



Time allocation and home production technology[☆]



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ABSTRACT

This paper studies the effect of the relative productivity between the market sector and the home sector on time allocation. A novelty of the paper is to jointly estimate home productivity and the elasticity of substitution between market goods and home hours, which is accomplished through structural estimation based on income-decile level data. With a high elasticity of substitution and a slower growth rate of productivity in the home sector relative to the market sector, the model can produce key data patterns of time allocation in both the cross sections and time series. Quantitatively, relative productivity can account for 32% of the variation in market hours and 18% of the variation in home hours.

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1. Introduction

It is well established that the allocation of time between market hours and home hours has important macroeconomic implications.¹ The allocation differs tremendously across households and over time. Intuitively, the difference reflects the heterogeneity in the relative productivity between the market sector and the home sector. This paper formalizes this intuition in a model of optimal time allocation. The model is estimated and then used to evaluate the quantitative effect of relative productivity on time allocation.

There are two challenges. First, while productivity in the market sector is well proxied by wage rate, home productivity is not directly observed. This paper infers the evolution of home productivity based on data on wage rate, time allocation, and market expenditure. A key novelty is the joint estimation of the growth rate of home productivity and the elasticity of substitution between market goods and home hours. Since both home productivity and the elasticity of substitution shape the willingness and abilities of households to shift time between the market sector and the home sector, joint estimation is an

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¹ For examples, see Benhabib et al. (1991), Greenwood and Hercowitz (1991), McGrattan et al. (1997), Ngai and Pissarides (2011), and Ragan (2013).

important strategy to avoid identification problems. By contrast, the existing studies referenced later typically estimate/infer them separately.

The second challenge is related to the data availability problem. The joint estimation of home productivity and the elasticity of substitution requires data on wage rate, time allocation, and market expenditure over a reasonably long period of time at some disaggregated level. No single data source satisfies such requirements. To overcome the problem, this paper constructs the needed variables at the income-decile level from three data sources: the Time Use Survey (TUS), the Current Population Survey (CPS), and the Consumer Expenditure Survey (CEX). Exploiting the variations both in the time series and in the cross sections, this paper carries out the estimation based on a standard home production model with the division of time into market hours, home hours, and leisure.

Several patterns are documented from the constructed data. First, in the cross sections, the wage rate is positively correlated with market hours but negatively correlated with home hours. Second, in the time series, the rise in the wage rate is accompanied by a decline in home hours and relatively little change in market hours, which leads to an increase in the ratio of market hours to home hours.

The estimation points to two key conditions for the model to generate the data patterns: a high elasticity of substitution between market expenditure and home hours and the slower growth of home productivity relative to market wage. The estimated elasticity of substitution is 2.1. The estimated home productivity has on average increased by 1.3% per year between 1965 and 2013. In the meantime, the average market wage rate has increased by 1.6% per year. Therefore, the ratio of market hours to home hours has increased during this period because (i) market productivity has risen more quickly and (ii) market goods and home hours are good substitutes. Following the same logic, households with a higher wage allocate more time to the market sector in the cross sections.

Quantitatively, the estimated model can account for 32% of the variation in market hours and 18% of the variation in home hours. The model predictions are also consistent with the data in the following aspects: the cross-sectional correlations between time allocation and wage rate, the time-series changes in time allocation, and the time-series evolution in the ratio of market hours to home hours.

This paper is related to the literature on the estimation of the elasticity of substitution between the market sector and the home sector. [McGrattan et al. \(1997\)](#) and [Chang and Schorfheide \(2003\)](#) estimate the elasticity of substitution using aggregate data. [Rupert et al. \(1995\)](#) and [Aguiar and Hurst \(2007a\)](#) estimate the elasticity of substitution based on cross-sectional micro data. Relative to these studies, the contribution of this paper is to jointly estimate the elasticity of substitution and home productivity. Perhaps more importantly, the estimated model can produce key features of the time allocation data in both the cross sections and the time series, whereas the referenced papers are not able to assess how successful their estimates are in replicating the data patterns.

Most of existing studies try to nail down home productivity by calibrating their models to certain aspects of the data.² By contrast, this paper estimates the growth rate of home productivity, reports the confidence level of the estimates, and conducts the over-identification test of the model.

[Bridgman \(2016\)](#) calculates the growth rate of home productivity following national accounting principles. Labor productivity in [Bridgman \(2016\)](#) is defined as output per hour, i.e., total output in the home production sector divided by total home production hours; while in this paper, it is defined as the labor-augmenting technology that enhances the marginal product of home hours. With this definition, home productivity is comparable to market wage, which proxies market productivity. The relative value between home productivity and market wage fundamentally drives the shift in time between the two sectors. By contrast, [Bridgman \(2016\)](#) assumes that the marginal product of home hours is the same as that of market hours of certain types of workers, in particular housekeepers. This assumption makes it difficult to study the allocation of time between the home sector and the market sector from the perspective of utility maximization. In addition, our approach produces similar time use patterns as in the data and generates fairly narrow confidence intervals for the estimates, while the national accounting approach fails along these dimensions. On the other hand, the national accounting approach has at least two advantages: (i) It does not rely on the model structure, and (ii) it mainly uses aggregate data and therefore can be applied to a much longer time span. [Section 4.2](#) compares our estimates with those in [Bridgman \(2016\)](#) in more detail.

There is a large body of literature that documents time allocation patterns. Because of space limitations, we only list a few. [Aguiar and Hurst \(2007b\)](#) document a negative correlation between educational attainment and leisure hours. Their paper also finds that between 1965 and 2003 average market hours and home hours both decreased, while leisure hours increased significantly. [Ramey \(2009\)](#) and [Ramey and Francis \(2009\)](#) find similar time use patterns. The constructed data in this paper also exhibit similar patterns. One strength of our study is that the time allocation data are accompanied by wage and expenditure, which enables us to conduct the joint estimation of the elasticity of substitution and home productivity.

The rest of the paper is organized as follows. [Section 2](#) discusses the construction of the data and documents the data facts. [Section 3](#) lays out the model. [Section 4](#) discusses the estimation strategy and reports the estimation results. [Section 5](#) concludes.

² For examples, see [McGrattan et al. \(1997\)](#), [Chang and Schorfheide \(2003\)](#), [Greenwood et al. \(2005\)](#), [Rogerson \(2008\)](#), [McDaniel \(2011\)](#), and [Bils et al. \(2012\)](#).

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