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# Labor and consumption across the lifecycle ☆

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ABSTRACT

We propose new measures to summarize and compare age profiles of consumption and labor income. One measure is the lifetime support ratio or the ratio of effective lifetime labor to effective lifetime consumption. Two other measures measure the timing of work and consumption over the lifecycle. Using a highly stylized model we show how changes in these features of the lifecycle influence the standard of living that can be achieved. To illustrate the value of these measures we consider two practical applications. In the first we analyze the effect of increasing life expectancy on lifetime effective labor and consumption. We show that in longer life is leading to greater lifetime consumption but little response in lifetime labor supply. The exception to this generalization is in low income, high mortality countries where the gains in life expectancy are occurring at the working ages as well as the non-working ages. In the second application we consider whether the lifetime support ratio and the timing of consumption relative to labor income are influenced most by variation in life cycle patterns of work or lifecycle patterns of consumption. The answer depends on the level of development. In upper-middle income countries and high-income countries both are important. In these countries, then, effective policy should address both sides of the lifecycle – producing and consuming. In lower-income countries, however, only the age patterns of labor income appear to matter. Policies related to labor markets and labor force behavior appear to be critical under these circumstances.



## Introduction

The lifecycle is a fundamental and important feature of every economy. Over extended periods at the beginning and end of life, individuals consume much more than they produce through their labor. During the middle years, they generate a surplus by producing much more through their labor than they consume. The lifecycle interacts with large, systematic changes in population age structure that occur over the demographic transition. In the early stages of the demographic transition, mortality declines from high levels producing population growth and, because mortality improvements are concentrated among infants and children, a very young population. During the next phase of the transition continued improvements in mortality and the onset of fertility decline lead to slower population growth and a shift in age structure into the ages where production through labor exceeds consumption. To varying degrees this has led to what is widely referred to as the *demographic dividend* (Bloom and Williamson, 1998; Mason, 2001, 2005; Bloom et al., 2002; Mason and Lee, 2007; Williamson, 2013).

At the end of the demographic transition, as it is playing out in many high-income countries, low fertility is leading to low population growth or population decline and rapidly aging societies. Rapid aging has two sources – mortality improvements concentrated at older ages and low fertility. The changes in population age structure at the end of the transition are a source of concern because they may undermine old-age support systems and retard economic growth (Cutler et al., 1990; National Research Council, 2012).

The conceptual foundations for understanding how population age structure interacts with the lifecycle to influence the economy have been established in several studies starting with the seminal work of Samuelson (Samuelson, 1958, 1976; Deardorff, 1976; Arthur and McNicoll, 1978; Lee, 1994a,b). Many empirical studies and simulation analyses have enhanced our understanding of the dynamics of population age structure's interaction with the economy (Kelley and Schmidt, 1995, 2001; Bloom and Canning, 2001,

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2003; Lee et al., 2003; Mason and Lee, 2007; Lee and Mason, 2010, 2011a,b; Mason et al., 2010).

Until recently the development of conceptual foundations has outpaced the availability of data to study the linkages between population and the macroeconomy. In recent years, however, members of an international research network, the National Transfer Account (NTA) network, have been constructing economic accounts that provide detailed estimates of economic flows by the age of individuals (Lee and Mason, 2011a,b). The analysis presented here relies on NTA data to quantify from an individual perspective how labor and consumption vary over the lifecycle and to analyze how variation in the economic lifecycle interacts with changing survival rates and population age distributions to influence standards of living. The broader goal of the paper is to understand how policies might influence the economic lifecycle to achieve better economic outcomes in a world where people are living much longer than in the past.

We propose new measures that can be used to summarize and compare age profiles of consumption and labor income. One measure is the lifetime support ratio or the ratio of effective lifetime labor to effective lifetime consumption. Two other measures are derived that measure the timing of work and consumption over the lifecycle. Using a highly stylized model we show how differences in these features of the lifecycle influence the standard of living that can be achieved.

To illustrate the value of these measures we consider two practical applications. In the first we analyze the effect of higher life expectancy on lifetime effective labor and consumption. Although a potentially valuable response to longer life is to work longer, we show that in practice longer life is leading to greater lifetime consumption but little response in lifetime labor supply. The exception to this generalization is in low income, high mortality countries where the gains in life expectancy are occurring at the working ages as well as the non-working ages.

In the second application we consider whether the lifetime support ratio and the timing of consumption relative to labor income are influenced most by variation in life cycle patterns of work or lifecycle patterns of consumption. The answer depends on the level of development. In upper-middle income countries and high-income countries both are important. In these countries, then, effective policy should address both sides of the lifecycle – producing and consuming. In lower-income countries, however, only the age patterns of labor income appear to matter. Policies related to labor markets and labor force behavior appear to be critical under these circumstances.

## Theory

The goal of this section is to develop measures that can be used to evaluate how patterns of work and consumption over the lifecycle influence standards of living. The emphasis is on measuring the "experience" of a representative individual over his or her hypothetical life, rather than on population measures. With a simple set of data, we might know the representative individual begins working at age A, retires at age R, and dies at age D. Lifetime earnings of the individual will depend on the average earnings per years and the lifetime years of work, R–A. Lifetime consumption depends on average consumption per year and lifetime years of consumption, D. Average consumption over the lifetime relative to average earnings during the working years will depend on years of work relative to year of consumption, (R–A)/D. We call this the lifetime support ratio and it is a key summary measure, calculated in a much more refined way than in this simple case.

Even in this simple case, the consumption our hypothetical individual can realize also depends on the timing of work and consumption over the lifecycle, because shifting resources over the lifecycle involves a cost. If she consumes before she earns, on average, she must pay for the privilege. If she relies on credit to realize her desired consumption path, interest paid on debt reduces the resources available to pay for consumption, for example. On the other hand, if she consumes after she earns, on average, she will be compensated for delaying her gratification. Interest earned on the assets she holds allows her to consume more during her life relative to her lifetime earnings.

Individuals can reallocate resources across age in two ways: by relying on intergenerational transfers or by relying on assets, i.e., using lifecycle saving. The price for reallocating resources will generally be different for these reallocation mechanisms as pointed out by Samuelson (1958). The price for reallocating resources using lifecycle saving is the interest rate whereas the price for reallocating resources using intergenerational transfers is the rate of economic growth. In the analysis presented here we assume that there is a single price for reallocating resources, the interest rate.[1]

The analysis presented here differs from this simple case in ways that improve the realism of the analysis and capture important differences across countries with very different levels of development and demographic conditions. First, rather than assume a constant supply of labor during the work span, we allow for age-specific variation in labor force participation, hours worked, unemployment, and productivity. Second, rather than assume that people at each age consume at the same level, we use a detailed measure of consumption that varies by single year of age. Third, we use age specific survival rates rather than age at death to analyze the impact of changes in mortality.

## Labor income

The average labor income of individuals at each age x in country j are influenced by two broad factors. First, the overall level of labor income of the country in which individuals live vary under the influence of country-specific features such as the quality of the education system, the capital intensity of the economy, the quality of government institutions and the financial sector, attitudes and practice towards gender and ethnic minorities, etc. Second, per capita labor income is affected by age due to a variety of factors, e.g., gains from experience, the influence of aging on cognitive and physical abilities, competing uses of time such as childbearing and childrearing, policies that influence work, e.g., child labor laws and retirement provisions, tastes about work and leisure, and a host of other factors.

These factors are incorporated into labor income, $y^l(x,j)$, using the following formulation:

$$y^l(x,j) = \bar{y}^l(j)\phi(x,j) \tag{1.1}$$

where $\bar{y}^l(j)$ is the level of labor income in country j and $\phi(x,j)$ is the age profile of labor income relative to the level of labor income. The level of labor income is measured as the average of per capita labor income at each age of prime-age adults, defined as persons age 30–49, in the base year. In other words, the relative age profile is calculated as the per capita labor income at age x divided by the average of per capita labor income at each age for the 30–49 age group.

Our interest here is in the age pattern of labor income and not its country-specific level. Hence, we analyze effective labor income relative to the labor income of prime age adults:

$$y^l(x)/\bar{y}^l = \phi(x) \tag{1.2}$$

[1] In a highly specialized case of golden rule growth the prices of reallocating resources through transfers and asset-based reallocations are the same. The interest rate is equal to the rate of growth of national income.