Measuring the Impact of Technological Progress on the Household

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The Trend in Retirement *(job market paper)*

Labor-force participation rates of elderly US males have been declining since the nineteenth century. Participation rates have decreased for each age above 65 and, in later years, for men aged 55 to 64. The decrease has resulted in an increase in the fraction of a man's life spent retired. Retired men spend the majority of their time engaged in leisure activities. Thus, the story of retirement is a story of leisure. Technological progress in the production of leisure goods has led to a decline in their relative price. In addition, the increased availability of new goods, and a continual increase in their quality, has made leisure activities more attractive and enjoyable. Combined with the rise in real wages, this has resulted in the emergence of a retirement lifestyle. The retirement lifestyle is characterized by time spent on vacations, sports such as golf, gardening, reading, and watching television. Retired individuals can enjoy their "golden years" in the privacy of their own homes, possibly located in a warmer part of the country. They may even spend summers north and winters south. Increased wealth, along with declining costs associated with travel and communication, has increased retirees' options.

In order to assess the ability of rising real wages and declining prices of leisure goods to drive a decrease in labor-force participation rates of elderly US males, a model economy in which agents choose the moment of their retirement is developed. Agents in the economy produce leisure by combining leisure time with leisure goods. Under the baseline calibration, leisure time and leisure goods are Hicksian complements and thus the falling relative price of leisure goods results in an increased demand for leisure time. In order to increase their leisure time agents retire earlier from market work.

An important characteristic of the retirement period is that it corresponds with a drop in market consumption by US households. One interpretation of the drop in market consumption is that it reflects households' attempts, facing a zero-one work choice, to smooth utility over their lifetimes. To capture this interpretation two assumptions are made. First, it is assumed that the utility function is intratemporally nonseparable in market consumption and leisure. Second, it is assumed that the intertemporal elasticity of substitution for consumption and leisure services is sufficiently low. The result is that agents discretely decrease their consumption of market goods at retirement to offset the discrete gain in utility derived from the discrete jump in leisure time.

The model is calibrated to to the year 2000 using cross-sectional data from the Health and Retirement Study. The calibration is done by minimizing the distance between the model and data along seven key moments: the labor-force participation rates of six age groups and the average drop in consumption. Then each of the six age groups' labor-force participation rates for the period 1850 to 2000, as predicted by the model, are computed and compared to the panel data. The model is able to generate the observed trends of decreased labor force participation.

Suburbanization and the Automobile *(with Richard M. H. Suen)*

Ever since the 1870's when streetcars were first implemented, suburbanization has been observed in cities throughout the US. But technological progress in transportation made its biggest contributions during the twentieth century with the invention of the automobile and later the modern highway system. In 1908, the release year of Ford's Model T, less than one percent of Americans

owned a car. In contrast, by 1970 almost every family in the US owned at least one automobile. Rising real wages, falling prices of automobiles, and massive investments in roads and highways led to the adoption of the car as the dominant form of transportation in the US. This adoption was synonymous with the movement of wealthier individuals to the outer edges of cities. Can the adoption of the automobile account for the decentralization observed throughout US cities during this period?

In order to assess, quantitatively, the relationship between the invention and diffusion of the automobile, on the one hand, and suburbanization, on the other, a general equilibrium model of a linear city is developed. Agents in the model economy choose both whether or not to own a car and where to live. In the framework developed, it is shown that wealthier agents tend to purchase a car and live further away from the city center. While poorer agents in the economy tend to travel by bus and stay close to the city center. Suburbanization is measured as the rate of change of the city's population density gradient.

The model's steady state is calibrated to US data by minimizing the distance between the model and the data; specifically, by minimizing the sum of the squares of 14 moments. The first 7 moments correspond to the percentage of car-owners in the US in the seven decennial years from 1910 to 1970. The second 7 moments correspond to the average population density gradients of US cities in the same decennial years. The calibrated model is able to predict the rising trends in both car-ownership and suburbanization. Quantitatively speaking, the model is able to explain 86 percent of car-ownership in 1970 and roughly 77 percent of suburbanization between 1910 and 1970.

Estimating the Welfare Gain from Personal Computers *(with Jeremy Greenwood, work in progress)*

Personal computers first became available in the United States in the 1950s but at prices so high that, for the most part, no one individual could reasonably afford to buy one. The first personal computer to be successfully mass produced was the Apple II, which was released in June of 1977 and sold for anywhere from 4 to 8 thousands dollars per unit depending on the features. Continuous and rapid technological progress in computer development since 1977 has led to an enormous fall in computer prices. In fact, prices have dropped at an astounding rate of 25 percent per year. Thus a computer today is more than 600 times cheaper than one in 1977. Starting from virtually zero demand for computers in and preceding 1977, the fall in prices throughout the last thirty years has been synonymous with a rapid rise in demand. What is the welfare gain to consumers from the development of and improvements in personal computers?

In order to measure the welfare gain from technological progress in personal computer production a simple model of computer demand is developed. The innovation of the model is in the agent's utility function. Note that with a standard utility function, one in which the marginal utility of zero consumption is infinite, an agent will always consume of positive quantity of the consumption good regardless of the good's price. Thus a model with a standard utility function is unable to match the zero demand for computers observed in 1977. This poses a problem for measuring the welfare gain from new goods since, with a standard utility function, the welfare gain will always be infinite. To avoid this result a utility function in which the marginal utility of zero consumption is finite is defined. Under the alternative utility function, high prices may result in the consumer optimally choosing to purchase zero computers. The model is calibrated using data on computer expenditures. The model suggests that the welfare gain from technological progress in personal computers is approximately 0.3 percent of total consumption expenditure.