500
Individual error rate = 0.00332

Critical value = 4.26

Intervals for (column level mean) - (row level mean)

	1960-93	1960-73	1974-93	1960s	1970s	1980s
1960-73	-0.04543 0.01775					
1974-93	-0.02704 0.03613	-0.02088 0.05766				
1960s	-0.02891 0.03427	-0.02275 0.05579	-0.04114 0.03740			
1970s	-0.02988 0.06295	-0.02157 0.08232	-0.03996 0.06393	-0.03809 0.06580		
1980s	-0.03776 0.01801	-0.03239 0.04032	-0.05078 0.02193	-0.04891 0.02380	-0.07619 0.02337	
1990s	-0.01783 0.03165	-0.01326 0.05476	-0.03164 0.03637	-0.02977 0.03824	-0.05772 0.03847	-0.01381 0.04738

Using the ANOVA technique, the F-tests show no evidence of statistically significant differences in the means that we identified in table EA-I-1 and the Tukey-test does not contradict the F-test conclusion. Therefore a hypothesis of statistically different means in Table EA-I-1 must be rejected. We may claim important differences but not statistically significant differences in the means.

Econometricians may state that attaching too much importance to the differences in the means could be exaggeration to be tempered by the statistical reality of the situation.

We could end our analysis of Gross Product at this point. *However,* we remind ourselves of the devastation of the Great Depression. Guarding against the reoccurrence of such a disaster is certainly consistent with Economic Welfare maintenance and improvement. We are in need of a more sensitive model that will separate economic growth rates that are at or near production possibility from growth rates that are in danger of repeating depression performance. We are therefore inspired to a more sensitive analysis of Economic Growth.

A More Sensitive Analysis of Economic Growth

Except for the 1990s, table EA-I-1 includes no period less than 10 years in length. The longer the analysis period, the longer the economy has to conceal multi-year periods of poor performance and distort their true impact.

On the other hand, if our analysis period is only a single year, we may have a bad growth rate year in the midst of outstanding growth rate years. In such a situation we would not want to identify the *era* as one of poor growth.

In essence, we want to identify epochs short enough to identify multi-year periods of poor growth rates but not so short as to overlook the potential neutralizing effect of strong growth rates in the neighborhood of a year (or two) of weak growths.

We will look at 5 year periods in a quest for more sensitive analysis. This choice of horizons is not arbitrary, given the convention of 5 (and 10 year) horizons in long-term business planning[3]. Alternately, we could have used 4 year periods corresponding to Presidential elections or any other logical configuration.

However, semi-decade analysis beginning with 1930 has the attraction of isolating: 1) the 4 worse contiguous years of the Great Depression, and 2)the 5 highest contiguous years of American economic

[3] For instance see: John J. Hampton, *Financial Decision Making: Fourth Edition*, (New Jersey: Printice Hall, 1989), p.302.

growth, i.e. the 1940-44 World War II era. This isolation will prove central in our quest to separate semi-decade periods of strong growth rates vs. those of depression prone growth rates.

Let's now apply our tools of variance analysis to 5 year GNP mean growth periods in search of significant differences that were not have previously been revealed. This is accomplished in Model Seven:

Model Five: Comparing GNP growth rates in 5 year groups beginning in 1930-34 and ending with 1990-93 (the only 4 year group)

Data Set Reference: EA-I-1

Model Five MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE ON GNP Growth Rates

SOURCE	DF	SS	MS	F	p
Between Groups	12	1231.6	102.6	4.48	0.000
Within Groups	51	1169.5	22.9		
TOTAL	63	2401.2			

LEVEL	N	MEAN	STDEV
1930-4	5	-5.578	8.467
1935-9	5	5.776	6.527
1940-4	5	13.090	4.925
1945-9	5	-4.366	9.664
1950-4	5	4.888	4.365
1955-9	5	2.800	2.725
1960-4	5	3.833	1.410
1965-9	5	4.108	1.513
1970-4	5	2.378	2.702
1975-9	5	3.134	2.675
1980-4	5	1.847	3.486
1985-9	5	3.242	0.734
1990-3	4	1.418	1.838

Tukey Intervals for (column level mean) - (row level mean)

	1930-4	1935-9	1940-4	1945-9	1950-4	1955-9	1960-4
1935-9	**-21.870** **-0.839**						
1940-4	**-29.184** **-8.153**	-17.829 3.201					
1945-9	-11.728 9.303	-0.373 20.657	**6.941** **27.971**				
1950-4	-20.981 0.049	-9.627 11.404	-2.313 18.718	-19.769 1.262			
1955-9	-18.894 2.137	-7.540 13.491	-0.225 20.805	-17.681 3.349	-8.428 12.603		
1960-4	-19.926 1.104	-8.572 12.458	-1.258 19.773	-18.714 2.317	-9.461 11.570	-11.548 9.483	
1965-9	-20.201 0.829	-8.847 12.184	-1.533 19.498	-18.989 2.042	-9.735 11.295	-11.823 9.208	-10.790 10.241
1970-4	-18.471 2.559	-7.117 13.914	**0.197** **21.228**	-17.259 3.772	-8.005 13.025	-10.093 10.938	-9.060 11.970
1975-9	-19.227 1.803	-7.873 13.157	-0.559 20.472	-18.015 3.016	-8.762 12.269	-10.849 10.182	-9.816 11.214
1980-4	-17.941 3.090	-6.586 14.444	**0.728** **21.758**	-16.728 4.302	-7.475 13.556	-9.562 11.468	-8.530 12.501
1985-9	-19.336 1.695	-7.981 13.049	-0.667 20.363	-18.123 2.907	-8.870 12.161	-10.957 10.073	-9.925 11.106
1990-3	-18.149 4.157	-6.794 15.512	**0.520** **22.826**	-16.936 5.370	-7.683 14.623	-9.770 12.536	-8.738 13.569

	1965-9	1970-4	1975-9	1980-4	1985-9
1970-4	-8.785 12.245				
1975-9	-9.542 11.489	-11.271 9.759			
1980-4	-8.255 12.776	-9.985 11.046	-9.229 11.802		
1985-9	-9.650 11.381	-11.380 9.651	-10.624 10.407	-11.910 9.120	
1990-3	-8.463 13.843	-10.193 12.113	-9.437 12.870	-10.723 11.583	-9.328 12.978

Tukey's pairwise comparisons

Family error rate = 0.0500
Individual error rate = 0.00106

Critical value = 4.91

Important concepts in an evaluation of GNP growth rates are *economic capacity* and *engineering (=physical) capacity*[4].

At economic capacity, the economy is operating on its production possibility curve (full employment of all productive resources), efficiently utilizing (no underutilization) economic resources and operating at minimum per unit cost. Economic capacity reflects prevailing values and norms, such as limits on workweek and work day time. Economic capacity is sustainable over the very long-run.

Engineering (=physical) capacity is the maximum output that an economy is capable of producing albeit with non-minimum unit costs. Factories may be operating 24 hours per day and individuals will be working at their maximum of 16 hours per day and 7 days per week, perhaps in atypical roles. Since engineering capacity deviates from usual norms, it can be expected to be embraced only during times of war or other similar (national) emergencies.

Economic capacity and engineering capacities are theoretical concepts. However, we can approximate views of these concepts through a perusal of our semi-decade intervals.

When we look at the 13.1% average growth for 1940-4, this probably is reflective of operating the economy at (or near) it's engineering capacity. No other 5 year period in this century, before or since approaches this high rate of growth.

With economic capacity we have no underutilized resources and we are operating in a minimum unit cost configuration. Economic Capacity, i.e. full resource employment is an achievable and desirable long term goal. However, it is difficult to define exactly what economic capacity is. Reynolds states: "Surveys of businesses suggest that economic capacity is typically in the neighborhood of 90 percent of engineering capacity."[5]

The Automation Age for non-military American Industry is definitely post-World War II and given an allowance of 5 years(1945-49)for transition from war time to peace time production, we might estimate the beginning of the Automation Age as 1950.

Since 1950 with about 9 five year periods, there have been only 3 of

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[4] Lloyd G. Reynolds, *Macroeconomics: Analysis and Policy: Sixth Edition*, (Homewood, Ill: Irvin, 1988), p. 222.

[5] Lloyd G. Reynolds, *Macroeconomics: Analysis and Policy: Sixth Edition*, (Homewood, Ill: Irvin, 1988), p. 222 & . J. Vernon Henderson and William Poole, *Principles of Macroeconomics*, (Lexington, MA: D. C. Heath, 1991), pp. 433-34.

our five year periods that have been statistically significantly different from our referential 1940-44 period. These periods are 1970-4, 1980-4, and 1990-3.

If we use the absence of statistical significant difference as an indication of operating at or near economic capacity, then the three periods 1970-4, 1980-4 and 1990-3 are periods of below economic capacity operation. (Here, we are using the results of the Tukey test procedure.)

Looking backwards at the four 5 year periods before 1950 (including the Great Depression), there are only two periods, 1930-4 and 1945-9, that are significantly different from our referential 1940-4 period.

1930-4 was the worst of the Great Depression. No subsequent five year period will be as dismal. But, any period that averages less than the 1940-4 period and is statistically different from the 1940-4 period can legitimately be called a *depression prone* period based on real GNP growth rate performance. That is, its deviation from a confidence interval about our referential engineering capacity period is certainly indicative of comparatively poor performance. Since the beginning of the Great Depression is the worse period, deviation from the engineering capacity can be considered depression prone.

In consideration of periods before 1950, the 1945-9 period should probably be excused. The American economy was recovering from a wartime mode in which durable goods rationing was in effect along with price controls. Much spending was government deferred to this post war period and the flood of previously repressed demand that was released during 1945-9 sought many goods that the war economy had not been able to produce. We had increased nominal but not real GNP due to the large increase in the price level. But unemployment rates were nowhere near their depression levels and this unusual period should therefore be excused.[6]

We have defined the term depression prone as being below and significantly different from our 1940-4 referential period. For a period not to depression prone is to imply that our economy operation is in the neighborhood of economic capacity.

In the past 65 years, only 25 years (5 periods) can be classified as depression prone. We have already justified separating two periods

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[6] Jonathan Hughes, *American Economic History* (Illinois: Scott Foresman and Co., 1983), 541-2.

(1930-4 and 1945-9). This leaves only 3 depression prone periods **all occuring within the past 25 years**. This is not a good phenomenon. We will not argue causation or trade-offs with other economic goals. In terms of economic growth, 15 of the past 25 years (including the current 5 year period) are depression prone. None of the 20 years 1950-69 can be classified as depression prone. As technology and technological unemployment (and technologically caused underemployment) are an increasing threat in the age of automation, the counterbalance of vigorous economic growth rates has become weaker. We are therefore compelled to judge the vast majority of the last 25 annual GNP growth rates as below economic capacity with the implication of a diminution of the potential economic welfare.

Now our concept of Depression Prone is not mainstream terminology (while statistical significance is). However there is a mainstream term that is related and that term is *recession*.

Amacher and Urbrich report the definition of recession as "a decline in real GNP for two or more successive quarters"[7]. Reynolds reports recessions in 1953-4, 1957-8, 1969-70, 1973-75 and 1981-2[8]. Parkin (writing after Reynolds) adds 1990-91 and 1991-92 as recession periods[9]. Our analysis is consistent with all but the 1953-4 and 1957-8 recessions. Our analysis indicates that the 1950 recessions were not sufficiently severe to cause their corresponding semi-decade periods to be labeled depression prone. It appears that our depression prone term is perhaps more rigorous than the mainstream term recession. This analysis simply amplifies the seriousness of the three 5 year depression prone periods in the past 25 years. GNP growth rates are currently disappointments in an economy that is being evaluated for welfare maximization.

Alternative View Points

Above we have provided evidence of significantly diminished GNP growth rates in the Age of Automation, in fact, in the past 25 years.

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[7] Ryan C. Amacher and Holly H. Ulbrich, *Principles of Economics: Fourth Edition*, (Cincinnati, South-Western Publishing Company, 1989), p.826

[8] Lloyd G. Reynolds, *Macroeconomics: Analysis and Policy: Sixth Edition*, (Homewood, Ill: Irvin, 1988), p. 228.

[9] Michael Parkin, Macroeconomics: Second Edition, (Reading, Mass.: Addison-Wesley Publishing Company, 1993), pp. 122, 175-76.

In a spirit of examining alternative conclusions (other than our depression prone finding), below we will briefly discuss the Underground economy as a possible source of hidden economic growth. Also, we will examine Griliches' argument that includes the assumption that some of the traditional economy production may be understated. Neither argument excuses the low growth rates disclosed above. However, the arguments are nonetheless quite interesting.

Subterranean Economics - A Digression

Professor Lusch has suggested that perhaps recent periods of less than capacity economic growth are compensated for by growth in the *underground economy*. This is an interesting hypothesis that we have sought to confirm or refute, although many, if not most, dollars of underground income imply impropriety of some sort.

A logical beginning would be a good general definition of the underground economy. Harry Greenfield has written a very definitive and summary book on this subject entitled *Invisible, Outlawed and Untaxed: America's Underground Economy*. Dr. Greenfield indicates that there is no *official* definition of the underground economy and proposes the adoption of the following:

> **...the production of goods and services that, for the most part, are *initially* undetected (and therefore unrecorded) in the U.S. national income and product accounts (NIPA).** The qualifying term *initially* is used since most of the incomes earned in the underground are ultimately spent for legitimate goods and services in the regular economy, and at that point, they are captured in the statistical net.[3]
>
> ...
>
> The underground economy is composed of ... 1) legal and unmeasured economic activity and 2) illegal and unmeasured economic activity.
>
> [3]For a systematic exposition of the national accounts see Carol S. Carson, "Gross National Product and Related Measures," in The Handbook of Economic and Financial Measures, ed.. Frank J. Fabozzi and Harry I. Greenfield (Homewood, Ill.: Dow Jones, Irwin, 1984) 3 and following.[10]

Given the above definition we can become more precise about the underground economy if we explore the Greenfield topology of underground economic activities. This topology helps to clearly delineate the underground economy and differentiate between actual underground activity and other illegal activity that may be thought of as underground, but actually isn't.

[10] Harry I. Greenfield, *Invisible, Outlawed and Untaxed: America's Underground Economy*, (Westport, Conn.: Praeger, 1993), pp. 2 &12.

Table EA-I-3 Typology of Underground Activities
Definitely Underground
Production and distribution of Drugs
Prostitution
Off-the-Books production of goods and services- (e.g. cash payment for tutoring, babysitting, unlicensed street vendors. Home repair services, etc.)
Child Pornography
Illegal Abortions
Video Piracy
Marginally Underground
Illegal gambling-redistributing income is not underground economy income, however the service of gambling recreation may be. Convention causes this category to often be included in underground economy.
Loan Sharking- mimics legal lending and therefore is considered part underground economy.
Barter - barter of newly created goods and services should be included (e.g. dental services for legal services) in underground economy, while barter for existing goods and services should not (e.g. a used snow blower for a used power saw.)
Do-it-Yourself - home repairs, mowing your own lawn, repairing appliances, etc. all reflect current output not recorded and is therefore consider part of underground.
Skimming=not recording part of sales or revenue. If employer is guilty, this is part of underground. If employee does this (=tax evasion), it is redistributive and not underground. If both are guilty then amount should be halved.
Cigarette-Liquor-gasoline Smuggling to avoid taxes - the manufacture is legal but the distribution is illegal and underground.
Illegal, But Not Part of Underground
Theft of all kinds: Personal, Household, Automobile, Employee Theft, Robbery, Burglary, Arson, Counterfeiting, Computer Crime, White Collar Crime (e.g. Securities Fraud)
source: Harry I. Greenfield, *Invisible, Outlawed and Untaxed: America's Underground Economy*, (Westport, Conn.: Praeger, 1993), pp. 7-13 .

Figure EA-I-3 is a time series estimate of understated *legal* underground income. The term *legal* here is misleading. What is actually meant is that the activities that generated the income are completely legitimate activities. The only potentially illegal part of this income is non-reporting. These activities are to be separated from activities that are illegal in their initial performance as well as in the improper reporting of income.

The basis of the estimates in Figure EA-I-3 are the corresponding tax gaps. Tax Gap is defined as the dollar amount of unpaid tax resulting from understated income from otherwise legal income activities. Separately graphed are corporation underreporting, the amount of income from low-income earners not required to file a tax form, and the amount of individual income underreported. The legal activity income line is derived from the tax gap by multiplying the total gap by 2.8, an estimating factor derived from IRS data.

Greenfield also provides rough estimates for the *entire* underground economy for the year 1990 in table EA-I-4 below. The illegal income numbers are considered very approximate and the potential for very great error is present. Greenfield himself states:

> Presented...are our estimates of unreported income from the illegal activities..., being fully aware of the very soft, and sometimes evanescent nature of the "guestimates" on which the dollar amounts were based. The seeming precision of numbers ought not blind us to the nature of their precise origins. ...[11]

Peter Reuter has written an article entitled *The (continued) vitality of mythical numbers*[12]. Reuther argues that many government agencies associated with anti-crime efforts, generate unfounded estimates of criminal income in order to support their petitions for additional funding. Government sources quote Ruether in their indications of the very approximate nature of their illegal income numbers. As an example of softness, Reuter indicates that estimates for domestic marijuana sales ranged from $5 billion to $26.8 billion in 1980. A range so wide as to engender grave doubt about any offered estimate.

In fact, there is a logic that renders even the legal underground

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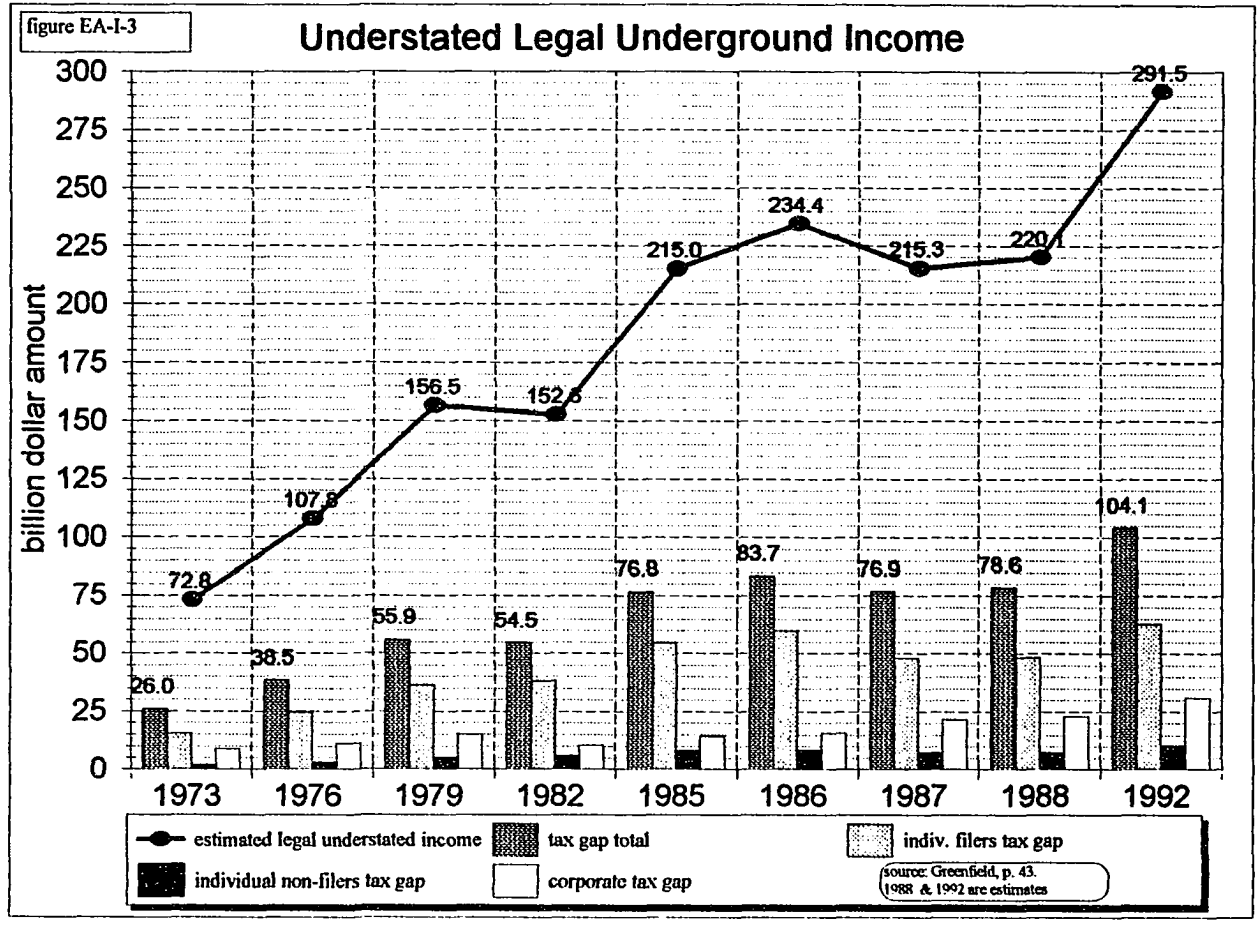
[11] Harry I. Greenfield, *Invisible, Outlawed and Untaxed: America's Underground Economy*, (Westport, Conn.: Praeger, 1993), p. 64.

[12] Peter Reuter, "The (continued) vitality of mythical numbers", *The Public Interest, Spring 1984*, pp. 135-47.



economy numbers very soft. Webster defines the term *market* as "the meeting together of people for the purpose of trade by public by private purchase or sale ..."[13] A number of economists have considered the work of housewives, or more generally housework, as a potential underground economy concept. On this subject, Greenfield offers the following:

> It should be pointed out here that some perfectly legal and necessary types of production, such as the value of housewives's services in the home-the rearing of children, shopping, cooking, and cleaning-and even the value of do-it-yourself activities, are not, included in GNP calculations; such activities are viewed as not-for-market production.[14]

In table EA-I-4 below, Greenfield does not include the work of housewives. Housework performed by the homeowners is considered not-for-market production. At least two parties must meet and decide on an exchange for the market to be utilized. If you hire a housekeeper, that's a market transaction. If you do it yourself, it's not.

Even Greenfield indicates that housework performed by the homeowner does meet some of the criteria for underground consideration, but he adds that these numbers are difficult to estimate.

Enter Gary Becker and Robert Eisner[15] who discuss just such an estimate, i.e. an estimate of the value of housework by attempting to compute what these services would cost on the open market. This estimate exceeds 20% of GNP during the age of automation. This certainly overwhelms Greenfield's estimate of the underground economy below which excludes not-for-market production.

Thus, all consideration of the underground involves very soft-numbers. There is no agreement on what constitutes the underground and even if definitional agreement is reached, the estimation process would still require huge refinement.

Given such admonition, we are now prepared to examine Greenfield 1990 estimate of the Underground Economy, exclusive of not-for-market production.

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[13] *Webster's Ninth New Collegiate Dictionary*, s.v. "market".

[14] Harry I. Greenfield, *Invisible, Outlawed and Untaxed: America's Underground Economy*, (Westport, Conn.: Praeger, 1993), p. 3.

[15] Gary S. Becker, "Housework: The Missing Piece of the Economic Pie", *Business Week*, October 14, 1995.

table EA-1-4 **Greenfield 1990 Underground Economy Estimates**

	$ Amt. in Billions	% of Illegal	% of 1990 GNP
Drugs	45.00	65.01%	0.9120%
Gambling	5.00	7.22%	0.1013%
Prostitution	15.00	21.67%	0.3040%
Pornography	1.00	1.44%	0.0203%
Illegal Abortion	0.02	0.03%	0.0004%
Audio, and Software Video Piracy	1.00	1.44%	0.0203%
Cigarette Smuggling	0.20	0.29%	0.0041%
Loan Sharking	2.00	2.89%	0.0405%
Total Illegal	69.22	100.00%	1.4029%
Total Legal	268	387.17%	5.4316%
Grand Total	337.22		6.8345%

source: Harry I. Greenfield, *Invisible, Outlawed and Untaxed: America's Underground Economy*, (Westport, Conn.: Praeger, 1993), p. 65. Estimate of 1990 real GNP has been taken from the 1994 Edition of the Statistical Abstract of the United States and is used to replace Greenfield's estimate.

Our original goal was to affirm or refute an hypothesis of mobility from the main economy into the underground economy when the main economy performs poorly (high unemployment, low GNP growth, etc.). While the estimates of underground income from legal activities is more reliable than estimates from illegal activities, both sources are too approximate to make good estimates or for serious hypothesis testing. We have spent time reviewing the work of Greenfield because he appears to be a scholar that is seriously contributing to the development of better estimates of underground activity from which refutable hypotheses can be tested. However, if we take Greenfield's preliminary estimate of the underground as being 6.8% of 1990 GNP, we probably will not reasonably expect the underground economy to solve poor performance problems of the main economy. Additionally, many underground activities imply deviant, illegal behavior for the participating citizen. Such is hardly a policy to be recommended by serious economists. However, our conservatism does not diminish our desire for better estimates of the dollars of Subterania.

An Alternate View via Zvi Griliches

Many economists believe that the above analysis indicating recent economic slowdown is too harsh. Ziv Griliches has written an interesting paper that delves into the productivity slowdown and attempts to explain why it has occurred. An excellent history of productivity literature is also provided.

This article is relevant, because the more successful Griliches is at arguing overstatement of the productivity slowdown, the less credible our argument of a statistically different slowdown becomes.

Offered reasons for the slowdown include:

1) diminishing returns to science and technology and socio-economic "sclerosis".

2) diminished number of recent patents (perhaps a bureaucratic mirage --has the threshold for what is patentable risen?)

3) diminished productivity of research and development and diminished investment in R&D.

4) impact of energy price shocks

5) growth opportunities were finite and are being exhausted

6) insufficient investment in physical and human capital.

7) [Griliches' personal belief] the slowdown in economic growth is overstated due to amount and quality of available data:

> ...we often misinterpret the available data because of inadequate attention to how they are produced and (that) the same inattention by us to the sources of our data helps explain why progress is so slow.
>
> ...
>
> Economists have little clout in Washington, especially as far as data-collection activities are concerned. ...[16]

a) construction, finance, government, and other services have output that is very difficult to measure. (Before WW II at least 1/2 the economy was measurable. This fraction has fallen to less than 1/3.) These changes diminish the reliability of technological change and total factor productivity measures. Since 3/4 of the investment in computers has gone into unmeasurable sectors, the full impact is understated.

b) a case in point is the computer industry which is an

[16] Zvi Griliches, "Productivity, R&D, and the Data Constraint", *The America Economic Review*, (March 1994): 2 & 14. This entire section is based on this article.

"outlier" when total factor productivity growth is plotted against R&D/Sales ratio, but which become more normal when adjustments are made in computer prices (left constant until 1986). This adjustment led to other distortions when computer inputs were not similarly adjusted.

c) another case in point is generic drugs which are judged separate commodities rather than reduced price versions of existing commodities, therefore causing pharmaceutical productivity to be understated.

d) proper treatment of price indexes can convert apparent economic growth decline to actual growth!

While the Griliches viewpoint has merit, we can offer at least a few counterpoints:

1) It's disappointing to hear senior economists criticize economic data collection as flawed. It would seem that the pervasive nature of the economics requirement in college curricula would be a sufficient platform to lobby among the college educated for improvements in data and data collection, yet this rarely occurs.

2) The creation of Macroeconomics after the Great Depression motivated the development of greatly improved economic data sets because such was in the national interest in order to never have a Great Depression again. If data is a serious problem, every senior economist in every publication and public appearance should be lobbying for a change. The failure of such an effort implies the general acceptability of existing data sets and collection techniques.

3) The fact that unmeasurable sectors have become more important in the U.S. economy is probably true. But America is consuming more not less manufactured goods. There is a tremendous increase in importation of manufactured goods of higher quality and lower price. For this reason alone, the Griliches argument is justifiably deflated, but certainly not to zero.

Econometric Analysis

Number: EA-II.

Title: Analysis of Technological Change as a Component of Economic Growth[1]

Null Hypothesis: Technological Change is the Most Important Component of U.S. Economic Growth in the Age of Automation

Alternate Hypothesis: Technological Change is not the Most Important Component of U.S. Economic Growth (Perhaps Capital Deepening is More Important)in the Age of Automation

Data Set Reference: All models in this analysis refer to data set EA-II-1

Model One: ANOVA Contrasting Mean Growth Rates of Technological Change vs. Capital Deepening for Years 1949-90

Model One MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F	p
FACTOR	1	6.30	6.30	2.71	0.104
ERROR	82	190.88	2.33		
TOTAL	83	197.18			

LEVEL	N	MEAN	STDEV
TC_{49-90}	42	1.390	2.013
$KINT_{49-90}$	42	0.843	0.776

POOLED STDEV = 1.526

Model Two: ANOVA Contrasting Mean Growth Rates of Technological Change vs. Capital Deepening for Year Groups 1949-72

Model Two MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F	p
FACTOR	1	10.36	10.36	5.29	0.026
ERROR	46	90.07	1.96		
TOTAL	47	100.43			

[1] Referential attention is directed to: United States Department of Labor, *News* (Washington, D.C.: 8/29/91)

LEVEL	N	MEAN	STDEV
TC_{49-72}	24	2.004	1.869
$KINT_{49-72}$	24	1.075	0.650

POOLED STDEV = 1.399

Model Three: ANOVA Contrasting Mean Growth Rates of Technological Change vs. Capital Deepening for Years 1973-90

Model Three MINITAB® ANOVA Results:

SOURCE	DF	SS	MS	F	p
FACTOR	1	0.01	0.01	0.01	0.939
ERROR	34	76.70	2.26		
TOTAL	35	76.71			

LEVEL	N	MEAN	STDEV
TC_{73-90}	18	0.572	1.952
$KINT_{73-90}$	18	0.533	0.838

POOLED STDEV = 1.502

Model Four: ANOVA Contrasts Economic Growth per Hour for Years 1949-72 vs. 1973-90

Model Four MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F	p
FACTOR	1	40.06	40.06	15.78	0.000
ERROR	40	101.57	2.54		
TOTAL	41	141.63			

LEVEL	N	MEAN	STDEV
Q/L_{49-72}	24	3.079	1.658
Q/L_{73-90}	18	1.106	1.502

POOLED STDEV = 1.593

Variable Dictionary for Models One - Four:

Q/L = output per labor hour, i.e. labor productivity.

TC= technological change = multifactor productivity = joint effects of many factors, including new technology, economies of scale, change in the composition of labor input, managerial skill, and change in the organization of production.

KINT = capital intensity = change in capital services per hour times capital's share of current dollar output.

NOTE: the annual percentage growth in Q/L = annual percentage growth in KINT + annual percentage growth in TC (i.e. multifactor productivity)

Discussion:

In Chapter I. discussion we have offered a graphic representation of economic growth separated into three sections of labor, capital intensity and technological change. The precision of the graphic and a valid perusal will "prove" that technological change is the most important component of economic growth.

However, we make our proof more concrete with reference to the original Department of Labor data set and performing the three ANOVA tests as indicated above. The % growth in output/labor hour = the % attributable to technological change (TC) + % attributable to capital intensity (KINT).

Model One analyzes TC and KINT for the 42 year period 1949 to 1990. The 1.390 TC mean is obviously greater than the .843 KINT mean, implying the greater importance of TC. However, analyzing the TC - KINT difference in the context of the respective variances can yield more confidence in the difference. With a p value of .104, 90% confidence intervals will barely overlap and lead us to conclude that the difference between the TC and KINT means are not statistically significant, while 89% confidence intervals will lead us to believe that the difference between the two means (KINT and TC) is statistically significant. Certainly, the p-value conveys better information than the confidence intervals.

A marked decrease in American economic growth marks the 1973-present era. This is evidenced by Model Four above. Output per Manhour Q/L for the 1949-73 period is significantly different from Q/L for the 73-90 period at a .001 level of significance. (Contrast this with Econometric Analysis I. that was not per labor hour based.)

We therefore are interested in separate looks at the 1949-72 series and the 1973-90 series for KINT and TC. The results of this analysis are quite informative. The TC_{49-72} mean of 2.004 is significantly different from the $KINT_{49-72}$ mean of 1.075 at the 95% level. However for 1973-90 we have a TC_{73-90} mean of .572 and an $KINT_{73-90}$ mean of .533. While TC remains higher than KINT during the 73-90 period, there is no statistical difference at any conventional level of significance.

It is apparent that the 1973-90 components are the elements that cause the overall difference between KINT and TC to converge to a quantity considerably less than 1949-72 difference. The overall contribution of TC to Economic Growth is therefore much greater from

1949-72 than it is from 1973-90. This yields a potential growth theory:

The TC component apparently results from the widespread **application** of new technology and **not from its mere existence.** We therefore posit that TC growth will have a stronger association with growth in Output (Q) than with the growth in the capital stock (K). The reason for this proposition is the realization that most new machinery will reflect the new technology of the era. If the new machinery is used at capacity, then sales are probably up. If the new machinery is used at less than capacity, technological change is **not less present but rather less applied.** The fact that economic welfare is diminished in the post 1972 era is no doubt due in a large extent to the slowed growth in Output. Reference to the growth rate of Output per unit of Capital series in data set EA-II shows that 22 of the 42 signs (52%) are negative. The almost even division between positive and negative signs indicates the frequent under-utilization of existing technological capacity and therefore operation at less than economic capacity. (max output vs. min cost per unit)

If businesses reacts to energy price increases with price increases (causing prices to increase independent of output increases) we have an inflationary pressure that is controlled most successfully (as per recent policy) with an increase in the interest rate. But the increase in the interest rate reduces aggregate demand far below supply capacity. The multiplier effect that causes output to grow also causes applied TC to grow. The reverse is also true. Cause a long-term decrease in Output and expect a decrease in (applied!) technological change. That is, we expect decreased Q/L to be associated with decreased TC. Let's look:

Table EA-II-1 Relation of Q/L and TC
Average Growth Rates

Time Period	Q/L	TC
1949-72	3.1%	2.0%
1973-90	1.1%	0.6%

We also expect a stronger correlation between Q and TC than between Q and K(capital intensity). Lets look at the correlation matrix:

Table EA-II-2 Economic Growth Rates Correlation				
	TC	Q	L	K
TC	1			
Q	0.8616188	1		
L	0.4343495	0.8222837	1	
K	-0.005396	0.2189007	0.2301322	1

In such analysis, we have explained a great deal of our original paradox. In proposing technological change as the primary ingredient in economic growth we did not err. However, failure to distinguish between actual technological change and applied technological change can lead to serious distortion. In the age of automation actual technological change is at perhaps the highest level in our history. However, the diminution in economic welfare (a product of economic growth) is traced not to a diminution of technological change but rather to a diminution in applied technological change. The return to economic prosperity is therefore seen not in more new inventions with greater capability to reduce the labor required to produce a given quantity of output. Rather, the solution must involve greater application of technological change.

Rational Expectation theory that argues that the economy is typically at capacity and additional demand is necessarily translated into greater inflation is preliminarily rejected. With Output per unit of Capital negative during half of the Automation Age years, at capacity arguments are less credible. However, this theory will require additional research.

Arguments that may have greater credibility include those that argue the predominance of imperfect competitors in the economy and their ability to increase prices without opposition if the public believes that a supply shock (energy crisis) is present. The increase in prices yield lower demand and eventually justify corporate downsizing particularly as the government leads with examples of such. The multiplier effect of downsizing crushes economic growth and perhaps helps explain our current paradox.

Given the above logic, Dr. Cunningham has suggested tracing causation as a useful exercise. Does technological change cause increases in labor productivity or do increases in output (per labor hour) cause increases in technological change? The answer of course

reviews our distinction between applied and actual technological change.

The production of a small inexpensive computer concurrent with the development of electronic spreadsheets that can be used on those new microcomputers undoubtedly reflects actual technological change. This particular technological change has the ability to render obsolete the job category "bookkeeper'. There is great potential for the increase of output per labor hour. However, if economic growth is being dampened by restrictive monetary policy to control inflation, the new technology may be slow to be applied.

The new technology has made increased labor productivity possible but does not require it. Company A trains all of its 5 bookkeepers in the new computerized spreadsheets and expands its workload many-fold. Output/labor hour is definitely increased. Company B on the other hand sees little opportunity for additional clients and sees the new technology as an opportunity to reduce its 5 member bookkeeping staff to 1 (recessionary times justified such a reduction) with no needed reduction in output but a definite reduction in labor cost and after about the first year a reduction in total costs. The laid off bookkeepers may have less money to spend in the short run and cause a multiplier contractionary effect on the economy (contracting output).

If the economy had been growing at a fast rate, the new technology could have helped fuel the immediate growth and greater growth thereafter. On the other hand if the economy was being constrained for fear of inflation, the new technology would be less applied (though no less present).

Therefore, new technology can be said not *to cause* growth in output but rather to facilitate it. But increased applied technological change is a causation of increased output. If growth is constrained (via monetary policy) the mere existence of new automation is not sufficient to cause greater growth, the new automation must be applied.

If Japan's economy is not constrained during the new technology era, we can subcontract our economic growth to their economy. But, is this really optimal public policy?

Econometric Analysis

Number: EA-III
Title: Analysis of Output Per Hour

Null Hypothesis: The Growth Rate of Output Per Labor Hour Has Not Diminished in the Automation Age

Alternate Hypothesis: The Growth Rate of Output Per Labor Hour Has Diminished in the Automation Age

Model One: ANOVA Comparing Output/Hour Growth for 1949-1972 versus 1973-1990

Model One MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F	p
FACTOR	1	40.06	40.06	15.78	0.000
ERROR	40	101.57	2.54		
TOTAL	41	141.63			

LEVEL	N	MEAN	STDEV
49-72	24	3.079	1.658
73-90	18	1.106	1.502

POOLED STDEV = 1.593

Discussion:

There has been a dramatic decrease in Output/labor hour growth since 1973. As a per labor hour analysis, this analysis may be considered more precise than analysis of GNP that occurred in EA-I. The conclusion is much the same. If Output/labor hour growth is accepted as a welfare measure, then economic welfare per this measure has diminished since 1973 compared to the earlier 1949-72 period. Referential attention is directed towards figures EA-III-1 and EA-III-2.

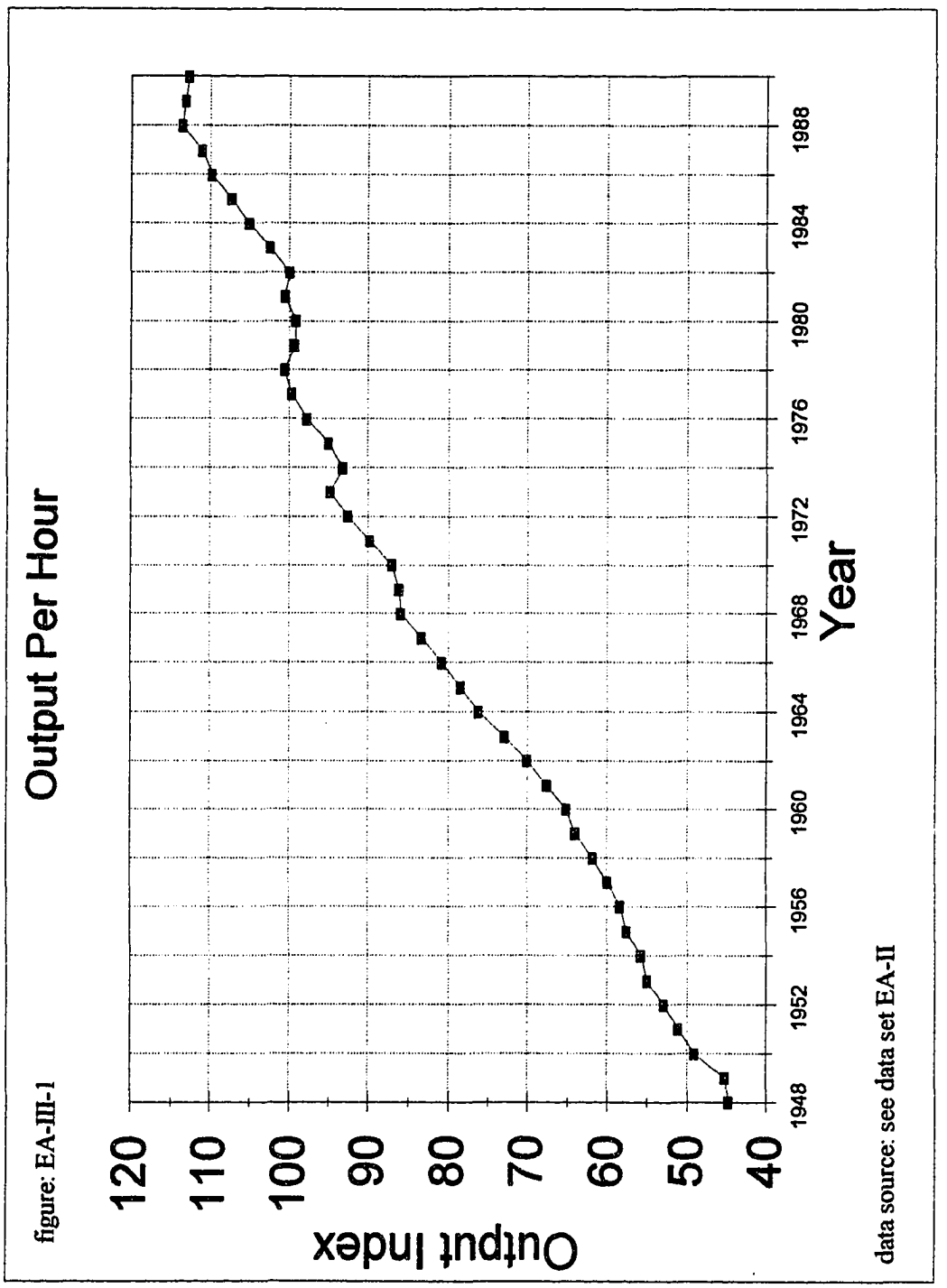
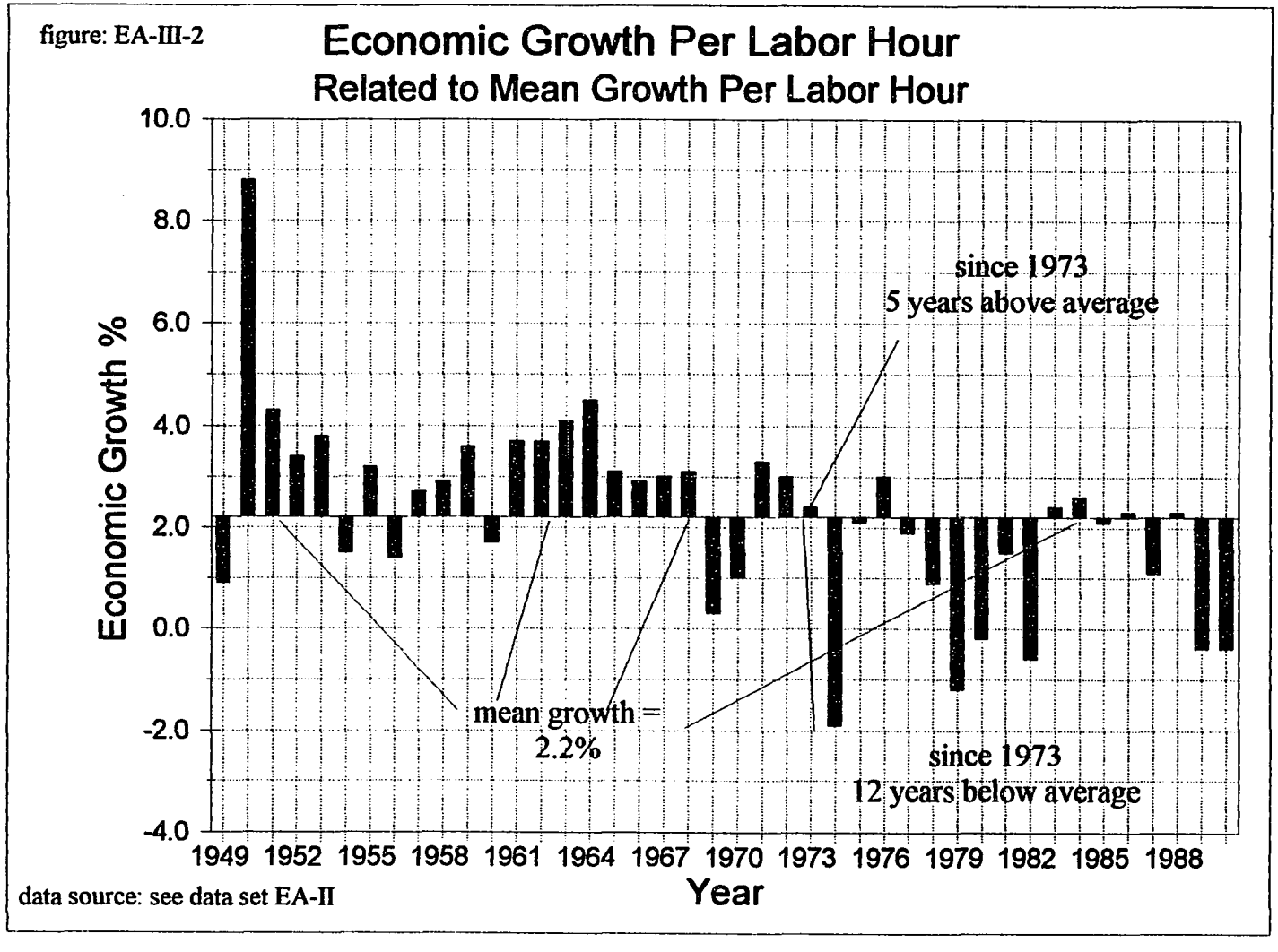


figure: EA-III-1

data source: see data set EA-II

figure: EA-III-2



data source: see data set EA-II

Model Two: Analysis of Variance of Growth Rate of Output Per Labor Hour comparing the Keynesian Period (1949-78)[1] to the Supply-Side Period (1979-90)

Null Hypothesis: Growth Rate of Output Per Labor Hour is significantly greater during the Keynesian period than during the Supply-Side Period

Alternate Hypothesis: Growth Rate of Output Per Labor Hour is NOT significantly greater during the Keynesian period than during the Supply-Side Period

Data Set Reference: EA-II

Model Two MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F	p
FACTOR	1	27.31	27.31	9.56	0.004
ERROR	40	114.32	2.86		
TOTAL	41	141.63			

LEVEL	N	MEAN	STDEV
Q/L4978	30	2.743	1.783
Q/L7990	12	0.958	1.418

POOLED STDEV = 1.691

Discussion:

There may be a better Economic Growth prescription than Keynesian Economics, but Supply-Side Economics appears not to be the answer. While one might argue that supply-side policies had some limited success, it is apparent that these policies were not sufficient to return productivity growth rates to the Keynesian standard.

The mean growth during the 12 year Supply-Side Economics experiment is .958%. This compares to 2.743% during the 30 year Keynesian period. The difference between the two means is not random but instead is statistically significant (at a 99%+ level) as indicated in the above ANOVA.

We need not offer any arguments of causation in order to demonstrate diminished welfare below the potential set by the Keynesian period.

---

[1] 1978 as the beginning of Supply-side Economics is suggested by John K. Manos, "The Great American Tax Fraud", *Consumers Digest* (September/October 1992), 68.

However, for the interested reader, the following information about capital intensity and technological change for the Keynesian and Supply-side periods is provided.

Model Three MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE ON TC

SOURCE	DF	SS	MS	F	p
FACTOR	1	14.60	14.60	3.85	0.057
ERROR	40	151.62	3.79		
TOTAL	41	166.22			

LEVEL	N	MEAN	STDEV
1949-78	30	1.763	1.976
1979-90	12	0.458	1.867

POOLED STDEV = 1.947

Model Four MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE ON KINT

SOURCE	DF	SS	MS	F	p
FACTOR	1	1.975	1.975	3.48	0.069
ERROR	40	22.688	0.567		
TOTAL	41	24.663			

LEVEL	N	MEAN	STDEV
1949-78	30	0.9800	0.7467
1979-90	12	0.5000	0.7699

POOLED STDEV = 0.7531

Variable Dictionary for all the above Models:

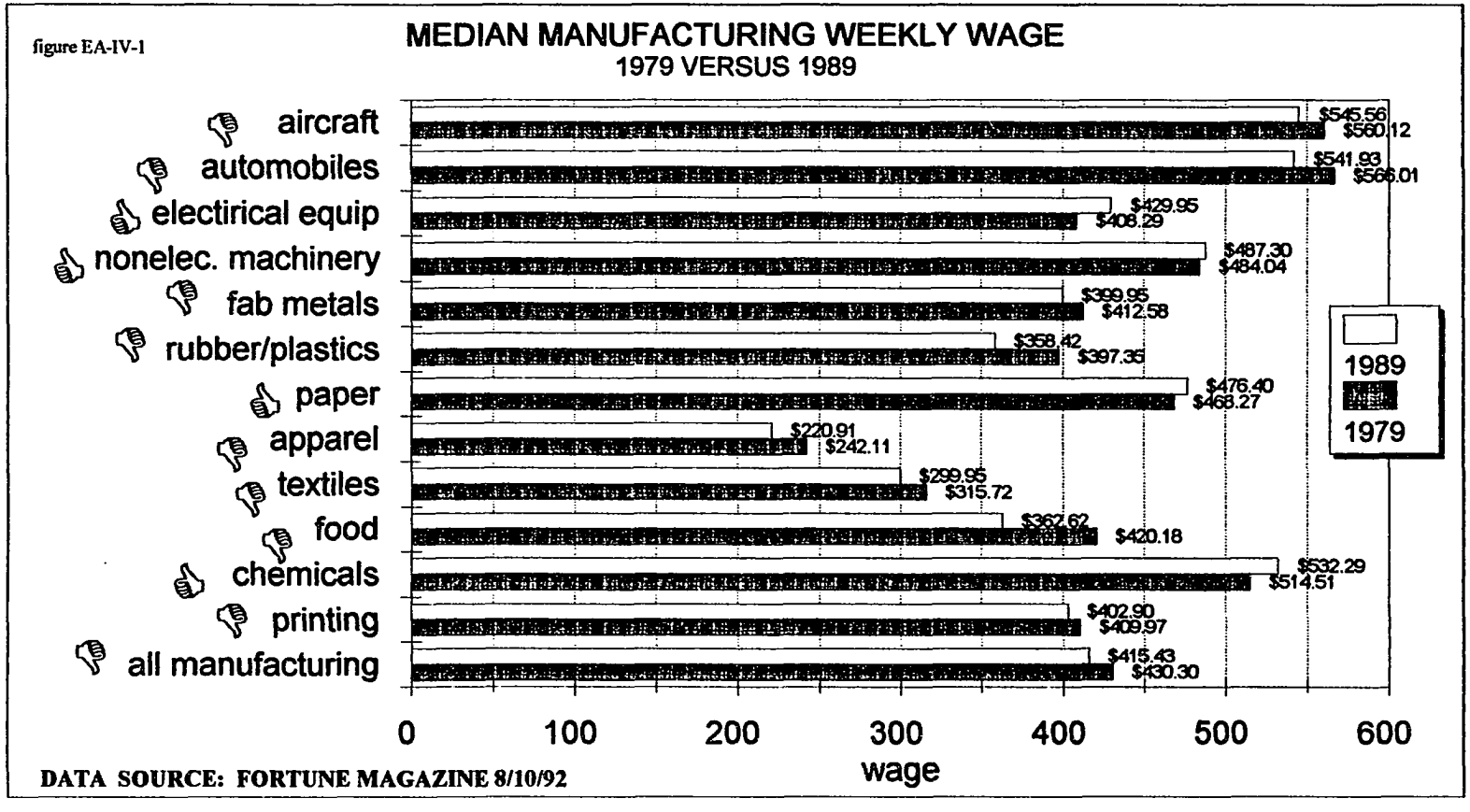
Q/L = growth rate of output per labor hour

TC= growth rate of technological change

KINT = growth rate of capital intensity

EA-IV. Analyzing the Real Hourly Wage

figure EA-IV-1



DATA SOURCE: FORTUNE MAGAZINE 8/10/92

Econometric Analysis

Number: EA-IV
Title: Analyzing the Real Hourly Wage

Null Hypothesis: The Real Hourly Wage Growth Rate **has Diminished Significantly** During the Automation Age.

Alternate Hypothesis: The Real Hourly Wage Growth Rate **has not Diminished Significantly** During the Automation Age.

> With the advance of technology and the piling up of a larger stock of capital goods, it would take a **veritable miracle of the devil** to keep real wages . . . from being bid ever higher with each passing decade. Who fails to see that, fails to understand economic history as it actually happened. Economic theories that do not fit these facts have to be junked and replaced by others that do.
>
> Paul Samuelson
> *Economics*[1]

Model One: Analysis of Variance Comparing the Real Wage Growth Rates from 1948-74 versus the Growth Rates from 1975-1993.

Model One MINITAB® ANOVA Results:

```
ANALYSIS OF VARIANCE
SOURCE     DF        SS        MS        F        p
FACTOR      1  0.009105  0.009105    23.98    0.000
ERROR      44  0.016710  0.000380
TOTAL      45  0.025815

                                    INDIVIDUAL 95+ PCT CI'S FOR MEAN
                                    BASED ON POOLED STDEV
 LEVEL      N      MEAN     STDEV  -----+---------+---------+---------+-
RW4874     27   0.03046   0.02255                      (----*----)
RW7593     19   0.00189   0.01392  (-----*-----)
                                    -----+---------+---------+---------+-
POOLED STDEV =  0.01949              0.000     0.015     0.030     0.045
```

[1]Paul Samuelson. *Economics: 8th Edition*, (McGraw-Hill Book Company, New York, 1970), 721.

Model Two: Discovering the Real Hourly Trend Growth Rates for 1948-74 and 1975-93

Model Two MINITAB® Regress Results:

```
The regression equation is
lnrw4893 =  0.499 con4893 + 0.0289 yrndx4893 + 2.06 con7593
            0.0286 yrndx7593

Predictor          Coef       Stdev       t-ratio      p
Con4893          0.49933    0.05537          9.02  0.000
yrndx4893        0.0288948  0.0008937       32.33  0.000
con7593          2.0573     0.1252          16.44  0.000
yrndx7593       -0.028553   0.001598       -17.86  0.000

s = 0.03418     R-sq = 97.9%     R-sq(adj) = 97.8%

Analysis of Variance

SOURCE       DF          SS          MS          F        p
Regression    3     2.30162     0.76721     656.85    0.000
Error        42     0.04906     0.00117
Total        45     2.35068


Durbin-Watson statistic = 0.34
```

Model Two Serial Correlation Correction

```
Full Maximum Likelihood Estimated Rho = 0.9370

The regression equation is
lnrw4893 =  0.289 Con4893 + 0.0315 yrndx4893 + 2.15 con7593
            - 0.0297 yrndx7593

Predictor          Coef          Stdev    t-ratio      p
Noconstant
Con4893          0.2892       0.1695       1.71  0.095
yrndx4893        0.031490     0.002681    11.75  0.000
con7593          2.1467       0.3304       6.50  0.000
yrndx7593       -0.029733     0.004267    -6.97  0.000

s = 0.01851
Analysis of Variance

SOURCE       DF          SS          MS          F        p
Regression    4     2.46221     0.61555    1796.21    0.000
Error        42     0.01439     0.00034
Total        46     2.47661


Durbin-Watson statistic = 1.37
```

Model Two Variable Dictionary

lnrw4893 = natural log of real wage from 1948-93
con4893 = constant term from 1948-93
yrndx4893 = year index from 1948-93
con7593 = intercept dummy from 1975-93
yrndx7593 = year index from 75-93 with 0s for 48-74.

Discussion:

Growth in the real wage annually averaged more than 3% from 1948 to 1974. However, from 1975-1993 the average growth in the real wage is not significantly different from zero. This zero real growth is verified in Model One above in that from 75-93, the confidence interval for mean growth rate includes zero.

In Model Two we look at trend growth rates. From the information derived from Model Two regression, we derive the trend growth rate from 48-74 as 3.15%. The trend growth rate for 75-93 is 0.18%. The lack of significant growth in the real wage during the past 2 decades implies a decrement in economic welfare.

We must conclude that Samuelson's "veritable miracle of the devil" (mentioned above) has occurred. The American economy is definitely "sick" (or "demon possessed" or some other more poignant adjective!). We look at figure EA-IV-2 to better visualize this rise and constancy of the Real Wage.

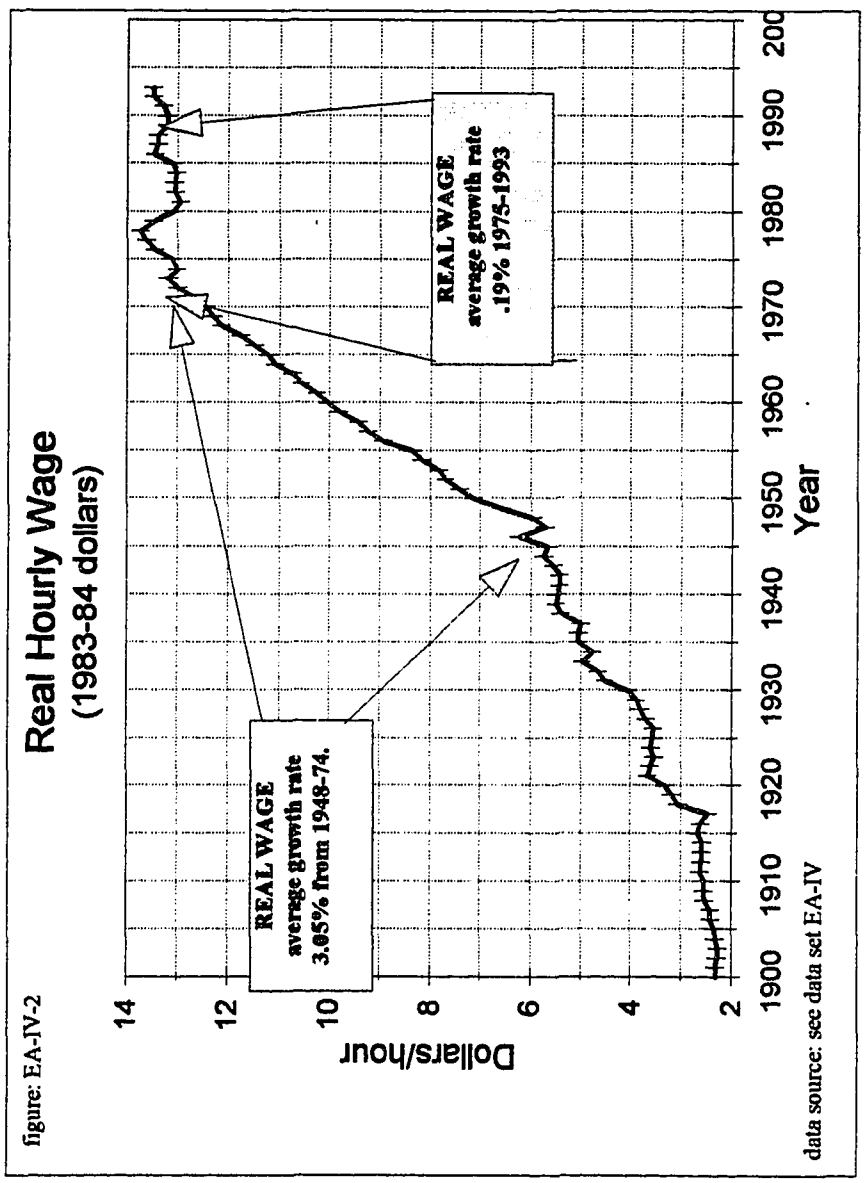


figure: EA-IV-2

data source: see data set EA-IV

Econometric Analysis

Number: EA-V
Title: Analysis of the Vedder Galloway (Real) Wage

Data Set Reference: EA-IV and V

Null Hypothesis: The V-G Wage is strongly and directly related to the Unemployment Rate

Alternate Hypothesis: The V-G Wage is not strongly and directly related to the Unemployment Rate

Vedder and Galloway have directed attention to a non-traditional conception of wage compensation. This alternative wage is called by Vedder and Galloway the "real wage". However, in order to avoid confusion with the "real wage" as traditionally conceived, we will refer to the Vedder-Galloway real wage as the V-G Wage. The V-G Wage is real wage/real output, where this real wage is the traditional real wage.

Interesting thoughts are generated by consideration of the V-G Wage. If the V-G Wage increases then perhaps a larger proportion of National Income is being paid to wage earners and a smaller proportion to Capital Owners. Similarly, if capital is primarily owned by the highest income class, an increase in the V-G Wage might imply more income accruing to the lower income earners. And, a decrease in the V-G Wage would signal the reverse. However, we have more direct means of ascertaining such shifts and we have done so elsewhere in this work.

Here it is instructive to look at a graph of the V-G Wage during the Automation era (1945-present) and attention is therefore directed at figure EA-V-1. We note that from 1945-1975 there is a distinct upward slope in the V-G Wage trend line and from 1975 to the present there is a distinct downward slope in the V-G Wage. Model One regression confirms our visual conclusion.

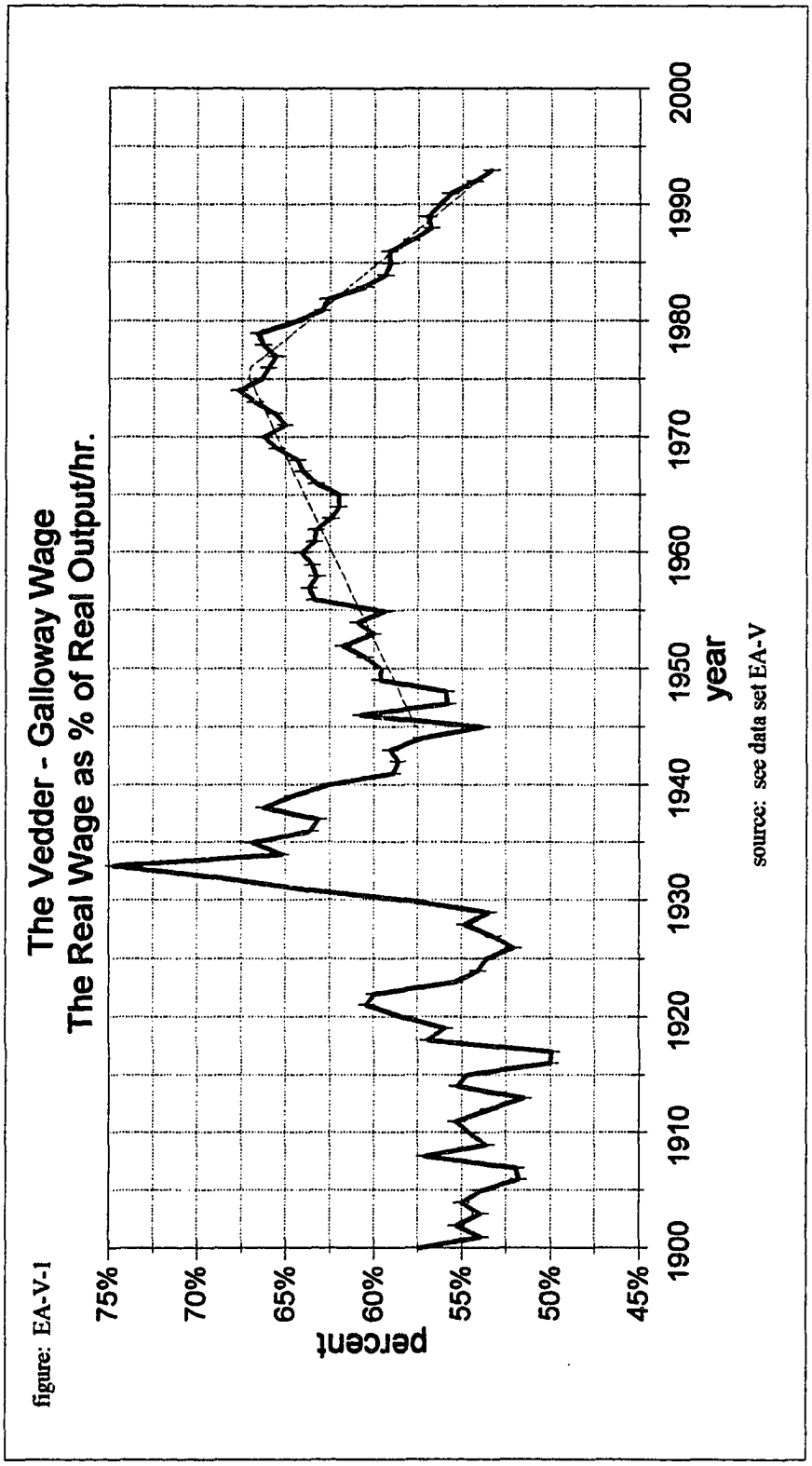


figure: EA-V-1

Model One: Regression to Discover Least Squares Trend Lines for V-G Wage

Model One MINITAB® Regress Results:

```
The regression equation is
VG4593 =  0.432 Con4593 + 0.00315 yrndx4593 + 0.855 con7693
          - 0.0112 yrndx7693

Predictor        Coef       Stdev    t-ratio        p
Con4593       0.43177     0.01684      25.64    0.000
yrndx4593  0.0031480   0.0002732      11.52    0.000
con7693       0.85517     0.05556      15.39    0.000
yrnx7693   -0.0111572   0.0006757     -16.51    0.000

s = 0.01360      R-sq = 88.0%      R-sq(adj) = 87.2%

Analysis of Variance

SOURCE       DF          SS          MS          F        p
Regression    3    0.060991    0.020330     109.85    0.000
Error        45    0.008328    0.000185
Total        48    0.069319

Durbin-Watson statistic = 1.54
```

Model One Serial Correlation Correction

```
Full Maximum Likelihood Estimated Rho = 0.1700

The regression equation is
VG4593=   0.429 Con4593 + 0.00319 yrndx4593 + 0.855 con7693
          - 0.0112 yrndx7693

Predictor        Coef       Stdev    t-ratio        p
Noconstant
Con4593       0.42907     0.01967      21.82    0.000
yrndx4593  0.0031875   0.0003189      10.00    0.000
con7693       0.85468     0.06404      13.35    0.000
yrndx7693 -0.0111608   0.0007796     -14.32    0.000

s = 0.01344

Analysis of Variance

SOURCE       DF          SS          MS          F        p
Regression    4     13.0494      3.2624   18053.00    0.000
Error        45      0.0081      0.0002
Total        49     13.0575

Durbin-Watson statistic = 1.90
```

Model One Variable Dictionary

Con4593 = constant term from 1945-93
yrndx4593 = year index from 1945-93
con7693 = constant term from 1976-93, 0s other years
yrnx7693 = year index from 1976-93, 0s other years

The results of Model One can be used to find slopes and intercepts for the 45-75 and 76-93 eras. The following equations are derived:

VG4575 = 0.429 + .00319 yrndx4575

VG7693 = 1.284 - .0081 yrndx7693

The coefficients of the year index variables can be interpreted as the change in the VG wage associated with a unit change in the year index (for the corresponding year). Of particular note is the change in the sign of the year index coefficient from positive to negative when the 45-75 era is compared to the 76-93 era. The real wage increased as a percent of real output for 45-75 and decreased as a percent of real output from 76-93.

Having established two V-G Wage Trends with differing signs, we now test the Vedder Galloway hypothesis of a Decreasing V-G Wage causing a lower rate of Unemployment. If the Vedder-Galloway hypothesis is true, we expect a strong positive correlation between the V-G Wage and the Unemployment rate for the same period. An increasing V-G Wage should be accompanied by increasing Unemployment and a decreasing V-G Wage should be accompanied by Decreasing Unemployment. That is, the correlation between the two variables should be positive and significant. The actual correlation between the V-G Wage and the Unemployment Rate for 1945-93 is .11108 (a resulting R^2 value would be .0123).

A t-test will conclude that the correlation of .11108 is not significantly different from zero.[1] The following statistic is computed, in which r is the computed correlation and n is the sample size. In this case r=.11108 and n= 52.

[1] Robert D. Mason and Douglas A. Lind, *Statistical Techniques in Business and Economics* (Homewood, Il.: Irwin, 1990), 502. We have used the small sampletest which is officially prescribed for n≤ 50. However, a large sample test (p. 503) will yield the same result.

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

The computed t is .7696/.9938 = .7744. The critical region with α =.01 is ± 2.68. Since .7744 falls within this range the null hypothes of $\rho = 0$ is not rejected.

Given the range of ρ from -1 to 1 and given the position of .11108 in that range, we reject the hypothesis of a **strong positive relationship** between the V-G Wage and the Unemployment Rate.

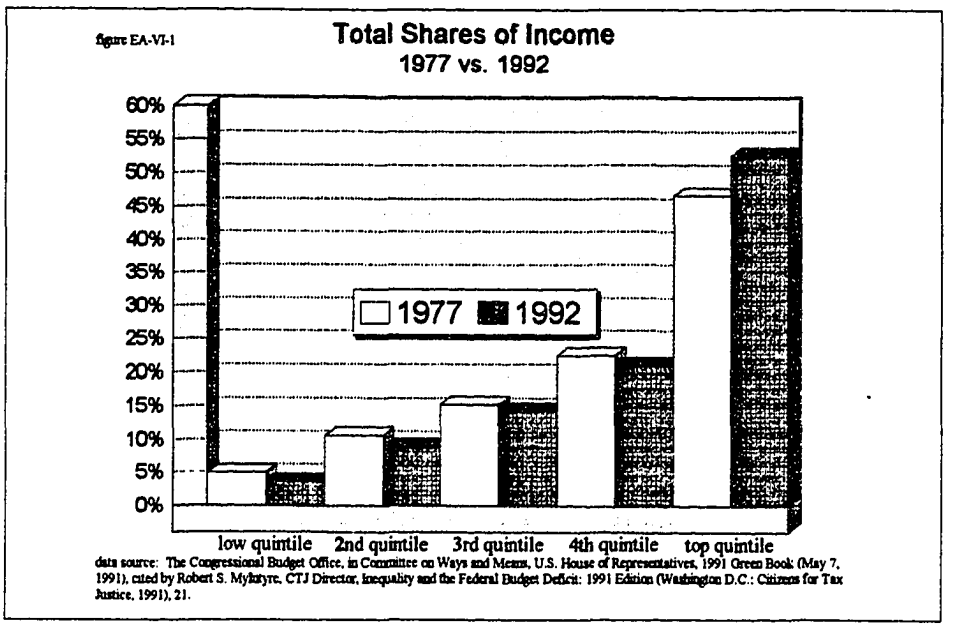
Readers interested in further analysis of the type suggested by Vedder and Galloway are referred to their book.[2])

[2] Richard Vedder and Lowell Gallaway, *Out of Work: Unemployment and Government in Twentieth-Century America* (New York: Holmes and Meier, 1993).

Econometric Analysis

Number: EA-VI.

Title: Analyzing Changes in the Distribution of Income



Null Hypothesis: The Distribution of Income in America has become more **Equal** During the Automation Age

Alternate Hypothesis: The Distribution of Income in America has become more **Unequal** During the Automation Age

Discussion:

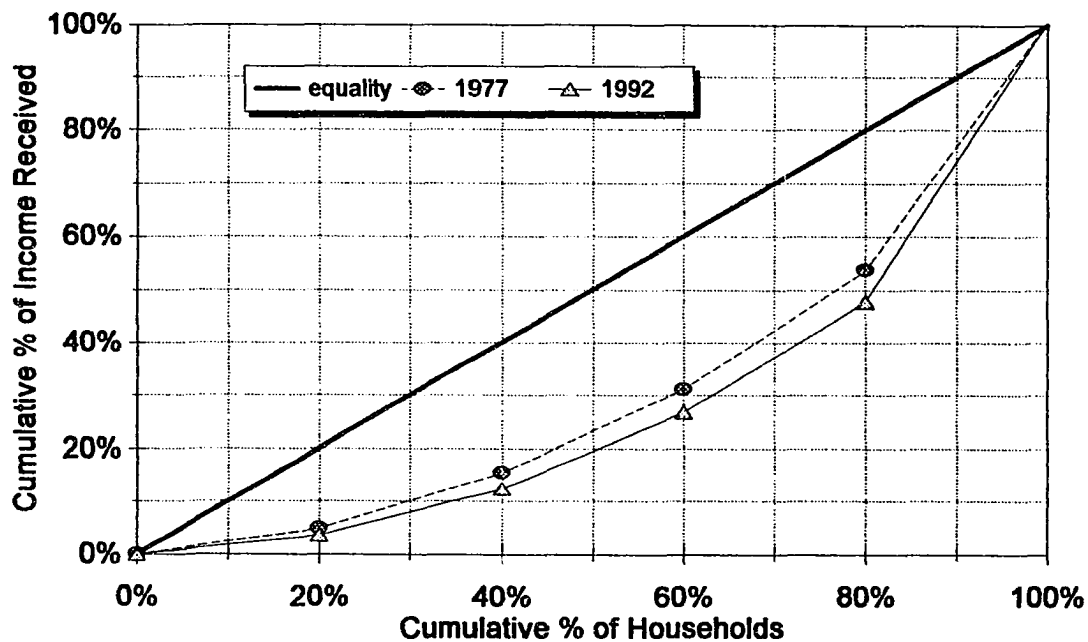
A generally accepted measure of income distribution equality is the Lorentz Curve. An example of the U.S. Lorentz Curves for 1977 and 1992 is illustrated in figure EA-VI-2.

By observation of our graphical constructs, Income Distribution is more equal in 1977 than in 1992. But how much more equal? It would be good if we could compute a **mathematical** measure of income distribution (in)equality.

Consider any Lorentz Curve constructed from quintiles. There are four distinct interior points on such a Lorentz Curve. Call these points 1,2,3 and 4 respectively, measuring from left to right.

We can easily form six triangles between the equality diagonal and

figure:EA-VI-2



data source: The Congressional Budget Office, In Committee on Ways and Means, U.S. House of Representatives, 1991 Green Book (May 7, 1991) as quoted by Robert S. McIntyre, Inequality and the Federal Budget Deficit, (Washington, D.C.: Citizens for Tax Justice), 21.

any quintile Lorentz curve in the following manner: 1)Draw a line parallel to the y axis from point 1 to the equality diagonal. Call the intersection of this line with the equality diagonal point 5. 2) Draw lines from point 5 to points 2 and 3. 3) Draw a line parallel to the y axis from point 4 to the equality diagonal. Call the intersection of this line with the equality diagonal point 6. 4) Draw a line from point 6 to point 3.

We now have six non-overlapping triangles. The sum of the areas of these six triangles is the area between the Lorentz curve and the equality diagonal. We will state without proof that the x,y coordinates of the six triangles' vertex points are easily identified. If we know these coordinates, we can determine the length of every side of every triangle using the formula[1]:

$$\text{length} = [(x_1 - x_2)^2 + (y_1 - y_2)^2]^{.5}$$

Knowing the length of every triangle side, we can calculate the area of every triangle using Hero's formula[2]:

Let a, b, and c represent the three sides of the triangle:

$$s = .5(a + b + c)$$

$$\text{area} = [s(s - a)(s - b)(s - c)]^{.5}$$

The greater the inequality, the larger the area between the equality diagonal and the Lorentz curve. That is, the greater the Lorentz Area, the greater is distribution inequality.

Now, we have a right triangle representing all the area under the equality diagonal. If we form a ratio = (Lorentz Curve area)/(total area under the equality diagonal), we have a numeric measure of inequality that can be compared in different time periods. Call that ratio the Gini ratio[3]. The Gini ratio ranges from 0 to 1. "A measure of 0 indicates perfect equality, i.e., all households having equal shares of income; a measure of 1 indicates perfect inequality, i.e., one household has all the income and the rest have none."[4]

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[1] Hadley. *Linear Algebra* (Massachusetts: Addison-Wesley Publishing Company, Inc., 1961), 3 For example see, G. 1.

[2] For example see, C. I. Palmer & L. A. Mrachek, *Practical Mathematics: Seventh Edition* (New York: McGraw-Hill Book Company, 1986), 299.

[3] U.S. Bureau of the Census, Current Population Reports, Series p60-183, *Studies in the Distribution of Income*, U.S. Government Printing Office, Washington, D.C. 1992, 29.

[4] Ibid, 29.

Consider the following table derived from data set EA-VI.

table EA-VI-1	GINI RATIOS				
year	1970	1975	1980	1985	1990
gini ratio	.394	.397	.403	.419	.429
sample size (thousands)	64778	72967	82368	88458	94312

We perceive a non-decreasing trend of growing inequality using 5th year Gini ratios for the years 1970-90. Let's test for statistical significance between the ratios.

Mason & Lind[5] recommend the following test statistic.

$$Z = \frac{\overline{p_1} - \overline{p_2}}{\sqrt{\frac{\overline{p_c} \times (1 - \overline{p_c})}{n_1} + \frac{\overline{p_c} \times (1 - \overline{p_c})}{n_2}}}$$

p_1 = the proportion from sample one

p_2 = the proportion from sample two

p_c = pooled estimate of the population proportion = $(n_1p_1 + n_2p_2) / (n_1+n_2)$

n_1 = the size of sample one

n_2 = the size of sample two

A Z value of ±1.96 represents confidence borders for $\alpha = .05$. We compute Zs for the following comparisons with the following results:

table EA-VI-2	Z Values - # Thousands
Years Compared	Z Value
1970 vs. 1975	1.1361
1970 vs. 1980	3.4997
1970 vs. 1985	9.8351
1970 vs. 1990	13.5264

[5] Robert D. Mason and Douglas A. Lind, *Statistical Techniques in Business and Economics* (Homewood, Ill.: Irwin,1990), p. 399-400.

These computations lead us to believe that there is a significant difference for all comparisons except 1970 vs. 1975. We show increasing inequality in the distribution of income during the years 1970-90. The Census Bureau also reports:

> ...Between 1947 and 1973, the period when family income was rising, inequality, as measured by the Gini index, was fairly stable or declining. In the 1973 to 1990 period, however, when family income grew very little, inequality began to rise.[6]

We therefore conclude that in the two decades 1970-1990 of the Automation Era, income distribution inequality is increasing. This decrease in equality implies a decrease in economic welfare in the Automation Age.

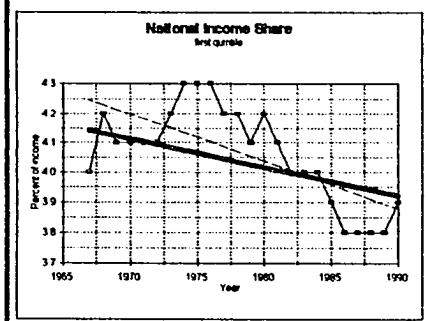
Who has suffered? That is, whose income share has diminished since 1970?

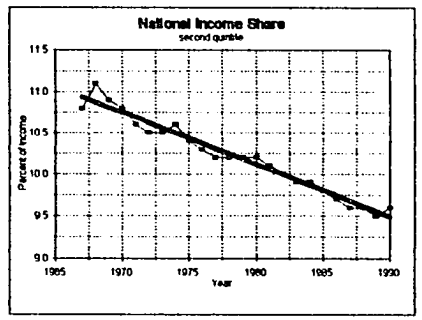
To answer this we use the data set EA-VI and plot the percent of total income for each quintile for all years 1967-1990. Next, on the same graphs, we plot least squares trend lines. The following graphs (figure EA-VI-3) result.

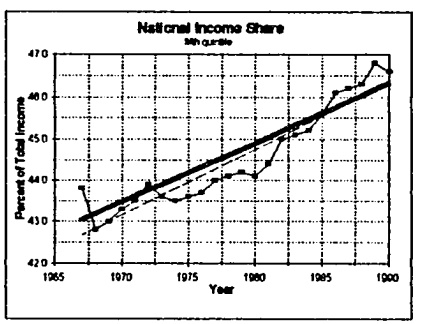
[6] U.S. Bureau of the Census, Current Population Reports, Series p60-183, *Studies in the Distribution of Income*, U.S. Government Printing Office, Washington, D.C. 1992. 3-5.

figure EA-VI-3

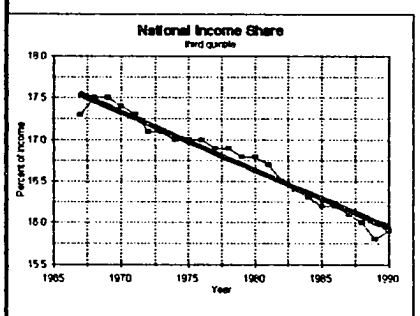
National Income Shares Per Qunitile

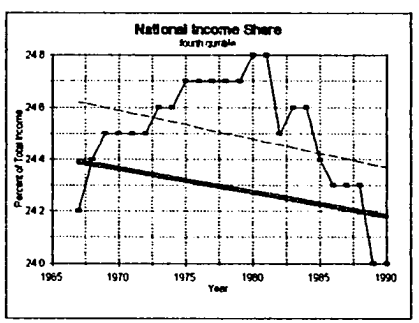






dashed trend lines are ordinary least squares estimated
solid trend lines are fml serial correlation corrected





data source: see data set EA-VI

Model One: Regression to Determine Trend Line for Lowest Quintile Income Share 1967-1990

Model One MINITAB® REGRESS Results:

The regression equation is
LOW = 4.26 - 0.0160 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Constant	4.26196	0.05109	83.42	0.000
YRINDX	-0.015957	0.003576	-4.46	0.000

s = 0.1213 R-sq = 47.5% R-sq(adj) = 45.1%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	0.29280	0.29280	19.92	0.000
Error	22	0.32345	0.01470		
Total	23	0.61625			

Durbin-Watson statistic = 0.47

Model One Serial Correlation Correction:

Full Maximum Likelihood Estimated Rho = 0.7910

The regression equation is
LOW = 4.15 - 0.00955 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Noconstant				
Constant	4.1549	0.1158	35.87	0.000
YRINDX	-0.009547	0.007515	-1.27	0.217

s = 0.07959

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	2	22.468	11.234	1773.51	0.000
Error	22	0.139	0.006		
Total	24	22.607			

Durbin-Watson statistic = 2.04

Model Two: Regression to Determine Trend Line for Second Quintile Income Share 1967-1990

Model Two MINITAB® REGRESS Results:

```
The regression equation is
SECOND = 11.0 - 0.0633 YRINDX

Predictor       Coef       Stdev    t-ratio        p
Constant     10.9996      0.0370     297.17    0.000
YRINDX     -0.063304    0.002590     -24.44    0.000

s = 0.08785     R-sq = 96.4%     R-sq(adj) = 96.3%

Analysis of Variance

SOURCE       DF          SS          MS          F        p
Regression    1      4.6086      4.6086     597.18    0.000
Error        22      0.1698      0.0077
Total        23      4.7783

Durbin-Watson statistic = 1.65
```

Model Two Serial Correlation Correction

```
Full Maximum Likelihood Estimated Rho = 0.0964

The regression equation is
SECOND = 11.0 - 0.0630 YRINDX

Predictor       Coef       Stdev    t-ratio        p
Noconstant
Constant     10.9959      0.0403     272.54    0.000
YRINDX     -0.063013    0.002818     -22.36    0.000

s = 0.08750
Analysis of Variance

SOURCE       DF          SS          MS          F        p
Regression    2      2064.0      1032.0 134807.52    0.000
Error        22         0.2         0.0
Total        24      2064.2

Durbin-Watson statistic = 1.79
```

Model Three: Regression to Determine Trend Line for Third Quintile Income Share 1967-1990

Model Three MINITAB® REGRESS Results:

```
The regression equation is
THIRD = 17.6 - 0.0723 YRINDX
```

Predictor	Coef	Stdev	t-ratio	p
Constant	17.6413	0.0425	414.80	0.000
YRINDX	-0.072304	0.002976	-24.29	0.000

s = 0.1009 R-sq = 96.4% R-sq(adj) = 96.2%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	6.0121	6.0121	590.10	0.000
Error	22	0.2241	0.0102		
Total	23	6.2362			

Durbin-Watson statistic = 0.88

Model Three Serial Correlation Correction

Full Maximum Likelihood Estimated Rho = 0.5820

The regression equation is
THIRD = 17.6 - 0.0691 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Noconstant				
CONSTANT	17.5871	0.0769	228.64	0.000
YRINDX	-0.069115	0.005236	-13.20	0.000

s = 0.08741
Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	2	1310.15	655.07	85733.45	0.000
Error	22	0.17	0.01		
Total	24	1310.32			

Durbin-Watson statistic = 1.89

Model Four: Regression to Determine Trend Line for Fourth Quintile Income Share 1967-1990

Model Four MINITAB® REGRESS Results:

The regression equation is
FOURTH = 24.6 - 0.0109 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Constant	24.6322	0.0904	272.49	0.000
YRINDX	-0.010913	0.006327	-1.72	0.099

s = 0.2145 R-sq = 11.9% R-sq(adj) = 7.9%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	0.13696	0.13696	2.98	0.099
Error	22	1.01263	0.04603		
Total	23	1.14958			

Durbin-Watson statistic = 0.31

Model Four Serial Correlation Correction

Full Maximum Likelihood Estimated Rho = 0.8933

The regression equation is
FOURTH = 24.4 - 0.0092 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Noconstant				
CONSTANT	24.4480	0.2618	93.38	0.000
YRINDX	-0.00919	0.01556	-0.59	0.561

s = 0.1194

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	2	274.66	137.33	9638.15	0.000
Error	22	0.31	0.01		
Total	24	274.98			

Durbin-Watson statistic = 1.92

Model Five: Regression to Determine Trend Line for Fifth (Highest) Quintile Income Share 1967-1990

Model Five MINITAB® REGRESS Results:

The regression equation is
FIFTH = 42.5 + 0.160 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Constant	42.5210	0.1738	244.72	0.000
YRINDX	0.15965	0.01216	13.13	0.000

s = 0.4124 R-sq = 88.7% R-sq(adj) = 88.2%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	29.312	29.312	172.37	0.000
Error	22	3.741	0.170		
Total	23	33.053			

Model Five Serial Correlation Correction

Full Maximum Likelihood Estimated Rho = 0.7330

The regression equation is
FIFTH = 42.9 + 0.142 YRINDX

Predictor	Coef	Stdev	t-ratio	p
Noconstant				
CONSTANT	42.8642	0.3927	109.15	0.000
YRINDX	0.14238	0.02601	5.47	0.000

s = 0.3193

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	2	4193.2	2096.6	20570.05	0.000
Error	22	2.2	0.1		
Total	24	4195.5			

Durbin-Watson statistic = 2.07

Variable Dictionary for Models One - Five

First - Fifth = % of total national income per year for each quintile (First = 1st quintile, etc.)

Yrindx = year index for years 1967-90 with 1=1967 and 24 = 1990

All slopes are significantly different from zero at the .10 level of significance.

The results? Only the trend for the top 20% is significantly positive. All others are less than zero, although the first and fourth quintile trends are not significantly different from zero. In plain English, the top quintile has prospered at the expense of the lower four quintiles. How in democratic capitalism can the minority siphon income from the majority? The paradox plot thickens!

[The discerner of subtlety probably recognizes that the fall into democratic irrationality (preferring less to more when you have the political ability to obtain more) is not necessarily obvious. Figure EA-VI-3 makes this vividly clear. The decline of the second and third quintile (middle class)is virtually continuous from 1968 forward. But these two-fifths do not represent a majority nor do other quintiles immediately (1968-1976) have an incentive to join the

middle-class in a coalition. The lower fifth did not being dramatic decline until 1977 (energy crisis - supply side era). The fourth quintile did not begin dramatic decline until 1982.

At the time that the decline of the first quintile and the fourth quintile are recognized as trends, these quintile have incentive to join in a lower-income coalition with the middle class second and third quintiles. Let's call 1982 the coalition date for the first quintile and 1985, the coalition date from the fourth quintile. Thus, the time of irrational behavior is not that long, but long enough to indicate the absence of rational expectations and a lack of effective "rational" (i.e. more is preferred to less) economic education.]

Income Group Mobility

Professor Lusch has suggested that conclusions about income group welfare should be tempered by an evaluation of the mobility between income groups.

We can envision this perspective by considering a modification of the children's game of "musical chairs". In this modified game, we always have five numbered chairs positioned in a circle. The music begins to play and the heads of five households begin to march around the chair circle. When the music stops the household head sits in the closest chair. If you sit in chair one, your income for the next year will be the highest. If you sit in chair two, your income will be that of the second highest group, etc.

Continuing our analogy, consider repeating the game at the beginning of every year. However, assume that annual national income increases accrue primarily to the top income group. That is, the percent of total income for the top quintile increases annually, while the percent of total income for the bottom four quintiles decreases every year. The rich are becoming relatively richer and the poor are becoming relatively poorer. Contrast this situation to a situation in which the rich get richer simultaneous with the poor getting richer.

In the former configuration, each time you play musical income group and you don't get the top income group chair, you can expect a

fate that is becoming relatively worse thru time. In the latter situation, even if you don't get the best chair, you can be certain of getting a chair whose economic welfare stance has improved since last year. Undoubtedly, most rational agents would prefer the latter situation to the former. If you agree with this conclusion then the income mobility consideration is not as important as it might otherwise be. That is, given mobility we are most happy if the condition represented by all chairs is ever-increasing in economic welfare.

In our fictitious example, the probability of being in any chair is 20%. If you are in the lowest chair, there is an 80% probability that you'll be in a higher chair next year. If you're in the highest chair, there is an 80% probability that you'll be in a lower chair next year.

We are of course interested in the real world situation. We therefore turn our attention to Mark Lilla and his article entitled "Why the 'income distribution' is so misleading" and his reference to the University of Michigan's Panel Study on Income Dynamics. Lilla cites the following PSID statistics.

Income Quintile Mobility between 1971 and 1978[a]

table EA-VI-3	1978 QUINTILE					
1971 quintile	**highest**	**second**	**third**	**fourth**	**lowest**	**total**
Highest	48.5%	29.5%	14.0%	4.5%	3.5%	100.0%
Second	22.0%	31.5%	25.5%	15.0%	6.0%	100.0%
Third	14.0%	18.5%	30.5%	23.5%	13.5%	100.0%
Fourth	9.0%	13.5%	21.5%	34.5%	21.5%	100.0%
Lowest	6.0%	7.0%	9.5%	22.0%	55.5%	100.0%

[a]Percentages calculated from Panel Study on Income Dynamics sample. Adapted from Table 1.1, *Years of Poverty, Years of Plenty: The Changing fortunes of American Workers and Families* (Ann Arbor: Institute for Social Research, University of Michigan; 1984), p. 13.

This table is derived from: Mark Lilla, Why the Income Distribution is So Misleading," *Public Interest* 77 (Fall 1984) p. 70.

From the PSID statistics, we are able to derive our own Quintile Mobility Probability table.

table EA-VI-4	Income Quintile Mobility Probability				
original quintile	P(same or lower)	P(lower)	P(same)	P(higher)	P(same or higher)
Highest	100.0%	51.5%	48.5%	0.0%	48.5%
Second	78.0%	46.5%	31.5%	22.0%	53.5%
Third	67.5%	37.0%	30.5%	32.5%	63.0%
Fourth	56.0%	21.5%	34.5%	44.0%	78.5%
Lowest	55.5%	0.0%	55.5%	44.5%	100.0%
avg	71.4%	31.3%	40.1%	28.6%	68.7%

As you can see, regardless of your present income classification, there is a more than 50-50 chance that your family income will be the same or lower in the subsequent time period. There is a less than 50-50 chance that you'll be in a higher income group.

In light of the mobility statistics, it is even more important that we become concerned with decreases in the income shares of the lower 4 quintiles. For the vast majority of us, it is quite likely that we will live our lives in the lower 4 quintiles. It is therefore in majority self interest to assure that these lower 4 quintiles are in a path of ever increasing economic welfare.

But Wait, doesn't the indicated Income Group Mobility, mitigate some of the negative welfare implications?

After all, the last two columns of table EA-VI-4 appear to imply considerable hope for upward mobility. Such a view is considered too optimistic for several reasons.

Duncan and Morgan have found that the primary causation of income group mobility is family composition (e.g. births, deaths, divorce,

marriage and children leaving home).[7] Given such causation if a major bread winner dies or is separated from the family through divorce, family income diminishes. If a single parent marries, family income may increase. If a teenager gets a part-time job family income is up. But when that child leaves home and is no longer considered part of the family unit, then originating family income is down. If a wife temporarily leaves the work force to raise a newborn, the family income is temporarily down. But when that same mother reenters the workforce, family income again rises. Family Composition caused fluctuations in family income are to be expected regardless of fate of the corresponding income quintile. Given the consistency of the expected fluctuations in family composition, we must still examine individual quintiles to ascertain whether these quintiles represent increases or decreases in share of National Income through time.

Additionally, Hungerford examines the same Panel Study of Income Dynamics data set mentioned above and finds that from 1969-76,70% of families remain within ± 1 quintile of their beginning quintile. From 1979-86, about 90% of families remain within ± 1 quintile of their beginning quintile.[8] We use data from table EA-VI-3 above for similar analysis for the period 1971-78, and we get the following:

[7] Greg J. Duncan and James M. Morgan, "Persistence and Chance in Economic Status and the Role of Changing Family Composition", in Hill, Martha S. Hill, Daniel, and Morgan, James N. (eds.) *Five Thousand Families--Patterns of Economic Progress*, Institute for Social Research, University of Michigan, Ann Arbor, MI, 1981. & Greg J. Duncan and James N. Morgan, "An Overview of Family Economic Mobility", in Greg J. Duncan et al., *Years of Poverty, Years of Plenty*, Institute for Social Research, University of Michigan, Ann Arbor, MI 1984. Both cited by Thomas L. Hungerford, "U.S. Income Mobility in the Seventies and Eighties", *Review of Income and Wealth*, Series 39, Number 4, December 1993.

[8] Thomas L. Hungerford, "U.S. Income Mobility in the Seventies and Eighties", *Review of Income and Wealth*, Series 39, Number 4, December 1993.

table EA-VI-5 Beginning Quintile	Probability of Rising or Falling More than One Quintile	Probability of Remaining in Same Quintile or Rising or Falling One Quintile
Highest	22.0%	78.0%
Second	21.0%	79.0%
Third	27.5%	72.5%
Fourth	22.5%	77.5%
Lowest	22.5%	77.5%
Average	23.1%	76.9%

For more than 3/4ths of our sample, income mobility will be limited to ± 1 quintile of their beginning quintile and as above, must be attributed primarily to changes in family composition.

Greg Duncan (a major Income Mobility scholar) in his February 1992 testimony before the House Select Committee on Children, Youth and Families gives us some information that is consistent with a theory of automation eliminating low skilled work.

> At the risk of oversimplification, recent trends regarding middle-class income can be summarized as follows: the economic fortunes of middle-class adults over the past decade followed two highly divergent paths. Those in the upper half of the income distribution, with incomes above $35,000 and with college degrees did very well indeed. Upward mobility was easier for them in the 1980s than in the 1970s and their incomes and wealth grew correspondingly. Although the current recession has induced in many of them a sense of economic vulnerability, and post-recession industrial restructuring may cause temporary hardship for some, there are relatively few dark clouds on their economic horizons for the years ahead.
>
> In sharp contrast, the economic aspirations of many adults in the bottom half of the income distribution, in particular young adults just starting out and lacking college degrees, have been increasingly thwarted. When compared with the 1970s, more dropped out of the middle-class during the 1980s, and fewer succeeded in climbing into the middle-class from below. As a result, they were much less likely than higher-income families to accumulate wealth. The fundamentally worse earning prospects of less-skilled workers suggest that the economic problems of this group will persist during the 1990s.[9]

[9] *Overview of Entitlement Programs, **1993 Green Book**, Background Material and Data on Programs within the Jurisdiction of the Committee on Ways and Means* (Washington D.C., U.S. Government Printing Office, 1993), p. 1450.

Econometric Analysis

Number: EA-VII.

Title: Generational Comparison of the Number of Earners per Household Required to Maintain a Standard of Living

Data Set Reference: EA VII

Null Hypothesis: More Earners Per Household are Required Each Generation to Maintain the Same Standard of Living in the Age of Automation

Alternate Hypothesis: More Earners Per Household are NOT Required Each Generation to Maintain the Same Standard of Living in the Age of Automation

Discussion

We begin this discussion with a review of a graph based on Census Data that lists Median Income of Families from 1947 to 1988 by the Number of Earners which range from zero earners to 2 earners. This is the content of Figure EA-VII-1.

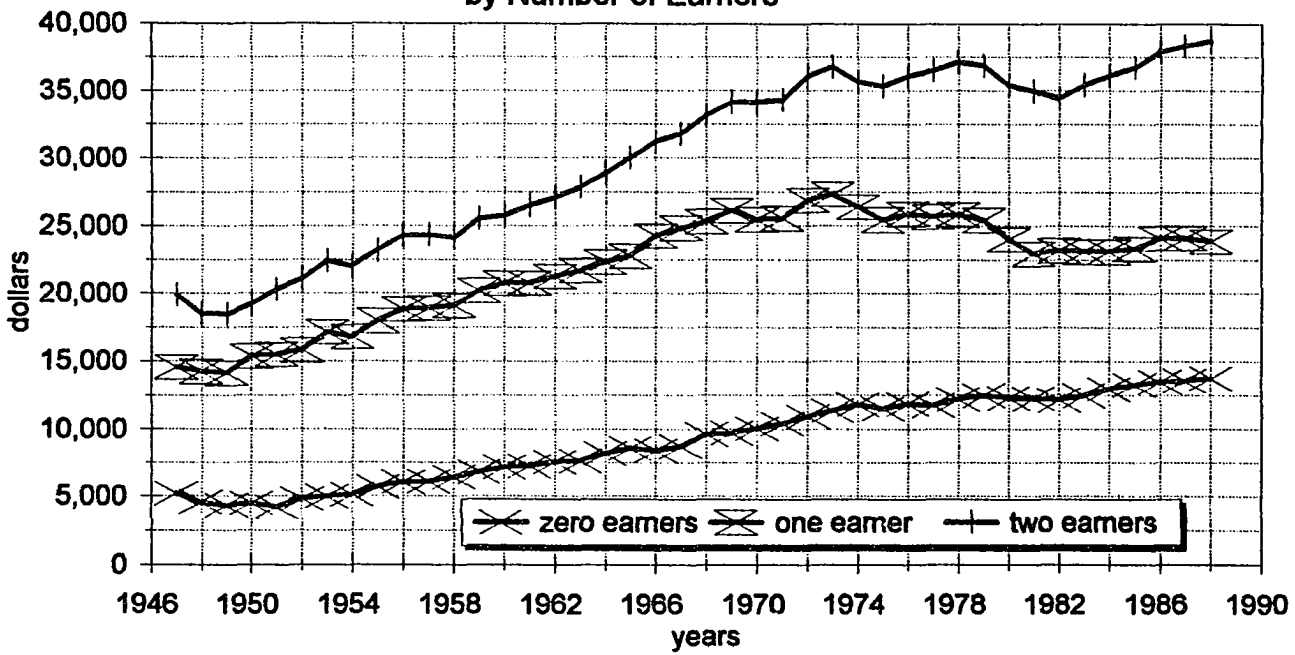
Let's let a zero earner household income represent a poverty level. Each year, every non-poverty level household's income can be expressed as a ratio of the non-poverty income to the poverty level income. For instance, if in a specified year, a household earns twice the income of a zero earner household its standard of living is 2, i.e. twice the poverty level.

Therefore, each year, we can form a ratio of the one-earner median income to the zero-earner median income and also form a ratio of two-earner median income to zero-earner median income. The results of this exercise are expressed in Figure EA-VII-2.

Now, let's make use of the horizontal grid lines in Figure EA-VII-2. We note that in 1951 one-earner median income is about 3.7 times poverty level (zero-earner) income. We also note that 1958 and 1959 two-earner median income is about 3.7 times poverty level (zero-earner) income.

We can therefore conclude that a household that could be supported

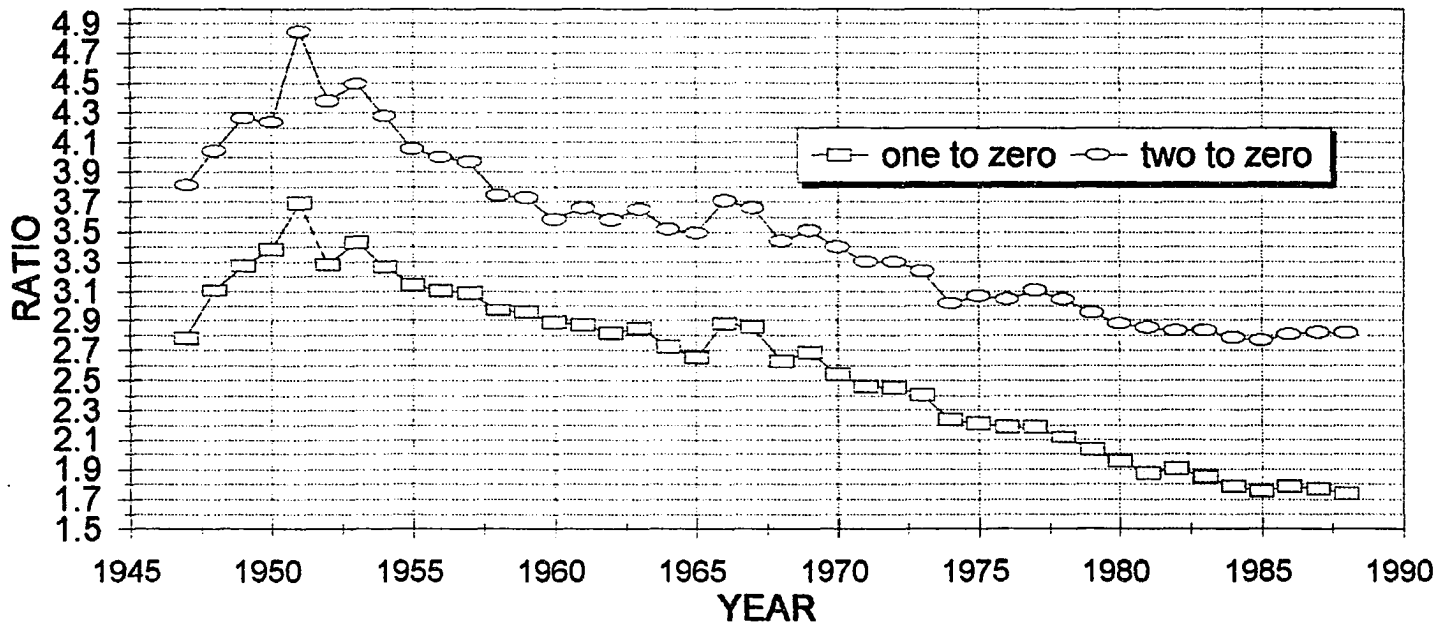
Figure EA-VII-1



data source: U.S. Department of Commerce, Current Population Reports, Consumer Income, Series P-60, No. 167, "Trends In Income, by Selected

Figure EA-VII-2

Ratio of Median Household Income to Zero Earner Median by # of Earners



data source: U.S. Department of Commerce, Current Population Reports, Consumer Income, Series P-60, No. 167, "Trends In Income, by Selected Characteristics: 1947 to 1988, issued April 1990, page 24.

by one earner in 1951 would require two earners in 1958-9. We can continue with similar examples using the same logic as follows:

Table EA-VII-1 Number of Earners Required to Provide Specified Standard of Living		
SOL ratio	one-earner year	two-earner year
3.7	1951	1958-9
3.4	1953	1968
3.0	1958-9	1974
2.9	1960 & 1966	1980
2.8	1962	1985

While we have not performed standard statistical analysis, the logic is sound and we will not reject the null hypothesis above.

Econometric Analysis

Number: EA-VIII
Title: Analyzing the Relationship between Real Compensation per Hour and Output per Hour[1]

Data Set Reference: EA-VIII

Discussion:

Elsewhere in this study we have separately demonstrated the diminution of real wage growth and of GNP growth rates(total and per capita) during the past 25 years and have indicated that these phenomena are reflective of diminished economic welfare in the Automation Age. In this analysis we are concerned with the *relationship between* real compensation and real output.

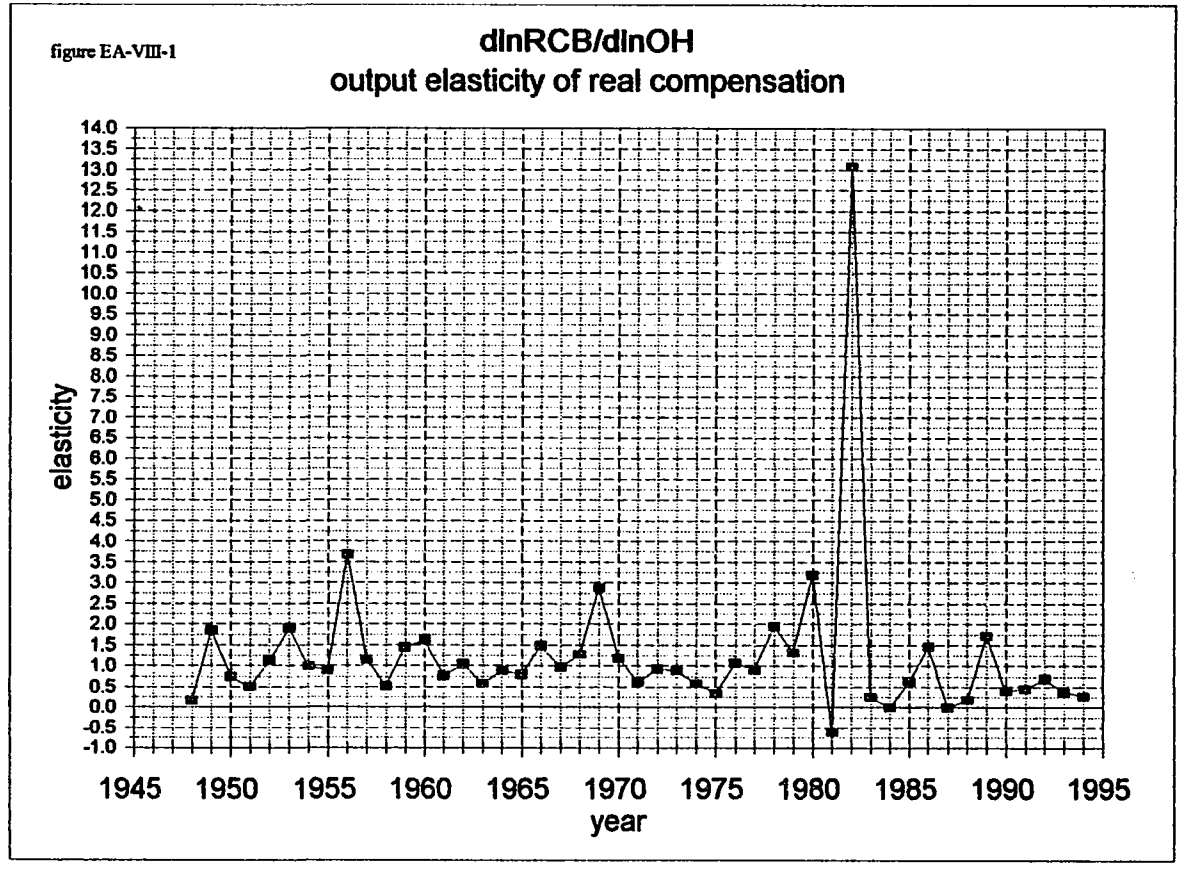
For instance, if real output changes by 1 percent, what is the resulting change in real compensation? The answer to this question defines the real output elasticity of real compensation. More precisely the ratio of the percentage change in real compensation to the percentage change in real output is the real output elasticity of real compensation.

Converting the variables in question to their natural log equivalents facilitates computation of elasticity because the difference between the natural log values of successive time periods equals the percentage changes between those time periods. Therefore if we compute the change in the natural log of real compensation for a time series and the change in the natural log of real output for the same time periods, we may form ratios of the former series over the latter series. We have plotted the results of such an exercise for the years 1947-94 in figure EA-VIII-1.

The average point elasticity from 1947-1994 is 1.26. However, as we observe the graph we notice an outlier for 1982. This outlier results from the extremely small change in real output compared to a non-atypical change in real compensation. If we omit this outlier, we

[1] Professor Dauffenbach has suggested this analysis and has assisted with its development.

figure EA-VIII-1



have an average real output elasticity of real compensation of 1.00 (i.e. unitary elasticity). Alternately, we may consider the median of the series (defined such that half the observations have values above and half the observations have values below the median). The median is .89. We may therefore report the central tendency of the point elasticities as being between .89 and 1.

We will next explore the least squares estimate of **trend elasticity**. The least squares trend elasticity stands in contrast to the *point* elasticities that we have been discussing above. When we calculate d(lnRC)/d(ln(OH) for a particular period, this computation is valid for that point and becomes less valid the further one moves from that point. Indeed, the arithmetic mean of point elasticities need not be closely related to the least squares trend elasticity. However, the least squares trend elasticity defines a constant elasticity that in a log transformed plane of the two variables in question is represented by a least squares defined straight line. This least squares trend elasticity defines a constant elasticity that will take us from the beginning of the series to the end and will minimize a sum of squared errors. This least squares least squares trend elasticity may be considered superior to an average of the point elasticities which can differ greatly from the slope of a best fitting longer-term straight line.

Let us compute the least squares trend elasticity for the 1947-94 series by using linear regression and calculus.

If we regress the following equation:

$$\mathbf{ln(RealCompensationBusiness) = ln(\alpha) + \beta * ln(realOutputHour)}$$

the estimate of the β coefficient is an estimate of the least squares trend elasticity because this is d(lnRC)/d(lnOH), by definition of the first derivative.

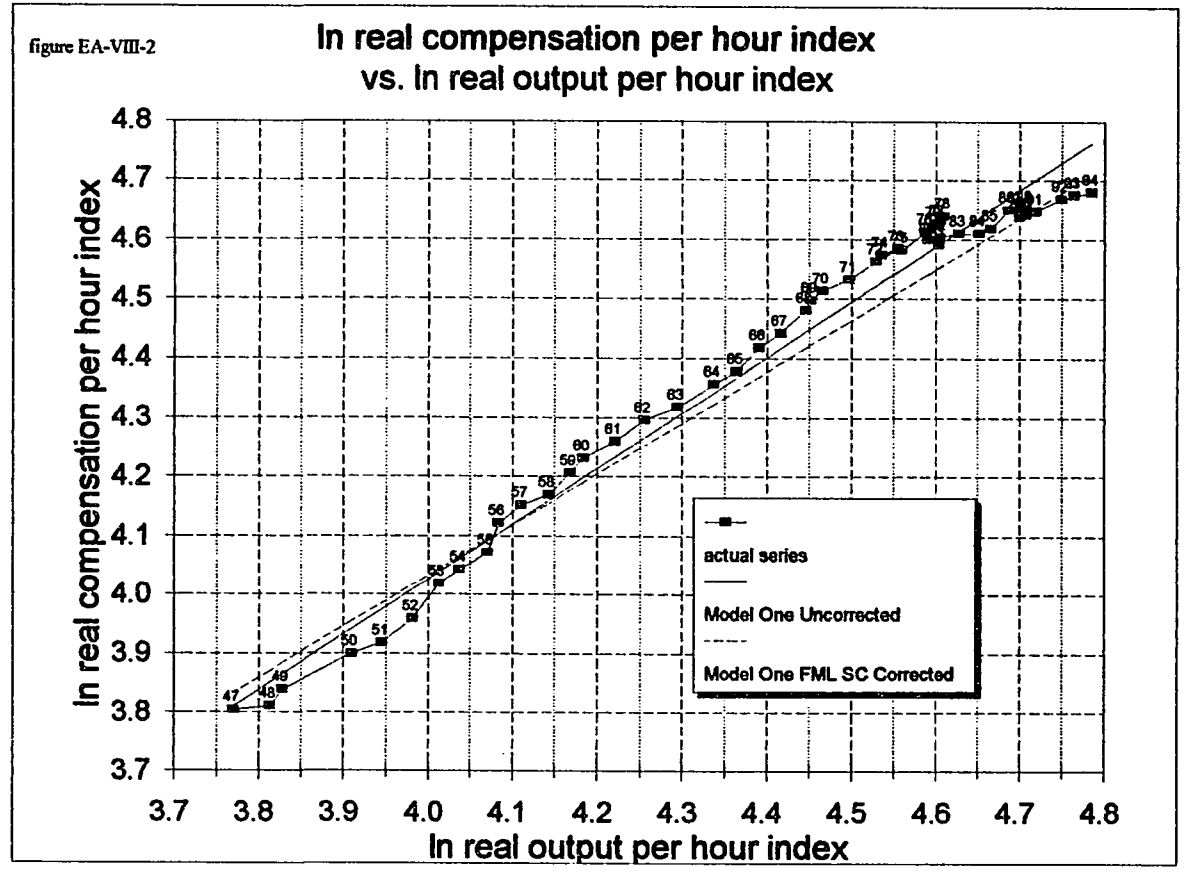
In Model One we perform the indicated regression (see figure EA-VIII-2):

Model One: Regression to find the real output least squares trend elasticity of real compensation

Model One MINITAB® Regress Results:

The regression equation is
lnRCB = 0.274 + 0.938 lnOH

figure EA-VIII-2



Predictor	Coef	Stdev	t-ratio	p
Constant	0.27418	0.08162	3.36	0.002
lnOH	0.93793	0.01852	50.63	0.000

s = 0.03714 R-sq = 98.2% R-sq(adj) = 98.2%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	3.5373	3.5373	2563.80	0.000
Error	46	0.0635	0.0014		
Total	47	3.6008			

Durbin-Watson statistic = 0.13

Model One Serial Correlation Correction

Full Maximum Likelihood Estimated Rho = 0.9570

The regression equation is
lnRCB* = 0.580 (Intercept) + 0.863 lnOH*

Predictor	Coef	Stdev	t-ratio	p
Noconstant				
Intercept	0.5801	0.2267	2.56	0.014
lnOH*	0.86255	0.05174	16.67	0.000

s = 0.01292
Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	2	3.2434	1.6217	9708.57	0.000
Error	46	0.0077	0.0002		
Total	48	3.2511			

Durbin-Watson statistic = 1.73

Model One Variable Dictionary:

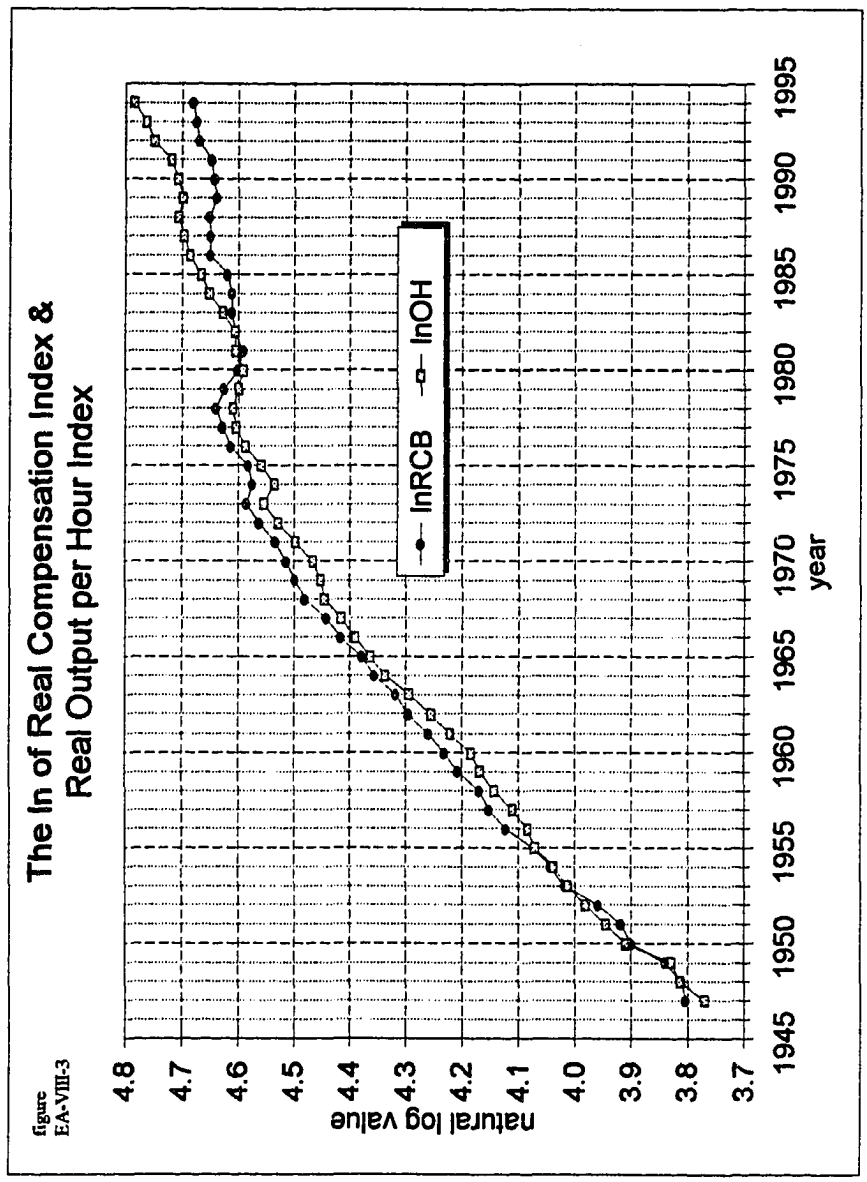
lnRCB=natural log of Real Compensation/hour in the Business sector

lnOH=natural log of Output/Hour

The long run result implied by Model One regression is real output elasticity of real compensation is equal to .863 .

In another Econometric Analysis, we have indicated that 1973 represents the beginning of a dramatic decline in the ratio of the real wage to real output.

Attention is directed towards figure EA-VIII-3 and its plot of both ln real compensation and ln real output per hour vs. time. It appears that the slopes of both variables diminish beginning in 1973. While



ln Output per Hour does appear to recover, the ln Real Compensation does not.

In figure EA-VIII-2 we have plotted ln of real compensation vs ln real output. The slope of this curve is the output elasticity of real compensation. We can formally test to find if the real output elasticity of real compensation is different when 47-73 is compared to 74-94. It *appears* that both the slope and the intercept may have both changed in the final 20 years.

Model Two: Regression to ascertain change in slope (elasticity) and/or intercept when 47-73 era is compared to 74-94 era

Model Two MINITAB® Regress Results:

The regression equation is
lnRCB = - 0.191 + 1.05 lnOH + 3.03 DUM7494 - 0.667 lnOH7494

Predictor	Coef	Stdev	t-ratio	p
Constant	-0.19095	0.05466	-3.49	0.001
lnOH	1.05086	0.01301	80.78	0.000
DUM7494	3.0319	0.2384	12.72	0.000
lnOH7494	-0.66671	0.05151	-12.94	0.000

s = 0.01556 R-sq = 99.7% R-sq(adj) = 99.7%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	3	3.5901	1.1967	4940.77	0.000
Error	44	0.0107	0.0002		
Total	47	3.6008			

Durbin-Watson statistic = 0.80

Model Two Serial Correlation Correction

Full Maximum Likelihood Estimated Rho = 0.6540

The regression equation is
lnRCB* = - 0.076 + 1.02 lnOH* + 2.68 DUM7494* - 0.588 lnOH7494*

Predictor	Coef	Stdev	t-ratio	p
Noconstant				
Intercept	-0.0756	0.1027	-0.74	0.466
lnOH*	1.02368	0.02446	41.85	0.000
DUM7494*	2.6751	0.4008	6.67	0.000
lnOH7494*	-0.58781	0.08671	-6.78	0.000

s = 0.01247

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	4	129.323	32.331	207784.84	0.000
Error	44	0.007	0.000		
Total	48	129.330			

Durbin-Watson statistic = 1.80

Model Two Variable Dictionary:

lnRCB=natural log of Real Compensation/hour
lnOH = natural log of Output/hour
DUM7494 = a column of 0s for the years 47-73 and 1s for years 74-94
lnOH7494 = column of 0s for 47-73 and ln(real output) for 74-94

Discussion:

Given the above OLS regression results, we have the following equations 1) for 1947-73:

$$\mathbf{lnRCB = -0.191 + 1.05\ lnOH}$$

and 2) for 74-94:

$$\mathbf{lnRCB = (-0.191 + 3.03) + (1.05 - 0.667)lnOH}$$

$$\mathbf{lnRCB = 2.839 + .383\ lnOH}$$

Given the above FML regression results, we have the following equations 1) for 1947-73:

$$\mathbf{lnRCB^* = -0.076 + 1.02\ lnOH^*}$$

and 2) for 74-94:

$$\mathbf{lnRCB^* = (-0.076 + 2.68) + (1.02 - 0.588)lnOH^*}$$

$$\mathbf{lnRCB^* = 2.604 + .432\ lnOH^*}$$

The small p-values for the coefficients of DUM7494* and lnOH7494* indicate that the slope and intercept differential terms are significantly different from zero and therefore we conclude that the output per hour elasticity of real compensation has changed in the 74-94 era.

We have confidence in our mathematical results, but what is the Economic interpretation of these results? Conceivably, more than one scenario might fit this statistical conclusion. However, we believe the following scenario has merit:

With the onset of the energy crisis, management is allowed unusually high price increases because of a public belief that such was justified by the energy cost increases due to foreign oil prices. Labor halts in its demand for matching wage increase, first in deference to a perceived national emergency (energy crisis),then later due to a perception of a weakened bargaining position personified by the Reagan Administration's dismissal of striking air traffic controllers. The concurrent intensification of Automation made labor more dispensable, i.e. more easily displaced with robots, computers, etc. Labor's position becomes politically weaker, the energy crisis proved that management could increase wages (relative to other prices) less than in the past. Automation was a primary facilitating reason.

Let's summarize. From 1947-73, a 1% increase in output was associated with a 1% increase in real compensation. However, from 1974-94 a 1% increase in output was associated with a .4% increase in compensation. This dramatic decrement may be associated with a weaker labor position due in part to greater automation. The energy crisis did not cause the weakening but it did contribute to a demonstration of the weakening. Pro-management political administration may be concurrent possible causation.

(This analysis utilizes full labor compensation and not simply wages. Therefore, arguments that fringe benefits increase may be replacing wage benefits are dismissed.)

Econometric Analysis

Number: EA-IX.

Title: Analyzing Inflation and the Price Level

Data Set References: EA-IX-1 & EA-IX-2

Discussion

Inflation is depicted in figure EA-IX-1. The Price Level is depicted in EA-IX-2. Inflation and the Price level are functionally related. Inflation is the percentage change in the price level per time period. These concepts have been previously discussed.

With regard to inflation (figure EA-IX-1), we note the extremely high levels of inflation during the 1970s associated with the stagflation period.

In order to have a decrease in the price level (fig. EA-IX-2), we must have a negative rate of inflation (fig. EA-IX-1), by definition. The last time we had deflation was in 1945. We therefore conclude that the price level (figure EA-IX-2) has risen continuously since 1945, i.e. during the Age of Automation.

Regarding inflation (ceterius paribus), those whose incomes rise at a rate equal or greater than the inflation rate are not worse off. All others are worse off. With zero inflation, no one is worse off because of increasing prices and with deflation all buyers are better off.

Keynes argues that a certain amount of inflation accompanies positive economic growth. So, we don't jump too quickly to judge inflation associated with vigorous economic growth. We should note that the price level for 1950 is the highest that the price level reached from 1776 until 1950[1], a period of 174 years of price level ups and downs. We are therefore concerned with inflation and the price level and we are inspired to study the dynamics of public policy that might reduce the price level. (For instance, in recent years Japan has managed to maintain a rather constant price level, albeit after many years of increase.)

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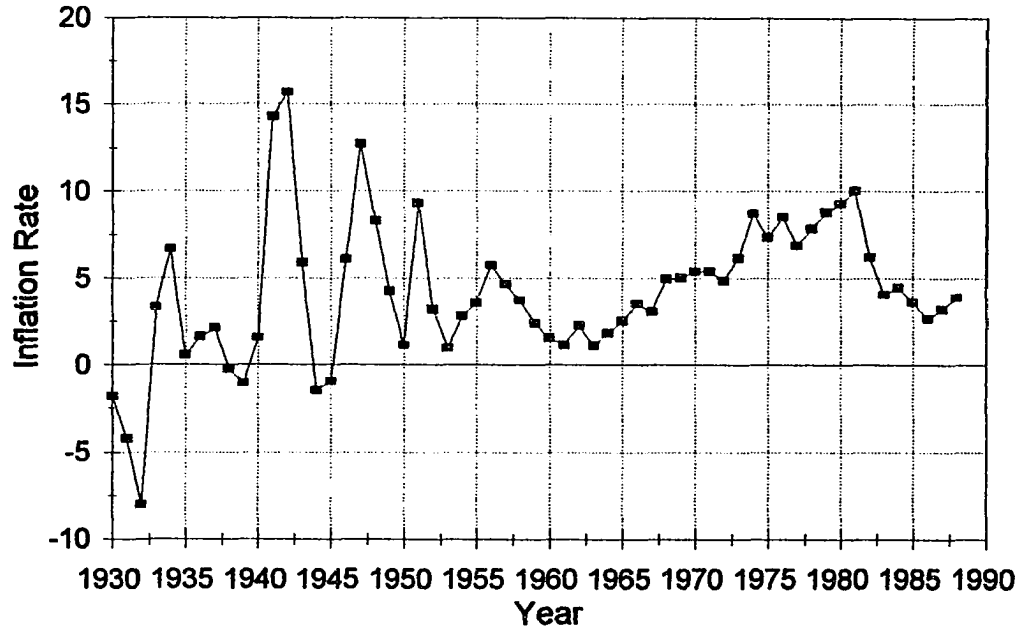
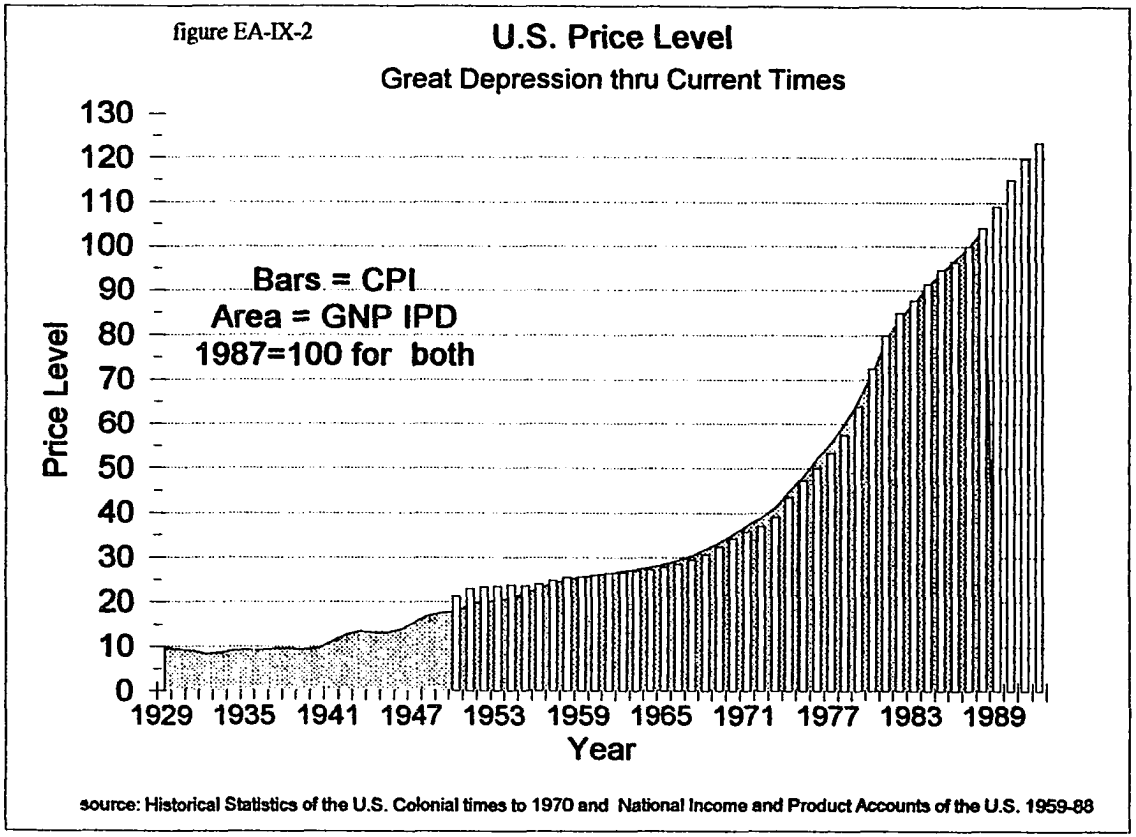
[1] William J. Boyes, *Macroeconomics: The Dynamics of Theory and Policy* (Cincinnati: South-Western Publishing Co., 1984), 5.

figure EA-IX-1



source: Historical Statistics of the U.S. Colonial times to 1970 and National Income and Product Accounts of the U.S. 1959-88

figure EA-IX-2



source: Historical Statistics of the U.S. Colonial times to 1970 and National Income and Product Accounts of the U.S. 1959-88

What follows is non-traditional analysis predicated upon the price level.

Null Hypothesis: There is a Significant Relationship Between the Price Level and the Level of Imports

Alternate Hypothesis: There is no significant relationship between the price level and the level of imports

Consider the following statement from Henderson and Poole concerning the price level and price indices:

...

> ... economic well-being is affected by the inflation rate rather than by the price level. Problems arise with changes in the price level and not from a steady level of prices, what ever that level might be.[2]

A corollary of this view is the concept of money illusion. Money illusion is an economic principle that implies that if prices and income both change by the same percentage, we are neither better off nor worse off (if you believe otherwise, you suffer from money illusion).[3]

While these concepts (common to elementary economics) are perhaps true in a closed economy, they are both weakened in a global economy of free trade. More precisely, we will argue that in a global economy, the price level may indeed have an important impact on economic welfare.

Towards an international focus, let us consider the concept of Purchasing Power Parity. With this theory, if the price of a good is cheaper in location B than in location A, buyers will gravitate to location B to buy their goods and the eventual equilibrium will have equal prices in both locations (regardless of how far apart the locations are). Thus, the ratio (foreign price level ÷ U.S. price level) defines the exchange ratio of how many foreign money units must be exchanged for 1 U.S. dollar. If the above exchange ratio decreases, the dollar depreciates and imports become more costly for

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[2] Henderson and Poole, *Principles of Macroeconomics* (Lexington, MA: D.C. Heath, 1991), p.386.

[3] Or more formally, consumers "demand functions are homogeneous of degree zero with respect to prices ...and income...." in E. Malinvaud, *Lectures on Microeconomic Theory* (New York: American Elsevier, 1972) p. 34.

Americans. Alternately if the above exchange ratio increases, the dollar appreciates and imports become cheaper.

Implications of the above include: 1)U.S. inflation less than foreign inflation will tend to increase dollar value of imports and 2)U.S. inflation greater than foreign inflation will tend to decrease imports.

The entire Purchasing Power Parity theory is of course considered ceterius paribus. That is, we assume that other factors such as international demand functions, international relative interest rates, and international relative growth rates, are all held constant.[4]

The Purchasing Power Parity theory therefore is consistent with the statement by Henderson and Poole of the preeminence of the inflation rate when compared to the price level.

Our alternative and simpler theory states that the price level is the primary causation of the level of imports to the United States.

Let's consider a statistical model:

Model One: Regression with imports as the dependent variable and the consumer price index as the independent variable (years 1959-92).

Model One MINITAB® REGRESS Results:

The regression equation is
imports = 6.0 + 4.11 CPI

Predictor	Coef	Stdev	t-ratio	p
Constant	5.95	13.65	0.44	0.666
CPI	4.1141	0.1754	23.46	0.000

s = 37.93 R-sq = 94.5% R-sq(adj) = 94.3%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	1	791594	791594	550.20	0.000
Error	32	46040	1439		
Total	33	837634			

Durbin-Watson statistic = 0.37

Model One Serial Correlation Correction

Full Maximum Likelihood Estimated Rho = 0.8030

[4] For an elementary discussion of this theory see: Michael Parkin, *Macroeconomics* (Second edition) (Reading, Mass. - Addison-Wesley Publishing Co., 1993), p. 521-22 and Walter J. Wessels, *Economics* (Woodbury N.Y. - Barron's) p. 429-431.

The regression equation is
imports = 8.3 + 4.07 CPI

Predictor	Coef	Stdev	t-ratio	p
Noconstant				
Constant	8.32	32.55	0.26	0.800
CPI	4.0750	0.3851	10.58	0.000

s = 22.17

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	2	202168	101084	205.61	0.000
Error	32	15732	492		
Total	34	217900			

Durbin-Watson statistic = 1.19

This regression result states that a unit change in the CPI implies a 4.07 change in the value of $billion of imports.

There is always excitement in finding a R^2 value greater than 90%, although experienced statistical investigators know that in isolation a 90%+ R^2 may not be practically significant (especially with time series data and associated serial correction procedures). Commonly stated, high correlation does not necessarily imply strong causation. The occurrence of sunspots may be correlated with the occurrence of business cycles, but an investigator will be hard pressed to prove causation.

An important question therefore becomes, does the statement "the price level *determines* the level of imports" have Econometric significance.

To begin justification for our theory, let us briefly review the theory of price discrimination for a monopolist or for one with monopoly type power. Profit maximization continues to be the assumed primary goal of business enterprise and for the monopolist.

Microeconomic theory predicts that firms (including Monopolists) will maximize profit by setting Marginal Revenue equal to Marginal Cost[5]. In many instances the monopolist has the ability to charge different prices to different classes of consumers and with each separate class, profit is maximized with marginal revenue equal to marginal cost (marginal revenue for the classes must equal one

[5] For discussion of monopolistic price discrimination see: Michael Parkin, *Microeconmics* (Second edition) (Reading, Mass. - Addison-Wesley Publishing Co., 1993), p. 322-28.

another). The theoretical limit of price discrimination is perfect discrimination with a different price for each class.

A key requirement for a price discriminating monopolist is the ability to prevent one class from reselling the commodity to another class. If discounts are given to senior citizens, the seniors must not be able to resale the commodity to younger classes (e.g. airplane flights). Resale is perhaps a valid concern when students get educational discounts on expensive computer software and must agree not to resale to non-student buyers.

The inability of one class to resale to another class stands in stark contrast to the Purchasing Power Parity described above. McDonald's Big Mac sandwiches are sometimes cited as examples of a failure of the Purchasing Power Parity theory (Big Macs sale for different prices in different countries) but others counter than Big Macs are not easily resellable from country to country. You don't buy low cost Big Macs and resale in high price Big Mac countries. It appears that McDonalds is practicing a form of price discrimination.

A relevant question in international trade becomes: "How easy is it to buy goods in a low price country and resale those goods in a high price country?" If the answer is "not very easy", we have an excellent opportunity for international price discrimination. The Japanese may sale cars at higher prices in Japan than in the United States in an effort to increase their profits. This could be rational economic behavior.

But consider the definition of a negative economic term called "dumping".

> Dumping is the selling of a good in a foreign market for a lower price than in the domestic market or for a lower price than its cost of production. ... Under current U.S. law, and under GATT, dumping is illegal and anti-dumping duties may be imposed on foreign producers if U.S. producers can show that they have been injured by dumping.[6]

If the penalty for dumping is slight, the benefit great (Americans get cheaper goods.), and occurrences hard to prove, the practice will continue. A fundamental long-run principle becomes practice price discrimination if it involves increased profit.

If such is the case, imports can be expected to rise as American price levels rise and as foreign production costs fall. Note that a

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[6] Michael Parkin, *Macroeconomics* (Second edition) (Reading, Mass. - Addison-Wesley Publishing Co., 1993), p. 495.

constant (non-changing, i.e. non-inflationary & non-deflationary) price level can call forth an increasing amount of imports if the exporting country is experiencing decreasing costs due for instance to Automation. The differential between the importing country's price level and the exporting country's production cost is important. We posit that this differential, or more simply the importing country's price level, can predict the level of imports.

Null Hypothesis: International Trade Deficits contribute Significantly to increased domestic unemployment

Alternate Hypothesis: International Trade Deficits DON'T contribute Significantly to increased domestic unemployment

Discussion with an OU ***Introduction to Macroeconomics*** student:

Student: "You said that true free trade is a two way street and both countries should have an open door to the goods of the other country?"
Johnson: "That's correct."
Student: "Isn't it true that America did very little to force the acceptance of American goods in Japan during the Reagan years?"
Johnson: "Some actions were taken but the effort could have been more vigorous."
Student: "Don't you think it was unusual that after leaving office, Reagan received $2 million dollars for speaking in Japan[7]?"
Johnson: "Unusual maybe, but not illegal!"
Student: "Unethical!"
Johnson: "Perhaps! What do you think the penalty for Reagan should have been?"
Student: "I don't know, I'll have to think about that one!"

In the long-run, the expected value of the trade deficit should be zero. While such a statement may contain some political bias, fundamentally, it's origin can be traced to ideas of perfect competition and free trade. This implies that foreign nations are as receptive to our goods as we are to theirs and that all other conditions favoring a zero expected value are meet.

Lets construct an impact table for analysis:

[7] See for instance,"Japan: Western stars shine in the East", *U.S. News and World Report*, November 6, 1989, p. 15.

table EA-IX-1	Trade Deficit Impact Table						
Year	GDP	Trade Deficit	Trade Deficit as % of GDP	T Deficit * Multiplier	Actual Unemp %	Unemp % w/o T Deficit Leak	1000s of jobs lost
1982	3760.3	7.4	0.2	12.48	9.7	9.6	108.4
1983	3906.6	56.2	1.4	94.78	9.6	8.9	802.4
1984	4148.5	122.0	2.9	205.74	7.5	6.0	1669.6
1985	4279.8	145.4	3.4	245.20	7.2	5.5	1961.3
1986	4404.5	155.1	3.5	261.56	7.0	5.2	2074.7
1987	4540.0	143.1	3.2	241.32	6.2	4.6	1889.1
1988	4718.6	104.1	2.2	175.55	5.5	4.4	1342.1
1989	4836.9	73.6	1.5	124.12	5.3	4.5	942.4
1990	4884.9	51.8	1.1	87.36	5.5	5.0	661.6
1991	4848.4	21.8	0.5	36.76	6.7	6.5	281.7

Data sources: Labor force data from *1994 Economic Report to the President*, GDP and Trade Deficit data from *1992 Economic Report of the President* as cited in Parkin, *Macroeconomics*, 597.

During the years 1982 to 1991, The United States had a trade deficit that was arguably different from a zero expected value. This insults our idea of a correct foreign trade policy and it has impacts, including a reduction in potential U.S. domestic employment.

The GDP and Trade Deficits are given national statistics. The trade deficit is multiplied times a conservative aggregate expenditure multiplier of 1.6864.[8] The result is the potential impact, if the trade deficit had instead been spent on American goods.

Now we add Okun's Law, the conservative version of which predicts that every 2 percent increase in National Output, reduces unemployment by 1 percent. These facts applied to the labor force size for the years in question yield the last column in the table above.

The number of jobs lost to international competition is considerable. Unemployment was the primary measure of the Great

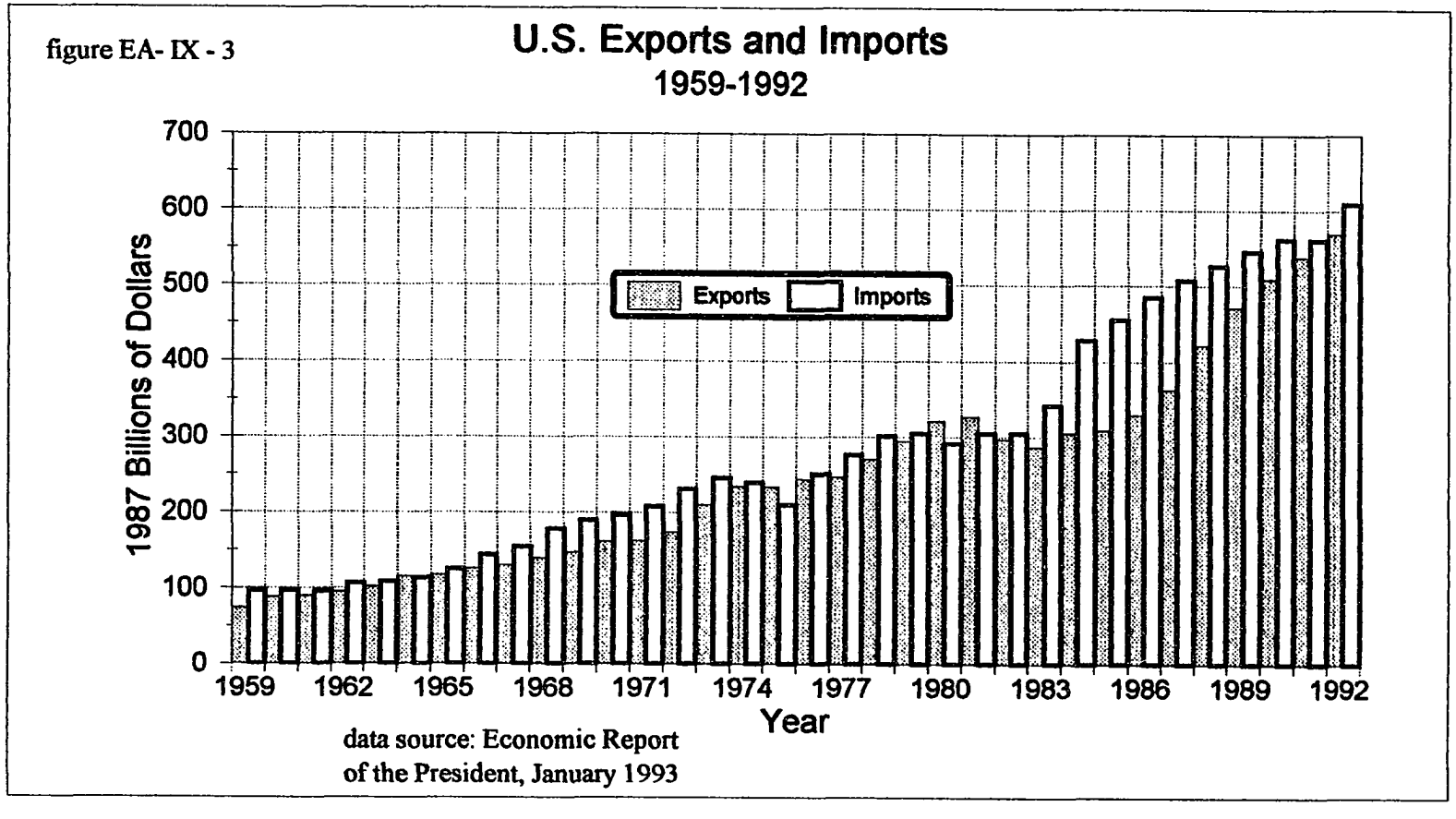
[8] For a discussion of the multiplier see: Michael Parkin, *Macroeconomics* (Second edition) (Reading, Mass. - Addison-Wesley Publishing Co., 1993), p. 236-38.

Depression. (Un)employment is inexorably tied to economic welfare. Diminution of potential economic welfare is implied, as many union members argue, "American jobs are exported to foreign markets". Counter arguments are limited to the cheaper goods we get in return. But these cheaper goods are cheaper due to the high American price level (as demonstrated above)! Thus the price level is tied to economic welfare.

Shouldn't the expected value of the American trade deficit be zero? (Japanese model enthusiasts might argue that a consistent trade surplus with strong blockages for potential imports would be best, but this contradicts free trade and perfect competition.)

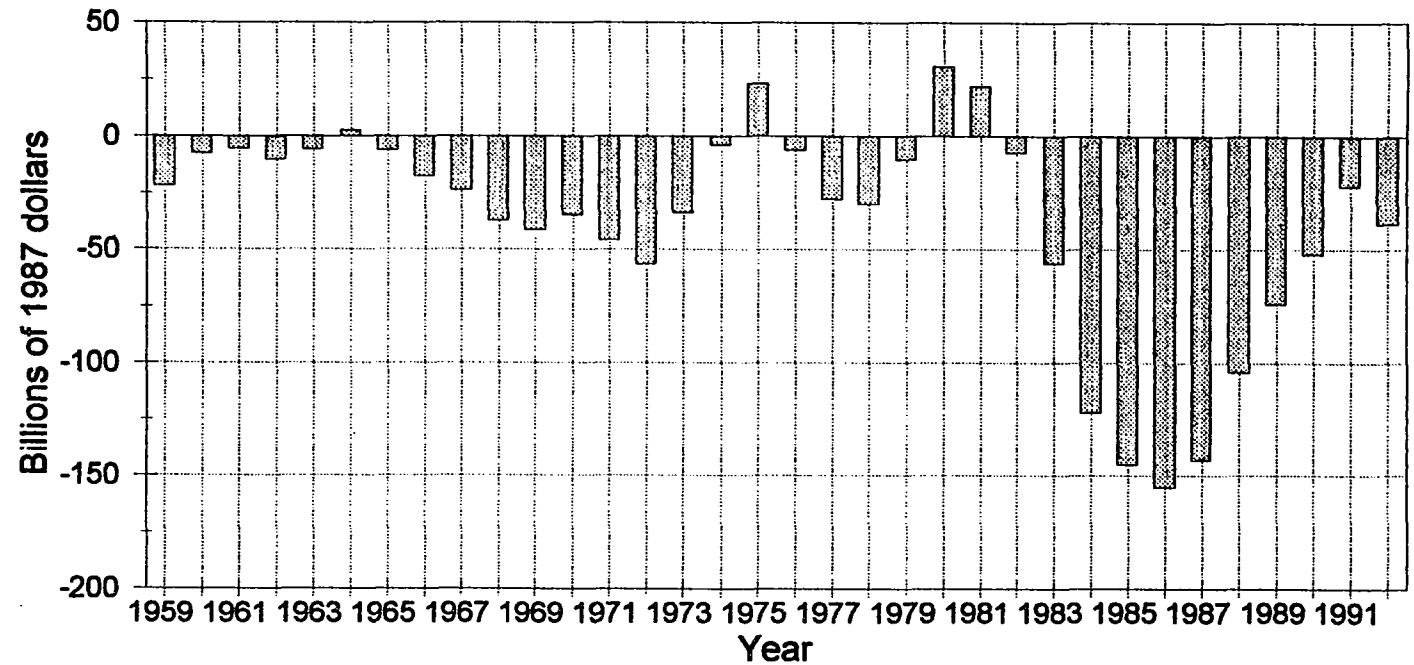
Figures EA-IX-3 and EA-IX-4 illustrate Imports, Exports, and the Balance of Trade from 1959 to recent times.

figure EA- IX - 3



data source: Economic Report
of the President, January 1993

figure EA- IX -4



data source: Economic Report of the President, January 1993 Table B19

Econometric Analysis

Number: EA-X
Title: Analyzing Unemployment

Data Set References: EA-X-1,2, & 3

Analysis of Traditional Data

A review of the definition of unemployment is in order, as we begin an analysis of unemployment data. Ehrenberg and Smith provide a comprehensive definition:

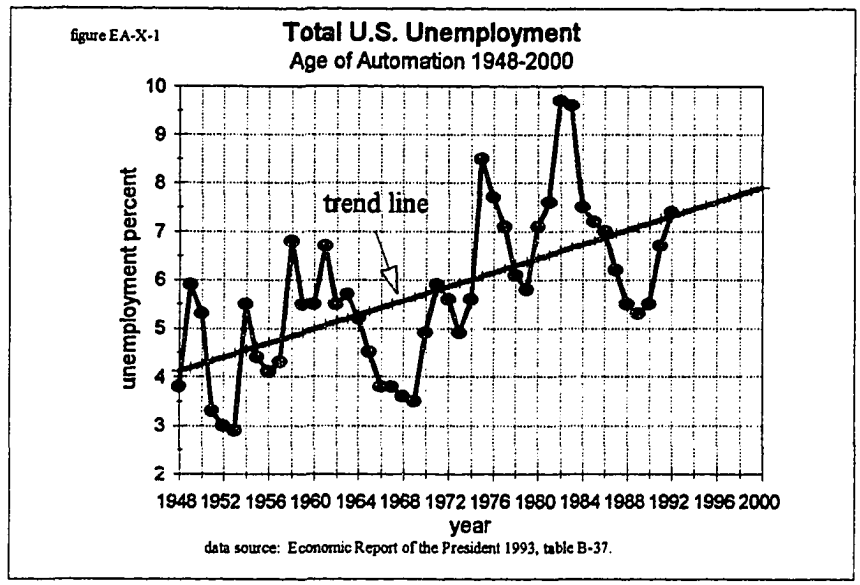
> The official definition of unemployment for purposes of government statistics includes those who have been laid off by their employers, those who have been fired or have quit and are looking for other work, and those who are just entering or reentering the labor force but have not found a job as yet.
> ...
> In 1957 the definition of the term *unemployed* was changed to include those who were waiting to be called back to a job from which they had been laid off, were waiting to report to a new wage or salary job scheduled to start within the next 30 days (and were not in school during the survey week), or would have been looking for work except that they were temporarily ill or believed no work was available in their line of work or in the community. Prior to 1957, part of those whose layoffs were for definite periods of less than 30 days were classified as employed, as were all those waiting to report to a new job.[1]

Interestingly, if unemployment benefits have been exhausted and the person has not been re-employed, regardless of the person's work ethic, the individual is considered no longer in the work force and therefore no longer unemployed.

Null Hypothesis: The Least Squares Trend of the Unemployment Rate is Upward During the Age of Automation

Alternate Hypothesis: The Least Squares Trend of the Unemployment Rate is NOT Upward During the Age of Automation

[1] Ronald G. Ehrenberg and Robert S. Smith, *Modern Labor Economics: Theory and Public Policy, 3rd Edition* (Glenview, IL: Scott Foresman and Company, 1988), p. 15 &18.



Model One: Discovering the Trend of Unemployment

Model One MINITAB® Regress Results:

```
The regression equation is
unemp = 4.03 + 0.0730 yrndx

Predictor       Coef      Stdev    t-ratio       p
Constant      4.0326     0.3995      10.09   0.000
yrndx        0.07298    0.01512       4.82   0.000

s = 1.318       R-sq = 35.1%     R-sq(adj) = 33.6%

Analysis of Variance

SOURCE       DF          SS          MS         F       p
Regression    1      40.422      40.422     23.28   0.000
Error        43      74.662       1.736
Total        44     115.084


Durbin-Watson statistic = 0.77
```

Model One Serial Correlation Correction

```
Full Maximum Likelihood Estimated Rho = 0.6020

The regression equation is
unemp = 3.99 + 0.0745 yrndx
```

Predictor	Coef	Stdev	t-ratio	p
Noconstant				
Constant	3.9897	0.7298	5.47	0.000
yrndx	0.07454	0.02718	2.74	0.009

s = 1.039

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	2	255.64	127.82	118.47	0.000
Error	43	46.39	1.08		
Total	45	302.03			

Durbin-Watson statistic = 1.70

Discussion

The above graphic indicates an upward trend in the rate of U.S. unemployment since 1948. The computation

of the trend line follows. The trend line has an unarguable positive slope, indicative of an increase in the rate of unemployment during the Age of Automation - the opposite of an expected trend if automation is a dominant source of greater employment.

However, there are alternate interpretations of this data and trend. Much of the alternate interpretation centers on a conception of the *Natural Rate of Unemployment* or perhaps more precisely the *Non-Accelerating Inflation Rate of Unemployment (NAIRU)*. These concepts have been discussed above in this document. Frictional unemployment (resulting from time spent in jobs search) and structural unemployment (resulting from a mismatch between existing jobs and the skills of the labor force) are primary components of NAIRU.

Economists record an increase in NAIRU over time (i.e. at the time of the passage of the Employment Act of 1946 NAIRU was 2%, during the 1960s we had 4%[2], the early 80s it's 7%, 5.5-6.0% in the mid-1980s[3], etc.). Therefore, it is possible that we are observing a NAIRU increase in the above upward trend. It's possible that deficient demand unemployment (the difference between NAIRU and actual unemployment) is not that great.

---

[2] Wasily Leontief, "The Distribution of Work and Income", *The Mechanization of Work* (U.S.: Scientific American, Inc., 1982), 102.

[3] F. Ray Marshall & V.M. Briggs, *Labor Economics: Theory, Institutions, and Public Policy* (Homewood, Ill.: Irwin, 1989)

NAIRU is a function of structural fluctuations, job search time (which is also a function of the existing unemployment rate), the level of aggregate demand, changes in the composition of the labor force, the level of unemployment and compensation available for those not-in-the-labor-force, etc.[4], and therefore becomes a quite complex term.

Baby Boomers and the increased number of women in the labor force are sources of increases in NAIRU according to Reynolds[5]. Women have higher unemployment rates than men. Monies available during and after spells of unemployment are greater and contribute to an increase in NAIRU.

Assuming that structural and frictional unemployment are beyond the control of Public Policy is a classical and laissez-faire conception. Believing that man-made objects will fail and need repair and modification, recognizing the Economy as a man-made object, recognizing Keynesian Policies as major modification of Democratic Capitalism, we must believe that frictional and structural unemployment are not parameters dictated by the economy but rather variables that (along with inflation) can be *engineered* to optimal levels.

Failure to engineer these key variables is failure in optimal economic management. In the Age of Automation (automation can be called a "structural" unemployment causation), it appears to be contradictory to see an increase in frictional unemployment concurrent with space age computerization. Frictional unemployment should diminish through time, regardless of the changing composition of the labor force, with computers capable of instantaneous matching of job vacancies and job seekers.

Structural unemployment is solved by matching training to projected job vacancies. The Japanese can virtually guarantee successful graduates immediate placement that does not represent underemployment. America does not. A change in American Public Policy is indicated.

Our conclusion is that an upward trend in unemployment is indicative of diminution of economic welfare in the Pigou sense.

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[4] Lloyd G. Reynolds, *Macroeconomics: Analysis and Policy, Sixth Edition* (Homewood, Ill.: Irwin, 1988). 222-25.

[5] Lloyd G. Reynolds, *Macroeconomics: Analysis and Policy, Sixth Edition* (Homewood, Ill.: Irwin, 1988), 222-25.

An Alternative View of Unemployment - The Employment/Population Ratio

Rather than focusing on the unemployed, perhaps we should look at those who are employed. Figure EA-X-2 does exactly that, as we view the Employment to Population Ratio during the Age of Automation.

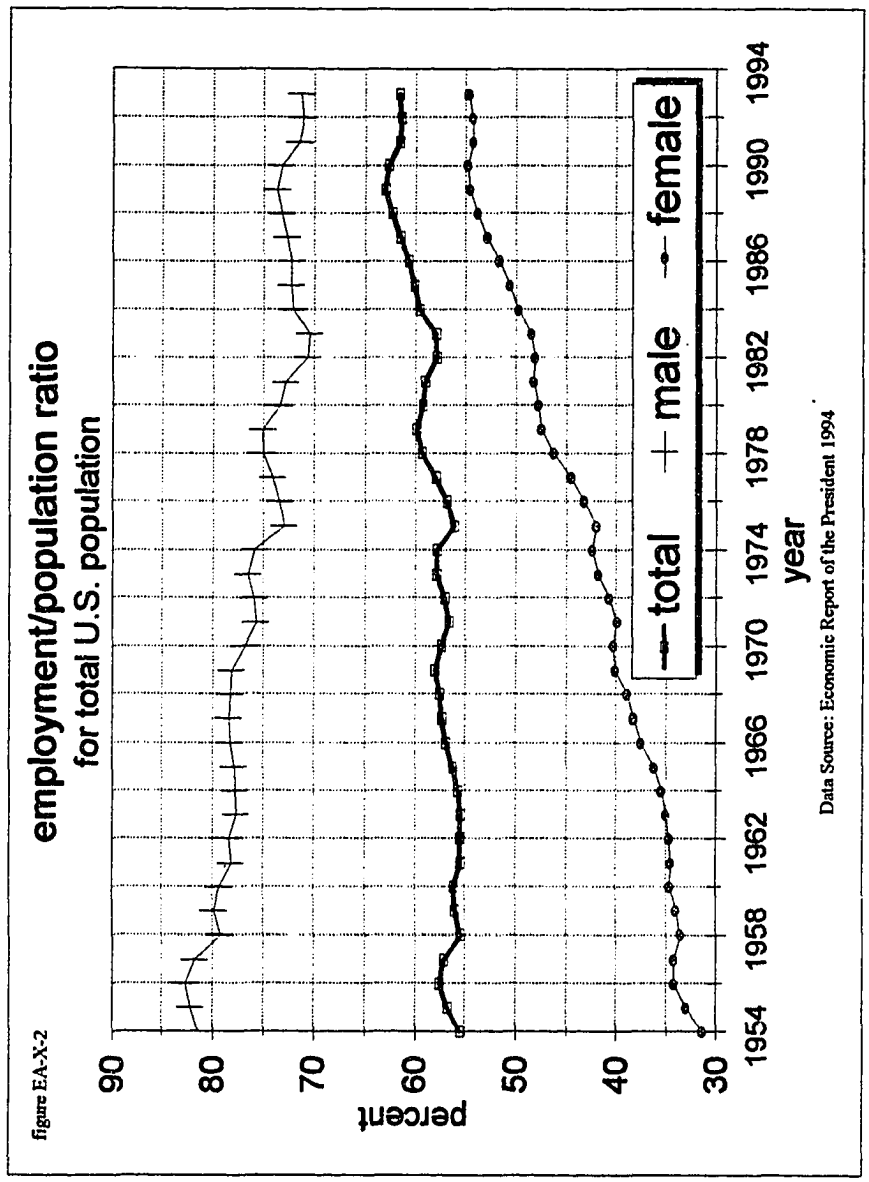
We immediately note that women as a group are increasing participation in the labor market while men as a group are doing the reverse. The overall employment rate has increase from near 55% in 1954 to over 60% in 1992.

Traditionally, work outside the home has been the purview of men. Seeing the sex trend reversal, one is lead to wonder what men who aren't employed are doing. The relatively new term of "house-husband" (similar to "housewife" in function) generates some potential conclusions. Some men may be financially independent and not rely on employment for income. Some men may be employed in the underground economy and therefore not be reflected in official statistics. However, it seems important to examine this group of not-employed-men to discern their actual welfare posture.

If criminal behavior, underemployment, underutilization, etc. dominate, then we have another need for remedial Public Policy. With reference to our previous discussion of the Production Possibility Frontier, we realize that the underutilization of any economic resource will yield diminished national output. Can we attribute recent trends of diminished economic growth to an underutilization of men in the labor force?

Young men (teenagers) placed in the labor force on a part-time basis are less prone to socially-deviant behavior. The work-world allows intense scrutiny by responsible adults who are part of the mainstream and know conscious and subconscious techniques of proper indoctrination of youth. Youth left to their own devices, or to excessive negative peer pressure, can be expected to engage in deviant behavior and to encounter the criminal justice system more often.

In a long or short-term cost/benefit analysis, it is to our societal advantage to engage youth in the labor force early and often. However, if real family incomes are down and if adults are competing with children for employment, we can expect less youth employment. And, if government programs that provide job opportunities for disadvantaged youth are discontinued, we can expect more deviant behavior in this group. At the time of life involving the most



energy, imagination and curiosity, we have a potential for great evil or great good. And, we reap what we sow.

An African-American Analysis

Null Hypothesis: African-American Unemployment is Significantly Greater than White American Unemployment during the Age of Automation

Alternate Hypothesis: African-American Unemployment is NOT Significantly Greater than White American Unemployment during the Age of Automation

Model Two: Comparing Black and White Unemployment Rates

Model Two MINITAB® ANOVA Results:

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F	p
FACTOR	1	854.65	854.65	132.15	0.000
ERROR	88	569.10	6.47		
TOTAL	89	1423.75			

LEVEL	N	MEAN	STDEV	INDIVIDUAL 95+ PCT CI'S FOR MEAN BASED ON POOLED STDEV
Blkunemp	45	11.241	3.308	(--*--)
whtunemp	45	5.078	1.412	(--*--)
POOLED STDEV =		2.543		5.0 7.5 10.0 12.5

Discussion

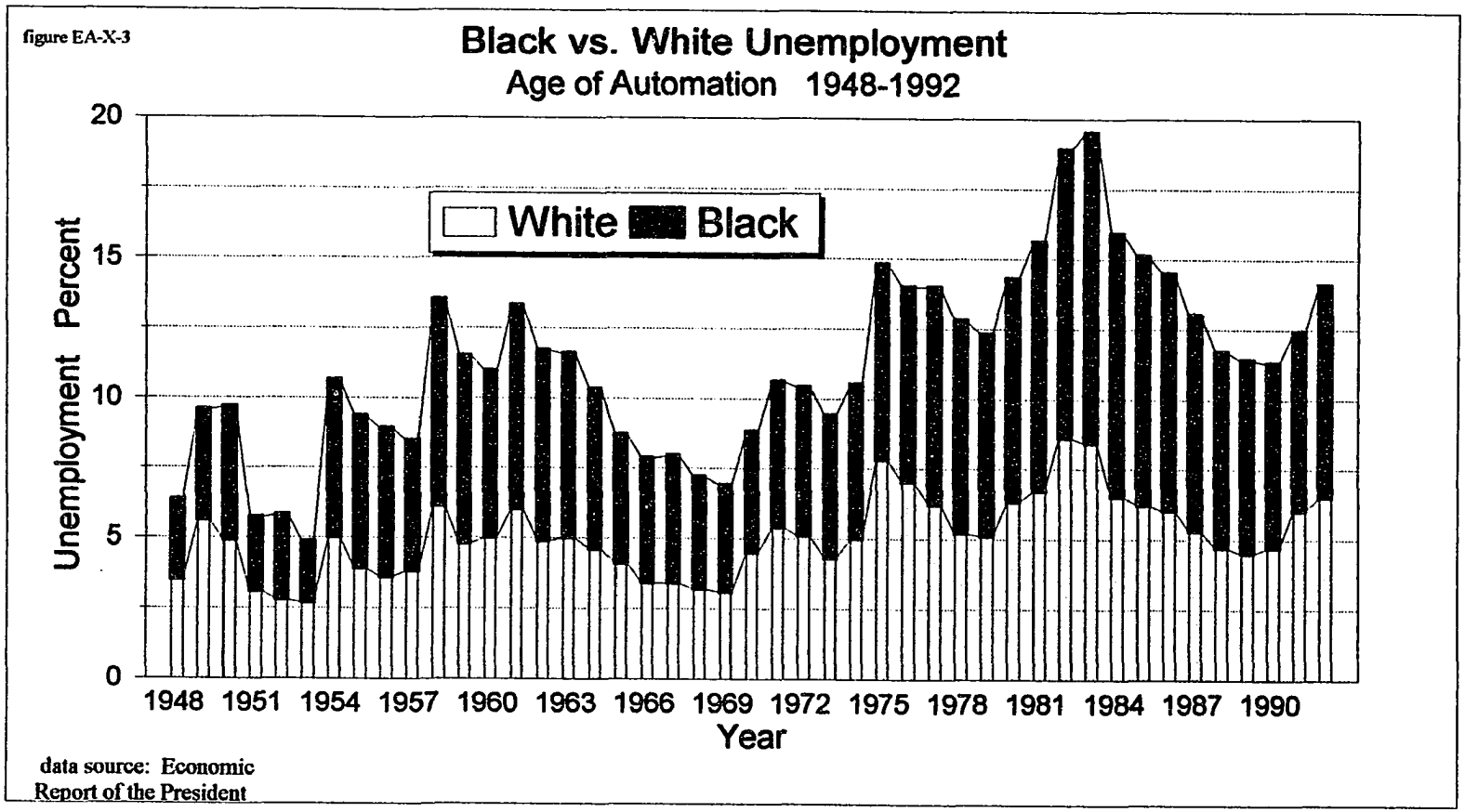
As can be seen in model two, ANOVA analysis yields a significant difference between Black and White unemployment. Black unemployment is significantly greater than White unemployment.

In fact, since Black Unemployment is greater than White Unemployment for every Automation Age year, the structure of figure EA-X-3 is fully appropriate (black rates always greater than white rates).

Again we refuse to accept "structural" or dual labor market arguments for such discrepancies. The historical contribution of African Americans to America more than justifies full integration which would imply comparable unemployment rates. Such is achievable through appropriate Public Policy measures.

Generally speaking, to derive Black unemployment given White unemployment, multiply the latter by 2.2137 (results can be obtained using the means acquired in the above ANOVA model). If unemployment

figure EA-X-3



data source: Economic Report of the President

is accepted as a welfare indicator, we may conclude that Black America is usually suffering at least twice the Unemployment Economic Negative Welfare of White America.

As Automation Intensifies, Whites Displace Blacks in Labor Force

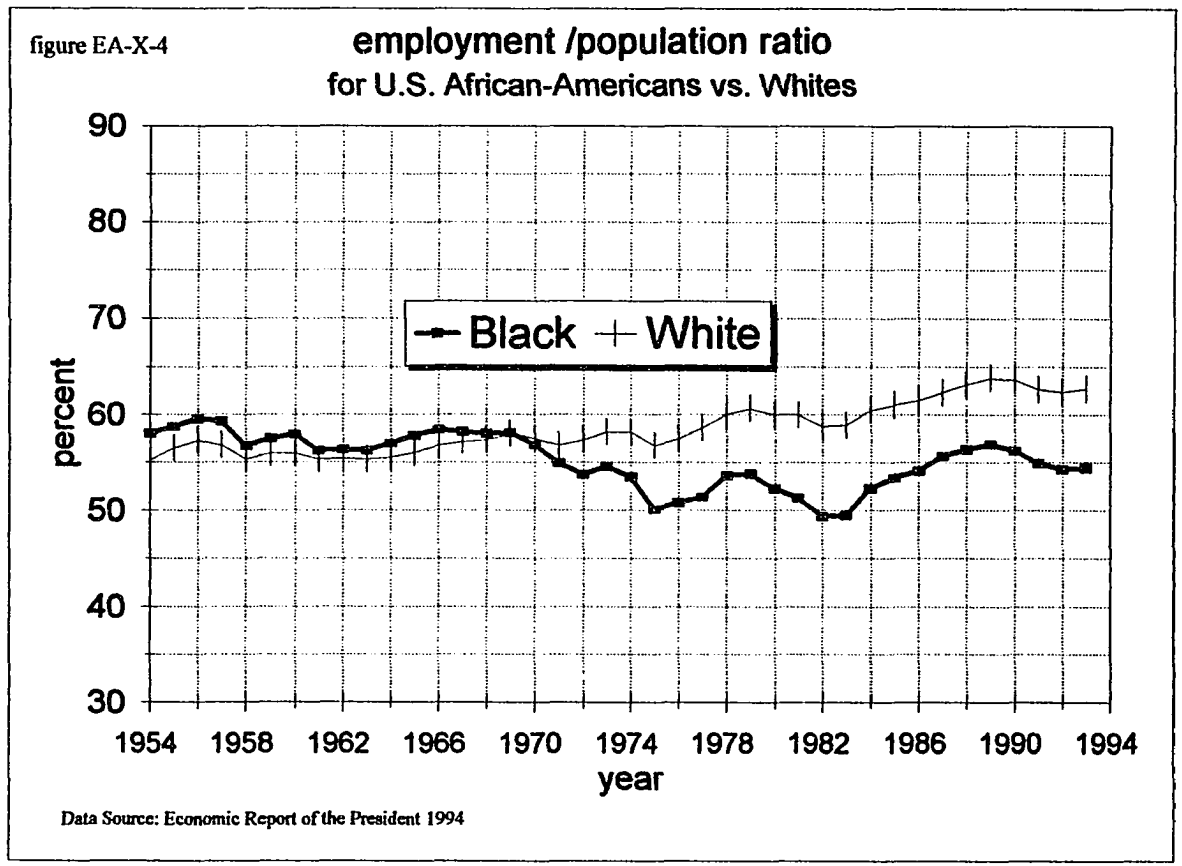
Figure EA-X-2 indicates White women entering the labor force at an accelerated rate, while White men are exiting. However, the infusion of White women exceeds the exodus of White men such that the overall employment rate for Whites is increasing to over 60%. If the Black employment rate did not diminish, we could conclude that Black employment opportunities increased dramatically.

But, Figure EA-X-4 indicates that Blacks at the beginning of the Automation Age had a higher employment rate than Whites. This phenomenon continued until about 1970, the beginning of the great stagflation period that included stagnated real wages and concurrently with a quantum leap in automation signaled by the advent of the microchip. From 1970 forward, the employment rate for Black Americans has diminished, while that of Whites has increased, indicative of the suggested displacement and additional Economic Welfare diminution for Black America.

Given that average and median income is lower for Blacks than for Whites and combining this with the diminishing marginal utility of money, we have a prima facie conclusion that the Economic Welfare diminution for displaced Black Americans exceeds the Economic Welfare gains of White Americans.

If overall economic welfare is closely related to unemployment, an overall conclusion for Black America seems to be that if economic conditions worsen for America, Black America (as a group) will encounter a disproportionate share of the malady.

figure EA-X-4



Data Source: Economic Report of the President 1994

Econometric Analysis

Number: EA-XI
Title: Hours of Work in the Age of Automation

Data Set References: EA-XI

Null Hypothesis: The Current Hours of Work Configuration in America is Preferred in terms of Economic Welfare

Alternate Hypothesis: The Current Hours of Work Configuration in America is NOT Preferred in terms of Economic Welfare

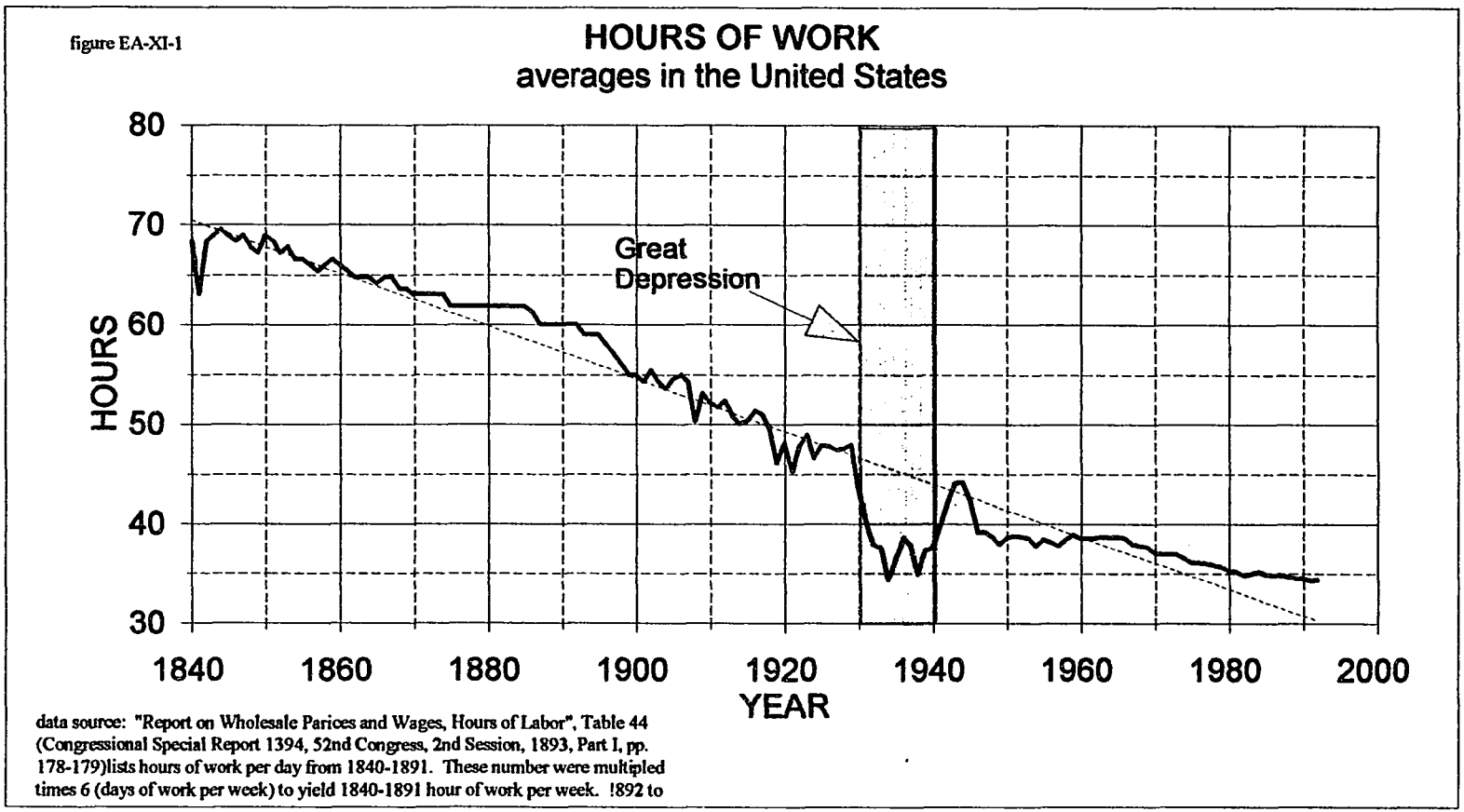
Discussion

Industrial Revolutions, Technological Change and Automation all cause desired work to be more easily accomplished. What more excellent way to celebrate such advancement than through a reduced workweek? Sure, you can argue that greater productivity is of greater virtue than more leisure. However, if the leisure time is provided and if people want greater productivity rather than more leisure, the greater productivity will emerge during the time allocated for leisure (barring opposing Public Policy). In Democratic Capitalism, it is not enough for "management" to desire greater productivity as an ultimate goal. It should be the conscious will of the people. While greater productivity will unambiguously yield greater welfare in the Pareto sense, it may not maximize in the Pigou interpretation if the marginal utility of leisure exceeds the marginal utility of work. This is part of the impetus of our CORE philosophy discussed in the Conclusion section.

[Leisure in this context should not be confused with leisure in the popular sense of the word. Leisure in Labor Economics is time not spent earning money, while leisure in the popular sense can imply general rest and relaxation.]

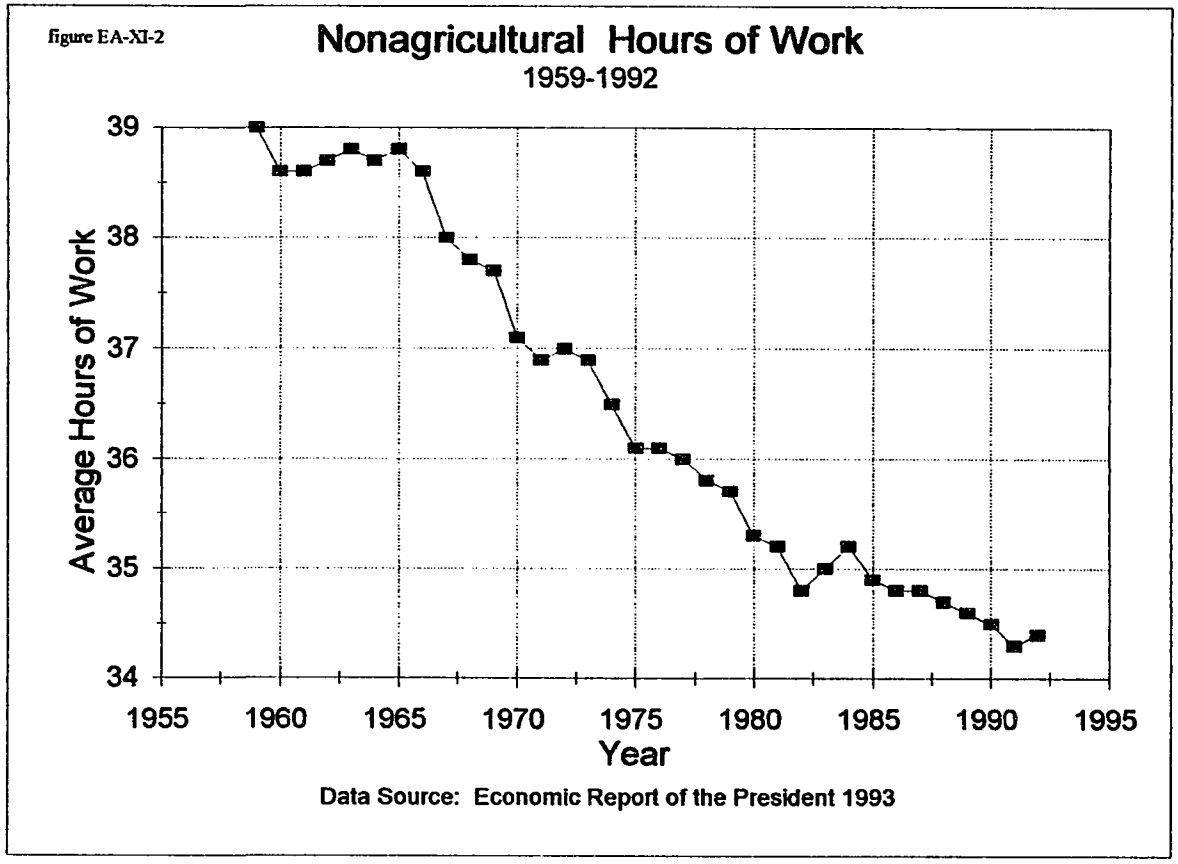
Workweek reduction is also a subtle form of income redistribution. If you automate, reduce required labor and don't have significant economic growth, then employment selection can become biased, with

figure EA-XI-1



data source: "Report on Wholesale Parices and Wages, Hours of Labor", Table 44 (Congressional Special Report 1394, 52nd Congress, 2nd Session, 1893, Part I, pp. 178-179)lists hours of work per day from 1840-1891. These number were multipled times 6 (days of work per week) to yield 1840-1891 hour of work per week. !892 to

figure EA-XI-2



those not working but willing to work being as well qualified as many that are working.

Therefore, part of the genesis of the Great Depression was prior technological advancement. Part of the solution to the Great Depression was a reduction in the work-week.

We logically expect Automation and a reduced workweek to accompany one another. We look to actual data to deny or confirm this theory.

Consider this excerpt from Economic History:

> American labor prospered, too. Immigration to America remained open until an isolationist fever in the 1920s closed the door to some nationalities. African-Americans were in America before the Civil War, the Chinese had been brought in to build the western railroads, and Irish, Germans, and Swedes populated the coal fields, steel mills, auto factories, and the farms of America. After 1880, another flow of Slovaks, Poles, and Italians added to the swelling force. The increased supply of workers did not result in lower wages for the American worker. Real wages (i.e., the purchasing power of the worker's income) doubled between 1865 and 1890. From 1890 to 1921, the annual compound increase in real wages was 1.6% per year, enabling another doubling. **In addition to gaining in terms of real wages, the hours of labor were starting to decrease: in 1890 the average industrial work week was 60 hours; in 1910, 55 hours, and in 1920, 50 hours.**[1]
>
> [1] Ross M. Roberston, *History of the American Economy, 3rd ed.*, New York: Harcourt, Brace, Jovanovich, 1973, pp. 379-380.

Figures EA-XI-1 and EA-XI-2 above show average weekly hours from 1840 to 1992 and Nonagricultural Hours of Work from 1959-1992, respectively. From these diagrams, it appears that we traditionally celebrate greater technology with a reduced workweek.

However, these initial statistics can be misleading. The subterfuge lies in the composition of the labor force as we compare part-time and full-time employee components. As figure EA-XI-3 indicates, there has been a tremendous increase in the number of part-time workers during the Age of Automation.

Of course, the labor force may be increasing concurrently and therefore we are concerned with the ratio of part-time workers to the entire labor force, and accordingly our attention turns to figure EA-XI-4.

We see that part-time workers are not only increasing in absolute numbers, but also as a fraction of the labor force during the Age of Automation.

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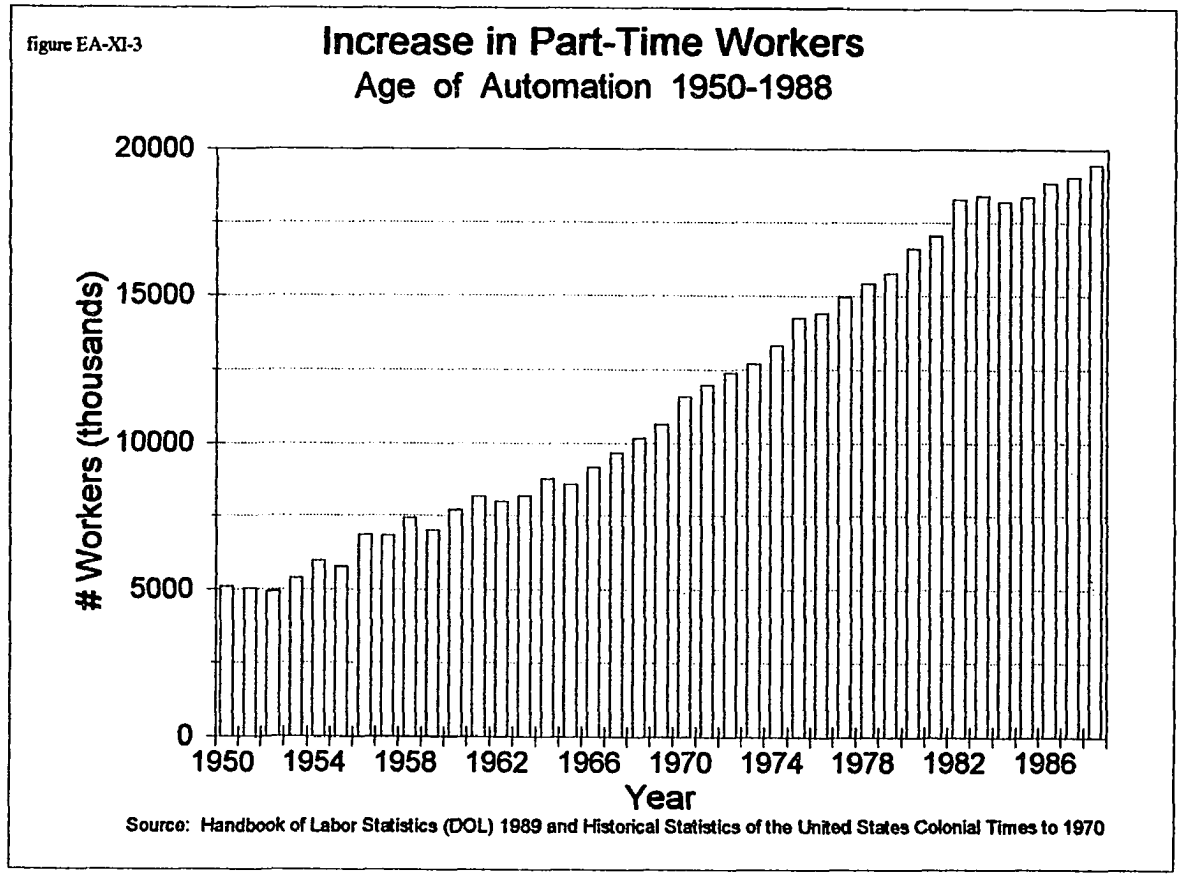
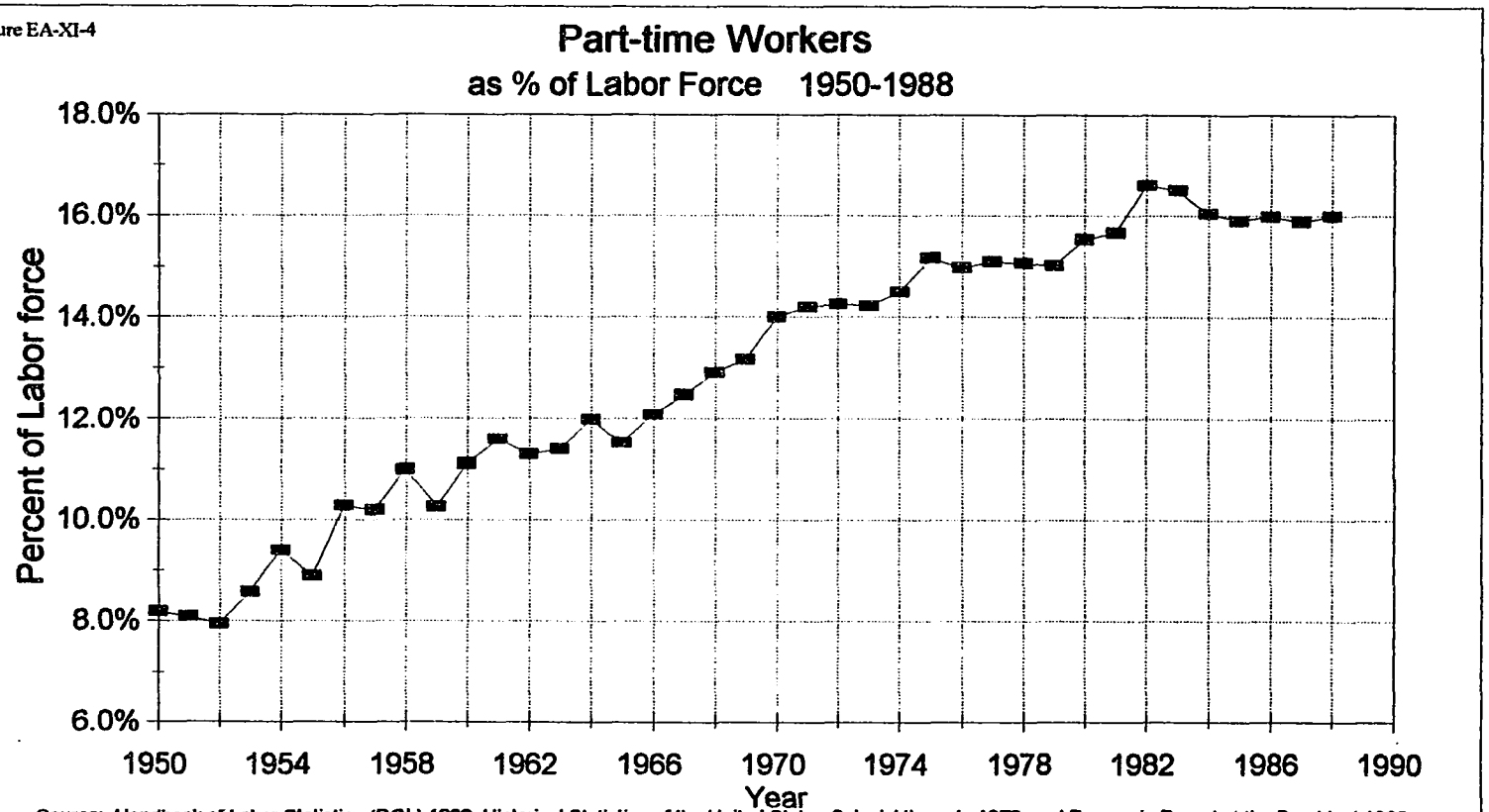
[1] Daniel A. Wren, *The Evolution of Management Thought*, (New York: John Wiley and sons, 1979), p. 274-75.

figure EA-XI-3



Source: Handbook of Labor Statistics (DOL) 1989 and Historical Statistics of the United States Colonial Times to 1970

figure EA-XI-4



Source: Handbook of Labor Statistics (DOL) 1989, Historical Statistics of the United States Colonial times to 1970, and Economic Report ot the President 1993.

Of course our objective is to determine changes in Economic Welfare. The question therefore is whether the labor force tendency towards a greater proportion of part-time workers represents a positive increment in Economic Welfare. 24% of the growth in employment from 1970 to 1985 was in the form of part-time workers.[2] If part-time work is not the form preferred by labor, then we have a negative indication for economic welfare.

Part-time employees are typically paid less in wages and receive less (if any) fringe benefits than their full-time counterparts. If an equitable reduction in the workweek fails to be part of Public Policy (as is true in the U.S. but not in Germany), then employers seeking to maximize profits will substitute overtime in lieu of additional workers and will substitute part-time workers (ineligible for fringe benefits) for full-time workers.

Do part-time workers prefer part-time work or full-time work? Ehrenberg et. al. report the following data:

table EA-XI-1 **Voluntary Part-time Non-Agricultural Employees**

year	percent
1965	10.6
1970	13.3
1975	13.8
1980	13.9
1984	13.1

Note: A part-time worker is one who works between 1 and 34 hours per week. Voluntary part-timers are those who work part-time because of family or school responsibilities.
Source: Ronald G. Ehrenberg, Pamela Rosenberg, and Jeanne Li, "Part-Time Employment in the United States," N.Y. State School of Industrial and Labor Relations, Cornell University, April 1986.[3]

For all included years, 85%+ of part-time workers are not in that status voluntarily. Since more preferred to less is a fundamental economic principle, we will assume that part-time employees would perfer full-time work that includes fringe benefits. (Either a 40

[2] Robert E. Kutscher, "Employment Growth in the United States," in *Job Generation: U.S. and European Perspectives*, ed. Howard Rosen (Salt Lake City: Olympus, 1986), pp. 1-22, cited by F.R. Marshall and V.M. Briggs, Jr., *Labor Economics: Theory, Institutions, and Public Policy. sixth edition* (Homewood, Ill.: Irwin, 1989), 82.

[3] Ronald G. Ehrenberg and Robert S. Smith, *Modern Labor Economics: Theory and Public Policy, 3rd Ed.*, (Glenview, Ill.: Scott Foresman and Company, 1988), 171.

hour workweek with fringe benefits or a reduce workweek with fringe benefits, or both.)

Technological advance has historically been accompanied with a decrease in the workweek. Failing dictating Public Policy measures, today's U.S. management has chosen the least cost alternative of using part-time workers and compensating this group of workers less than full-time workers.

To see the true trend in the official U.S. workweek we look at Manufacturing Hours of Work from 1840-1989 because this sector shuns the use of part-time workers.

Figure EA-XI-5 indicates hours of work in manufacturing since 1840. What can easily be seen is the steady drop in hours from 1840 to circa the Fair Labor Standards Act of (1938)1940[4]. That act established the standard 40 hour workweek. There is remarkable constancy of hours since 1946. Remarkable when compared to the history of the workweek. Although we live in the Age of Automation and we live in a time in which women have entered the workforce at record levels and immigrants are entering the U.S. at record levels, we have not changed the length of the official average work week since 1946.

In terms of Economic Welfare, part-time workers who want to be full-time are certainly worse off. A recent Harris poll indicates that for the first time in recent history, the majority of working Americans are willing to sacrifice a day's pay for a day of leisure.[5] A recent General Motor's strike was not for additional compensation, but rather for a reduction in overtime which was considered excessive.

Casual oberservation yields two seemingly contradictory preferences. Full-time workers desire less hours and part-time workers desire full-time status. These are not necessarily contradictory. The full-time workers do not want to forego their fringe benefits, they simply want more leisure time. The part-time workers don't necessarily want 40 hour weeks, but they definitely

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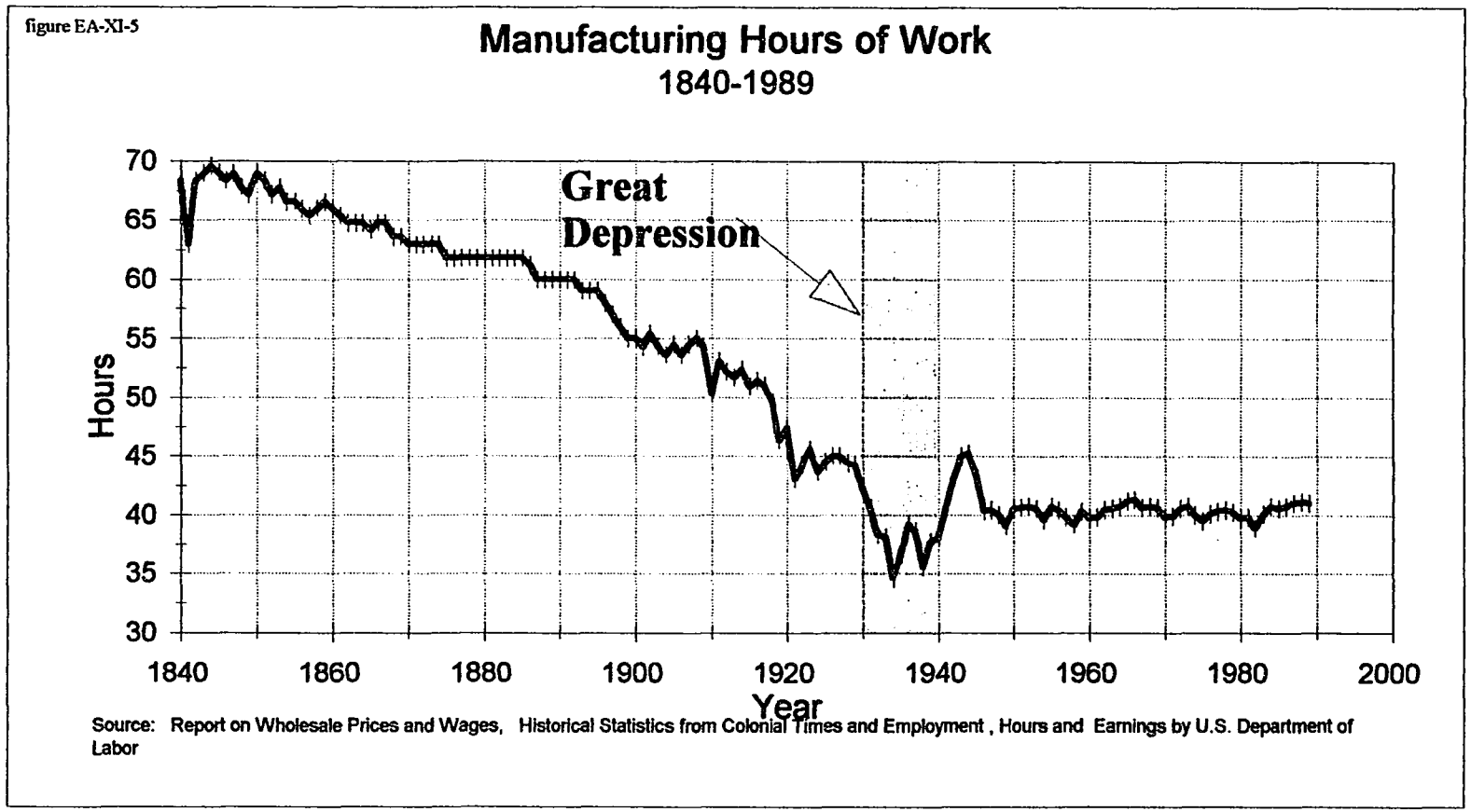
[4] F Ray Marshall and Vernon M. Briggs, Jr., *Labor Economics: Theory, Institutions, and Public Policy, Sixth Edition*, (Homewood IL: Irwin, 1989), p. 523.

[5] John De Graaf and Vivia Boe, Co-Producers, *Running Out of Time*, a PBS Presentation produced by Oregon Public Broadcasting and KCTS/Seattle, ©1994.

figure EA-XI-5



Source: Report on Wholesale Prices and Wages, Historical Statistics from Colonial Times and Employment , Hours and Earnings by U.S. Department of Labor

want full-time status and the fringe benefits that goes with that status. Given these perferences, a reduced workweek retaining full fringe benefits would be preferred by non-voluntary part-time workers and a majority of full-time workers.

While much of this evidence may be charactrized as prima facie, our Economic Welfare conclusion regarding Hours of Work must be that the current configuration reflects a less than optimal pattern for our Democratic Capitalistic Economy.

ECONOMETRIC ANALYSES METHODS

The following is an alphabetic listing of the methods used in the Econometric Analyses.. Below find descriptions of the methods also listed in alphabetical order.

ANOVA Correlation Correlation Significance Dummy Variables Durbin -Watson Test for Serial Correlation Gini Ratio for Income Distribution Equality Maximum Likelihood Correction for Serial Correlation (see Serial Correlation Correction)	Proportions -testing for significant differences Regression Serial Correlation Correction Tukey Method for Comparing Means (see ANOVA)

ANOVA

In this work, the Analysis of Variance Technique (ANOVA) is used to compare means and to determine if the difference between any means is statistically significant. ANOVA is based on the F statistic. Comparing calculated F statistic to a table F statistic will indicate whether any of the means are significantly different but it won't indicate which means are different, if a significant difference is indicated.

In this work, the Tukey Method is often used in conjunction with ANOVA. The Tukey method will compare all possible pairs of means and identify which pairs are significantly different. The Tukey Method is not based on the F statistic and therefore need not conform with F-test conclusions. In fact, the Tukey test may stand alone and need not be used with the F test at all.

The Tukey Method is not the only method available for comparing pairs of means. It does not produce the shortest confidence intervals (Dunnett and MCB produce shorter intervals[1])

[1] *Minitab Reference Manual, Release 8: PC Version* (Rosemont, PA: Quickset Inc. 1991), p. 8-6 to 8-8.

and may therefore be considered conservative. While some authors do not defend the Tukey method for unbalanced designs, Hayter[2] does and the method is available as a MINITAB subroutine.

The interested reader is referred to Webster[3] for a detailed discussion of ANOVA and a justification of the Tukey Method. See Hayter for a defense of the conservative nature of the Tukey method.

method used in: EA-I, EA-II, EA-IV, EA-X

Correlation

Correlation is computed via a Quattro Pro® or Minitab®[4] computer algorithm. While Quattro Pro® does not report its method, it appears equivalent to Minitab® which uses the Pearson product moment correlation utilizing the following formula:

$$\frac{\sum (x - \bar{x})(y - \bar{y})}{(n - 1)s_1 s_2}$$

x and y are samples with equal number of elements. s_1 and s_2 are the standard deviations of each of the samples respectively.

method used in: EA-I, EA-V

Correlation Significance

In the use of correlation, the investigator has occasion to wonder if the computed correlation is significantly different from 0. The null hypothesis is $\rho = 0$, while the alternate hypothesis is $\rho \neq 0$.

For small samples ($n \leq 50$), the following statistic is computed and compared to the critical region from a t table. If the computed t lies within the boundaries defined by the t table, the

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[2] Anthony J. Hayter, "A Proof of the Conjecture that the Tukey-Kramer Multiple Comparisons Procedure is Conservative", *The Annals of Statistics*, 1984, Vol. 12, No. 1, 61-75.

[3] Allen Webster, *Applied Statistics for Business and Economics*, (Homewood, Ill: Irwin, 1992), p. 523-43.

[4] *Minitab Reference Manual, Release 8: PC Version* (Rosemont, pa: Quickset Inc. 1991),p. 6-10.

null hypothesis is not rejected.

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

For large samples (n>50), the following statistic is used instead and critical values are derived from a normal distribution table. Testing is analogous to the small sample methodology.

$$z = \frac{r}{\frac{1}{\sqrt{n-1}}}$$

Both tests are discussed in greater detail by Mason and Lind.[5]

method used in: EA-V

Dummy Variables

Dummy variables (a.k.a. indicator variables) of two types are utilized in the analyses.

0, 1 dummy variables will attain a value of 0 to indicate the absence of an effect and 1 to indicate the presence of an effect, usually through time. The 0, 1 dummies can often be associated with variations of the intercept term.

0,value dummy variables will essentially have 0 entries when an effect is assumed absent and an independent variable value when an effect is assumed present. The independent variable may be a time index, or non-temporal variable. The 0,value configuration is assumed when

[5] Robert D. Mason and Douglas A. Lind, *Statistical Techniques in Business and Economics* (Homewood, Il.: Irwin. 1990), 501-3.

a differential slope value is hypothesized. See Pindyck and Rubenfeld[6] & Draper and Smith[7] for more details on the theory of the dummy variable approach.

Durbin-Watson Test for Serial Correlation

The equation for the Durbin-Watson statistic is:

$$DW = d = \frac{\sum_{t=2}^{n} (e_t - e_{t-1})^2}{\sum_{t-1}^{n} e_t^2}$$

Once this statistic is computed, reference is made to a Durbin-Watson d statistic table. The reference table provides upper and lower bounds. Given the number of observations and the number of non-intercept regressors, serial correlation conclusions are reached as follows:

testing for positive serial correlation	
result of table search	conclusion
computed d less than table lower limit	serial correlation exists
computed d between table upper and lower limits	serial correlation indeterminate
computed d greater than table upper limit	no serial correlation

[6] Robert Pindyck and Daniel Rubenfeld, *Econometric Models & Economic Forecasts: Second Edition*, (New York: McGraw Hill, 1981), pp. 111-116.

[7] N.R. Draper and H. Smith, *Applied Regression Analysis: Second Edition*, (New York, John Wiley, 1981), pp. 241-257.

testing for negative serial correlation	
result of table search	conclusion
computed d greater than 4 minus table lower limit	serial correlation exists
computed d between 4 minus table lower limit & 4 minus table upper limit	serial correlation indeterminate
computed d less than 4 minus table upper limit	no serial correlation

The MINITAB® package automatically computes the DW statistic upon request. See Bails and Peppers[8] for further information.

method used in: EA-I, EA-IV , EA-V, EA-VI, EA-VIII, EA-IX, EA-X

Gini Ratio for Income Distribution Equality

The Gini Ratio is a method recommended by the Census Bureau for measuring the degree of income distribution inequality. An x, y plane is defined with Percent of Aggregate Income on the vertide axis and Percent of households on the horizontal axis. In this x,y plane imagine a 45° line emanating from the origin. This line defines perfect equality in the distribution of income. Consider the triangle formed below the 45° line and the area of this right triangle. Also below the 45° line we plot the cumulative distribution of income from quintile distribution information. This is the Lorentz curve. Let area A equal the area between the 45° line and the Lorentz curve. Let area B represent the total area below the 45° line less

[8] Dale Bails and Larry Peppers, *Business Fluctuations: Forecasting Techniques and Applications*, (Englewood Cliffs, NJ: Printice-Hall, Inc.,1982), p. 213-16, 286-87..

area A. Then the Gini Ratio = A/(A+B). The range for Gini is from 0 to 1. The higher the ratio the greater the inequality. See Census Bureau publication for more detail.[9]

method used in: EA-VI

Proportions -testing for significant differences

$$Z = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{\frac{\bar{p}_c \times (1-\bar{p}_c)}{n_1} + \frac{\bar{p}_c \times (1-\bar{p}_c)}{n_2}}}$$

The above statistic is used to detect significant differences in population proportions using the results from two representative samples. n_i = number in each sample. $\bar{p}_c$ =pooled estimate of the population proportion=sum of successes in both samples divided by sum of the samples' sizes. $\bar{p}_1$ and $\bar{p}_2$ = number of successes/size of each sample. The computed Z determined by the above formula is compared to critical values (e.g. ±1.96 for a 5% significance level). If the computed Z falls outside the critical values, the null hypothesis of no significant difference is rejected. For additional detail and examples see Mason and Lind.[10]

method used in: EA-VI

Regression

The Minitab Regress® command is the primary tool for regression. Minitab® describes its regression utility as follows:

> The computational method is Givens transformations using Linpack routines[8]. The method described in Chapter 10 of the *Linpack User's Guide*, has very high accuracy. This allows Minitab to do computations to single precision, yet obtain accuracy comparable to, or better

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[9] U.S. Bureau of the Census, Current Population Reports, Series P60-183. *Studies in the Distribution of Income*, U.S. Government Printing Office, Washington, D.C. 1992, pp. 29-30.

[10] Robert D. Mason and Douglas A. Lind, *Statistical Techniques in Business and Economics* (Homewood, Ill.: Irwin, 1990), p. 398-402.

than, using double precision in methods which solve for the normal equations. However, on most computer, all computations are done using double precision. The method is quite fast, and gives good diagnostics for ill-conditioned problems.
[8]D.C. Hoaglin and R.E. Welsch (1978) "The Hat Matrix in Regression and ANOVA," *American Statistician 32*, pp..... 17-22, and Corrigenda 32,p. 146.

method used in: EA-I, EA-IV, EA-V, EA-VI, EA-VIII, EA-IX, EA-X

Serial Correlation Correction

The ordinary least squares method assumes that observation errors are independent and normally distributed. Times series analysis via regression often yields correlated errors which don't usually bias the coefficient estimates but often yield understated coefficient variances which impacts hypotheses testing. The Durbin-Watson test is used to detect serial correlation and if it exists, the Maximum Likelihood technique is used for correction (or at least improvement).

Beach and MacKinnon wrote the referential article for Maximum Likelihood correction for serial correlation[11]. This is the technique that is used in this work. Judge et. al.[12] conditionally recommend this technique citing its inclusion of the initial observation (ignored by some other techniques) and stating that the maximum likelihood "seldom performs poorly" in Monte Carlo simulation studies. However, the same authors state that estimated ρ, (a key parameter in Maximum Likelihood and competing techniques), is often biased in the ML procedure. The overall conclusion appears to be that Maximum Likelihood is the best of the currently popular techniques but may be replaced by a technique that produces better estimates of ρ in the future.

Essentially, the ML technique performs iterative searches for a ρ value that is used in computing replacement vectors for the original regression variables. Once a specified objective function is maximized (or alternate function is minimized), iteration ceases and the

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[11] Charles M. Beach and James G. MacKinnon, "A Maximum Likelihood Procedure for Regression with Autocorrelated Errors," *Econometricia*, Vol. 46, No. 1 (January, 1978).

[12] George G. Judge, W. E. Griffiths, R. Carter Hill, Helmut Lütkepohl and Tsoung-Chao Lee, *The Theory and Practice of Econometrics: Second Edition*, (New York: John Wiley and Sons, 1985), p. 289-91.

resulting ρ and regression coefficients are reported as best and more suitable for hypothesis testing. The technique is available in several Econometric time series packages or the interested reader can refer to the original Beach and MacKinnon article or the Judge et al text and use that information to write a maximum likelihood macro for a regression package allowing such. This author has used the latter technique (with MINITAB®) and has had a sampling of results confirmed by Professor Dauffenbach's RATS package which has the technique preloaded at the factory.

For a discussion of two other popular techniques for serial correlation, see Pindyck and Rubenfeld[13] for a comparison of the Hildreth-Lu and the Cochrane-Orcutt methods.

method used in: EA-I, EA-IV, EA-V, EA-VI, EA-VIII, EA-IX, EA-X

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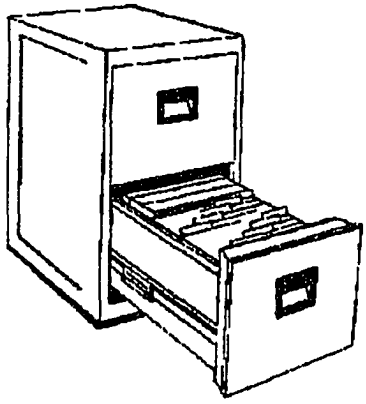
[13] Robert Pindyck and Daniel Rubenfeld, *Econometric Models & Economic Forecasts: Second Edition*, (New York: McGraw Hill, 1981), pp. 154-58.

DATA SETS



the following data sets reflect data used in the preceding Econometric Analyses

DATA SET EA-I-1

YEAR	82GNP	82GNPgrw	ln82GNP
1929	709.6		6.56
1930	624.8	-12.73%	6.44
1931	588.1	-6.05%	6.38
1932	509.2	-14.41%	6.23
1933	498.5	-2.12%	6.21
1934	536.7	7.38%	6.29
1935	580.2	7.79%	6.36
1936	662.2	13.22%	6.50
1937	695.3	4.88%	6.54
1938	664.2	-4.58%	6.50
1939	716.6	7.59%	6.57
1940	772.9	7.56%	6.65
1941	909.4	16.26%	6.81
1942	1080.3	17.22%	6.98
1943	1276.2	16.66%	7.15
1944	1380.6	7.86%	7.23
1945	1354.8	-1.89%	7.21
1946	1096.9	-21.12%	7.00
1947	1066.7	-2.79%	6.97
1948	1108.7	3.86%	7.01
1949	1109.0	0.03%	7.01
1950	1203.7	8.19%	7.09
1951	1328.2	9.84%	7.19
1952	1380.0	3.83%	7.23
1953	1435.3	3.93%	7.27
1954	1416.2	-1.34%	7.26
1955	1494.9	5.41%	7.31
1956	1525.6	2.03%	7.33
1957	1551.1	1.66%	7.35
1958	1539.2	-0.77%	7.34
1959	1629.1	5.68%	7.40
1960	1665.3	2.20%	7.42
1961	1708.7	2.57%	7.44
1962	1799.4	5.17%	7.50
1963	1873.3	4.02%	7.54
1964	1973.3	5.20%	7.59
1965	2087.6	5.63%	7.64
1966	2208.3	5.62%	7.70
1967	2271.4	2.82%	7.73
1968	2365.6	4.06%	7.77
1969	2423.3	2.41%	7.79
1970	2416.2	-0.29%	7.79
1971	2484.8	2.80%	7.82
1972	2608.5	4.86%	7.87
1973	2744.1	5.07%	7.92
1974	2729.3	-0.54%	7.91
1975	2695.0	-1.26%	7.90
1976	2826.7	4.77%	7.95
1977	2958.6	4.56%	7.99
1978	3115.2	5.16%	8.04
1979	3192.4	2.45%	8.07
1980	3187.1	-0.17%	8.07
1981	3248.8	1.92%	8.09
1982	3166.0	-2.58%	8.06
1983	3279.1	3.51%	8.10
1984	3501.4	6.56%	8.16
1985	3618.7	3.30%	8.19
1986	3717.9	2.70%	8.22
1987	3845.3	3.37%	8.25
1988	4016.9	4.37%	8.30
1989	4117.7	2.48%	8.32
1990	4186.2	1.66%	8.34
1991	4134.4	-1.24%	8.33
1992	4234.0	2.41%	8.35
1993	4354.3	2.84%	8.38

SOURCE: Henderson and Poole inside front cover + 1994 Statistical Abstract of the U.S. is the source for GNP82. All other vectors are computed by author.

DATA SET EA-I-2

GDP (nonfinancial institutions) 1987 dollars

Year	GDP1987	YRINDX	lnGDP87	lnYRINDX	YR	GDPgrw	Trend
1959	928.7	1	6.8338	0.0000	59		6.89
1960	955.6	2	6.8623	0.6931	60	2.86%	6.93
1961	978.2	3	6.8857	1.0986	61	2.34%	6.96
1962	1047.5	4	6.9542	1.3863	62	6.84%	6.99
1963	1104.8	5	7.0074	1.6094	63	5.33%	7.03
1964	1179.3	6	7.0727	1.7918	64	6.53%	7.06
1965	1262.2	7	7.1406	1.9459	65	6.79%	7.09
1966	1336.0	8	7.1974	2.0794	66	5.68%	7.13
1967	1367.4	9	7.2207	2.1972	67	2.32%	7.16
1968	1444.3	10	7.2754	2.3026	68	5.47%	7.19
1969	1492.5	11	7.3082	2.3979	69	3.28%	7.23
1970	1473.4	12	7.2953	2.4849	70	-1.29%	7.26
1971	1525.9	13	7.3303	2.5649	71	3.50%	7.29
1972	1629.5	14	7.3960	2.6391	72	6.57%	7.32
1973	1706.9	15	7.4424	2.7081	73	4.64%	7.36
1974	1669.7	16	7.4204	2.7726	74	-2.20%	7.39
1975	1625.6	17	7.3936	2.8332	75	-2.68%	7.42
1976	1748.5	18	7.4665	2.8904	76	7.29%	7.46
1977	1866.7	19	7.5319	2.9444	77	6.54%	7.49
1978	1967.1	20	7.5843	2.9957	78	5.24%	7.52
1979	1995.7	21	7.5988	3.0445	79	1.44%	7.56
1980	1980.9	22	7.5913	3.0910	80	-0.74%	7.59
1981	2035.1	23	7.6183	3.1355	81	2.70%	7.62
1982	2001.3	24	7.6016	3.1781	82	-1.67%	7.66
1983	2112.3	25	7.6555	3.2189	83	5.40%	7.69
1984	2284.1	26	7.7337	3.2581	84	7.82%	7.72
1985	2364.3	27	7.7682	3.2958	85	3.45%	7.76
1986	2439.3	28	7.7995	3.3322	86	3.12%	7.79
1987	2547.3	29	7.8428	3.3673	87	4.33%	7.82
1988	2684.8	30	7.8954	3.4012	88	5.26%	7.86
1989	2718.9	31	7.9080	3.4340	89	1.26%	7.89
1990	2747.4	32	7.9184	3.4657	90	1.04%	7.92
1991	2710.0	33	7.9047	3.4965	91	-1.37%	7.96
1992	2822.3	34	7.9453	3.5264	92	4.06%	7.99
1993	2911.0	35	7.9763	3.5553	93	3.09%	8.02

source: GDP87 is from Economic Report of the President 1994. Other vectors are computed by author.

DATA SET FOR ECONOMETRIC ANALYSIS II & III

	Percentage Changes in Key Economic Variables										index
YEAR	Q/L	Q/K	TC	Q	L	K	K&L	K/L	Kint		out/hr
1948	———	———	———	———	———	———	———	———	———		44.8
1949	0.9	-4.8	-1.2	-2.6	-3.4	2.4	-1.4	6.0	2.1		45.2
1950	8.8	4.9	7.4	9.9	1.0	4.7	2.3	3.7	1.4		49.1
1951	4.3	1.2	3.2	7.2	2.8	6.0	3.9	3.1	1.1		51.2
1952	3.4	-0.5	2.1	3.2	-0.1	3.7	1.1	3.9	1.3		52.9
1953	3.8	1.6	3.1	4.7	0.9	3.1	1.6	2.2	0.7		55.0
1954	1.5	-4.0	-0.2	-1.9	-3.4	2.3	-1.7	5.8	1.7		55.8
1955	3.2	3.1	3.1	7.0	3.7	3.8	3.8	0.1	0.1		57.6
1956	1.4	-1.3	0.5	2.9	1.5	4.3	2.4	2.8	0.9		58.4
1957	2.7	-2.3	1.1	1.1	-1.6	3.5	0.0	5.2	1.6		60.0
1958	2.9	-4.0	0.7	-2.0	-4.8	2.1	-2.7	7.2	2.2		61.8
1959	3.6	4.8	4.0	7.6	3.8	2.6	3.4	-1.2	-0.4		64.0
1960	1.7	-1.3	0.8	1.8	0.0	3.1	1.0	3.0	0.9		65.1
1961	3.7	-0.4	2.4	2.0	-1.7	2.3	-0.4	4.1	1.3		67.5
1962	3.7	2.0	3.2	5.3	1.6	3.3	2.1	1.7	0.5		70.0
1963	4.1	1.1	3.2	4.6	0.5	3.5	1.4	3.0	0.9		72.9
1964	4.5	2.1	3.7	6.1	1.5	3.9	2.3	2.3	0.8		76.2
1965	3.1	1.3	2.5	6.3	3.1	5.0	3.7	1.8	0.6		78.5
1966	2.9	-0.7	1.7	5.2	2.3	6.0	3.5	3.6	1.2		80.8
1967	3.0	-2.8	1.1	2.7	-0.3	5.6	1.5	6.0	1.9		83.3
1968	3.1	-0.2	2.1	4.5	1.4	4.7	2.4	3.3	1.0		85.9
1969	0.3	-2.1	-0.4	2.7	2.4	4.9	3.2	2.5	0.7		86.1
1970	1.0	-5.2	-0.9	-1.0	-1.9	4.4	-0.1	6.5	1.9		87.0
1971	3.3	-0.9	2.0	2.8	-0.5	3.8	0.8	4.3	1.3		89.8
1972	3.0	2.4	2.9	6.4	3.3	3.9	3.5	0.6	0.1		92.6
1973	2.4	0.9	2.0	6.1	3.6	5.1	4.0	1.5	0.4		94.8
1974	-1.9	-6.6	-3.3	-1.9	0.0	5.0	1.5	5.0	1.4		93.1
1975	2.1	-5.4	-0.2	-2.2	-4.2	3.4	-2.0	8.0	2.3		95.0
1976	3.0	3.1	3.0	5.9	2.9	2.7	2.8	-0.2	0.0		97.8
1977	1.9	2.5	2.1	5.9	3.9	3.3	3.7	-0.6	-0.2		99.7
1978	0.9	1.7	1.2	5.8	4.9	4.0	4.6	-0.8	-0.3		100.6
1979	-1.2	-2.3	-1.5	2.0	3.2	4.3	3.5	1.2	0.3		99.4
1980	-0.2	-6.0	-2.0	-1.2	-1.0	5.1	0.8	6.1	1.8		99.2
1981	1.5	-2.2	0.4	2.2	0.7	4.5	1.8	3.7	1.1		100.6
1982	-0.6	-6.4	-2.4	-3.1	-2.5	3.5	-0.7	6.2	1.8		100.0
1983	2.4	1.8	2.3	4.3	1.8	2.4	2.0	0.6	0.1		102.4
1984	2.6	4.8	3.3	8.5	5.8	3.5	5.1	-2.1	-0.7		105.1
1985	2.1	0.4	1.6	4.3	2.1	3.8	2.6	1.7	0.5		107.3
1986	2.3	-0.6	1.4	3.1	0.7	3.7	1.6	3.0	0.9		109.8
1987	1.1	1.4	1.2	4.2	3.1	2.8	3.0	-0.2	-0.1		111.1
1988	2.3	2.7	2.4	5.3	3.0	2.5	2.8	-0.4	-0.1		113.6
1989	-0.4	-0.4	-0.4	2.1	2.5	2.5	2.5	0.0	0.0		113.2
1990	-0.4	2.0	-0.8	0.2	0.6	2.2	1.1	1.6	0.4		112.8

DATA SET FOR ECONOMETRIC ANALYSIS II & III

YEAR	Percentage Changes in Key Economic Variables Q/L	Q/K	TC	Q	L	K	K&L	K/L	Kint	index out/hr
AVG4990	2.2	-0.3	1.4	3.3	1.0	3.7	1.9	2.8	0.8	
MAX4990	8.8	4.9	7.4	9.9	5.8	6.0	5.1	8.0	2.3	
MIN4990	-1.9	-6.6	-3.3	-3.1	-4.8	2.1	-2.7	-2.1	-0.7	
AVG4972	3.1	-0.2	2.0	3.6	0.5	3.9	1.6	3.4	1.1	
MAX4972	8.8	4.9	7.4	9.9	3.8	6.0	3.9	7.2	2.2	
MIN4972	0.3	-5.2	-1.2	-2.6	-4.8	2.1	-2.7	-1.2	-0.4	
AVG7379	1.0	-0.9	0.5	3.1	2.0	4.0	2.6	2.0	0.6	
MAX7379	3.0	3.1	3.0	6.1	4.9	5.1	4.6	8.0	2.3	
MIN7379	-1.9	-6.6	-3.3	-2.2	-4.2	2.7	-2.0	-0.8	-0.3	
AVG7990	1.0	-0.4	0.5	2.7	1.7	3.4	2.2	1.8	0.5	
MAX7990	2.6	4.8	3.3	8.5	5.8	5.1	5.1	6.2	1.8	
MIN7990	-1.2	-6.4	-2.4	-3.1	-2.5	2.2	-0.7	-2.1	-0.7	
AVG7390	1.1	-0.5	0.6	2.9	1.7	3.6	2.3	1.9	0.5	
MAX7390	3.0	4.8	3.3	8.5	5.8	5.1	5.1	8.0	2.3	
MIN7390	-1.9	-6.6	-3.3	-3.1	-4.2	2.2	-2.0	-2.1	-0.7	
YEAR=year										
Q/L= output per labor hour										
Q/K = output per unit of capital										
TC = technical change or multifactor productivity										
Q= national output										
L = labor hours										
K = capital										
K&L = capital and labor										
K/L = capital labor ratio										
Kint = capital intensity										
out/hr=output per labor hour										
Source: U.S. DOL Bureau of Labor Statistics News Release 8/29/91										
"Multifactor Productivity Measures, 1990".										
Summary statistics are computed.										

DATA SETS FOR ECONOMETRIC ANALYSIS EA-IV AND EA-V

Year	money W	CPI	real Wage	output/HR	VG-Wage	rlWageGrw	UNEMP
1900	0.193	8.4	2.311	4.026	0.574		5.00%
1901	0.194	8.4	2.323	4.309	0.539	0.52%	4.00%
1902	0.199	8.7	2.292	4.145	0.553	-1.38%	3.70%
1903	0.206	9.0	2.284	4.235	0.539	-0.32%	3.90%
1904	0.210	9.0	2.329	4.235	0.550	1.92%	5.40%
1905	0.211	9.0	2.340	4.339	0.539	0.48%	4.30%
1906	0.218	9.0	2.417	4.667	0.518	3.26%	1.70%
1907	0.226	9.4	2.417	4.652	0.519	-0.03%	2.80%
1908	0.228	9.0	2.528	4.429	0.571	4.52%	8.00%
1909	0.230	9.0	2.550	4.757	0.536	0.87%	5.10%
1910	0.238	9.4	2.545	4.667	0.545	-0.22%	5.90%
1911	0.246	9.4	2.630	4.757	0.553	3.31%	6.70%
1912	0.251	9.7	2.591	4.846	0.535	-1.50%	4.60%
1913	0.256	9.9	2.581	5.010	0.515	-0.41%	4.30%
1914	0.260	10.1	2.586	4.682	0.552	0.21%	7.90%
1915	0.271	10.2	2.669	4.876	0.547	3.15%	8.50%
1916	0.286	10.9	2.619	5.234	0.500	-1.91%	5.10%
1917	0.318	12.8	2.479	4.965	0.499	-5.46%	4.60%
1918	0.460	15.1	3.054	5.368	0.569	20.76%	1.40%
1919	0.554	17.3	3.202	5.726	0.559	4.74%	1.40%
1920	0.664	20.0	3.313	5.681	0.583	3.42%	5.20%
1921	0.656	17.9	3.664	6.069	0.604	10.06%	11.70%
1922	0.604	16.8	3.602	6.009	0.599	-1.71%	6.70%
1923	0.602	17.1	3.527	6.367	0.554	-2.11%	2.40%
1924	0.615	17.1	3.596	6.650	0.541	1.94%	5.00%
1925	0.624	17.5	3.559	6.635	0.536	-1.05%	3.20%
1926	0.628	17.7	3.548	6.814	0.521	-0.31%	1.80%
1927	0.640	17.4	3.685	6.934	0.531	3.80%	3.30%
1928	0.651	17.1	3.799	6.934	0.548	3.06%	4.20%
1929	0.664	17.1	3.875	7.247	0.535	1.98%	3.20%
1930	0.676	16.7	4.048	6.978	0.580	4.36%	8.70%
1931	0.687	15.2	4.511	7.038	0.641	10.82%	15.90%
1932	0.635	13.7	4.648	6.770	0.687	3.01%	23.60%
1933	0.631	12.7	4.959	6.635	0.747	6.46%	24.90%
1934	0.638	13.4	4.764	7.306	0.652	-4.01%	21.70%
1935	0.692	13.7	5.041	7.545	0.668	5.66%	20.10%
1936	0.699	13.9	5.043	7.933	0.636	0.04%	16.90%
1937	0.718	14.4	4.999	7.918	0.631	-0.87%	14.30%
1938	0.761	14.1	5.399	8.156	0.662	7.69%	19.00%
1939	0.762	13.9	5.484	8.484	0.646	1.56%	17.20%
1940	0.765	14.0	5.453	8.723	0.625	-0.56%	14.60%
1941	0.800	14.7	5.431	9.215	0.589	-0.41%	9.90%

DATA SETS FOR ECONOMETRIC ANALYSIS EA-IV AND EA-V

Year	money W	CPI	real Wage	output/HR	VG-Wage	rlWageGrw	UNEMP
1942	0.883	16.3	5.417	9.245	0.586	-0.26%	4.70%
1943	0.960	17.3	5.549	9.394	0.591	2.39%	1.90%
1944	1.010	17.6	5.738	10.020	0.573	3.35%	1.20%
1945	1.022	18.0	5.677	10.542	0.538	-1.07%	1.90%
1946	1.216	19.5	6.223	10.244	0.608	9.18%	3.90%
1947	1.277	22.3	5.715	10.244	0.558	-8.52%	3.90%
1948	1.433	24.1	5.951	10.647	0.559	4.04%	3.80%
1949	1.570	23.8	6.583	11.034	0.597	10.10%	3.90%
1950	1.714	24.1	7.117	11.944	0.596	7.80%	5.30%
1951	1.922	26.0	7.396	12.227	0.605	3.84%	3.30%
1952	2.041	26.6	7.686	12.451	0.617	3.85%	3.00%
1953	2.093	26.8	7.823	13.032	0.600	1.76%	2.90%
1954	2.196	26.9	8.167	13.405	0.609	4.31%	5.50%
1955	2.235	26.8	8.344	14.046	0.594	2.13%	4.40%
1956	2.430	27.2	8.938	14.106	0.634	6.88%	4.10%
1957	2.599	28.2	9.231	14.494	0.637	3.22%	4.30%
1958	2.725	28.9	9.429	14.911	0.632	2.13%	6.80%
1959	2.851	29.1	9.797	15.433	0.635	3.83%	5.50%
1960	2.969	29.6	10.030	15.661	0.640	2.35%	5.50%
1961	3.066	29.9	10.254	16.182	0.634	2.21%	6.70%
1962	3.186	30.2	10.550	16.675	0.633	2.84%	5.50%
1963	3.287	30.6	10.742	17.204	0.624	1.81%	5.70%
1964	3.432	31.0	11.071	17.855	0.620	3.02%	5.20%
1965	3.529	31.5	11.203	18.074	0.620	1.19%	4.50%
1966	3.720	32.4	11.481	18.143	0.633	2.45%	3.80%
1967	3.925	33.4	11.751	18.362	0.640	2.32%	3.80%
1968	4.220	34.8	12.126	18.858	0.643	3.14%	3.60%
1969	4.508	36.7	12.283	18.750	0.655	1.29%	3.50%
1970	4.825	38.8	12.436	18.776	0.662	1.23%	4.90%
1971	5.134	40.5	12.677	19.487	0.651	1.92%	5.90%
1972	5.430	41.8	12.990	19.793	0.656	2.45%	5.60%
1973	5.858	44.4	13.194	19.762	0.668	1.55%	4.90%
1974	6.413	49.3	13.008	19.230	0.676	-1.42%	5.60%
1975	7.056	53.8	13.115	19.763	0.664	0.82%	8.50%
1976	7.648	56.9	13.441	20.365	0.660	2.45%	7.70%
1977	8.252	60.6	13.617	20.766	0.656	1.30%	7.10%
1978	8.951	65.2	13.729	20.711	0.663	0.81%	6.10%
1979	9.770	72.6	13.457	20.222	0.665	-2.00%	5.80%
1980	10.777	82.4	13.079	20.265	0.645	-2.85%	7.10%
1981	11.755	90.9	12.932	20.538	0.630	-1.13%	7.60%
1982	12.577	96.5	13.033	20.803	0.627	0.78%	9.70%
1983	13.002	99.6	13.054	21.560	0.605	0.16%	9.60%

DATA SETS FOR ECONOMETRIC ANALYSIS EA-IV AND EA-V

Year	money W	CPI	real Wage	output/HR	VG-Wage	rlWageGrw	UNEMP
1984	13.527	103.9	13.019	21.926	0.594	-0.27%	7.50%
1985	14.083	107.6	13.088	22.150	0.591	0.53%	7.20%
1986	14.741	109.6	13.450	22.735	0.592	2.72%	7.00%
1987	15.208	113.6	13.387	23.129	0.579	-0.47%	6.20%
1988	15.833	118.3	13.384	23.572	0.568	-0.03%	5.50%
1989	16.377	124.0	13.207	23.189	0.570	-1.33%	5.30%
1990	17.246	130.7	13.195	23.446	0.563	-0.09%	5.50%
1991	18.087	136.2	13.280	23.865	0.556	0.64%	6.70%
1992	18.915	140.3	13.482	24.836	0.543	1.51%	7.40%
1993	19.483	144.5	13.483	25.287	0.533	0.01%	6.80%

Data Sources:

The Money Wage for 1900-1957 is from Ethel B. Jones, "New Estimates of Hours of Work Per Week and Hourly Earnings, 1900-1957", The Review of Econmics and Statistics 45(November 1963), 376. The choice of the Railroad series is based on subjective blending judgement with the later Money Wage data.

The Money Wage for 1959-1993 is from Economic Report of the President, February 1994, U.S. Printing Office, Washington D. C., 285.

The CPI series for 1900-57 is from Historical Statistics of the United Sates: Colonial Times to 1970, Part I, U.S. Department of Commerce, Series E 135-166, p. 211. CPI numbers from 1958 forward are from Economic Report of the President, February 94, U.S. Printing Office, Washington D.C., Table B-59, p. 335. The 1900-57 series is converted to make 1983-84=100 for entire series.

The Real Wage is simply the Money Wage divided by CPI times 100

Output/Hour from 1900-58 is from Historical Statistics of the United States: Colonial Times to 1970, Part 1, U.S. Department of Commerce, Series D683-704, p. 162. Output/Hour from 1959 to 1993 is from Economic Report of the President, February 1994, U.S. Printing Office, Washington D.C., Table b-14, p. 285. The 1900-58 series is converted to conform to 1959-93 series.

The Vedder-Galloway wage is the ratio (real wage/output per hour). Graph shows this number as a percent.

UNEMP=(decimal X 100) Historical Statistics of the U.S. Colonial Times to 1970, series D85-86 to 1958, Economic Report of President 1994 , for balance.

Data Set for Econometric Analysis VI

			PERCENTILE				
YEAR	YRINDX	#(THOUS)	LOWEST	SECOND	THIRD	FOURTH	FIFTH
1967	1	60813	4.0	10.8	17.3	24.2	43.8
1968	2	62214	4.2	11.1	17.5	24.4	42.8
1969	3	63401	4.1	10.9	17.5	24.5	43.0
1970	4	64778	4.1	10.8	17.4	24.5	43.3
1971	5	66676	4.1	10.6	17.3	24.5	43.5
1972	6	68251	4.1	10.5	17.1	24.5	43.9
1973	7	69859	4.2	10.5	17.1	24.6	43.6
1974	8	71163	4.3	10.6	17.0	24.6	43.5
1975	9	72867	4.3	10.4	17.0	24.7	43.6
1976	10	74142	4.3	10.3	17.0	24.7	43.7
1977	11	76030	4.2	10.2	16.9	24.7	44.0
1978	12	77330	4.2	10.2	16.9	24.7	44.1
1979	13	80776	4.1	10.2	16.8	24.7	44.2
1980	14	82368	4.2	10.2	16.8	24.8	44.1
1981	15	83527	4.1	10.1	16.7	24.8	44.4
1982	16	83918	4.0	10.0	16.5	24.5	45.0
1983	17	85290	4.0	9.9	16.4	24.6	45.1
1984	18	86789	4.0	9.9	16.3	24.6	45.2
1985	19	88458	3.9	9.8	16.2	24.4	45.6
1986	20	89479	3.8	9.7	16.2	24.3	46.1
1987	21	91124	3.8	9.6	16.1	24.3	46.2
1988	22	92830	3.8	9.6	16.0	24.3	46.3
1989	23	93347	3.8	9.5	15.8	24.0	46.8
1990	24	94312	3.9	9.6	15.9	24.0	46.6

Data Source: U.S. Bureau of the Census, Current Population Reports, Series P60-183, Studies in the Distribution of Income, U.S. Goverment Printing Office, Washington, D.C. 1992, p.4.

Data Set for Econometric Analysis VII.

Number of earners-Median Income of Families 1947 to 1988

year	no earners	one earner	two earners	ratio one to zero	ratio two to zero
1947	5215	14525	19893	2.79	3.81
1948	4578	14235	18525	3.11	4.05
1949	4314	14116	18411	3.27	4.27
1950	4531	15354	19208	3.39	4.24
1951	4191	15475	20288	3.69	4.84
1952	4817	15794	21084	3.28	4.38
1953	4989	17138	22419	3.44	4.49
1954	5137	16773	21989	3.27	4.28
1955	5712	17961	23174	3.14	4.06
1956	6063	18824	24252	3.10	4.00
1957	6130	18924	24317	3.09	3.97
1958	6427	19100	24065	2.97	3.74
1959	6838	20229	25485	2.96	3.73
1960	7182	20750	25730	2.89	3.58
1961	7236	20788	26465	2.87	3.66
1962	7564	21267	27068	2.81	3.58
1963	7628	21704	27843	2.85	3.65
1964	8182	22340	28808	2.73	3.52
1965	8574	22759	29981	2.65	3.50
1966	8412	24241	31178	2.88	3.71
1967	8685	24815	31775	2.86	3.66
1968	9624	25329	33134	2.63	3.44
1969	9715	26123	34114	2.69	3.51
1970	10028	25465	34118	2.54	3.40
1971	10390	25564	34295	2.46	3.30
1972	10930	26855	36042	2.46	3.30
1973	11356	27292	36764	2.40	3.24
1974	11818	26396	35672	2.23	3.02
1975	11505	25437	35310	2.21	3.07
1976	11828	25856	36053	2.19	3.05
1977	11750	25667	36513	2.18	3.11
1978	12189	25835	37137	2.12	3.05
1979	12485	25395	36875	2.03	2.95
1980	12292	23996	35400	1.95	2.88
1981	12246	22939	34956	1.87	2.85
1982	12150	23186	34415	1.91	2.83
1983	12502	23109	35432	1.85	2.83
1984	12954	23103	36101	1.78	2.79
1985	13274	23297	36733	1.76	2.77
1986	13499	24081	37895	1.78	2.81
1987	13585	24067	38321	1.77	2.82
1988	13729	23872	38702	1.74	2.82

data source: U.S. Dept. of Commerce, Current Population Reports, Consumer Income, Series P.-60, No. 167,Trends in Income by Selected Characteristics: 1947-1988, Table 17: Number of Earners-Median Income of Families 1947 to 1988 in 1988 cpi-u adjusted dollars. Last two columns are computed.

DATA SET FOR ECONOMETRIC ANALYSIS VIII

Nat Log of Real Compensation and Output/hour

YEAR	lnRCB	lnOH
1947	3.8044	3.7705
1948	3.8111	3.8133
1949	3.8395	3.8286
1950	3.9000	3.9100
1951	3.9180	3.9455
1952	3.9589	3.9815
1953	4.0182	4.0128
1954	4.0431	4.0378
1955	4.0724	4.0707
1956	4.1223	4.0843
1957	4.1526	4.1109
1958	4.1698	4.1431
1959	4.2062	4.1682
1960	4.2312	4.1836
1961	4.2599	4.2210
1962	4.2959	4.2556
1963	4.3188	4.2946
1964	4.3567	4.3373
1965	4.3783	4.3644
1966	4.4176	4.3907
1967	4.4427	4.4164
1968	4.4807	4.4462
1969	4.4976	4.4520
1970	4.5142	4.4659
1971	4.5337	4.4976
1972	4.5633	4.5294
1973	4.5860	4.5549
1974	4.5747	4.5358
1975	4.5829	4.5591
1976	4.6141	4.5880
1977	4.6289	4.6042
1978	4.6405	4.6102
1979	4.6260	4.5992
1980	4.6002	4.5911
1981	4.5921	4.6042
1982	4.6052	4.6052
1983	4.6112	4.6279
1984	4.6112	4.6521
1985	4.6201	4.6663
1986	4.6501	4.6867
1987	4.6501	4.6968
1988	4.6521	4.7068
1989	4.6396	4.6996
1990	4.6425	4.7068
1991	4.6482	4.7194
1992	4.6691	4.7493
1993	4.6747	4.7639
1994	4.6803	4.7850

source: Economic Report of the President 1995

Data Set for Econometric Analysis IX
Consumer Price Index and Implicit Price Deflator

YEAR	GNP IPD58	GNP IPD87	CPI(87=100)	CPI (83-84=100)	inflation using GNP IPD87
1929	38.6	9.65			
1930	37.9	9.48			-1.81
1931	36.3	9.08			-4.22
1932	33.4	8.35			-7.99
1933	34.5	8.63			3.29
1934	36.8	9.20			6.67
1935	37	9.25			0.54
1936	37.6	9.40			1.62
1937	38.4	9.60			2.13
1938	38.3	9.58			-0.26
1939	37.9	9.48			-1.04
1940	38.5	9.63			1.58
1941	44	11.00			14.29
1942	50.9	12.73			15.68
1943	53.9	13.48			5.89
1944	53.1	13.28			-1.48
1945	52.6	13.15			-0.94
1946	55.8	13.95			6.08
1947	62.9	15.73			12.72
1948	68.1	17.03			8.27
1949	71	17.75			4.26
1950	71.8	17.95	21.21	24.1	1.13
1951	78.5	19.63	22.89	26	9.33
1952	81	20.25	23.33	26.5	3.18
1953	81.8	20.45	23.50	26.7	0.99
1954	84.1	21.03	23.68	26.9	2.81
1955	87.1	21.78	23.59	26.8	3.57
1956	92.1	23.03	23.94	27.2	5.74
1957	96.4	24.10	24.74	28.1	4.67
1958	100	25.00	25.44	28.9	3.73
1959	102.4	25.60	25.62	29.1	2.40
1960	105	26.00	26.06	29.6	1.56
1961	107.1	26.30	26.32	29.9	1.15
1962	109	26.90	26.58	30.2	2.28
1963	111.8	27.20	26.94	30.6	1.12
1964	115.7	27.70	27.29	31	1.84
1965	119.4	28.40	27.73	31.5	2.53
1966	124	29.40	28.52	32.4	3.52
1967	128.5	30.30	29.40	33.4	3.06

Data Set for Econometric Analysis IX

Consumer Price Index and Implicit Price Deflator

YEAR	GNP IPD58	GNP IPD87	CPI(87=100)	CPI (83-84=100)	inflation using GNP IPD87
1968	135.1	31.80	30.63	34.8	4.95
1969	144	33.40	32.31	36.7	5.03
1970	157.6	35.20	34.15	38.8	5.39
1971		37.10	35.65	40.5	5.40
1972		38.90	36.80	41.8	4.85
1973		41.30	39.08	44.4	6.17
1974		44.90	43.40	49.3	8.72
1975		48.20	47.36	53.8	7.35
1976		52.30	50.09	56.9	8.51
1977		55.90	53.35	60.6	6.88
1978		60.30	57.39	65.2	7.87
1979		65.60	63.91	72.6	8.79
1980		71.70	72.54	82.4	9.30
1981		78.90	80.02	90.9	10.04
1982		83.80	84.95	96.5	6.21
1983		87.20	87.68	99.6	4.06
1984		91.10	91.46	103.9	4.47
1985		94.40	94.72	107.6	3.62
1986		96.90	96.48	109.6	2.65
1987		100.00	100.00	113.6	3.20
1988		103.90	104.14	118.3	3.90
1989			109.15	124	
1990			115.05	130.7	
1991			119.89	136.2	
1992			123.28	140.05	

data source: Historical Statistics of the U.S. Colonial Times to 1970 and National Income and Product Accounts of the U.S. 1959-88. Sixth column is computed.

DATA SET FOR ECONOMETRIC ANALYSIS IX		
YEAR	IMPORTS	CPI
1959	95.6	29.1
1960	96.1	29.6
1961	95.3	29.9
1962	105.5	30.2
1963	107.7	30.6
1964	112.9	31.0
1965	124.5	31.5
1966	143.7	32.4
1967	153.7	33.4
1968	177.7	34.8
1969	189.2	36.7
1970	196.4	38.8
1971	207.8	40.5
1972	230.2	41.8
1973	244.4	44.4
1974	238.4	49.3
1975	209.8	53.8
1976	249.7	56.9
1977	274.7	60.6
1978	300.1	65.2
1979	304.1	72.6
1980	289.9	82.4
1981	304.1	90.9
1982	304.1	96.5
1983	342.1	99.6
1984	427.7	103.9
1985	454.6	107.6
1986	484.7	109.6
1987	507.1	113.6
1988	525.7	118.3
1989	545.4	124.0
1990	561.8	130.7
1991	561.2	136.2
1992	607.7	140.1

source: Economic Report of the President

Data Set for Econometric Analysis X-1

Age of Automation Unemployment

year	total unemp	trend line
1948	3.8	4.11
1949	5.9	4.18
1950	5.3	4.25
1951	3.3	4.32
1952	3.0	4.40
1953	2.9	4.47
1954	5.5	4.54
1955	4.4	4.62
1956	4.1	4.69
1957	4.3	4.76
1958	6.8	4.84
1959	5.5	4.91
1960	5.5	4.98
1961	6.7	5.05
1962	5.5	5.13
1963	5.7	5.20
1964	5.2	5.27
1965	4.5	5.35
1966	3.8	5.42
1967	3.8	5.49
1968	3.6	5.57
1969	3.5	5.64
1970	4.9	5.71
1971	5.9	5.78
1972	5.6	5.86
1973	4.9	5.93
1974	5.6	6.00
1975	8.5	6.08
1976	7.7	6.15
1977	7.1	6.22
1978	6.1	6.29
1979	5.8	6.37
1980	7.1	6.44
1981	7.6	6.51
1982	9.7	6.59
1983	9.6	6.66
1984	7.5	6.73
1985	7.2	6.81
1986	7.0	6.88
1987	6.2	6.95
1988	5.5	7.02
1989	5.3	7.10
1990	5.5	7.17
1991	6.7	7.24
1992	7.4	7.32
1993		7.39
1994		7.46
1995		7.54
1996		7.61
1997		7.68
1998		7.75
1999		7.83
2000		7.90

data source: Economic Report of the President, January 1993, Table B-37.
Trend line is computed.

Data Set for Econometric Analysis X-2
Age of Automation Unemployment

Year	black uemp	white unemp
1948	6.3	3.5
1949	9.5	5.6
1950	9.7	4.9
1951	5.7	3.1
1952	5.8	2.8
1953	4.8	2.7
1954	10.6	5.0
1955	9.3	3.9
1956	8.9	3.6
1957	8.5	3.8
1958	13.5	6.1
1959	11.5	4.8
1960	10.9	5.0
1961	13.3	6.0
1962	11.7	4.9
1963	11.6	5.0
1964	10.3	4.6
1965	8.7	4.1
1966	7.8	3.4
1967	7.9	3.4
1968	7.2	3.2
1969	6.9	3.1
1970	8.8	4.5
1971	10.6	5.4
1972	10.4	5.1
1973	9.4	4.3
1974	10.5	5.0
1975	14.8	7.8
1976	14.0	7.0
1977	14.0	6.2
1978	12.8	5.2
1979	12.3	5.1
1980	14.3	6.3
1981	15.6	6.7
1982	18.9	8.6
1983	19.5	8.4
1984	15.9	6.5
1985	15.1	6.2
1986	14.5	6.0
1987	13.0	5.3
1988	11.7	4.7
1989	11.4	4.5
1990	11.3	4.7
1991	12.4	6.0
1992	14.1	6.5

Source: Economic Report of the President 1993, Black rate 48-71 invloves some approximation.

Data Set for Econometric Analysis X-3 & 4

EMPLOYMENT/ POPULATION RATIOS

	TOTAL			BLACK			WHITE		
year	total	male	female	Total	male	female	Total	male	female
1954	55.5	81.0	32.5	58.0	76.5	41.9	55.2	81.5	31.4
1955	56.7	81.8	34.0	58.7	77.6	42.2	56.5	82.2	33.0
1956	57.5	82.3	35.1	59.5	78.4	43.0	57.3	82.7	34.2
1957	57.1	81.3	35.1	59.3	77.2	43.7	56.8	81.8	34.2
1958	55.4	78.5	34.5	56.7	72.5	42.8	55.3	79.2	33.6
1959	56.0	79.3	35.0	57.5	73.0	43.2	55.9	79.9	34.0
1960	56.1	78.9	35.5	57.9	74.1	43.6	55.9	79.4	34.6
1961	55.4	77.6	35.4	56.2	71.7	42.6	55.3	78.2	34.5
1962	55.5	77.7	35.6	56.3	72.0	42.7	55.4	78.4	34.7
1963	55.4	77.1	35.8	56.2	71.0	42.7	55.3	77.7	35.0
1964	55.7	77.3	36.3	57.0	72.9	43.4	55.5	77.8	35.5
1965	56.2	77.5	37.1	57.8	73.7	44.1	56.0	77.9	36.2
1966	56.9	77.9	8.3	58.4	74.0	45.1	56.8	78.3	37.5
1967	57.3	78.0	39.0	58.2	73.8	45.0	57.2	78.4	38.3
1968	57.5	77.8	39.6	58.0	73.3	45.2	57.4	78.3	38.9
1969	58.0	77.6	40.7	58.1	72.8	45.9	58.0	78.2	40.1
1970	57.4	76.2	40.8	56.8	70.9	44.9	57.5	76.8	40.3
1971	56.6	74.9	40.4	54.9	68.1	43.9	56.8	75.7	39.9
1972	57.0	75.0	41.0	53.7	67.3	43.0	57.4	76.0	40.7
1973	57.8	75.5	42.0	54.5	66.8	43.8	58.2	76.5	41.8
1974	57.8	74.9	42.6	53.5	67.5	43.5	58.2	75.9	42.4
1975	56.1	71.7	42.0	50.1	65.8	41.6	56.7	73.0	42.0
1976	56.8	72.0	43.2	50.8	60.6	42.8	57.5	73.4	43.2
1977	57.9	72.8	44.5	51.4	61.4	43.3	58.6	74.1	44.5
1978	59.3	73.8	46.4	53.6	63.3	45.8	60.0	75.0	46.3
1979	59.9	73.8	47.5	53.8	63.4	46.0	60.6	75.1	47.5
1980	59.2	72.0	47.7	52.3	60.4	45.7	60.0	73.4	47.8
1981	59.0	71.3	48.0	51.3	59.1	45.1	60.0	72.8	48.3
1982	57.8	69.0	47.7	49.4	56.0	44.2	58.8	70.6	48.1
1983	57.9	68.8	48.0	49.5	56.3	44.1	58.9	70.4	48.5
1984	59.5	70.7	49.5	52.3	59.2	46.7	60.5	72.1	49.8
1985	60.1	70.9	50.4	53.4	60.0	48.1	61.0	72.3	50.7
1986	60.7	71.0	51.4	54.1	60.6	48.8	61.5	72.3	51.7
1987	61.5	71.5	52.5	55.6	62.0	50.3	62.3	72.7	52.8
1988	62.3	72.0	53.4	56.3	62.7	51.2	63.1	73.2	53.8
1989	63.0	72.5	54.3	56.9	62.8	52.0	63.8	73.7	54.6
1990	62.7	71.9	54.3	56.2	61.8	51.6	63.6	73.2	54.8
1991	61.6	70.2	53.7	54.9	60.5	50.3	62.6	71.5	54.3
1992	61.4	69.7	53.8	54.3	59.1	50.4	62.4	71.1	54.3
1993	61.6	69.9	54.1	54.4	59.1	50.5	62.7	71.3	54.7

source: Economic Report of the President 1994

Econometric Analysis X I - 1 & 2
Weekly Hours of Work 1840-1992

YEAR	HOURS/WK	HRS/DAY
1840	68.4	11.4
1841	63.0	10.5
1842	68.4	11.4
1843	69.0	11.5
1844	69.6	11.6
1845	69.0	11.5
1846	68.4	11.4
1847	69.0	11.5
1848	67.8	11.3
1849	67.2	11.2
1850	69.0	11.5
1851	68.4	11.4
1852	67.2	11.2
1853	67.8	11.3
1854	66.6	11.1
1855	66.6	11.1
1856	66.0	11.0
1857	65.4	10.9
1858	66.0	11.0
1859	66.6	11.1
1860	66.0	11.0
1861	65.4	10.9
1862	64.8	10.8
1863	64.8	10.8
1864	64.8	10.8
1865	64.2	10.7
1866	64.8	10.8
1867	64.8	10.8
1868	63.6	10.6
1869	63.6	10.6
1870	63.0	10.5
1871	63.0	10.5
1872	63.0	10.5
1873	63.0	10.5
1874	63.0	10.5
1875	61.8	10.3
1876	61.8	10.3
1877	61.8	10.3
1878	61.8	10.3
1879	61.8	10.3
1880	61.8	10.3
1881	61.8	10.3

Econometric Analysis X I - 1 & 2
Weekly Hours of Work 1840-1992

YEAR	HOURS/WK	HRS/DAY
1882	61.8	10.3
1883	61.8	10.3
1884	61.8	10.3
1885	61.8	10.3
1886	61.2	10.2
1887	60.0	10.0
1888	60.0	10.0
1889	60.0	10.0
1890	60.0	10.0
1891	60.0	10.0
1892	60.0	
1893	59.0	
1894	59.0	
1895	59.0	
1896	58.0	
1897	57.0	
1898	56.0	
1899	55.0	
1900	55.0	
1901	54.3	
1902	55.4	
1903	54.3	
1904	53.6	
1905	54.5	
1906	55.0	
1907	54.3	
1908	50.3	
1909	53.1	
1910	52.2	
1911	51.7	
1912	52.4	
1913	50.9	
1914	50.1	
1915	50.4	
1916	51.4	
1917	51.0	
1918	49.6	
1919	46.1	
1920	48.1	
1921	45.3	
1922	47.9	
1923	48.9	

Econometric Analysis X I - 1 & 2
Weekly Hours of Work 1840-1992

YEAR	HOURS/WK	HRS/DAY
1924	46.6	
1925	47.9	
1926	47.8	
1927	47.4	
1928	47.6	
1929	48.0	
1930	43.6	
1931	40.2	
1932	38.0	
1933	37.6	
1934	34.4	
1935	36.4	
1936	38.7	
1937	37.9	
1938	35.0	
1939	37.3	
1940	37.6	
1941	40.0	
1942	42.3	
1943	44.1	
1944	44.2	
1945	42.4	
1946	39.2	
1947	39.2	
1948	38.8	
1949	38.0	
1950	38.7	
1951	38.9	
1952	38.8	
1953	38.6	
1954	37.8	
1955	38.5	
1956	38.2	
1957	37.8	
1958	38.5	
1959	39.0	
1960	38.6	
1961	38.6	
1962	38.7	
1963	38.8	
1964	38.7	
1965	38.8	

Econometric Analysis X I - 1 & 2
Weekly Hours of Work 1840-1992

YEAR	HOURS/WK	HRS/DAY
1966	38.6	
1967	38.0	
1968	37.8	
1969	37.7	
1970	37.1	
1971	36.9	
1972	37.0	
1973	36.9	
1974	36.5	
1975	36.1	
1976	36.1	
1977	36.0	
1978	35.8	
1979	35.7	
1980	35.3	
1981	35.2	
1982	34.8	
1983	35.0	
1984	35.2	
1985	34.9	
1986	34.8	
1987	34.8	
1988	34.7	
1989	34.6	
1990	34.5	
1991	34.3	
1992	34.4	

data source: Report On Wholesale Prices and Wages, Hours of Labor , Table 44 (Congressional Special Report 1394, 52nd Congress, 2nd session 1893, Part I, pp. 178-179) lists hours of work per day from 1840 to 1891. These numbers were multiplied times 6 (days of work per week) to yield 1840-1891 hours of work per week. 1892 to 1899 hours/week are interpolated. 1900-1957 hours/week are Manufacturing hours from Ethel B. Jones, New Estimates of Hours of Work Per Week and Hourly Earnings, 1900-57, table I. 1959-1992 data is from Economic Report of the President 1993, table B-42.

Econometric Analysis XI - 3 & 4

Part-time Workers

		total labor	part-time as
1950	5089	62208	8.18%
1951	5019	62017	8.09%
1952	4932	62138	7.94%
1953	5401	63015	8.57%
1954	5984	63643	9.40%
1955	5776	65023	8.88%
1956	6837	66552	10.27%
1957	6823	66929	10.19%
1958	7435	67639	10.99%
1959	7011	68369	10.25%
1960	7729	69628	11.10%
1961	8166	70459	11.59%
1962	7973	70614	11.29%
1963	8178	71833	11.39%
1964	8763	73091	11.99%
1965	8578	74455	11.52%
1966	9158	75770	12.09%
1967	9659	77347	12.49%
1968	10167	78737	12.91%
1969	10637	80734	13.18%
1970	11590	82771	14.00%
1971	11981	84382	14.20%
1972	12415	87034	14.26%
1973	12724	89429	14.23%
1974	13333	91949	14.50%
1975	14236	93775	15.18%
1976	14411	96158	14.99%
1977	14965	99009	15.11%
1978	15411	102251	15.07%
1979	15778	104962	15.03%
1980	16619	106940	15.54%
1981	17038	108670	15.68%
1982	18307	110204	16.61%
1983	18414	111550	16.51%
1984	18216	113544	16.04%
1985	18372	115461	15.91%
1986	18847	117834	15.99%
1987	19050	119895	15.89%
1988	19474	121669	16.01%

source: Handbook of Labor Statistics (DOL) 1989
and Historical Statistics of the United States,

DATA SET FOR ECONOMETRIC ANALYSIS XI - 5

Manufacturing Hours of Work

YEAR	HOURS/WK	
1840	68.4	
1841	63.0	
1842	68.4	
1843	69.0	
1844	69.6	
1845	69.0	
1846	68.4	
1847	69.0	
1848	67.8	
1849	67.2	
1850	69.0	
1851	68.4	
1852	67.2	
1853	67.8	
1854	66.6	
1855	66.6	
1856	66.0	
1857	65.4	
1858	66.0	
1859	66.6	
1860	66.0	
1861	65.4	
1862	64.8	
1863	64.8	
1864	64.8	
1865	64.2	
1866	64.8	
1867	64.8	
1868	63.6	
1869	63.6	
1870	63.0	
1871	63.0	
1872	63.0	
1873	63.0	
1874	63.0	
1875	61.8	
1876	61.8	
1877	61.8	
1878	61.8	
1879	61.8	
1880	61.8	
1881	61.8	

DATA SET FOR ECONOMETRIC ANALYSIS XI - 5

Manufacturing Hours of Work

YEAR	HOURS/WK
1882	61.8
1883	61.8
1884	61.8
1885	61.8
1886	61.2
1887	60.0
1888	60.0
1889	60.0
1890	60.0
1891	60.0
1892	60.0
1893	59.0
1894	59.0
1895	59.0
1896	58.0
1897	57.0
1898	56.0
1899	55.0
1900	55.0
1901	54.3
1902	55.4
1903	54.3
1904	53.6
1905	54.5
1906	53.6
1907	54.5
1908	55.0
1909	54.3
1910	50.3
1911	53.1
1912	52.2
1913	51.7
1914	52.4
1915	50.9
1916	51.4
1917	51.0
1918	49.6
1919	46.3
1920	47.4
1921	43.1
1922	44.2
1923	45.6

DATA SET FOR ECONOMETRIC ANALYSIS XI - 5

Manufacturing Hours of Work

YEAR	HOURS/WK	
1924	43.7	
1925	44.5	
1926	45.0	
1927	45.0	
1928	44.4	
1929	44.2	
1930	42.1	
1931	40.5	
1932	38.3	
1933	38.1	
1934	34.6	
1935	36.6	
1936	39.2	
1937	38.6	
1938	35.6	
1939	37.7	
1940	38.1	
1941	40.6	
1942	43.1	
1943	45.0	
1944	45.2	
1945	43.2	
1946	40.3	
1947	40.4	
1948	40.0	
1949	39.1	
1950	40.5	
1951	40.6	
1952	40.7	
1953	40.5	
1954	39.6	
1955	40.7	
1956	40.4	
1957	39.8	
1958	39.2	
1959	40.3	
1960	39.7	
1961	39.8	
1962	40.4	
1963	40.5	
1964	40.7	
1965	41.2	

DATA SET FOR ECONOMETRIC ANALYSIS XI - 5

Manufacturing Hours of Work

YEAR	HOURS/WK
1966	41.3
1967	40.6
1968	40.7
1969	40.6
1970	39.8
1971	39.9
1972	40.5
1973	40.7
1974	40.0
1975	39.5
1976	40.1
1977	40.3
1978	40.4
1979	40.2
1980	39.7
1981	39.8
1982	38.9
1983	40.1
1984	40.7
1985	40.5
1986	40.7
1987	41.0
1988	41.1
1989	41.0

data source: Report on Wholesale Prices and Wages, Historical Statistics from Colonial Times and Employment, Hours and Earnings by U.S. Department of Labor

PART IV

SUMMARY & CONCLUSION

S U M M A R Y

Chapter I - Automation in the Context of Technological

This chapter defines automation in the context of modern technological change (last 300 years), which is defined in the context of technological change dating to the origin of man.

Economic growth implies an increase in the amount of goods and services available to society. Such growth will occur thru labor force size increases or capital resource increases. American population grows very slowly. Growth attributable to capital is subject to diminishing returns, which would attain except for the technological change factor, the most important component contributing to economic growth.

Technological change is an improvement in society's knowledge about how to produce goods or services. Modern technological change is a phenomenon no older than 300 years, barely temporally significant when compared to the 2.5 million plus years of man's existence as a tool making entity of increasing sophistication. Many assume that technological change is constant and continuous and perhaps putting technological change in historical perspective tempers such a view. The historical perspective will undoubtedly show modern

technological change as a relatively new phenomenon with significant increases not necessarily guaranteed forever.

Since writing dates back only about 5000 years, the study of ancient technological change is pre-historic by definition. Such a study is by implication and depends on items that can survive time. Prominent among such long-lived items are stone, bronze and iron.

In temporal order beginning in the Stone Age 2,600,000 years ago, man was a hunter and gatherer using crude stone tools. Man evolved as did his tool set and beginning in the Middle Stone Age (10000 to 3000 b.c.) man became more social and lived and hunted in groups. In the New Stone Age (8000 to 2000 b.c.) man's tools became even more sophisticated, as did his agriculture including animal domestication. Transportation using the wheel and boats, etc. also evolved.

The Bronze age (3000 to 1000 b.c.) followed marking the beginning of the use of metals in the development of tools and also the development of written language. Egypt is probably a good example of this age, using metal tools to develop the Pyramids concurrent with the development of the written language.

The iron age (1000 b.c. to present) is marked by the widespread use of metals facilitated by Bronze technology, yet using the more abundant iron. Of

course this change made possible a more sophisticated tool set than previously possible.

The European Middle Ages (300-500 a.d. to 1500 a.d.) mark the beginning of European distinguish leadership in invention, separating from a tradition of "copying" from inventions of other parts of the world. Sophisticated machinery including firearms, and water-power tools evolved.

The years 1500-1700 formed a prelude to the Industrial Revolutions. Inventions of increasing sophistication were developed including glass, telescopes, microscopes, the submarine and high dams.

1700-1900 is the **First Industrial Revolution** and is marked by successfully replacing man-power with machine power, i.e. steam power. The internal combustion engine followed at the end of the 19th century along with radio and electricity. This was truly an age of tremendous inventiveness.

1900-1948 is the **Second Industrial Revolution** marked by the assembly line and widespread use of electricity. The computer and transistor were both developed in this time period.

We live in the **Third Industrial Revolution**. Previously, regardless of the sophistication of the machinery, men were still needed as a complementary factor in production. However, beginning with this automation era, we have

machines that are perfectly capable of monitoring other machines and entire productive processes. Space travel and lasers also mark this period.

Having provided the above historical milestone summary of technological evolution, the Fundamental Concepts of Technological Change are next reviewed.

Pure Science, Technology, invention, innovation, and additional terms that assist in a technical understanding of technological change are defined in direct detail and through a case study using the development of the transistor as the case-in-point.

Measurement of Technological Change is next considered. Following the logic of Edward Dennison, John Kendrick and Robert Solow, the preeminence of technological change in economic growth is demonstrated graphically. Other economic growth measurement statistics are also reviewed.

We finally turn our attention to Automation. Automation replaces a previous human function of control of a mechanism with automatic control. The origin of the term automation is traced to Harder, Diebold, etc. Examples of automation are provided to demonstrate that Automation is not simply a mid-20th century forward concept but has rather existed for hundreds of years only to be amplified by computer technology in recent times.

The great debate with Automation as Potential Economic Hazard or Unrestricted Automation as Certain Economic Benefit. is reviewed to determine whether Automation represents a real threat to employment and economic health or whether unrestricted automation is best. Multiple examples of each side of the debate are reviewed. The conclusions of the debate are uncertain. Of important note is the difference between Leontief when compared to Cyert and Mowery. Leontief is optimistic about predicting the short-term and long-term impact of Automation, using output-input analysis, and has done so with the Austrian economy, while Cyert and Mowery state that sufficient data for projections simply does not exist.

A brief history of calculating devices is provided that extends from the use of the abacus to the development of the modern microchip. The evolution from the electronic tube to the transistor seems to be a key development in this history.

Current instances of Automation including examples of Computers; Automation in the Home, School, Office and Industry; Artificial Intelligence; applications in Medicine and the Military are all listed to further delineate the nature of automation.

Chapter II - Economic Welfare

Economic Welfare is a subset of the General Welfare dictated by the U.S. Constitution as a national objective. Professor Pigou is considered a founder of Welfare State thought and dictates that the measuring rod of money defines the borders of economic welfare. Positive and Normative Economics are separated according to whether we are involved in description and prediction (positive) or prescription (normative). These perspectives are compared and contrasted.

Classical Economics follows a fundamental positive economic path. Indeed, the sphere of economics prior to the Keynesian Revolution was primarily positive. Economics was forced into a normative mode in order to solve the problems of the Great Depression and in so moving the so-called Welfare State evolved. Without intervention similar to that prescribe by Keynes, one can argue that true democratic capitalism may not have survived the Depression-World War II challenge. Keynes argued for the direct interference of the government to solve certain economic problems, especially unemployment.

Perhaps as a compromise between the older classical school and the new Keynesian school, post-depression economics was divided between Microeconomics (classical thought) and Macroeconomics (Keynesian). The prefixes do not reflect the fundamental differences in philosophy that are

expressed by these two thought paths especially regarding Welfare Economics. Keynes' *General Theory* is the origin of modern Macro-economics. And by Keynes' own admission it is normative in content.

Utility is want-satisfying power. Cardinal Utility is measurable and allows interpersonal comparisons while Ordinal Utility is measured in levels only and doesn't permit interpersonal comparisons. The disallowance of interpersonal comparisons leads to the Pareto criteria for Welfare evaluation which states that the only justifiable economic welfare judgements concern those situations in which at least one person can be made better off with no one being made worse off.

With cardinal utility we may argue that a year-long cafeteria meal ticket has much greater value to a homeless person than it does for the most recent winner of a $10 million lottery. With ordinal utility we may not justify taxing the lottery winner to feed the homeless. With cardinal utility we can justify such a transfer.

Cardinal utility can lead to a national welfare function requiring a redistribution of income beyond that dictated by the Pareto criteria. However, Arrow's (Im)Possibility Theorem indicates that national welfare functions in a democracy may lead to irrational conclusions. This conclusion has lead many to believe that the Pareto Criteria is the extent of the redistribution

prescription that may obtain without embracing possible irrationality and as such is a considerable blow to cardinal utility based redistribution plans.

An increase in economic welfare via economic growth may not be criticized by either cardinal or ordinal utility. Economic Growth means that the "pie" of economic goods and services is greater during this time period than the last, allowing someone to be better off with no one needing to be made worse off (i.e. economic growth is potentially Pareto optimal).

Economic Growth is our first economic welfare criteria.

The Welfare State has origins as old as economics itself but in modern form it owes much to the developments of Pigou and to the solution of the Great Depression including the Keynesian contribution. The Welfare State according to Pigou allowed redistribution of income if total GNP was not reduced in the process. If an additional $500 has greater utility for a homeless person than it does for a millionaire then the totality of national utility is increased through such a transfer if output is not diminished. Using the government as a taxer and redistributor is therefore justified. Using such logic, we are in the realm of cardinal utility and use arguments beyond the ability of Pareto Optimality to justify.

Welfare State roots can be traced to Bernoulli's St. Petersburg paradox (1730-31) and therefore exist prior to the Adam Smith logistics. Progressive income tax can be traced to Edgeworth in 1897 relying in part on the logic of Bernoulli.

Historical provisions for the old and the indigent are reviewed in considerable detail both in Europe and America. Unemployment compensation and progressive income tax are both discussed.

The Great Depression and the transition from the Hoover to the Roosevelt administrations are discussed in considerable detail. Minimum wage, social security, aid to dependent children were all part of the Roosevelt response to the Depression.

Many economists recommended that the Government do nothing and allow "natural" economic forces to solve the economic problems of the Depression. Towards this "classical" viewpoint stood J.M. Keynes in steadfast contradiction.

Keynes recommend Government expenditures not matched by tax revenue as a major component of the solution. This solution simultaneously supported emergence from the Great Depression and America's participation in World War II (defending democracy and democratic capitalism).

The Employment Act of 1946 was enacted by Congress in part to promote maximum employment, production and purchasing power and thereby

increased the importance of the intervening Economics' function of Government.

Health Insurance, AFDC, enhanced Social Security Act, job training, housing subsidies, the Kennedy-Johnson War on Poverty, Head Start, Job Corps, food stamp enhancement, Medicare and Medicaid, and many other programs marked increases in the post World War II "Welfare State".

The Reagan Administration began a national anti-welfare expenditure movement inspired by Reagan's California governorship experience. Reagan emphasized workfare as an alternative to welfare. Reagan Administration legislation was enacted requiring states to institute education, training and placement programs and supplemental programs of child care and transportation by October 1990. The program did not fully achieve its goals due in part to a recession that diminished the number of available jobs.

Healthcare is another current economic welfare concern. We are currently spending a larger portion of GNP for healthcare than at any previous time and more per capita than any other country, yet our per capita health trails that of many countries including Canada which spends 50% less per capita than we do.

The Accelerationist Theory, Rational Expectations, and Supply-side Economics are all reviewed as recent economic developments that seriously

challenge Keynesian Economics. The Accelerationist and Rational Expectations theories offer possible explanations of why Keynesian policies may have only short-run effectiveness and lead to long term inflation. However Keynes offers an alternative definition of inflation that diminishes both the Accelerationist and Rational Expectations theories. Supply-side Economics is presented as a failed policy responsible for the current national debt problem.

This history and evolution of the progressive income tax is reviewed. Regressive, proportional, and progressive taxation occur as the poor are taxed by a greater percent than the rich, the poor are tax at the same percent as the rich or the poor are taxed by a smaller percent than the rich, respectively.

The St. Petersburg Paradox is offered as proof of the diminishing marginal utility of money. If a person is risk-averse, the St. Petersburg Paradox proves the diminishing marginal utility of money. However, in order to prove that risk-aversion is the dominate belief in society we need additional support. This additional support emerges in the form of analysis of insurance. Insurance is justifiable primarily for the risk-averse. Therefore the pervasion of insurance in a society is an indicator of risk aversion. 80%+ of American households own life insurance attesting to at least a 4/5 majority belief in risk aversion -

diminishing marginal utility of money - interpersonal comparisons of utility - progressive taxation.

Belief in diminishing marginal utility leads one to progressive taxation. But, some interpret the Arrow Possibility Theorem as implying: "It is impossible to say that taking a dollar away from a rich person and giving it to a poor person will make society better off, in some nondictatorial or imposed sense". We therefore have a conflict between the Arrow Theory and the Pigou based arguments. We can strengthen belief in Pigou if we find fundamental weakness in the Arrow Theory. Rather than survey literature that finds modification in the Arrow assumptions in order to overcome the impossibility, we create programmable robots programmed individually according to Arrow type societal logic and we find that an individual robot can easily be driven to an irrational conclusion using similar logic that allowed society to be driven to irrationality. Irrationality becomes the result of too simplistic assumptions of intelligence either individual or societal. We therefore argue that society can reach conclusions more complex than the Pareto criteria and be consider rational in doing so.

Our democratic voting system implies interpersonal comparisons of utility since a poor man has the apparent same voting power as does a rich man. However, if the rich can pay Economists to propagandize the irrationality of

diminishing marginal utility and if the rich can pay Politicians to impose a regressive tax system we can erode Welfare State philosophy until the majority of voters are again educated as to their rational self-interest (more preferred to less, etc.)

Given an explanation of the Welfare State, the following Economic Welfare Indicators are justified as valid: 1) Hours of Work, 2) Inflation and the Price Level, 3) Income and the Distribution of Income, and 4) Unemployment.

Hours of Work is justified as an Economic Welfare indicator because of the desirability of leisure when accompanied by a desired wage. If leisure time is increased and the wage remains constant, economic welfare has undoubtedly increased. If leisure is increased and the wage rate decreased, yet the marginal utility of the leisure increase exceed the marginal disutilty of the wage decrease we still have an increase in economic welfare. Hours of Work is an important economic welfare indicator.

Inflation and the Price Level is justified as an Economic Welfare indicator because one's economic welfare can remain constant in the face of inflation only if one's income keeps pace with the inflation. The degree of price level changes and their measurements are key in evaluation of economic welfare.

Income and the Distribution of Income is justified as an Economic Welfare Indicator because money is the source of economic welfare and income is a primary source of money. The Government structure allows us to move income from the rich to the poor or in reverse. To have an increased GNP and yet to redistribute the increased income primarily to the rich, yields a potential diminution in economic welfare for the poor. Having a larger economic pie does not imply that everyone is going to get a bigger slice. We need to carefully examine income and the distribution of income in order to determine shifts in economic welfare.

Rational Expectations leads us to believe than society cannot be fooled, in the long-run, about regressive tendencies in taxation that could easily be overcome with rational democratic techniques. Recent data indicates that Rational Expectations has not dominated in recent years regarding the distribution of income.

Unemployment is justified as an Economic Welfare indicator because it is through employment that most of us receive money, the source of Economic Welfare. Massive Unemployment was the primary symptom of the Great Depression and current Federal Legislation requires that it continue as a major concern of public policy.

PART III - The Paradox (Econometric Analysis and Data Sets)

In the process of analyzing the possible existence of a paradox between Automation and Economic Welfare, Econometric Tests were performed resulting in the following:

EA-I. Analysis of GNP and GDP magnitudes and growth rates

The poor economic growth associated with the 1970s, 1980s and early 1990s, represents a decrease in economic welfare because potential growth defined by rates of the 1950s and 1960s was not achieved. In fact two eras, 1970-4 and 1980-4, qualify as "depression prone".

Some economists, including Ziv Griliches, offer excuses for the dismal growth, but these are not convincing given the negative Welfare implications of our other examined Welfare Indicators.

We may hypothesize that the "underground economy" has grown to compensate for the lack of growth in the main economy, sufficient data do not exist to confirm or deny this notion. Available information tends to oppose this theory.

EA-II. Analysis of Technological Change as a Component of Economic Growth

Technological Change is the most important component of Economic Growth. However, care should be taken in distinguishing between

technological change and applied technological change. Understanding such distinction helps explain the Automation - Economic Welfare Paradox.

EA-III Analysis of Output Per Hour

It is in this analysis that the inferiority of Supply-Side Economics is more clearly demonstrated when compared to Keynesian Policy. Output Per Hour is investigated so that changes in labor force participation will be neutralized.

EA-IV Analyzing The Real Hourly Wage

Samuleson predicts that a miracle of the devil would be required to keep real hourly wages from increasing every decade. Since the first mid-70s energy crisis, the real wage has not been rising (has tended to remain constant). Economic Welfare for wage earners is diminished leading to statements that the previous generation enjoyed greater economic welfare that the current generation.

EA-V Analyzing Vedder - Galloway (Real) Wage

Vedder and Galloway have proposed that their version of the real wage (i.e. real wage/real output per hour) should be highly negatively correlated with employment. That is, a reduction in the real wage should lead to increased

employment and should be used more often to solve unemployment problems. Our analysis shows their assumption is not supported by the data.

EA-VI Analyzing Changes in the Distribution of Income

Democratic Capitalism has tax policies that are ultimately controlled by the majority of voters who according to economic assumption, act in their own self-interest. The data shows that National Income (during times of slow growth) has been redistributed from the lower four-fifths and given to the upper one-fifth, counter to a democratic assumption. The Pigou Economic Welfare principle allows for redistribution of income to lower-income groups if this does not cause a diminution of total income. A preliminary conclusion may be that Automation has redirected economic power to the owners of capital (primarily the very rich) and away from labor. However, given such power of Automation, one wonders why the worse-off majority tax the better off minority less instead of more. The hypnotic psychology of Supply-Side tax cuts for the rich followed by federal deficits followed by reduction of federal programs that favor the poor 4/5 minority is demonstrated here and presents a key component of the Automation - Economic Welfare Paradox.

There is considerable mobility among income groups. However, this mobility is primarily caused by changes in family composition and is usually plus or minus one quintile of original income. Thus, Income mobility is not

considered a sufficient counterargument against the diminution of economic welfare due to the decrease in nation income share of the lower 4/5ths of earners.

EA-VII Generational Comparison of the Number of Earners per Household Required to Maintain A Standard of Living

Census data is used to show that it takes two earners per household to provide the level of support that a generation ago could be provided by one earner. This supports popular belief and further indicates a decrement of Economic Welfare in the Age of Automation.

EA-VIII Analyzing the Relationship Between Real Compensation Per Hour and Output Per Hour

From 1947-73, a 1% increase in output was associated with a 1% increase in real compensation. However, from 1974-94, a 1% increase in output was associated with a .4% increase in compensation. This dramatic decrement may be associated with a weaker labor position due in part to greater automation. The energy crisis did not cause the weakening but it did contribute to a demonstration of the weakening. Pro-management political administration may be concurrent possible causation.

EA-IX. Analyzing Inflation and the Price Level

While Keynes indicates that some degree of inflation should be expected with normal economic growth, we note that post-1950 price levels (i.e. Automation Age) are higher than any time period from the Revolutionary War forward. We are therefore concerned with inflation and the price level.

Elementary Economic indicates that the price level is of minor importance and inflation is more important. Such a position is questioned.

We posit and demonstrate a significant relationship between the price level and the level of imports. This theory is part of the motivation to investigate the employment impact of trade deficits, found to be quite significant.

EA-X Analyzing Unemployment

The trend in unemployment during the Age of Automation has been an upward one. Trend projected unemployment is 4% in 1948 and 8% in 2000.

Structural and Frictional forces are deemed not sufficient to explain away an unemployment rate that had a 2% ideal rate in 1946.

Overall women are increasing their participation in the labor force while men are decreasing participation, the net effect is a slight total increase.

African-Americans, whose unemployment rates are usually at least twice those of Whites, were displaced in the labor force by whites beginning with the stagflation period.

EA-XI Hours of Work in the Age of Automation

The trend in hours of work per week is downward since 1840, perhaps in celebration of the advance of technology. However, in recent time the reduction in the number of hours per week is highly influenced by a growing number and percentage of part-time works. The average workweek has diminished only through the great increase in part-time employees.

Employers may prefer part-time employees because they are cheaper, but studies show that most part-time employees would prefer to work full-time (with more pay and fringe benefits).

Since part-time workers distort the actual evolution of the official American workweek, we rely on Hours of Work per week in the Manufacturing section to observe the trend for full-time workers and we find that 40 hours has been and continues to be the standard since the Employment Act of 1946. The *official* workweek has not decreased in response to Automation, the greatest technological change in the history of mankind.

Many full-time workers (overworked due to extra cost of hiring additional workers) are willing to relinquish a day's pay for an extra day off. Such an attitude indicates that a reduction in the workweek should seriously be considered as a reaction to Automation and therefore qualifies as legitimate further study.

C O N C L U S I O N

The economy was invented to serve man. Man was not created to serve the economy.

Oren Johnson

Automation and Economic Welfare

If the evolution of technology is continuous and if we assume few major reversals in technology (i.e. negative technological changes), the technology of today will always be greater than the technology of yesterday. That is, we currently live in the greatest age of Technology.

Automation, the latest form of technical change, is unlike any previous change in technology and has unique implications for our modern economies. Automation not only creates a more intelligent machine with which to work, but more than any other genre of technological change, it allows the complete replacement of man in the manufacture of goods and in the provision of services. Having found a most excellent "substitute" for labor, management (more precisely, capitalists) can be expected to gain power over labor that may require remedial legislation. Given automation's unique ability to displace people in the workplace and given the unique power of work to provide the essentials of life for the majority of us, it is imperative that we monitor and direct the short-run and long-run impacts of Automation using all reliable and

available methodology. Short-run costs must not be an excuse for not developing the necessary Automation projection models (short-run and long-run).

If the Great Depression did nothing more, it taught us that modern complex economies cannot be left to their own laissez faire devices and be expected to maximize economic welfare in the Pigou sense.

We entered the Age of Automation at the middle of this century using Keynesian techniques for resolving most of our greatest potential economic problems. These Keynesian techniques were proven in the Great Depression, proven again in World War II, and they also worked rather well immediately after the War Period.

Beginning in the early 1970s we encountered "shocks" to the American economy in the form of the Energy Crisis. Perhaps in response to a weakening U.S. dollar, foreign oil producers formed cartels to charge higher prices for the oil that was so essential to the proper functioning of our entire economy. The impact of the oil price increase was amplified through the *paranoid* response of American businesses who in an attempt to guarantee their profit stance, increased prices to compensate for the actual higher cost of energy, the imagined additional future cost of energy, and cost increases by suppliers attributable to the increased energy costs. The reaction of American business

was probably an overreaction due to the false anticipations of a continual escalation of energy prices.

The demise of Keynesian policy was proclaimed during this time, primarily because of this massive wave of inflation that seemed not to respond to so-called traditional Keynesian thought (and also demonstrated "power" of modern imperfect competition). For example, the Phillips Curve showing an inverse relationship between inflation and unemployment was erroneously called Keynesian (Keynes knew the difference between "good" and "bad" inflation) and its failure was seen as prima facie evidence of a failure of Keynesian logic.

No doubt inflation was a primary problem as Ronald Reagan assumed the office of U.S. President in the early 80s. On the one hand, Reagan (sub)consciously represented a government equivalent of a "John Wayne" type with the implication of potential use of U.S. militarism to solve the (energy) conflict with Middle Eastern powers. This image was validated early in his administration as Middle East American hostages were released at the beginning of his administration.

The Reagan Administration included a larger than usual percentage of representatives of American corporations. This gave corporate America a greater sense of participation in federal government control and they felt

confident in relinquishing their inflationary response to energy for this new militarism. This new attitude along with double digit interest rates from the Fed brought inflation under control. (A substitute for a rich person making higher business profits is earning more interest on savings.)

Having arrested public enemy number one (inflation), the American people attributed almost magical powers to the Reagan administration and its ability to solve the problems of America. When the Reagan Administration recommended a reduced Federal Government, this philosophy was adopted even though the international expectations of America in the new world order are more complex. Our computers get more complex and more powerful but our national government should do the reverse?

Given the pseudo-death of Keynesianism, the door was opened to strange economic doctrines such as rational expectations and supply-side economics. The latter recommend dramatic reduction in taxes especially on the rich with the hope that the rich would spend more and thereby accelerate economic growth (contrast with traditional theories that argue that the poor have a higher marginal propensity to consume).

Congress acceded to this philosophy and so began a reduction in tax receipts that ultimately led to the federal deficit/debt problems that plague us today. The promises of greater economic growth and increased tax revenues pledged

by supply-side supporters turn out not to be true. Upon realizing the failure of the supply-side policy a reversion to the previous tax structure would have minimized our current deficit problems. However, supply-siders refused to admit defeat.

[This is a good time to review the definitions of *earned* and *unearned* income. Earned income is the opposite of unearned income and "arises from labor, salaries, wages, fees, commissions, etc."[1] While unearned income "arises from capital, interest, dividends, gains, etc."[2] This terminology is not accidental and it shouldn't take doctoral level analysis to see what type of income is most consistent with economic growth. If unearned income is taxed at very high rates, then the rich have an incentive towards earned income which is more consistent with economic growth. None of this document should be consider an "anti-rich" campaign, rather the objective is to provide correct incentives for the rich to **lead** in economic development. Reducing the capital gains tax is an incentive for the rich to involve themselves in "unearned income" inconsistent with vigorous economic growth. This is another reason why some economists labeled supply-side economics a failed policy from the start. As the

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[1]R.M. Sommerfeld, H.M. Anderson, H.R. Brock and J. O. Everett, *HBJ Federal Tax Course 1985*, (Orlando, Fl: Harcourt, Brace, Jovanovich, 1984), 608.

[2] R.M. Sommerfeld, H.M. Anderson, H.R. Brock and J. O. Everett, *HBJ Federal Tax Course 1985*, (Orlando, Fl: Harcourt, Brace, Jovanovich, 1984), 608.

automation model is perfected we can logically imagine another form of "unearned" income!]

In a fifteen year period, from 1977-92, the supply-side experiment was tried and it failed. While the super-rich more than doubled their income, the balance of America primarily lost ground, while a few segments made very modest gains.

Given Macroeconomic theory that predicted that technological advance would lead to greater economic growth and income improvement for all, the reality of 1977-92 stands in stark contrast.

Who compels Congress to continue to pursue supply-side theory and lead America to greater depths of economic despair?

> Luke 18:18-24
> 18 A certain ruler asked him, "Good teacher, what must I do to inherit eternal life?"
> 19 "Why do you call me good?" Jesus answered. "No one is good-- except God alone.
> 20 You know the commandments: 'Do not commit adultery, do not murder, do not steal, do not give false testimony, honor your father and mother.'"
> 21 "All these I have kept since I was a boy," he said.
> 22 When Jesus heard this, he said to him, "You still lack one thing. Sell everything you have and give to the poor, and you will have treasure in heaven. Then come, follow me."
> 23 When he heard this, he became very sad, because he was a man of great wealth.
> 24 Jesus looked at him and said, "How hard it is for the rich to enter the kingdom of God!
>
> New International Version of the *Holy Bible*

It appears not to be Jesus Christ. Jesus evidently is an Economist with welfare views consistent with those of Pigou (e.g. belief in higher tax rates for the rich).

However, we can place certain current segments of the economics profession in a group that does not emphasize a return to progressive taxation. These economists evidently did not learn the great lesson of the Great Depression. The economics profession continues to teach the Pareto philosophy and Arrow's Impossibility Theorem in Microeconomics courses as limits of the Economic Welfare prescription. This dogma supports a philosophy that could have continued and justified the Great Depression indefinitely!

An Amendment to the Constitution allowing progressive taxation and federal law mandating full employment and the maintenance of purchasing power as national policy are cornerstones of American Democratic Capitalism. Yet, these principles are eroded due to Pareto-Arrow Impossible economics and Congressional reluctance to re-institute progressive taxation structures (which could jeopardize reelections).

> Unknown politician in defense of accepting large 'contributions' from the rich:
> "I don't know anyone who works for a poor man!"

Refusing to reinstate the prior tax structure amplifies our federal budget crisis.

The Grand Deception

Economists and Politicians are currently involved in a grand deception of the American Public. Economists are teaching the supremacy of Pareto Optimality as a welfare measure and use Arrow's Impossibility theory to argue against progressive taxation. The insurance industry has proven the majority belief in the decreasing marginal utility of money, the primary prerequisite for progressive taxation. A democracy based on majority rule has the ability to enforce progressive taxation because more people are made better off than are made worse off.

Indeed this was the case until American's were told that a deviation from progressive taxation would provide greater economic growth, greater employment and a better standard of living for all. This myth was labeled supply-side economics and was a demonstrated failure. Rather than admit this failure, the policy was continued until the Federal government's debt and deficit were at unacceptably high levels.

At this point politicians argued for a Balanced Budget Constitutional Amendment which could potentially render future Keynesian anti-recession policies impotent in the long-run. In any event, the consistent excess of federal expenditure over receipts is being used as justification for long-run reduction of federal programs which could have been afforded if the tax structure had not

become regressive. Reliance on the Constitution is probably a sub-conscious realization by the Congress that their actions have violated the spirit of the 13th Amendment and if the States should ratify the Balanced Budget Amendment without increased taxation, it would render Congress innocent of deceit albeit via "irrational" behavior on the part of the electorate.

What an underhanded method of the rich and their agents to gain a reduction in the size of federal government (and therefore in their tax payments)! Federal expenditure reduction could not be justified by the rich minority a priori because the voting majority would lose more than it would gain. However it was achieved, by first) promising a better economy for all if you will simply reduce taxes on the rich, then) not delivering on the promise and publicizing that the resulting economy would get better some time in the future, and finally) with the federal government in extreme debt claiming that federal programs must be cut to avoid collapse. A more honest approach would send the following letter to the America public from the Congress.

Dear American Public:

In the 1980s and early 1990s we engaged in a supply-aide economic experiment that we believed would yield a stronger and better economy for all in exchange for a reduction of taxes particularly on the rich. Such an expectation was not realized, the supply-side policy failed. During the time of our supply-side experiment, the incomes of the super-rich more than doubled. The forgone tax receipts from the rich almost exactly equal our current national debt. That is, if we had continued with our previous tax system we would not be in national debt. We now have a choice. We can 1) tremendously cut federal programs until a balance is achieved or 2) increase taxes on the super-rich whose incomes more

than doubled in the last decade. We hesitate to do the latter because we depend on the super-rich for funds to run for Congress. However, we won't be elected without your votes either. We therefore put this question to the American public. What would you have us do?

Sincerely, Your Honest Congressperson

[Our position should not be interpreted as being at variance with zero based budgeting. "With *zero based budgeting*, every expense or item must be justified and historical levels do not justify future continuation or existence."[3]]

The current political movement ironically called "Conservative," (The word conservative actually means one who preserves a standard that exits and not a group that extinguishes existing ideology.) is composed of one of the oddest coalitions conceivable. The super-rich join the coalition to avoid progressive taxation and thereby maximize income. The middle-class not educated about the reversal in progressive taxation for the rich and trained in Pareto thought, support a "don't increase taxes philosophy on anyone" and therefore support the super-rich position. The third component in the coalition, the racists, join the coalition in the belief that the federal budget should be balanced in part by reducing assistance for minorities. Therefore, we have "conservative" politicians running for office based on smaller federal government, returning power to the localities (at reduced funding levels, although not emphasized), and a repeal of Affirmative Action.

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[3]Richard J. Tersine, *Production/Operations Management: Concepts Structure and Analysis, second edition* (North-Holland: New York, 1985) p. 185.

This coalition has been successful in winning short-term power in part due to many Americans using a surrogate voting technique in which they allow a small percent of voters to express the sentiment of the entire electorate. The weakness in such an approach is that the conservative coalition may vote en masse while others believe the surrogate system is still working, causing a short-term reversal of power configuration. And, if the "conservative coalition" can convince the American public that their policies are sound (even though irrational in an economic sense, i.e. "more is preferred to less"), we may well say "Goodbye Welfare State" as indicated in a recent Newsweek article![4] To what extent has this projected death been engineered? Who is guilty of this murder?

The Paradox

Our five evaluation Welfare Indicators: Economic Growth, Income and Distribution of Income, Inflation and the Price Level, Unemployment and Hours of Work are not some obscure Welfare measures developed by some eccentric economist. These are mainstream criteria and our data sources are primarily governmental. Without exception we find diminished economic welfare in the Age of Automation, particularly since the time of the Energy Crisis.

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[4] "Goodbye Welfare State", *Newsweek*, November 21, 1994.

Automation reduces the bargaining power of Labor by creating cheaper substitutes with superior performance. Atheletes and Entertainers are somewhat exempt because it is more difficult (and sometimes impossible) to create an automated substitute. However bookeepers, new auto painters, etc. are easily replaced with automation.

Power has shifted from labor to capitalists without much government intervention. In the absence of government intervention, the owners of capital are expected to get richer and the displaced or displaceable laborers are expected to get poorer. Indeed this is the case since about the mid-1970s and forward.

However, we live not in a fascist capitalistic state but rather in a democratic capitalism in which the majority (regardless of financial status) may invoke whatever income redistributive formula that is deemed best.

In 1995, however, the power of the majority to redistribute wealth has been negated thru the use of an elaborate (and perhaps unconscious) illusion. Economics courses teaching generations of student the preeminence of Pareto Criteria and Arrow's Impossibility as Welfare criteria plus the failed Supply-Side experiment plus the motivation of Politicians to satisfy their rich financial supporters, sometimes at the expense of the poor, have created the illusion.

A return to economic rationality will have lower income groups insisting on progressive taxation (enforceable by their majority standing) and economic leadership by the rich in which the rich get richer and the non-rich get richer simultaneously.

An African-American Perspective

Since African-Americans have historically been relegated to lower skilled positions in society, the impact of Automation is potentially greater. A male in good physical condition and disciplined enough to perform repetitive daily tasks had a guarantee of employment virtually on demand until the dawn of the Second Industrial Revolution. Until that time, we can envision a job for a man with skills matching the oldest(2,000,000 years plus) Man from ancient Africa. It's only as automation-mechanization models have become perfected that unemployment is a serious concern and low-skill manual labor is becoming more obsolete. African-American's disproportionate historical representation in the low-skilled group is a prefix in need of specific remedial policy completely contrary to the growing current sentiment of neo-Jim Crowism.

The early Civil Rights movement to a large extent was involved in aligning States having illegal, prejudiced, separatist and Ku Klux Klan orientations with a superior federal standard. Many Southern States were still refusing to accept the verdict of the Civil War and wanted to continue the philosophy of Blacks

as inferior humans more comparable to livestock. Martin Luther King personifies and symbolizes this Grand Realignment. Because the Federal Government represented a righteousness that states were made to adhere to, Blacks see the current movement of a smaller, weaker, Federal Government as a neo-Jim Crowism philosophy, and indeed, in part, it is.

Original Civil Rights legislation and the Johnson-Kennedy War on Poverty while benefiting Blacks greatly, could have permanently ended poverty and could have been configured to move the income distribution patterns of Blacks to an equivalent of that of Whites (i.e. state of no economic discrimination). More than any other single move this would have be an admirable apology for 400 years of slavery in which Blacks worked for free for the American economy facilitating her move to international greatness.

Instead, the American family was re-structured with women becoming minorities and entering the workforce in mass. While not generally recognized, this symbolized the fact that automation-mechanization had reach a level such that a woman could be expected to be able to well perform almost any job a man could perform and housework no longer required a full-time worker. Certainly, the Black originated civil rights movement is not ashamed or remorseful about its contribution to women's liberation. However, the concept of "minority" was distorted so that paper corporations symbolically

headed by women were able to siphon much of the aid originally designed for the relief of racial minorities. Given suitable public policies, women could have been fully integrated into the work-world and Blacks could have simultaneously achieved income distribution equal to that of Whites, but this did not occur.

Youth training programs provided income and work experience for minority youth also provided key income assistance for low income families. When these programs were severely cut and falsely labeled as ineffective, Black youth turned to the underground economy in an attempt to maintain their contribution to family finance. These created a huge trend towards criminal activity and the perversely high rate of Black incarceration. The majority sector ignores this causality and argues that either 1) Blacks should accept lower wages and be happy -(unacceptable because of seeming tie to a return to slavery) or 2) Blacks have a serious inclination towards crime and should be incarcerated at extremely higher rates. The majority sector pursues and prefers a policy of high incarceration even though this is economically irrational in that it cost far more to incarcerate Black youth than to train and integrate them into mainstream America.

The Welfare System has provided a legal outlet for some Black female youth in part causing their rates of incarceration to be far less than for Black males.

In an attempt to make the "oppression" more uniform, the Welfare System is now under attack. Blacks disproportionately are represented in the Welfare System due to the failure to fully integrate them into the economy. We can't integrate you into society because that would represent reverse discrimination etc. and we can't leave you on Welfare because "we can't afford it", the implied recommendation is of course Black self-destruction using powerful drugs as a catalyst, another manifestation of neo-Jim Crowism. [Of course, if jobs are available for welfare mothers that would not leave them worse off and if welfare remains an option for those ejected from the work world, "workfare" solutions are indeed justified.)

Affirmative Action's reversal was personified by the 1978 Bakke decision concerning reverse discrimination. Scholastic Aptitude Tests are not completely objective and include subtleties that are passed from college-educated parents to their children, thereby increasing the child's scores. Blacks who lack such a tradition can be expected to score lower. Good parent's pass that language observed as consistent with optimal survival. Given that Blacks are disproportionately represented in lower-income-not-college-educated groups there scores will be lower than the majority sector. Ideally, this has little to do with college success. For many year colleges have recognized that some students with lower aptitude scores can and do graduate with higher grade

averages than many with higher scores. (Every crime imaginable has been committed by those with the highest aptitude scores.) Theoretically, if greater intelligence resides in the faculties at U.S. colleges and universities, historical trends of miseducation can be overcome. That is, the brightest minds in the country should be able to design and execute programs that properly educate Blacks and other minorities. Success of such programs should be measured by the *output* and not the *input*. A Black attorney graduating from a leading school of law should be considered generally as qualified as one of his White cohorts regardless of input scores. Alternatively, we can begin to teach the taking of aptitude tests, if you really believe that higher aptitude tests imply greater college performance. If this were the case, all major American college prep programs could do so and require minimum scores for graduation.

The CORE Philosophy

Economists telling students that "full" (i.e. equilibrium capacity) employment has been reached and that further employment is undesirable because it would be inflationary and momentary, and politicians simultaneously telling the public that welfare recipients will be dramatically reduced by funneling this group into full employment is at least a philosophical contradiction, particularly with so many unemployed or underemployed college graduates.

CORE is an acronym for Central Occupations with Revisable Extensions. This philosophy represents a compromise between the European Model of a reduced workweek and the American philosophy of maximal continuous vigorous Economic Growth. A detailed discussion of this philosophy has been deemed beyond the purview of this document, but a brief introduction has been allowed:

A case can be made for Automation either causing long-term unemployment or being a source of the reduction of long-term unemployment. Our current unemployment measure is a momentary statistic not reflective of those long-term unemployed who are no longer registered as unemployed. We have therefore looked at employment/population ratios as more indicative of actual long-term unemployment. And, given dramatic decreases of male labor force participation, we conclude that our automation age is resulting in a decrease in employment opportunities. Such a conclusion is supported by widespread corporate and government downsizing, weak economic growth trends, economic structure that supports increased imports without balancing exports, underemployed college and graduate school graduates, increased and economically motivated crime, etc.

If employment opportunities are declining due in part to automation being substituted for human labor we should celebrate such a change with reduced

work time. The CORE philosophy would allow major employment entities to provide a CORE job with hours that would be equivalent to 4 days/week at 8 hours for 50 weeks, while available in every feasible configuration resulting in the same number of annual CORE hours. Time not spent in CORE activities may be used at the discretion of the citizen. Some will engage in economic growth activities, some will solve family and community problems (school, crime, etc.). In the short-run the labor force participation rates will improve, economic incentives for crime will decrease, family tensions built on economic problems will decline, racial tension will decline, etc. If economic growth is the will of the people, the extra time allowed by CORE employment will facilitate economic growth by reducing the risk resulting from a failed new economic venture.

Almost essential for the success of a CORE national policy is a reduction in the quasi-fixed costs of employing human labor. The major component of these quasi-fixed costs is fringe benefits, primarily health insurance. Canada enjoys better per capita health and pays 50% less per capita for their health care. A mis-specified revised American health care plan has recently failed to be approved, but an optimized replacement plan is needed to facilitate a CORE implementation. CORE implementation will reduce the current "fascist" momentum in America (increased policing and incarceration a #1 priority,

more spent on incarceration of youth rather than programming youth for optimal societal interface, 50% of American states voting to legalize the carrying of concealed weapons by private citizens as in the Old West, etc.)

Future Research

As the scientific reader of this conclusion will realize, much of the content of this Conclusion section is *conjecture.* Further research is required to confirm that purported fact is not fantasy and to devise and recommend optimal public policy. However, as a collegiate student of social science for more than 2.5 decades, the above appears to be a reasonable interpretation of the state of America and her optimal future path. What an exciting and challenging time to become a professional social scientist!

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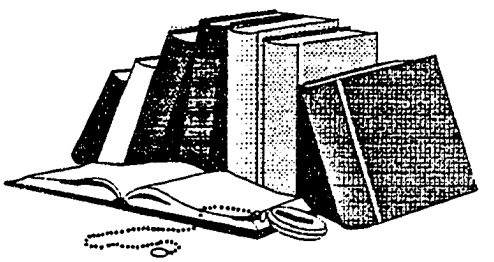

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