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CAN ECONOMIC GROWTH BE SUSTAINED?
A POST-MALTHUSIAN PERSPECTIVE

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Can economic growth be sustained? Is technical change the engine of economic growth? These issues have generated intense controversy since at least the early years of the industrial revolution. They emerged with even greater intensity during the last half of the 20th century. During the late 1990's, a spurt of growth in output and productivity led the business press, and some economists, to proclaim that the economy had entered a new era in which the old rules that had governed cyclical and secular growth in the past no longer obtained (Stiroh, 1999). During this next century the U.S. and the other advanced industrial countries will be confronted by a new challenge - to make the service sector the driver of economic growth.

In the Malthus-Ricardo classical model growth is constrained by an inelastic supply of natural resources.[1] In the neoclassical model, economic growth is constrained by the rate of growth of the labor force (Solow, 1956; Prescott, 1988). In both the classical and neoclassical models the constraints on growth were released by exogenous technical change. In the new growth economics the constraints are released by endogenous technical change driven by the

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1 The classical model, termed by Schumpeter "the magnificent dynamics, emerged between the publication in 1776 of Adam Smith's *Wealth of Nations* (1937) and the publication in 1817 of David Ricardo's, *The Principles of Political Economy and Taxation* (1991). Malthus is best known for his 1798, *An Essay on the Principle of Taxation* (1970). For an intellectual history of the development of the classical model see Tribe (1978: 110-46).

accumulation of knowledge and human capital (Romer, 1986, 1996; Lucas, 1988, 1993).[2] In this note I argue that in the future economic growth in the United States will be constrained by service sector productivity.

LIMITS TO GROWTH

Economists and technologists have typically taken an optimistic view toward the possibilities of sustainable growth. Ecologists and many natural scientists have often taken a more pessimistic view.[3] Environmentalists have replaced economists as the dismal scientists! The trauma of the Great Depression and the fear of post World War II economic instability directed economists' attention to explore the conditions, and the economic policies that could lead to "steady state" sustainable economic growth (Harrod, 1939; Domar, 1946, Solow, 1956). Productivity growth, resulting from technical change, was identified as a fundamental source of economic growth. Concerns about the constraints imposed by natural resource scarcity receded.

Beginning in the 1970s, economists' optimism about economic growth was challenged by the coincidence of a global energy crisis and the slowing of economic growth in the developed industrial economies. The Ricardo-Malthus concern with the adequacy of the natural resource base to sustain economic growth was supplemented by an intense concern about environmental degradation. These were highlighted for the general public by the press coverage given to the book *Limits to Growth* sponsored by the Club of Rome.[4]

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2 For a review of both the neoclassical and the new growth economics literature from a development economics perspective see Ruttan (1998).

3 This disagreement is illustrated by the running debate between ecologist Paul Ehrlich and economist Julian Simon. For the Ehrlich and Simon arguments see: P. R. Ehrlich (1986); P. R. Ehrlich and A. H. Ehrlich (1970); Simon (1980, 1981). For comment in the popular press on the debate see J. Tierney (1990) and C. McCoy (1995); P. R. Ehrlich and S. H. Schneider (1995). See also Myers and J. Simon (1994).

[4]See Meadows, Meadows and Randers (1972). For a critical review see Nordhaus (1973). For an update see Meadows, Meadows and Randers (1992).

The three main elements in these new concerns were:

- Continued concern about scarcity of food, raw materials and energy under conditions of burgeoning population growth.

- Rising demand for environmental assimilation of residuals--the spillovers into the environment of pollutants arising as by-products from commodity production, energy production and transportation.

- Growth in consumer demand for environmental amenities--for the direct consumption of environmental services associated with rapid growth in per capita income and high income elasticity of demand for environmental services such as freedom from pollution and congestion.

During the 1980s fears about the adequacy of material and energy resources abated. But concern about the implications of a series of environmental changes that were occurring at the global level intensified. These included the possibility that increases in the concentration of carbon dioxide (CO_2) and other "greenhouse" gasses in the atmosphere were leading to massive climate change and that human encroachment on the environment was leading to irreparable loss of biodiversity (Turner et al., 1990; Stern et al., 1992).

There has also emerged since the 1970s a renewed concern about the "social limits to growth." In the 1920s the German historian Oswald Spengler (1926, 1928) argued that Western "culture" had lost its dynamism and was heading toward becoming a static "civilization." In the mid-1980s Yale historian Paul Kennedy (1986) put forth the theses that strategic "overreach"--an imbalance between strategic commitment and economic capacity--had been the major source of decline in major empires in the past and had become a source of excessive burden on economic growth in the U.S. and U.S.S.R. since the middle of the 20th century. It would have been

considered excessively audacious however, even in 1986, to predict the imminent collapse of Soviet Empire.

Among its critics technical change came to be regarded as part of the problem confronting both the modern world and the poor countries that had been left behind. The view became pervasive in both popular and elite culture that modern technology--reflected in the cataclysm of war, the degradation of the environment, and the psychological cost of rapid social change--was dangerous to the modern world and the future of humankind (Lawless, 1977; Wager, 1982). In a much more sophisticated exploration of the social limits to growth Fred Hirsch (1976) has argued that the good things of life are restricted not only by the physical limits imposed by natural and human resources but also by the capacity to expand consumption without quality deterioration.

PRODUCTIVITY GROWTH

In this section I present the results of a two sector economic growth simulation constructed in the spirit of the Ricardo-Malthus classical model. Natural resources, however, play no role in the model. The model is excessively simple when compared to the complexity of the world that we live in. Yet even in its simplicity it has features that most of us will recognize as similar to our world. The lesson of the simulation is that continued slow growth in productivity in the service sector of the U.S. economy will result in a dampening of economic growth for the entire economy. An implication of the model is in that slow growth in labor

productivity and in per capita income may be unavoidable even in the absence of resource

constraints![5]

The model economy is composed of two sectors--the automobile sector and the education

sector (Table 1). In the automobile sector technical change generates a rate of growth in labor

productivity (output per worker) of 3.0 percent per year. In the education sector there is no

technical change. Labor productivity, the student-teacher ratio, remains unchanged. The name

that I have given the two sectors is not important. I could have labeled one sector "professional

sports"--the number of players on baseball and football teams have not changed in my memory.

I could have labeled the other sector "everything else"--all those progressive goods and service

production activities that have experienced technical change and productivity growth. I could

have labeled one section the service sector and the other the material goods producing sector.

In Table 1 I present two sub models. In Model I all of the gains in productivity are

realized in the form of an increase in automobile (or material) consumption. None of the labor

released by gains in labor productivity in the automobile sector is transferred to the education (or

service) sector. It is used to produce more automobiles (or material goods). In Model II, I

assume that all of the labor released by productivity in the automobile sector is transferred to the

education (or service) sector. The two models can be viewed as extreme limiting cases of the

same underlying model.[6]

(Table 1 about here)

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[5] The standard neoclassical model avoids the Ricardian constraints by including only labor and capital in its
aggregate production function. But, as Solow has noted, if land and other resource constraints were included the
neoclassical model "would become more classical" (Solow, 1956:66).
[6]The inspiration for the two models in Table 1 is the Baumol service sector "cost-disease" model (1967); Baumol,
Batey-Blackman and Wolff (1989): 124-126.

In Model I population and labor force remains unchanged--the economy has already achieved zero population growth. Note that the number of workers in each sector remains 100 (or an index of 100) over the entire 30 years in which I let the simulation run. With labor productivity rising at 3 percent per year and the number of workers unchanged labor productivity and automobile production both rise from an index of 100 to 243. I also assume that workers have a contract with the automobile industry that specifies that wages will increase at the same rate as labor productivity. This assumption is consistent with the overall experience in the U.S. economy for most of the post World War II period (Figure 1). Thus wage rates rise to $2.43 per hour. If we had started with wages at $10.00 per hour they would have risen to $24.30 per hour. Note also that the price of automobiles remains unchanged. Because of the rise in labor productivity it was possible to hold automobile prices unchanged while increasing workers' wage rates because of productivity growth.

(Figure 1 about here)

Now let us examine what happens in the education sector. Labor productivity does not rise at all but teachers' wages rise at the same rate as in the automobile sector. If teachers' wages do not rise they will walk across the street and take jobs in the automobile sector. But if productivity doesn't rise and wages do rise, the cost of schooling (or tuition) must also rise. In the economy of Model I students (or taxpayers) are paying a lot more for education but are not consuming more education. This tendency for wages to rise in labor intensive sectors that are not able to achieve productivity growth has been termed by Baumol "the service sector cost-disease" (Baumol, 1967).

The world of Model I may not look exactly like the world we live in. But most of us would agree that it has been easier to get productivity growth in the automobile sector than in the

education sector. And most would also agree, even without looking at the numbers, that the cost of education has risen several times as fast as the cost of automobiles.

In Model II we take a modest step toward making that simulation more realistic. It is quite possible, even before we have two cars in every garage, the demand for automobiles--or the material components of consumption--might begin to fall off. People begin to resist what Easterlin has termed "the triumph of material wants over humanity" (1996: 154) In more technical language, the income elasticity of demand for automobiles (or material consumption) declines as incomes rise. People prefer to consume more education or other forms of "cultural consumption" (such as baseball games or symphony concerts).

It may be a bit extreme but in Model II we are going to hold automobile consumption unchanged. As productivity growth releases workers from automobile production they will be transferred to the education sector. This resembles the structural transformation that has occurred in the American economy over the last half century (Figures 2 and 3; Table 2). Consumption of agricultural commodities in the U.S. no longer rises as income rises. Employment in agriculture has declined from almost 50 percent of total employment in 1870 to less than 2 percent in the late 1990s. Employment in manufacturing, mining and construction has declined from over 30 percent of total employment in 1950 to less than 20 percent. Employment in the service sector (including government) accounted for over 75 percent of the labor force in the late 1990s. Even before the burst of the "new economy" growth bubble it was already clear that employment in the sectors producing material goods, agriculture and manufacturing, would fall to below 10 percent of the labor force in the U.S. within the next several decades. The recent declaration of a global "war on terrorism" will accelerate the transfer

of labor from the goods producing to the service sector in the form of domestic and international security services. The effect will be a further dampening of service sector productivity growth.

(Figures 2 and 3; Table 2 about here)

Note that in the model economy, employment in the automobile sector has declined from 100 workers to 41 (or from 100,000 to 41,000) over the 30-year period. If the productivity growth process that has been set in motion continues to run the time will come, in the not too distant future, when there will be only one worker left in the automobile sector. Note also that in each decade the three percent annual decline in the labor force releases fewer workers to be transferred to the education sector (3 percent of 100 workers is 3 workers, 3 percent of 67 workers is only 2 workers and 3 percent of 33 workers is only 1 worker).

As the number of workers released by productivity growth in the automobile sector declines the rate of growth of output in the education sector slows down. But the cost per unit of output in the education sector continues to rise as before. As the number of workers that can be transferred from the automobile sector declines, and the share of employment in the total economy employed in the education sector rises, the growth of the total economy grinds to a halt. Workers and consumers have higher levels of consumption than at the beginning--either in the form of more automobiles (as in Model I) or in the form of more education (as in Model II) or, under some cases intermediate to I and II, more of both. But eventually growth stops! We have backed into a no growth economy—not because of the 19th century Malthus-Ricardo resource constraints or the late 20th century environmental constraints—but because of failure to achieve productivity growth in at least some service sector industries.

PERSPECTIVE

It appears from the simulation that if there is even one important sector which does not achieve productivity growth, it will eventually cause the entire economy to grind to a halt--and the larger the share of the economy that does not achieve productivity growth the more rapidly the economy will approach a zero growth "steady state"! This will be substantially lower than the common high per capita income-low steady state growth that Lucas (2000) recently suggested the world would adhere to by the closing decades of the 21st century (Lucas, 2000).

The "New Economy" growth acceleration that began in the mid-1990's was due to a dramatic rise in the rate of growth of investment and in technical change in the information technology (IT) industries. The IT industries accounted for less than 5 percent of Gross National Product (GNP). But they accounted for almost half of productivity growth in the U.S. economy during 1995-1999. A rate of growth in labor productivity in the 4.0 percent per year range is unlikely to survive an anticipated slowdown in the maturing IT industries (Jorgenson 2001). The more serious constraint on growth in labor productivity will, however, occur as a result of the continuing decline in the share of output accounted for by the goods producing sectors and the difficulty of enhancing the rate of productivity growth across the service sector.[7]

The classicals were mistaken when they assumed productivity growth was not possible in the agricultural sector. It is also a mistake to assume that productivity growth is not possible in the service sector. Use of computers is, after some delay, contributing to productivity growth in the financial services sector. Television has made it possible for more people to watch World Series baseball or the Metropolitan Opera. Real costs in technology intensive transmission of television signals have declined. But the costs of labor-intensive programming have risen.

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7 Estimates of industry contributions to U.S. aggregate total factor productivity growth during 1958-96 by Jorgenson and Strioh (2000) indicate negative contributions from the service sector and zero or negative contributions from 12 non-service sector industries.

Similarly the costs of computers, and of computing have declined dramatically. But the costs of the more labor intensive software development has risen and accounts for an increase in cost share in the information sectors. The drivers of brown UPS trucks employ substantial information technology—but it still requires one driver to load and unload the packages and to drive the truck (Gordon 2000).

It would be possible to make the model more sophisticated, and less intelligible, by introducing more sectors and making more realistic assumptions about substitution in the material and service components of consumption. One could also appeal to the scale economies and technological spillovers that have been emphasized in endogenous growth theory (Ruttan, 1998). The allocation of greater resources to the statistical agencies of the federal government would undoubtedly repair the underestimation of productivity growth in some service sectors. But it would take some very "creative" growth accounting to avoid a conclusion that if there are significant sectors in which productivity growth is not feasible, or is severely constrained, the effect would be some combination of increasing costs, or decline in quality, that would severely limit the possibilities of long-term sustainable economic growth.

A clear implication is that the rate of growth in the total economy will regress toward the rate of growth in its least productive sectors! This implies that in the early decades of the 21st century the rate of economic growth in the U.S. will regress towards the low rate that will be achieved in an expanding service sector.

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   University Press, 1982.

Figure 1:   Real Income, Productivity and Compensation in the U. S. Economy, 1947-2000
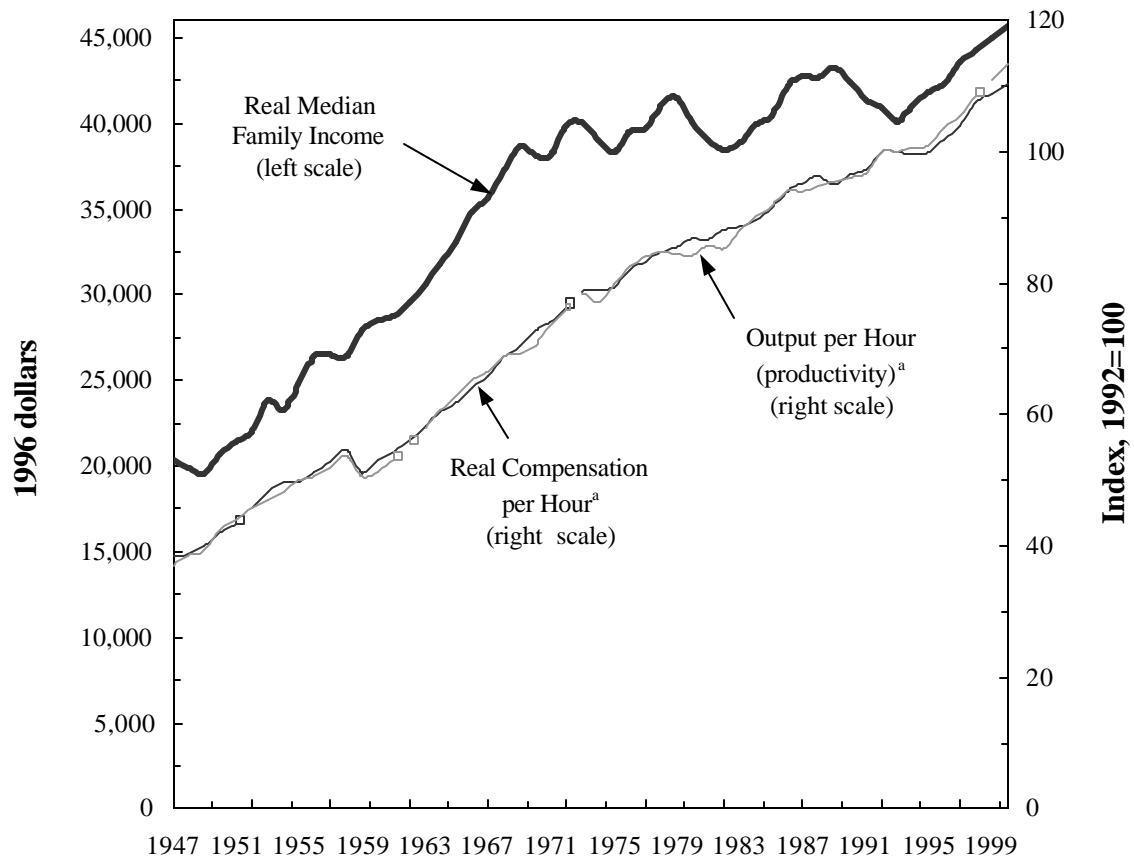
^a Business sector. Compensation deflated by implicit price deflator.

Source: Adapted from Chart 1-4 of *Economic Report of the President*, 1995, p. 26. Real
income data for 1994–1997, productivity data for 1994–1998 and compensation data
for 1994–1998 are from *Economic Report of the President*, 1999, p. 366 and 384.
Real income data for 1998–2000, productivity data for 1999-2000 and compensation
data for 1999-2000 are projected.

Figure 2: Sectoral Distribution of Employment in the United States 1870-2000 (thousand persons)

Figure 3: Sectoral Distribution of Employment in the United States 1970-2000 (percent of total employment)
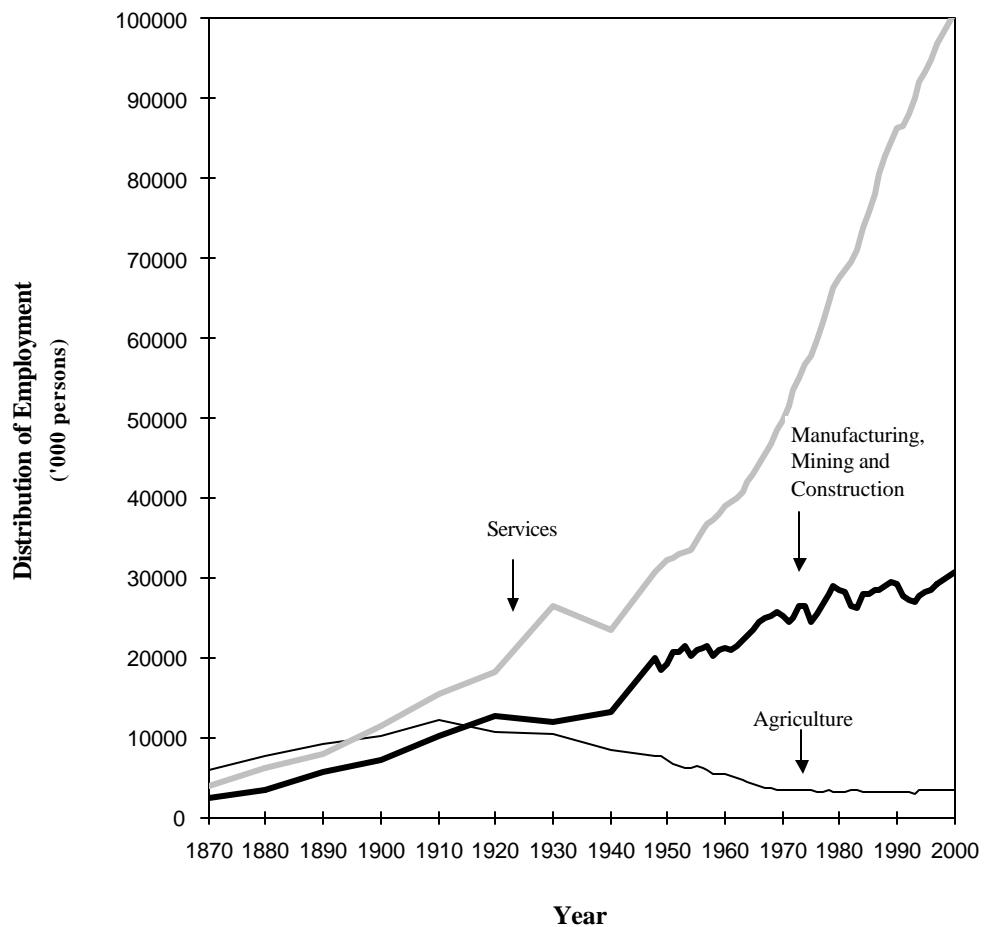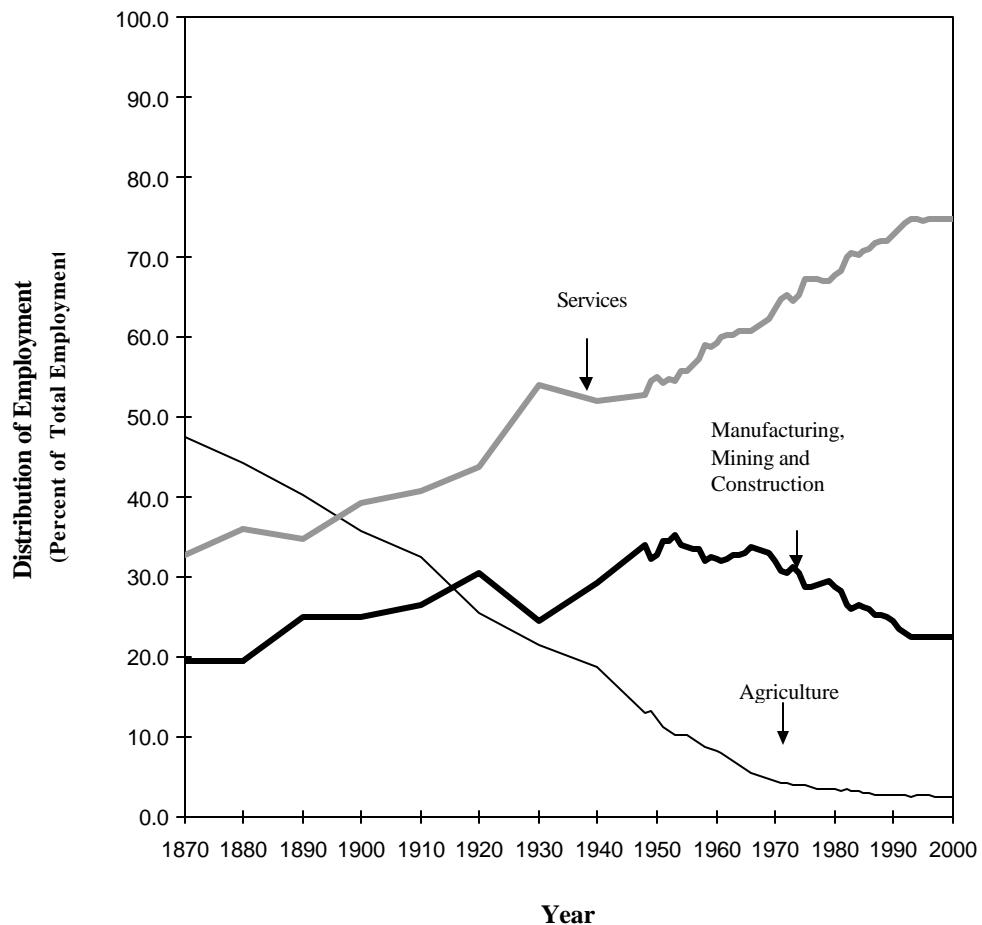
Source: *Statistical Abstract of the United States*. Prepared by the Chief of the Bureau of Statistics, Teasury Department 1899, 1911. Bureau of the Census. *Historical Statistics of the United States* (Washington, D.C. : U.S. Government Office, 1970. *Current Population Survey*. U.S. Deparment of Labor. Bureau of Labor Statistics.

Table 1.   Hypothetical Growth Paths for a Two-Sector Economy

Year	AUTOMOBILE SECTOR					EDUCATION SECTOR				
	Labor input (#)	Labor produc-tivity (index)	Auto Output (Index)	Wage Rate ($/hr)	Auto Price ($/unit)	Labor Input (#)	Labor produc-tivity (index)	Education Output (Index)	Wage Rate ($/hr)	Cost of education ($/unit)
					Model I: No Reallocation of Labor					
t_0	100	100	100	1.00	1,000	100	100	100	1.00	1,000
t_{10}	100	135	135	1.35	1,000	100	100	100	1.35	1,345
t_{20}	100	181	181	1.81	1,000	100	100	100	1.81	1,805
t_{30}	100	243	243	2.43	1,000	100	100	100	2.43	2,425
					Model II: Full Reallocation of Labor					
t_0	100	100	100	1.00	1,000	100	100	100	1.00	1,000
t_{10}	74	135	100	1.35	1,000	126	100	126	1.35	1,245
t_{20}	55	181	100	1.81	1,000	145	100	145	1.81	1,805
t_{30}	41	243	100	2.43	1,000	159	100	159	2.43	2,425

Assumption: Productivity growths of 3.0 percent per year in automobile sector and 0.0 percent in the education sector.

Source: Author's calculations.

Table 2   The Distribution of GNP by Major Industrial Sector, in Current Prices percentages)

Industry	1947	1959	1969	1977	1990	1997
1. Declining Shares						
Agricultural, forest and fishing	8.8	4.1	3.0	2.8	2.0	1.6
Mining	2.9	2.5	1.8	2.7	1.8	1.5
Manufacturing	28.1	28.6	26.9	23.6	18.4	17.0
Total	**39.8**	**35.2**	**31.7**	**29.4**	**22.2**	**20.1**
2. Stable Shares						
Transportation and utilities	8.9	9.1	8.6	9.1	8.7	8.3
Construction	3.9	4.8	5.1	4.8	4.4	4.1
Wholesale Trade	7.1	6.9	6.7	7.0	6.5	6.9
Retail Trade	11.7	9.9	9.8	9.6	9.3	8.8
Total	**31.6**	**30.7**	**30.2**	**30.5**	**28.9**	**28.1**
3. Rising Shares						
Finance, insurance, and real estate	10.1	13.8	14.2	14.4	17.7	19.4
Other services	8.6	9.7	11.5	13.	18.9	20.4
Government	8.6	10.2	12.6	12.5	12.2	12.7
Total	**27.3**	**33.9**	**38.3**	**39.9**	**48.6**	**52.5**
Overall Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Sources: Adapted from Z. Griliches. "Productivity, R&D, and the Data Constraint." *American Economic Review* 84 (1), March 1994, p. 1-23. Data are from Tables 6.1 and 6.2 of the National Income and Product Accounts. 1928-1982, and Survey of Current Business. May 1993 and March 1999.