Luxuries, Necessities, and the Allocation of Time*

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Abstract

Households enjoy utility from activities that require a combination of time and goods. We classify activities into two types: luxuries and necessities. Luxuries (necessities) are activities for which time and expenditure shares rise (decline) with income. We develop and estimate a model with nonhomothetic preferences and find that time and goods are substitutable in producing activities. Activities are also substitutable among themselves. Hence, wage and price changes cause large reallocations of time and expenditures across activities. This effect is quantitatively important for welfare inequality. Since 2003, the rise in the price of leisure luxuries has reduced welfare inequality while the rise in wage dispersion has increased it.

JEL Codes: J22, E21, D11

Keywords: time allocation, consumption expenditures, luxuries, necessities, activity production, inequality

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1. Introduction

Households spend most of their time on activities other than market work. Becker (1965) recognized early on that households divide time into many segments and pair them with market goods[1] to produce activities they enjoy. Households' allocations to consumption activities depend on their wages. For example, high-wage households spend more time and money on vacations and dining out, and less time watching TV, than low-wage households. Such differences generate inequality in welfare. Differences in prices of market goods also affect households' allocations. Prices are quite heterogeneous and evolve differently over time (see figure 1). For example, the price of TVs has declined continuously over time, while the price of recreational activities, such as tennis lessons, has steadily increased. In this paper, we study how changes in wages and prices of market goods determine how households bundle time and goods into different activities and the implied changes in welfare inequality. The answer to this question improves our understanding of important topics in macroeconomics and labor economics. For example, it helps us design tax and transfer policies that affect wage and price dispersion and thus welfare inequality.

When examining activities at the household level, we find that it is important to distinguish between luxuries and necessities to understand the responses of time and expenditures to changes in wages and prices. We define luxuries as those activities for which time and expenditure shares rise with income, while time and expenditure shares fall for necessities. This differential response is important when explaining welfare inequality. Hence, our first contribution is to empirically identify luxury and necessity activities. Doing so requires data on time use and expenditures bundled for every activity. However, time use and expenditure data categories are not assigned to the same set of activities. So we begin by mapping time use and expenditures at the activity level using data from the American Time Use Survey (ATUS) and the Consumer Expenditure Survey (CEX). The mapping allows us to assign time and expenditures to particular consumption activities. Using the resulting data set, we study the correlations of time and expenditure shares with wage and income. According to these correlations, we classify activities into four categories: leisure

[1] For simplicity, we refer to market goods and services as market goods.

luxuries, leisure necessities, home luxuries, and home necessities.[2]

We develop a model in which utility is a CES (constant elasticity of substitution) aggregator of luxury and necessity activities to account for the differences in how households allocate their time and expenditures. Each activity is produced according to a CES production function that combines market goods and households' time. The activity-production function is nonhomothetic in time and the elasticity of substitution between time and goods in the production function differ across activities. The nonhomothetic term, the activity-specific elasticity of substitution, and the intensity of time in the activity production are crucial in generating the empirical relationship of time and expenditure shares with wages.

We identify the parameters of the model by exploiting the fact that the composition of activities varies over time and across households. Several important results about the parameters emerge. First, the estimation results demonstrate that the production processes of luxuries and necessities differ. Necessities are time-intensive activities, while luxuries are goods-intensive activities. In addition, the nonhomothetic term of time is positive for necessities and negative for luxuries. Taken together, these results imply that low-wage households who have a lower opportunity cost of time consume more necessities while high-wage households consume more luxuries. Second, the two necessities - leisure necessities and home necessities - have a combined weight of 0.84 in the utility function. The two luxury activities - leisure luxuries and home luxuries - have a combined weight of 0.16. More importantly, the two types of leisure activities have a combined weight of 0.43, implying that leisure production is important in explaining households' allocations. Third, time and goods are substitutes in the production process of individual activities except for leisure luxuries, for which time and goods are complements. The substitutability among activities is even larger. This suggests that it is easier for households to substitute among activities than to substitute time for goods in producing a single activity. These margins of adjustment are important for household welfare and absent in models that abstract from the production of activities.

To explore the mechanisms of the model, we simulate the responses of time use and expenditures to wage and price changes. An increase in wages makes the production of

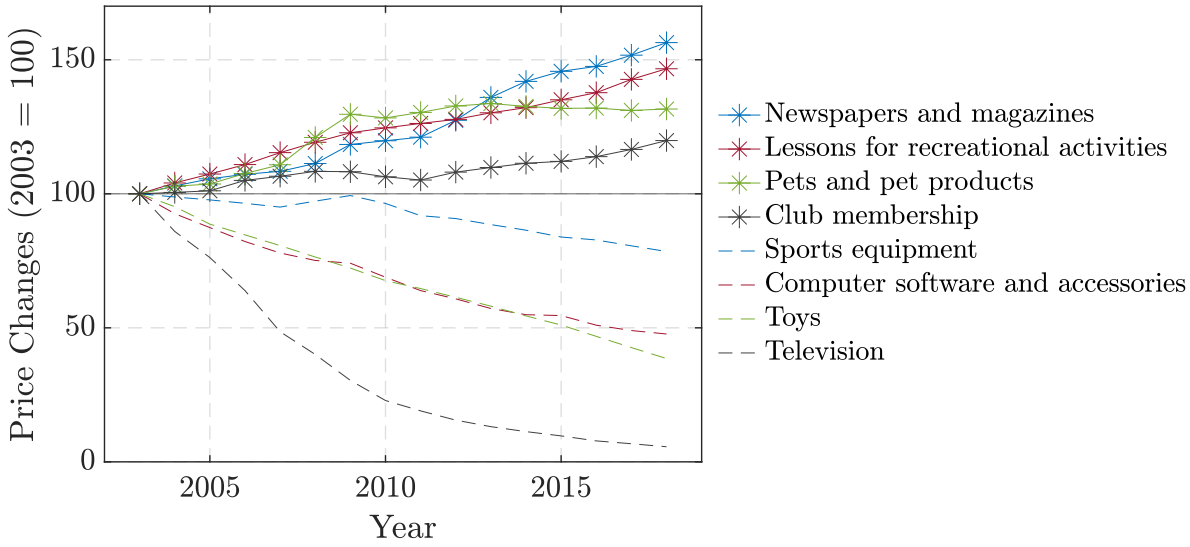
[2]The distinction between home and leisure activities follows Aguiar et al. (2013).

time-intensive necessities more costly. As a result, households shift their consumption from necessities to luxuries. An increase in the price of market goods needed to produce a specific activity leads to a shift of consumption away from that activity. The freed-up resources are allocated to the production of all other activities. This is true independent of whether the price increase is for a luxury or a necessity. To examine the importance of dividing activities into luxuries and necessities, we estimate a version of the model with only two activities: home production (the aggregation of home luxuries and home necessities) and leisure (the aggregation of leisure luxuries and leisure necessities). The estimated model can not generate the empirical correlations of time and expenditure shares with wages for these two activities.

Finally, we use the model to study the evolution of income and welfare inequality over the sample period from 2003 to 2018. Two findings emerge. First, welfare inequality, measured by the cross-sectional dispersion in the consumption composite of all activities, increased by 11 percent between 2003 and 2018. The rise in wage dispersion over this period increased welfare inequality, while the rise in prices reduced welfare inequality. Although the effects of wages and prices are both quantitatively important, the wage effect dominates and generates an overall rise in welfare inequality. Second, among all price changes, the large rise in the price of luxury leisure reduced welfare inequality the most. The reason is that luxury leisure is the most goods-intensive activity and low-wage households cannot afford it in large quantities. Hence the rise in the price of luxury leisure reduces the difference in the consumption of such activities between rich and poor households. This reduction, in turn, reduces welfare inequality. Conversely, the rise in wage dispersion over this period has the opposite effect on welfare inequality since it heightens the difference in the consumption composition of activities across households.

Related Literature This paper contributes to a growing literature on home production and leisure production. Aguiar et al. (2012) summarize the literature on the importance of home production in accounting for business-cycle fluctuations. Greenwood et al. (2005) show that the emergence of consumer durables is important in accounting for the rise in female labor-force participation in the past century. Rogerson (2008), McDaniel (2011), Ngai and Pissarides (2011), Ngai and Petrongolo (2017), and Duernecker and Herrendorf

(a) Leisure Activities



(b) Home Activities

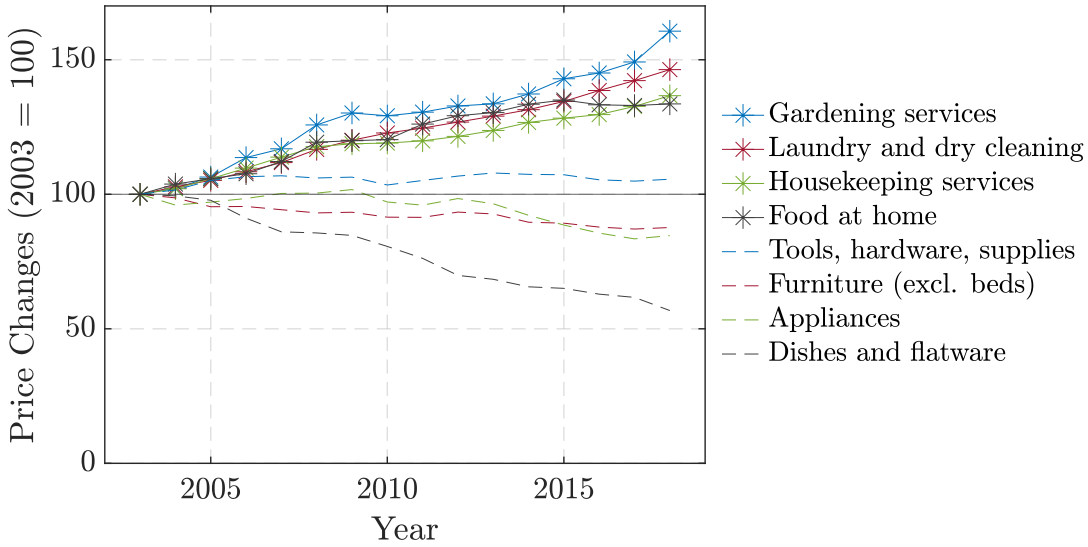


Figure 1: Prices of Goods and Services for Individual Activities

Notes: The data come from the Consumer Price Index database provided by the Bureau of Labor Statistics. Monthly data are averaged to obtain annual values. For leisure activities, we plot subindices SERG01, SERF03, SERB01, SERF01, SERC02, SEEE02, SERE01, and SERA01. For home activities, we plot subindices SEHP02, SEGD03, SEHP01, SAF11, SEHM01, SEHJ02, SEHK, and SEHL03.

(2018) find that home production is important in propagating the effects of taxes and social subsidies on market labor supply.[3] Two papers on leisure production, Vandenbroucke (2009) and Kopecky (2011), find that declining relative prices of goods inputs for leisure activities can help explain employment declines over the last century.[4] Boppart and Ngai (2021) propose a model with leisure production that can generate rising average leisure time and increasing leisure inequality over time. We contribute to this literature in two ways. First, we classify home and leisure activities as luxuries or necessities. Second, we quantitatively estimate a model with both home and leisure production using data that combine time and expenditures at the activity level. The estimated model allows us to analyze the effects of wage and price changes on allocations and welfare inequality.

A related literature separates goods into luxuries and necessities to study their macroeconomic implications. Luxuries are typically classified as goods whose expenditure shares rise with income. Browning and Crossley (2000) find that if the utility function is additively separable over time and over goods, luxuries, defined as goods with higher income elasticity of demand, also have higher within period intertemporal elasticity of substitution (IES). Aguiar et al. (2012) and Aguiar and Hurst (2013) extend the insight of Browning and Crossley (2000) to the activity production model and find a similar relationship between the income elasticity and the IES. These papers assume that the activity production function is linearly homogeneous. Our model differs because we do not restrict the utility function to be additively separable over activities and we do not restrict the activity production function to be linearly homogeneous. We show that when separability and homogeneity both hold, the income elasticities of both goods and time for an activity only depend on this activity's IES. Therefore, whether an activity is a luxury or necessity, depends only on its own IES. This result is consistent with Aguiar et al. (2012) and Aguiar and Hurst (2013). However, when both conditions are relaxed, the income elasticity of an activity is no longer only determined by its own IES, but also the IES of all other activities and the technology to produce all activities.

Aguiar et al. (2020) define leisure luxuries as activities that exhibit little diminishing re-

[3] See, for more examples, Olovsson (2009), Ragan (2013), and Fang and Zhu (2017).

[4] Aguiar et al. (2020) and Kopytov et al. (2020) also study the effects of the decline in recreation prices on labor supply but do not use the leisure-production model.

turns in time. These activities therefore respond more to changes in total leisure time. In contrast, because we focus on activities produced with both time and goods, our definition of luxuries and necessities incorporates the response of both expenditure and time to income changes. Aguiar et al. (2020) identify leisure luxuries by estimating model-derived Engel curves in time while we empirically classify luxuries and necessities by examining the correlations of both time and expenditure shares with income. Hence, our definition of luxuries and necessities applies to activities. This difference leads to a disparity in our empirical classification of leisure luxury activities from Aguiar et al. (2020).

This paper is also related to the literature on income, consumption, and welfare inequality. Krueger and Perri (2006), Blundell et al. (2008), and Aguiar and Bils (2015) focus on changes in inequality over time and the relationship between income and consumption inequality. Attanasio and Pistaferri (2016) point out that a complete welfare analysis will need to go beyond looking at aggregate categories of household expenditure, and consider in addition the basket of goods households consume, the quality of goods they consume, and the value they assign to leisure. Boerma and Karabarbounis (2021) take the value of non-market time into account while analyzing welfare inequality in a version of the Beckerian model. They find that heterogeneity in home-production efficiency raises welfare inequality because the time input in home production does not covary negatively with wages in the cross section. We complement their works by showing that besides productivity (market and home), the differential evolution in prices of market goods is crucial to the evolution of welfare inequality. Moreover, we contribute to the inequality literature by showing that the distinction between luxuries and necessities is important for the analysis in welfare inequality.

Our data analysis is related to the empirical literature on time allocation. Aguiar et al. (2012) discuss the available time use data and review the recent literature in analyzing the long-run trends in time use. We contribute to this literature by mapping time-use and expenditure data for particular activities. Using the mapped data, we study the effects of wage and price changes on time and expenditure allocations of luxury and necessity activities and the implied changes in welfare inequality.

The rest of the paper is organized as follows. Section 2 presents stylized facts on the correlations of time and expenditure shares with wages, and it classifies consumption ac-

tivities into luxuries and necessities. Section 3 presents the theoretical framework. Section 4 explains the estimation strategy, summarizes the estimation results, and discusses the model fit. Section 5 simulates the model to highlight the key model mechanisms. Section 6 analyzes the implications of wage and price changes from 2003 to 2018 for income and welfare inequality through the lens of our estimated model. Section 7 concludes.

2. Stylized Facts

In this section, we present stylized facts on time and expenditure allocations. An ideal data set would include the allocation of both time and expenditures to detailed consumption activities since the production of such activities requires both inputs. However, to our knowledge, such a data set does not exist. To overcome this challenge, we mapped time use and expenditures onto a consistent set of activities across data sets. We applied the mapping to time-use data from the ATUS and expenditure data from the CEX. The result is a unique data set that combines time and expenditures for each consumption activity. Using the constructed data, we regress time and expenditure allocations on income (wages) and a set of controls. The objective of the regression analysis is to empirically classify activities into luxuries and necessities. Based on the resulted correlations of time and expenditures with wage and income, we classify consumption activities into four categories: leisure luxuries, leisure necessities, home luxuries, and home necessities.

2.1 Mapping Time and Expenditures to Activities

We started by mapping consumption activities between the ATUS and CEX. The ATUS records individuals' time allocation for more than one hundred activities in a twenty-four-hour period. We followed Aguiar et al. (2013) in classifying the activities into fourteen distinct categories. The CEX collects data on over six hundred different types of expenditures on market goods and services. We mapped these expenditures to the fourteen activities identified in the time-use data. The matching involved two steps. First, we created a baseline match for the fourteen activities between both surveys using the aggregated consumption-expenditure categories provided by the Bureau of Labor Statistics. We then

checked the underlying expenditure series at the most detailed expenditure level, and, if necessary, we reassigned detailed expenditures to a different activity in order to consistently map time use and expenditures. We describe the details of the data-construction process in appendix A.

In this paper, we study allocations of time and goods to activities in a static framework. For this reason, we excluded any activity that can be considered an investment activity or that has a strong life-cycle component. In the time-use data, such activities mainly constitute time spent on education and own medical care. Time and expenditures allocated to these activities represent investment in human capital and are thus excluded from our analysis. Similarly, child care is strongly tied to the life cycle, so we excluded it as well. Lastly, we removed time spent sleeping. In the expenditure data, the most significant investment is the purchase of a house, and we excluded it from our analysis. Time and expenditures related to maintaining a house, such as gardening or installing new hardwood floors, are consumption activities, and we include them in the analysis. Our analysis is an important starting point to understand the implications of allocations across multiple activities. Studying activities that have dynamic implications over the life cycle are important extension of our analysis.

One important drawback of the CEX data is that expenditures on transportation, such as gas, maintenance of a vehicle, or public transportation, cannot be separated into expenditures associated with distinct activities (e.g. driving to work versus driving to enjoy a holiday weekend). Hence, we disregarded them in our analysis. Despite these shortcomings, we were still left with roughly 60 percent of total consumption expenditures reported in the CEX. We refer to these expenditures as core expenditures. As a robustness check, we allocate the transportation cost proportionally by the travel time spent on each activity. Appendix table B.21 shows that the classification of luxuries and necessities is the same as the case excluding the transportation costs.

Excluding life-cycle-related activities and transportation expenditures left us with four home activities, four leisure activities, and market work. Expenditures on market work, such as work clothes and meals at work, are only 0.72% of the core expenditures so we assume that market work only involves time but not expenditures. For all other activities, we can classify time from the ATUS data and expenditures from the CEX data consistently.

Home activities include core home production (e.g. cooking and cleaning), homeownership activities (e.g. house maintenance), obtaining goods and services (e.g. shopping), and other care (e.g. care for an adult relative). Leisure activities include watching TV, socializing (e.g. parties), eating & personal care (e.g. dining out), and hobbies & entertainment (e.g. vacation). For each of these eight consumption activities, table A.1 outlines the time uses in detail and table A.3 outlines the expenditures in detail.

2.2 Activities and Wages

Using the mapping between time use and expenditures, we can now study the correlations of time and expenditure shares with wages and income for every activity. The resulting correlations are robust to using either wages or income, and they are reported in tables 1 and 2. Because the wage drives the allocations of households in our model, we focus on the relationship between allocations and wages. We used the data from 2003 to 2018 and imposed a minimal set of sample restrictions on both data sets. In each data set, we required the reference person to be between the ages of twenty-one and sixty-five and we removed students and retirees. In the ATUS, we further restricted the sample to working individuals. In the CEX, we dropped households in which neither the heads of household nor their spouses are working.

We express expenditures as the ratio of activity-related expenditures to core expenditures and express time use as the ratio of activity-related time to total time, where total time is defined as the sum of market work and the time spent on the eight activities included in our analysis. Defining variables as shares alleviates the problem that the ATUS surveys individuals while the CEX surveys households. This inconsistency problem is further alleviated, as detailed in appendix tables B.17-B.20, by the relationship between wages, time-use shares, and expenditure shares by activity being unaffected if we restrict the sample to only men or women, single individuals or married couples, or households with or without children.

2.2.1 Time Allocation and Wages

The ATUS records time use in the form of time diaries that cover twenty-four-hour periods. The diaries are either recorded on weekdays or weekends. Not surprisingly, individuals on average spend a lot more time on home-production and leisure activities on weekends than on weekdays. As a result, individuals who were surveyed on weekdays allocated relatively little time to home and leisure activities. We addressed this issue by approximating the average time spent on each activity throughout the week for each individual. To do so, we computed time-use averages of each activity on weekdays and weekends for different demographic cells. Demographic cells consist of four education groups, five age groups, two gender groups, and groups for households with and without a child younger than eighteen years of age.[5] This gave us a total of seventy-two demographic cells. The individual time use for an activity is defined as the weighted average of time use during weekdays and weekends, with weekdays having a weight of five-sevenths and weekends a weight of two-sevenths. For individuals who were surveyed on weekdays, their weekend time allocation is approximated by the average weekend time use of their demographic cell. Similarly, we used the weekday averages of individuals' demographic cells to approximate time allocations for those who were surveyed on weekends.

We used a linear regression model to study the relation of time use with wage at the individual level. The dependent variable is the ratio of activity-related time to total time. Wages were constructed from the ATUS data by dividing individual income by market hours. All regressions control for age, and, to capture nonlinear age effects, age squared. The regression also includes a set of indicator variables that take the value of one if the individual is male, married, or Black and zero otherwise. Finally, the regression controls for the number of children younger than eighteen years of age in the household and includes a linear time trend.

Table 1 shows that the relation between wages and time differs across activities. For example, among home-production activities, time spent on homeownership activities and obtaining goods and services increases as wages rise, and the opposite is true for core home production and other care. Among the four leisure activities, time spent watching

[5] We follow Aguiar and Hurst (2007b) in constructing demographic cells. For ages sixty and above, we do not distinguish between households with and without children.

Table 1: Time-Use Regressions

	A. Home Activities			
	(1)	(2)	(3)	(4)
	Core Hm	Oth Care	Obt Gds Svs	Hm Own
Ln Wage	-0.18***	-0.05***	0.08***	0.02***
	(0.01)	(0.00)	(0.00)	(0.00)
N	96,754	96,754	96,754	96,754
Ln Income	-0.09***	-0.03***	0.04***	0.00
	(0.01)	(0.00)	(0.01)	(0.00)
N	84,748	84,748	84,748	84,748
	B. Leisure Activities			
	(5)	(6)	(7)	(8)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
Ln Wage	-1.00***	-0.09***	0.17***	0.26***
	(0.02)	(0.01)	(0.01)	(0.01)
N	96,754	96,754	96,754	96,754
Ln Income	-0.71***	-0.04***	0.10***	0.20***
	(0.02)	(0.01)	(0.01)	(0.02)
N	84,748	84,748	84,748	84,748

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: The table reports the results from the linear regression model. The data come from the American Time Use Survey between 2003 and 2018. The dependent variable is the weighted average of hours on weekdays and weekends spent on each activity as a fraction of the total time from the following categories: market work; the four home activities of (1) core home production, (2) other care, (3) obtaining goods and services, and (4) homeownership activities; and the four leisure activities of (5) watching TV, (6) socializing, (7) eating & personal care, and (8) hobbies & entertainment. Control variables include age; age squared; dummy variables for gender, marital status, and race; number of children; and the year of the survey. Appendix tables B.7 and B.8 provide the full regression results for home activities. Appendix tables B.9 and B.10 provide the full regression results for leisure activities.

TV and time spent socializing are negatively associated with wages, while higher wages are associated with more time spent on activities related to eating & personal care and to hobbies & entertainment. The sizes of the regression coefficients represent the effect of wages on time allocations. For example, doubling wages leads to an increase in the share of time allocated to hobbies & entertainment by 0.26 percentage point and a decline in time allocated to watching TV by 1 percentage point. The mean total weekly hours for the eight activities and market work is 105.35. Doubling wages therefore generates an average increase in time spent on hobbies & entertainment of 0.27 (0.26%*105.35) hours per week and an average decline in time spent on watching TV of 1.05 (1%*105.35) hours per week.

The results presented in table 1 are robust to (i) using income instead of wage and (ii) using average household wage instead of individual wage.[6] The discussion of these cases are as follows. First, because the ATUS has limited information on household income, we turned to the linked income variables from the Current Population Survey (CPS).[7] For single households, income is directly reported in the CPS for salaried workers and is the product of hourly wage and weekly hours for hourly workers. For married households we construct household income as the sum of both spouses' income from the CPS. As reported in table 1, the regressions with household income are consistent with the regressions using wages. Second, time allocation of one spouse could be affected by the other spouse's wage. We thus replaced individual wage with average household wage for married households. The average household wage was computed by dividing total income by total working hours of the two adult members in the household using the linked CPS data. The regression results in appendix tables B.11 and B.12 show that using average household wage does not affect the results reported in table 1.

Boerma and Karabarbounis (2020) also examine the correlation between time use and wages; they find that these correlations are relatively small. Our data analysis differs from Boerma and Karabarbounis (2020) in two fundamental ways. First, Boerma and Karabarbounis (2020) only consider two types of activities: home activities and leisure activities. In contrast, we further divided home and leisure activities into luxuries and necessities and

[6]The results are also largely consistent when performing the analysis separately for time diaries recorded on weekdays and those recorded on weekends. See appendix tables B.22 and B.23.

[7]The ATUS only reports household income in brackets. However, it surveys a subsample of the CPS, and individuals surveyed in the ATUS can be linked to the CPS.

found that the correlations of time with wages for luxuries and necessities go in opposite directions. Hence lumping luxuries and necessities together gives smaller correlations in absolute term. Second, Boerma and Karabarbounis (2020) measure the relation between time use and wages by calculating the raw correlation coefficient after taking out age effects. In contrast, we measured the relation by regressing time on wages after controlling for a variety of demographics characteristics, including age.

2.2.2 Expenditure Allocation and Wages

Using expenditure and wage data from the CEX, we repeated the regression analysis for the relationship between expenditure shares and wages for each set of activities. The dependent variable is the share of expenditures for each activity relative to core expenditures. Household income is measured as the sum of the adult members' income, and wages are calculated by dividing households' income by the total working hours of their adult members.

Table 2 summarizes the regression results. Among home-production activities, we see that the share of expenditures allocated to core home production declines as wages increase; expenditure shares for homeownership activities and obtaining goods and services, on the other hand, increase with wages. The relationship between wages and expenditure shares for other care is not well identified since only less than 10 percent of households have positive expenditures for this category. Among leisure activities, the shares of expenditures allocated to watching TV, eating & personal care, and hobbies & entertainment are increasing in wages, while the expenditure share for socializing activities declines in wages. The regression coefficients of using household income are largely consistent with those using wages. One exception is watching TV, for which the coefficient is not well identified with income. The quantitative effect of wages on expenditure share is important. For example, doubling wages decreases the average share of expenditures allocated to core home production by 5.40 percentage points and increases the share of expenditures allocated to hobbies & entertainment by 1.33 percentage points.

Table 2: Expenditure Regressions

	A. Home Activities			
	(1)	(2)	(3)	(4)
	Core Home	Oth Care	Obt Gds Svs	Home Own
Ln Wage	-5.40***	0.00	0.31***	1.02***
	(0.06)	(0.00)	(0.02)	(0.03)
N	130,360	130,360	130,360	130,360
Ln Income	-8.41***	0.01**	0.48***	1.44***
	(0.06)	(0.00)	(0.02)	(0.03)
N	176,481	176,481	176,481	176,481
	B. Leisure Activities			
	(5)	(6)	(7)	(8)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
Ln Wage	0.07***	-0.37***	2.10***	1.33***
	(0.02)	(0.02)	(0.04)	(0.05)
N	130,360	130,360	130,360	130,360
Ln Income	-0.00	-0.62***	2.91***	2.68***
	(0.02)	(0.02)	(0.04)	(0.04)
N	176,481	176,481	176,481	176,481

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: The table reports the results from the linear regression model. The data come from the Consumer Expenditure Survey between 2003 and 2018. The dependent variable is the ratio of activity-related expenditures to the core expenditures. The four home activities are (1) core home production, (2) other care, (3) obtaining goods and services, and (4) homeownership activities; and the four leisure activities are (5) watching TV, (6) socializing, (7) eating & personal care, and (8) hobbies & entertainment. Control variables include age; age squared; dummy variables for gender, marital status, and race; number of children; and the year of the survey. Appendix tables B.13 and B.14 provide the full regression results for home activities. Appendix tables B.15 and B.16 provide the full regression results for leisure activities.

2.3 Luxuries and Necessities

Thus far, we have demonstrated that the correlations of time and expenditure shares with wages and income vary across activities. Table 3 summarizes the estimated regression coefficients with wages from tables 1 and 2. Based on the results, we identify two distinct types of activities: luxuries and necessities. We refer to an activity as a luxury if the allocated time and expenditure shares are both positively correlated with income, while we refer to all other activities as necessities. Hence our definition of luxuries and necessities is at the activity level. This definition differs from the standard one that classifies only goods as luxuries or necessities based on their demand response to changes in income (or total expenditure). One exception in classifying time is Aguiar et al. (2020) who define leisure luxuries as activities that exhibit little diminishing returns to time and therefore display larger responses to changes in total leisure time. In contrast, our definition is based on the signs of the correlations with income for both expenditure and time.

Both home and leisure activities consist of luxuries and necessities. The classification gives rise to four types of activities: (1) home luxuries, including homeownership activities and obtaining goods and services; (2) home necessities, including core home production and other care; (3) leisure luxuries, including eating & personal care and hobbies & entertainment; and (4) leisure necessities, including watching TV and socializing.

Table 3: Correlations of Time and Expenditure Shares with Wage

	A. Home Activities				B. Leisure Activities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cr Hm	Oth C	Obt GS	Hm Own	TV	Soc	Eat	Hobby
Time	−	−	+	+	−	−	+	+
Exp. Share	−	o	+	+	+	−	+	+

Notes: This table summarizes the sign of the estimated coefficient on wage from the linear probability models presented in tables 1 and 2. Home activities include (1) core home production, (2) other care, (3) obtaining goods and services, and (4) homeownership. Leisure activities include (5) watching TV, (6) socializing, (7) eating & personal care, and (8) hobbies & entertainment.

By our definition, for all activities classified here as luxuries, both time and expenditure shares increase as wage rises. For necessities, the correlations of time and expenditure shares with wage are both negative for core home production and socializing. For other care, the regression coefficient between the expenditure share and wage is not well identified, and the correlation between time use and wage is negative. We thus categorize other care as a home necessity. Time spent watching TV is negatively correlated with wage, and its expenditure share is positively correlated with wage but is uncorrelated with income. In addition, watching TV on average accounts for 14 percent of weekly hours (see table B.5) but less than 4 percent of core expenditures (see table B.6). We thus classify it as a leisure necessity. Overall for the broad category of home necessities (core home production plus other care) and for the broad category of leisure necessities (watching TV plus socializing) the correlations of time and expenditure shares with wages are all negative.

3. Model

Becker (1965) emphasizes that different types of time use and different types of goods can be combined in various ways to provide utility. This notion of utility is far more general than the standard notion in macroeconomics, in which all types of nonmarket time are combined into a single type of leisure time. Models with home production and leisure production are special versions of the model proposed by Becker (1965). These models assume that there is a single home-consumption activity or a single leisure-consumption activity. Expanding the number of consumption activities beyond a single home or a single leisure activity gives rise to multiple divisions of time and goods that are used as inputs in the production of activities. A key implication is that leisure (home) time is divided into several time segments and each segment is linked to the production of one specific leisure-consumption (home-consumption) activity. Hence leisure hours are not perfect substitutes anymore, so do home-production hours. Similarly, market goods are divided into multiple types and each type is combined with time to produce one specific home or leisure activity. As a result, goods are also imperfect substitutes.

We formalize Becker's notion in a nested CES utility function. Household j combines

time l_{ij} and goods x_{ij} in a CES function to produce consumption of activity i, denoted by c_{ij}. Household utility is defined over the combination of all activities and aggregated using CES preferences:

$$\begin{aligned} U(c_{1j},...c_{nj}) &= log\left(\sum_i \alpha_i c_{ij}^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}} \\ c_{ij} &= \left(\kappa_i x_{ij}^{\frac{\xi_i-1}{\xi_i}} + (1-\kappa_i)(\ell_{ij}+\bar{\ell}_i)^{\frac{\xi_i-1}{\xi_i}}\right)^{\frac{\xi_i}{\xi_i-1}}. \end{aligned}$$

Here, $0 \leq \alpha_i \leq 1$, $\sum_i \alpha_i = 1$, $0 \leq \kappa_i \leq 1$, $\rho \geq 0$, and $\xi_i \geq 0$.

Each household has one unit of time that can be allocated to the production of consumption activities or market work. Households differ in their wage w_j. Let p_i be the price of goods input x_{ij} associated with activity i. The budget constraint is

$$\sum_i p_i x_{ij} = w_j(1 - \sum_i \ell_{ij}).$$

Several sets of parameters govern the utility function. First, α_i determines the relative weights of every activity in the overall set of activities. Second, ρ captures the elasticity of substitution among consumption activities. Third, for a given activity i, κ_i determines the weight of goods in the production of the activity. Fourth, ξ_i determines the activity-specific elasticity of substitution between time and goods. ξ_i can vary across activities, implying that the extent to which households substitute between goods and time may differ by activity. This makes preferences nonhomothetic. One other feature that also introduces nonhomotheticity is the presence of fixed-cost terms $\bar{\ell}_i$. These terms are measured in units of time and can be either positive or negative.[8] As discussed in section 4.5, ξ_i and $\bar{\ell}_i$, together with other model parameters, help us to generate the correlations between time and expenditure shares with wages shown in the data.

[8]Alternatively, we can model the nonhomethetic term on goods. All the analysis in the paper goes through but the model's fit is worse.

3.1 Substitution between Time and Goods

Our model departs from the standard assumption that all non-market hours are perfect substitutes. When non-market hours are imperfect substitutes, households care about the allocation of time to each activity instead of only the total time spent on leisure. Changes in wages therefore have different effects on the allocation of time across activities since the intensity of time and goods in the production function differs by activity and since the substitutability between the two inputs is also activity specific. To see this, we derive the ratio between time and goods inputs for activity i from the FOCs,

$$\frac{\partial U}{\partial c_{ij}}\frac{\partial c_{ij}}{\partial x_{ij}} = \lambda p_i \tag{1}$$

$$\frac{\partial U}{\partial c_{ij}}\frac{\partial c_{ij}}{\partial \ell_{ij}} = \lambda w_j, \tag{2}$$

where λ is the Lagrangian multiplier. Taking the ratio between these two equations gives

$$\frac{\ell_{ij}+\bar{\ell}_i}{x_{ij}} = \left(\frac{p_i}{w_j}\right)^{\xi_i}\left(\frac{1-\kappa_i}{\kappa_i}\right)^{\xi_i}. \tag{3}$$

Since $\xi_i \geq 0$, an increase in wage leads to a decline in the input ratio $\frac{\ell_{ij}+\bar{\ell}_i}{x_{ij}}$. The intuition is simple: Wage increases induce more market work, and the increase in income enables households to purchase more goods inputs x_{ij}. As a result, households substitute time with goods in the production of activities. The magnitude of the substitution is governed by ξ_i. Since ξ_i is activity specific, so is the response of allocations to wage increases. A higher elasticity ξ_i implies that time and goods are more substitutable, resulting in a larger decrease in the input ratio $\frac{\ell_{ij}+\bar{\ell}_i}{x_{ij}}$. A decrease in the price of goods has a similar effect and also induces households to substitute time with goods in the production of activities.

3.2 Substitution across Activities

As discussed above, changes in wages and prices lead households to reallocate their time and expenditures. This generates reallocation of resources across activities. The effect can

be seen from the following equation derived from equation (1):

$$\frac{\frac{\partial U}{\partial c_{kj}}\frac{\partial c_{kj}}{\partial x_{kj}}}{\frac{\partial U}{\partial c_{ij}}\frac{\partial c_{ij}}{\partial x_{ij}}} = \frac{p_k}{p_i}. \tag{4}$$

Plugging in the partial derivatives gives

$$\frac{\alpha_k \kappa_k}{\alpha_i \kappa_i}\frac{c_{kj}^{\frac{1}{\xi_k}-\frac{1}{\rho}}}{c_{ij}^{\frac{1}{\xi_i}-\frac{1}{\rho}}}\frac{x_{kj}^{-\frac{1}{\xi_k}}}{x_{ij}^{-\frac{1}{\xi_i}}} = \frac{p_k}{p_i}. \tag{5}$$

The above equation implies that the response of allocations to wage and price changes is affected not only by the elasticity of substitution between goods and time ξ_i, but also by the elasticity of substitution among activities ρ. A higher ρ implies that activities are more substitutable, resulting in a larger reallocation of time and expenditures across activities in response to wage and price changes.

3.3 Discussion

In appendix D, we explore the relationship between the intertemporal elasticity of substitution (IES) and an activity being luxury or necessity. The IES, γ^i, for activity i, is defined as in Aguiar et al. (2012):

$$\gamma^i = -\frac{\partial U(c_1, ...c_n)/\partial c_i}{c_i \partial^2 U(c_1, ...c_n)/\partial^2 c_i}. \tag{6}$$

Browning and Crossley (2000) and Aguiar et al. (2012) also study the relationship between luxury or necessity with the IES. Our results (see appendix D) differ from theirs because our preferences differ in two dimensions. First, our activity production function is not linearly homogeneous, an important assumption made in Aguiar et al. (2012). Second, the utility function is not additively separable over activities, an assumption made in both Browning and Crossley (2000) and Aguiar et al. (2012).

The derivations in appendix D show that when the separability and homogeneity conditions hold, whether an activity i is a luxury or a necessity only depends on that activity's IES. Hence luxuries are more likely to have higher IES. This result is consistent with Browning and Crossley (2000) and Aguiar et al. (2012). However, when the separability condition

holds while the homogeneity condition is relaxed, the classification of an activity i depends on both γ_i and the technology in producing activity i. Finally, when both conditions are relaxed, the classification of an activity depends on the IES of all activities and the production function for all activities.

4. Estimation

Our estimation exploits the variation in time and expenditure shares across activities by education group and over time. In this section, we explain how we constructed, first, a pseudo-panel of activity inputs for different education groups and, second, prices of goods inputs and education-group-specific wages to estimate the model. After summarizing the estimation results, we show that the model replicates the signs of the correlations between activity inputs and wages as documented in the data. We emphasize that the nonhomothetic term in time and the variations in the elasticity of substitution between goods and time are crucial to generate these correlations. Finally, we show that numerically, luxury activities are associated with larger IES.

4.1 Estimation Strategy

The estimation focuses on four activities, home luxuries, home necessities, leisure luxuries, and leisure necessities, as defined in section 2. Our activity-specific data on time and expenditure shares come from different sources and can only be linked at the group level. We thus constructed a pseudo-panel of activity inputs for different education groups over the entire sample period between 2003 and 2018. Four education categories were considered: less than high school, high school, less than college, and college and above. The averages of time and expenditure shares for each education group were then assigned as inputs to the production of the four activities. This procedure averages out the cross-sectional variations caused by idiosyncratic shocks but preserves the cross-sectional dispersion in allocations that is directly or indirectly related to permanent differences in wages across education.

Taking education-group-specific wages and the prices of goods inputs for each activity

from the data, the estimation minimizes the distance of time and expenditure shares between the data and the model prediction. We have twelve parameters to estimate: $\{\xi_i\}_{i=1}^4$, $\{\kappa_i\}_{i=1}^4$, $\{\alpha_i\}_{i=1}^3$, and ρ. The estimation targets allocations of time and expenditure shares between 2003 and 2018 for each activity and each education group. Since households face different wages in the cross-section and over time and also face different prices over time, they choose different allocations. Conversely, given wage and price variations, these differences in allocations reflect the degree of substitutability between time and goods within an activity and the substitutability among activities. As a result, variation in allocations in the cross-section and over time identify the model parameters.

4.2 Wages and Prices

Information on both goods prices and wages was needed to estimate the model. We obtained prices of goods inputs from the disaggregated indices of the Consumer Price Index (CPI) published by the Bureau of Labor Statistics. We followed the method of Casey (2010) to consistently map these disaggregated indices to activity-specific expenditures. The aggregated price index for each of the four activities was derived in three steps. First, we computed expenditure shares at the household level using the most detailed level of data on expenditures available in the CEX. Second, we used these shares as weights to aggregate the corresponding CPI indices to weighted price indices for the four activities at the household level. Finally, we averaged across all households using CEX sample weights to find the aggregated price index for the four activities every year between 2003 and 2018.

We relied on the CPS Outgoing Rotation Group (CPS-ORG) to construct wages by education group since hourly wages can be measured more precisely in the CPS-ORG than in the ATUS or CEX. For hourly workers, hourly wages are directly observed. For salaried workers, wages are defined as the ratio between usual weekly earnings and usual weekly hours worked. We dropped workers with more than one job and applied the same age restriction as with the ATUS and the CEX. We top-coded hourly wages at USD 100 and dropped hourly wages less than USD 5 as they are below the 2003 federal minimum wage. We averaged the remaining hourly wages by education group and year using the weights provided by the CPS-ORG. Appendix figure E.1 documents the changes in wages and prices

over our sample period.

4.3 Estimation Results

Table 4 summarizes the estimated parameters with standard errors in parentheses. We obtained standard errors by bootstrapping the individual-level data of the ATUS and CEX. The standard errors are small, implying that the model parameters are all precisely identified. Formal proof of identification is difficult since the model is highly nonlinear. Instead, we examined the curvature of the minimized objective function in the neighborhood of the estimated parameter values. As figure E.2 in the appendix shows, by changing one parameter at a time, the objective function indeed reaches its minimum at the estimated parameter values.

We now turn to the results of the estimation. The estimated elasticities of substitution between goods and time, ξ_i, differ across activities. The elasticities are larger than one for leisure necessities and the two home activities, with home luxuries having the largest elasticity. This implies that time and goods are quite substitutable for these activities. Hence, households react strongly to wage and price changes by substituting between time and goods for these activities. The elasticity of substitution for leisure luxuries, on the other hand, is less than one. This implies that, all else equal, time and goods are less substitutable for this activity. Hence the substitution between time and goods in response to price and wage changes is smaller than for other activities.

The share of goods in activity production, κ_i, is larger for luxuries than for necessities. Hence, luxuries are more goods intensive, while necessities are more time intensive. It follows that high-wage households engage in more luxury activities since they can afford them, while low-wage households have a lower opportunity cost of time and consume more necessities. The estimated standard errors for all κ_i's are small, implying that the share of time inputs required for every activity, 1 - κ_i, is significantly different from zero. This provides support for Becker's notion that households require a combination of time and goods to enjoy consumption activities.

The estimates of the nonhomothetic term $\bar{\ell}_i$ further support the notion that luxuries and necessities are different types of activities. The term is negative for luxuries and posi-

Table 4: Parameter Estimates

	(1) Home Luxuries	(2) Leis Luxuries	(3) Home Necessities	(4) Leis Necessities
Elast. Time & Goods	$\hat{\xi}_{HL}$	$\hat{\xi}_{LL}$	$\hat{\xi}_{HN}$	$\hat{\xi}_{LN}$
	1.683	0.347	1.112	1.431
	(0.032)	(0.005)	(0.012)	(0.013)
Share of Goods	$\hat{\kappa}_{HL}$	$\hat{\kappa}_{LL}$	$\hat{\kappa}_{HN}$	$\hat{\kappa}_{LN}$
	0.161	0.999	0.068	0.035
	(0.007)	(0.000)	(0.001)	(0.000)
Nonhomotheticity	$\hat{\bar{\ell}}_{HL}$	$\hat{\bar{\ell}}_{LL}$	$\hat{\bar{\ell}}_{HN}$	$\hat{\bar{\ell}}_{LN}$
	-0.020	-0.207	2.127	1.269
	(0.003)	(0.002)	(0.027)	(0.013)
Utility Weights	$\hat{\alpha}_{HL}$	$\hat{\alpha}_{LL}$	$\hat{\alpha}_{HN}$	$\hat{\alpha}_{LN}$
	0.110	0.046	0.461	0.384
	(0.002)	(0.002)	(0.001)	(0.002)
Elast. b/w Activities	$\hat{\rho}$			
	2.628			
	(0.028)			

Notes: The table reports the means of the bootstrapped distributions for the preference parameters of the model described in section 3 (bootstrapped standard errors are in parentheses).

tive for necessities. Together with ξ_i and κ_i, it governs the allocation of time and goods in the production of an activity. We discuss the joint impact of ξ_i, κ_i, and ℓ_i for luxuries and necessities in section 4.5.

Not all activities are equally important in determining the overall utility of households. The weight of an activity, α_i, varies substantially. The two necessities have a combined weight of 0.84, while the combined weight of luxuries is 0.16. At the same time, leisure luxuries and leisure necessities together constitute an important component of households' utility, with a combined utility weight of 0.43. Thus it is not surprising that formalizing Becker's idea beyond home production significantly alters how households allocate time

and expenditures when wages or prices change.

Finally, we found that activities are highly substitutable. The estimated elasticity of substitution across activities, ρ, is 2.6 and therefore even larger than all the estimated elasticities of substitution between time and goods, ξ_i. This suggests that it is easier for households to substitute between activities than to substitute between time and goods in the production of a single activity. Hence, households strongly adjust their portfolio of activities in response to wage and price changes.

4.4 Model Fit and Correlation with Wages

We identified four ways to check the fit of our model. First, we confronted the model with cross-sectional data on expenditure shares and time spent on each activity. Table 5 reports the average allocations by education group over the sample period. The model does a good job in generating the varying time and expenditure shares by activity and education group.

Second, we further validated the estimation results by testing whether the model can generate the activity-specific correlations of time and expenditure shares with wages that we documented in section 2. To generate the correlations implied by the model, we simulated the model using the entire distribution of wages from the CPS-ORG between 2003 and 2018. We then regressed the simulated time and expenditure shares for every activity on the natural logarithm of wages. Table 6 reports the results. We see that the model can generate positive correlations of both time and expenditure shares with wages for luxuries and negative correlations of both time and expenditure shares with wages for necessities.

Third, to explore the importance of the nonhomothetic term $\bar{\ell}_i$ and the differentials in ξ_i across activities, we estimated two special cases of the model. In the first case, we set $\bar{\ell}_i$ to zero for all activities and restrict ξ_i to be the same across activities. In the second case, we set $\bar{\ell}_i$ to zero but allow ξ_i to be different across activities. The estimation procedure and the targeted moments were the same as before. We report the estimated parameters in appendix tables E.25 and E.26. Table 7 reports the regression coefficients of time and expenditure shares with wages implied by the two cases. In the first case, the correlations between wages and time for home luxuries and and leisure luxuries and the correlation between wages and expenditure shares for leisure necessities are the opposite to those in

Table 5: Model Fit: Allocation of Time and Expenditure Shares

	Time							
	Model				Data			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Education	HL	LL	HN	LN	HL	LL	HN	LN
$<$ HS	0.116	0.209	0.115	0.311	0.120	0.207	0.128	0.315
HS	0.118	0.222	0.111	0.274	0.113	0.217	0.103	0.283
Some College	0.119	0.226	0.109	0.262	0.117	0.238	0.098	0.251
College $+$	0.123	0.254	0.088	0.202	0.125	0.249	0.090	0.199
	Expenditure Share							
	Model				Data			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Education	HL	LL	HN	LN	HL	LL	HN	LN
$<$ HS	0.067	0.208	0.597	0.128	0.064	0.201	0.610	0.120
HS	0.078	0.249	0.547	0.126	0.070	0.250	0.544	0.130
Some College	0.081	0.261	0.532	0.125	0.084	0.277	0.505	0.127
College $+$	0.101	0.316	0.463	0.121	0.103	0.308	0.467	0.114

Notes: The top panel reports the share of time for each activity in the model and in the data (averages between 2003 and 2018). The bottom panel reports expenditure shares by education group in the model and in the data (averages between 2003 and 2018). HL is home luxury, LL is leisure luxury, HN is home necessity, and LN is leisure necessity.

Table 6: Correlation with Ln Wages: Data vs. Model

	A. Time			
	(1)	(2)	(3)	(4)
	Home Lux	Leisure Lux	Home Nec	Leisure Nec
Data	1.02***	3.20***	-0.42***	-2.46***
	(0.08)	(0.10)	(0.08)	(0.13)
N	96,761	96,761	96,761	96,761
Model	0.94***	6.19***	-5.14***	-13.77***
	(0.00)	(0.00)	(0.00)	(0.00)
N	1,442,140	1,442,140	1,442,140	1,442,140
	B. Expenditure Shares			
	(1)	(2)	(3)	(4)
	Home Lux	Leisure Lux	Home Nec	Leisure Nec
Data	1.52***	3.85***	-5.23***	-0.23***
	(0.04)	(0.06)	(0.07)	(0.03)
N	119,173	119,173	119,173	119,173
Model	5.83***	10.02***	-14.94***	-0.91***
	(0.00)	(0.00)	(0.00)	(0.00)
N	1,442,140	1,442,140	1,442,140	1,442,140

Standard errors in parentheses. $^{*}\ p < .10$, $^{**}\ p < .05$, $^{***}\ p < .01$

Notes: Data regressions for the correlations between the share of time for each activity and the natural log of wages in the top right panel are based on data from the American Time Use Survey for 2003–18. Data regressions for the correlations between expenditure shares and the natural log of wages in the bottom right panel are based on data from the Consumer Expenditure Survey for 2003–18. All data regressions include as control variables age; age squared; dummy variables for gender, marital status, and race; number of children; and the year of the survey. Model regressions regress the simulated time and expenditure shares on the natural log of wages.

the data. In the second case, the correlations between wages and time for all four activities have the opposite sign as those in the data. Hence, the model without the nonhomothetic terms in time or without variations in the elasticity of substitution between goods and time cannot generate the correlations between activity inputs and wages that we observe in the data.

Fourth, to illustrate the importance of separating activities into luxuries and necessities, we estimate a model with only two activities: home production and leisure. Home production is a combination of both home necessities and home luxuries. Leisure is a combination of both leisure necessities and leisure luxuries. We report the estimated parameters of this model in appendix table E.27. Table 8 reports the regression coefficients of time and expenditure shares with wages implied by the two-activity model. The table shows that without the distinction between luxuries and necessities, the estimated model can not generate correlations that are consistent with the data.

4.5 Determinants of Luxuries and Necessities

The elasticity of substitution between time and goods, ξ_i, the nonhomothetic term, $\bar{\ell}_i$, and the share of goods in the production of an activity, κ_i, determine whether the correlations of time and expenditure shares with wages are positive or negative. They therefore determine whether an activity is a luxury or a necessity. The intuition is as follows. A wage increase leads to a substitution from time to goods in the production of activities. The size of the substitution effect determines the magnitude of the change in the input ratio $\frac{\ell_{ij}}{x_{ij}}$. From equation (3), a larger ξ_i, a smaller κ_i, or a larger $\bar{\ell}_i$ gives rise to a larger decline in $\frac{\ell_{ij}}{x_{ij}}$ as wages rise.[9]

Since necessities are activities for which time use declines in wages and luxuries are activities for which time use increases in wages, the substitution effect is stronger for necessities than for luxuries. Hence, a larger ξ_i, a smaller κ_i, or a larger $\bar{\ell}_i$, all else equal, is more likely to be associated with necessities than luxuries. However, this does not imply that a larger estimate of ξ_i always makes an activity a necessity. What matters for the relationship between time, expenditure shares, and wages is the parameter combination of ξ_i,

[9]To see it, rewrite equation (3) as $\frac{\ell_{ij}}{x_{ij}} = \left(\frac{p_i}{w_j}\right)^{\xi_i} \left(\frac{1-\kappa_i}{\kappa_i}\right)^{\xi_i} - \frac{\bar{\ell}_i}{x_{ij}}$.

Table 7: Models with Restricted Parameter Values

	A. Time			
	(1)	(2)	(3)	(4)
	Home Lux	Leisure Lux	Home Nec	Leisure Nec
Data	1.02***	3.20***	-0.42***	-2.46***
	(0.08)	(0.10)	(0.08)	(0.13)
N	96,761	96,761	96,761	96,761
A. $\bar{\ell}_i = 0, \xi_i = \xi, \forall i$	-1.97***	-5.96***	-8.61***	-1.24***
	(0.00)	(0.00)	(0.00)	(0.00)
B. $\bar{\ell}_i = 0, \forall i$	-0.78***	-2.37***	3.33***	0.47***
	(0.00)	(0.00)	(0.00)	(0.00)
N	1,448,697	1,448,697	1,448,697	1,448,697
	B. Expenditure Shares			
	(1)	(2)	(3)	(4)
	Home Lux	Leisure Lux	Home Nec	Leisure Nec
Data	1.52***	3.85***	-5.23***	-0.23***
	(0.04)	(0.06)	(0.07)	(0.03)
N	119,173	119,173	119,173	119,173
A. $\bar{\ell}_i = 0, \xi_i = \xi, \forall i$	6.25***	5.42***	-18.70***	7.03***
	(0.00)	(0.00)	(0.00)	(0.00)
B. $\bar{\ell}_i = 0, \forall i$	4.72***	8.11***	-15.73***	2.91***
	(0.00)	(0.00)	(0.00)	(0.00)
N	1,448,697	1,448,697	1,448,697	1,448,697

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Data regressions for the correlations between the share of time for each activity and the natural log of wages in the top panel are based on data from the American Time Use Survey for 2003–18. Data regressions for the correlations between expenditure shares and the natural log of wages in the bottom panel are based on data from the Consumer Expenditure Survey for 2003–18. All data regressions include as control variables age; age squared; dummy variables for gender, marital status, and race; number of children; and the year of the survey. Model regressions regress the simulated time and expenditure shares on the natural log of wages.

Table 8: Model with Home Production and Leisure (Two categories)

	A. Time		B. Expenditure Shares	
	(1)	(2)	(3)	(4)
	Home Activities	Leisure	Home Activities	Leisure
Data	0.50***	0.79***	-0.04***	0.04***
	(0.11)	(0.15)	(0.00)	(0.00)
N	96,761	96,761	118,665	118,665
Model	21.66***	-43.51***	7.12***	-7.12***
	(0.00)	(0.01)	(0.01)	(0.01)
N	1,228,168	1,228,168	1,228,168	1,228,168

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Data regressions for the correlations between the share of time for each activity and the natural log of wages in the top panel are based on data from the American Time Use Survey for 2003–18. Data regressions for the correlations between expenditure shares and the natural log of wages in the bottom panel are based on data from the Consumer Expenditure Survey for 2003–18. All data regressions include as control variables age; age squared; dummy variables for gender, marital status, and race; number of children; and the year of the survey. Model regressions regress the simulated time and expenditure shares on the natural log of wages.

κ_i, and $\bar{\ell}_i$. For example, even though home and leisure necessities have smaller estimates for κ_i and larger estimates for $\bar{\ell}_i$ than home luxuries do, their estimates for ξ_i are smaller. This example implies that the parameters affect the allocations in a complex way and that one parameter alone cannot determine whether an activity is a luxury or necessity.

4.6 Luxuries, Necessities, and the IES

Since we do not impose separability of activities in the utility function and homogeneity in the activity production function, there is no guarantee that luxuries have a higher IES as defined in equation (6). However, table 9 shows that numerically luxuries do correspond to higher IES in our model. The table calculates the IES by education group for each of the four activities following equation (6). The two luxury activities have an IES greater than 2.5 while the two necessities have an IES less than 1.7. This relationship between luxuries and the IES is consistent with Browning and Crossley (2000) and Aguiar et al. (2012).

Table 9: Intertemporal Elasticity of Substitution

	(1) Home Luxuries	(2) Leis Luxuries	(3) Home Necessities	(4) Leis Necessities
< HS	2.563	2.555	1.355	1.607
HS	2.557	2.532	1.355	1.618
Some College	2.554	2.516	1.356	1.626
College +	2.540	2.457	1.362	1.649

Notes: The table reports the means (across years) of the estimated intertemporal elasticity of substitution computed according to (6). For each year and each education group we calculate the IES for each activity using the estimated values of the parameters and the model-implied allocations of expenditures and time use.

5. Model Mechanisms

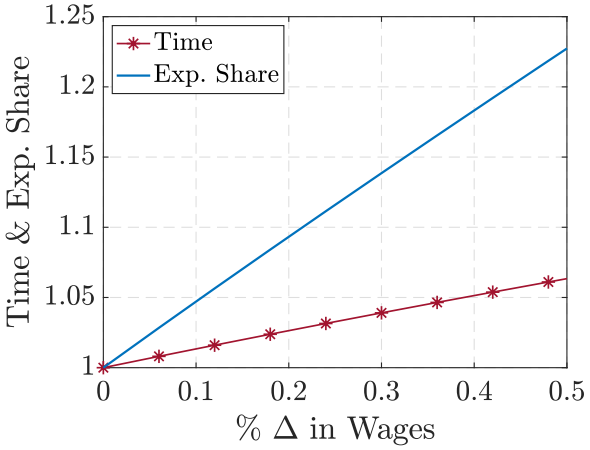
To highlight the mechanism underlying our model, we explore the effects of changes in wages and prices on the allocations of time and expenditure shares across activities. More specifically, we simulate changes in time and expenditure allocations for a household with average wages in our CPS-ORG sample. Prices for market goods are kept at their average levels between 2003 and 2018.

5.1 Response to Wage Changes

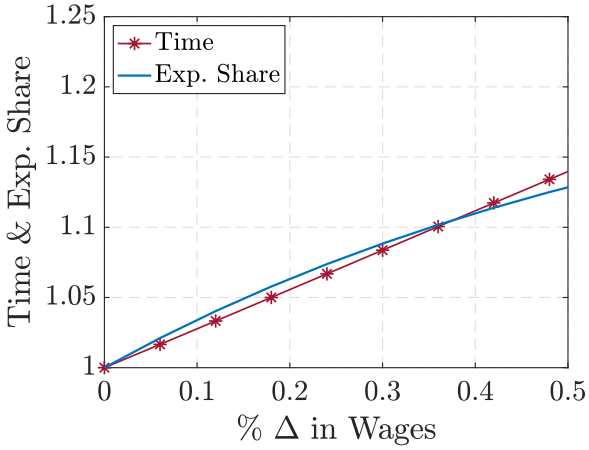
Figure 2 shows the simulated changes in time and expenditure shares for each activity in response to increases in wages ranging from 0 to 50 percent. We plot time and expenditure shares relative to the baseline allocations. For luxuries, an increase in wages leads to increases in both time and expenditure shares, while for necessities, wage increases lead to a decline in both time and expenditure shares. The decline in time spent on necessities is larger than the increase in time spent on luxuries. Hence, market hours increase as a result. The intuition is as follows. An increase in wages raises the opportunity cost of time. The increase in the opportunity cost of time makes it more expensive to produce necessities since they are time intensive. The rise in income due to the combination of ris-

ing wages and higher market hours allows households to engage in more luxury activities since they are goods intensive. Because activities are highly substitutable ($\rho = 2.6$), such income effects lead to shifts of time and expenditures away from necessities and toward luxuries.

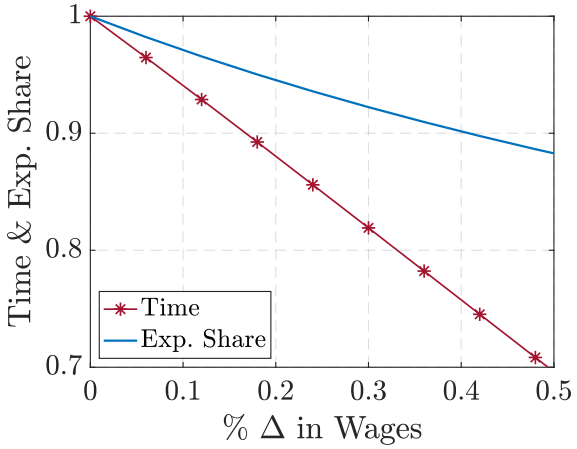
(a) Home Luxuries



(b) Leisure Luxuries



(c) Home Necessities



(d) Leisure Necessities

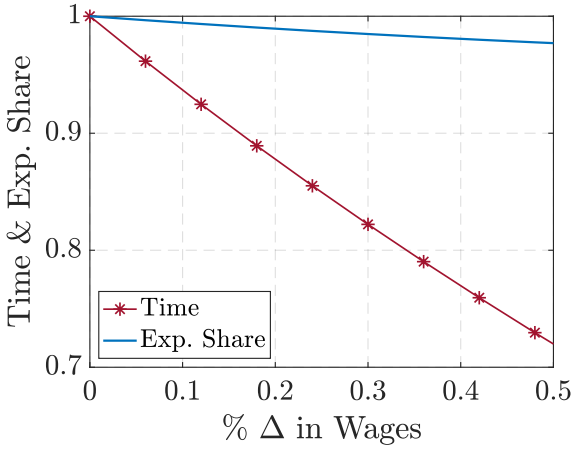


Figure 2: Responses of Time and Expenditure Shares to Wage Changes

Notes: Solid lines plot the expenditure shares for an activity relative to the baseline allocations if wages increase by somewhere between 0 and 50 percent. Crossed lines plot the time allocated to an activity relative to the baseline allocations if wages increase by somewhere between 0 and 50 percent.

5.2 Response to Price Changes

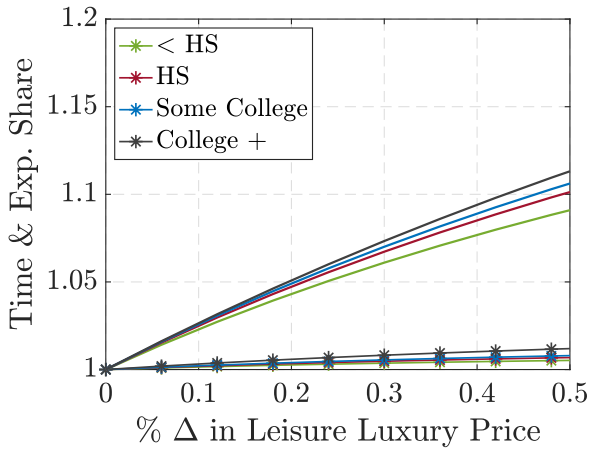
We now turn to the effect of changing goods prices on the allocations of time and expenditures. Figure 3 plots the time and expenditure shares for an increase in the price of leisure luxuries relative to the baseline allocations with average prices. We simulate price increases ranging from 0 to 50 percent. The change in the price of leisure luxuries could be caused by a change in technology. An improvement in the technology reduces the price of goods needed to produce leisure luxuries. Therefore, it is less costly to consume such activity and households react by allocating more time and expenditures to it. This result is consistent with Aguiar et al. (2020) who find that the improvement in computing technology raises the time young men spent on video gaming and other recreational computer activities.

The expenditure share allocated to leisure luxuries responses more than time to its own price changes (see figure 3.b) because luxury activities are goods intensive. As the price for leisure luxuries declines (rises), less (more) time and expenditures are allocated to other activities. The changes in expenditure shares are similar across these activities, while the changes in time vary. The key for the changes in the allocations is the high degree of substitutability among activities ($\rho = 2.6$), which allows households to substitute across activities in response to price changes. An example of such a reallocation is that households switch to watching sports games on TV when ticket prices of live games increase.

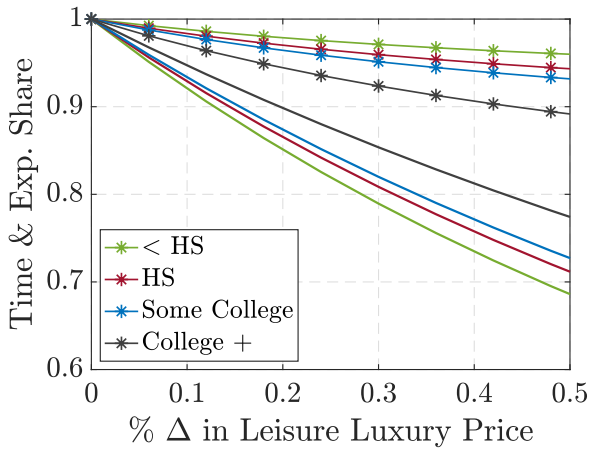
Figure 4 considers the effects of an increase in the price of home necessities. Similarly to the case of leisure luxuries, a home-necessity price increase (decrease) causes a decline (rise) in the time and expenditure shares allocated to home necessities, while the production inputs for all the other activities increase (decrease). A key difference is, however, that necessities are time intensive. Therefore, the change in time for home necessities is more pronounced than the change in the expenditure share (see figure 4.c).

Finally, figure 5 plots the response of market hours to an increase in one activity price while holding all other activity prices and wages fixed. Hours worked decline when activity prices increase. The reason is that an input-price increase causes households to reduce the time allocated to that activity and increase the time allocated to all other activities. The overall increase of time in producing other activities is larger than the decline in time

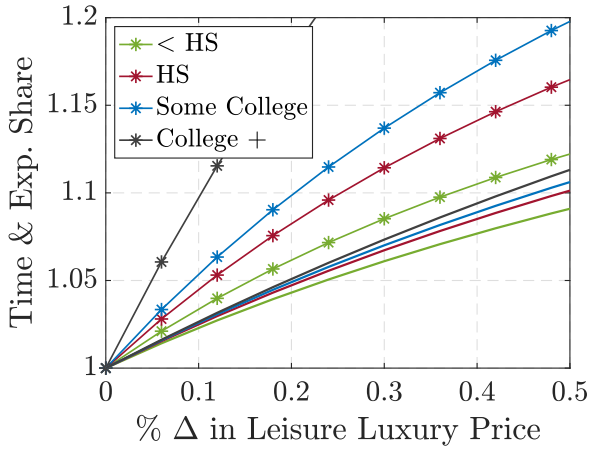
(a) Home Luxuries



(b) Leisure Luxuries (P↑)



(c) Home Necessities



(d) Leisure Necessities

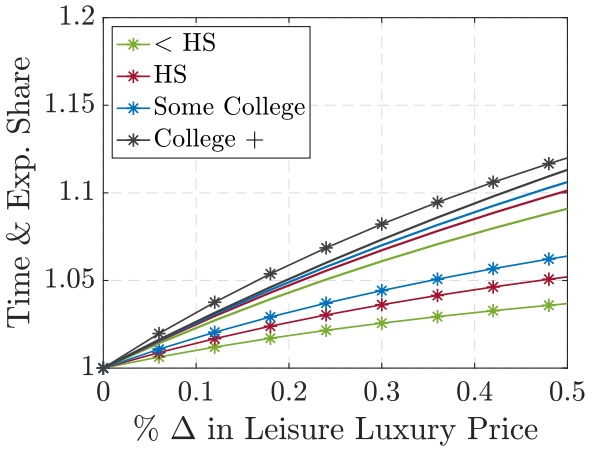
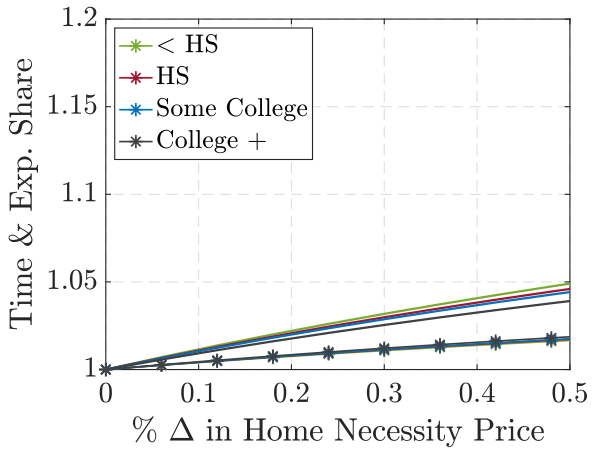


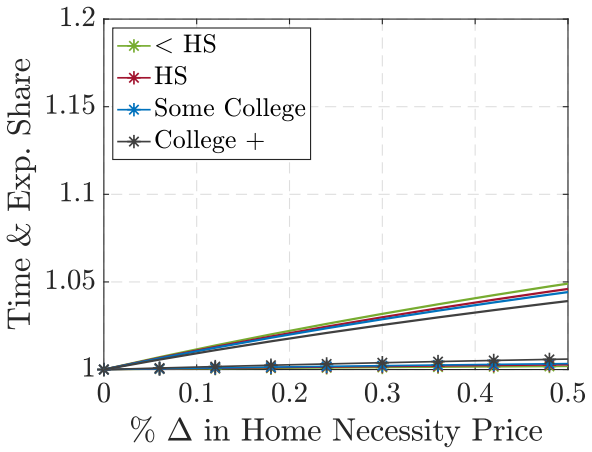
Figure 3: Responses of Time and Expenditure Shares to Changes in Leisure-Luxuries Price

Notes: Solid lines plot the expenditures shares for an activity relative to the baseline allocations if the leisure-luxury price increases by somewhere between 0 and 50 percent. Crossed lines plot the time allocated to an activity relative to the baseline allocations if the leisure-luxury price increases by somewhere between 0 and 50 percent.

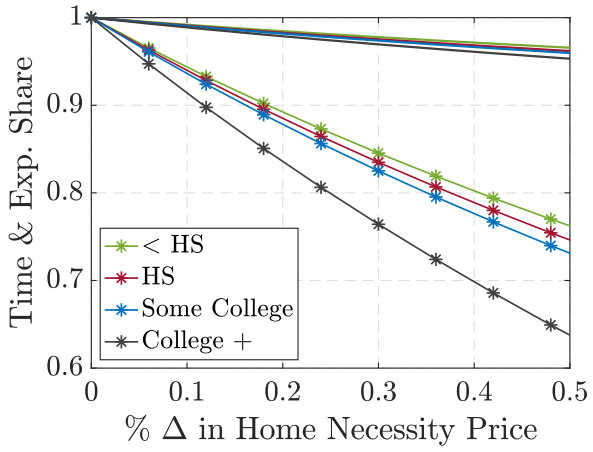
(a) Home Luxuries



(b) Leisure Luxuries



(c) Home Necessities (P↑)



(d) Leisure Necessities

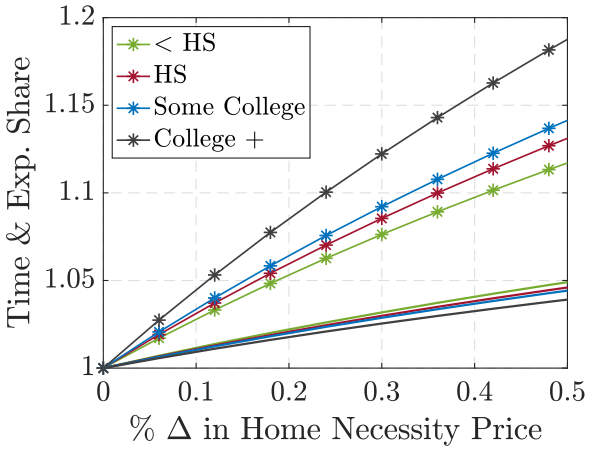
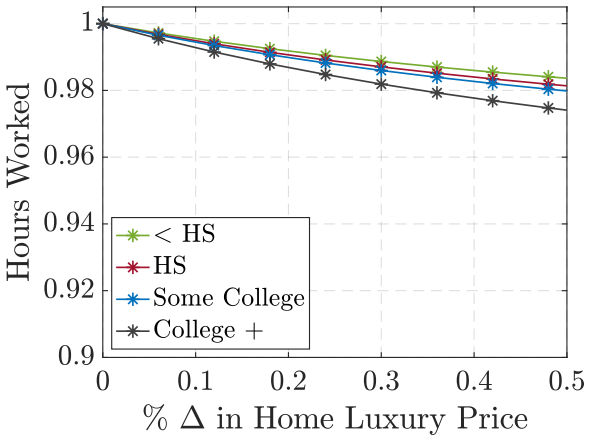


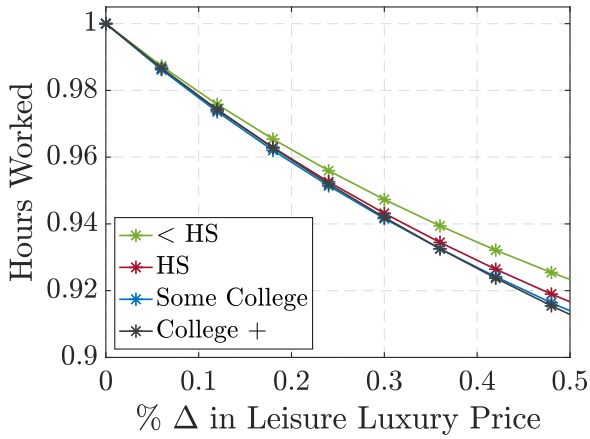
Figure 4: Responses of Time and Expenditure Shares to Changes in Home-Necessity Price

Notes: Solid lines plot the expenditure shares for an activity relative to the baseline allocations if the home-necessity price increases by somewhere between 0 and 50 percent. Crossed lines plot the time allocated to an activity relative to the baseline allocations if the home-necessity price increases by somewhere between 0 and 50 percent.

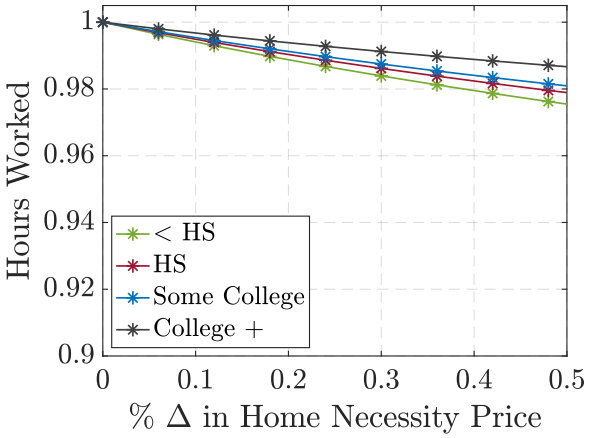
(a) Home Luxuries



(b) Leisure Luxuries



(c) Home Necessities



(d) Leisure Necessities

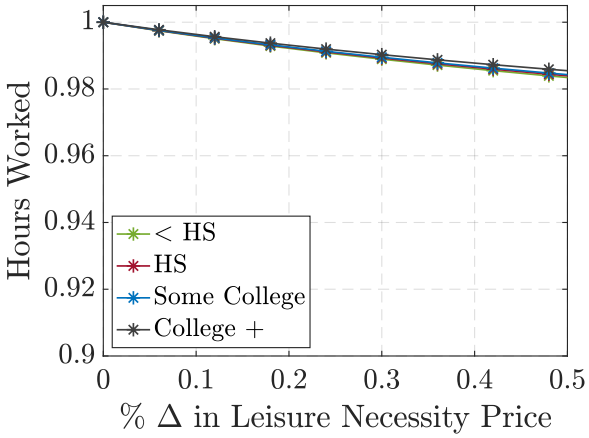


Figure 5: Responses of Hours Worked to Price Changes

Notes: Solid lines plot hours worked relative to the baseline allocation for a given activity's price increase of somewhere between 0 and 50 percent.

for the activity with a price increase, and thus the net effect is a decline in market hours. The magnitude of the decline in market hours is most pronounced for rises in the leisure-luxury price since leisure luxuries are the most goods-intensive activity and therefore market hours are most responsive to a rise in their price.

6. Income and Welfare Inequality

Section 5 showed that changes in wages and goods prices lead households to reallocate time and expenditures among activities. Such a reallocation necessarily leads to changes in income and welfare. In this section, we use the model to study changes in income and welfare inequality between 2003 and 2018. To do so, we simulate the model using the entire distribution of wages from the CPS-ORG and the prices constructed in section 4. Figure 6 plots income and welfare inequality over the sample period and the values in 2003 are normalized to one. Income inequality is measured by the variance of the natural log of income. Welfare is measured by the amount of the consumption composite of all activities that a household consumes.[10] Welfare inequality is measured by the variance of the natural log of welfare. From the figure, both income inequality and welfare inequality increased between 2003 and 2015. From 2015 to 2018, income inequality declined while welfare inequality rose.

6.1 Effect of Wages and Prices

Wage Effect In this subsection, we decompose the rise in income and welfare inequality between 2003 and 2018 to assess the contributions of wage and price changes. Figure 7 simulates the model using the distribution of wages in a given year from the CPS-ORG while keeping activity prices fixed at 2003 values. Thus, figure 7 only captures the effects of changing wages over the sample period. Because the dispersion in wages increased over this period, wage changes led to higher income inequality. In fact, a comparison between figures 6.a and 7.a reveals that almost all the rise in income inequality can be accounted

[10]The consumption composite is $\left(\sum_i \alpha_i c_{ij}^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}}$.

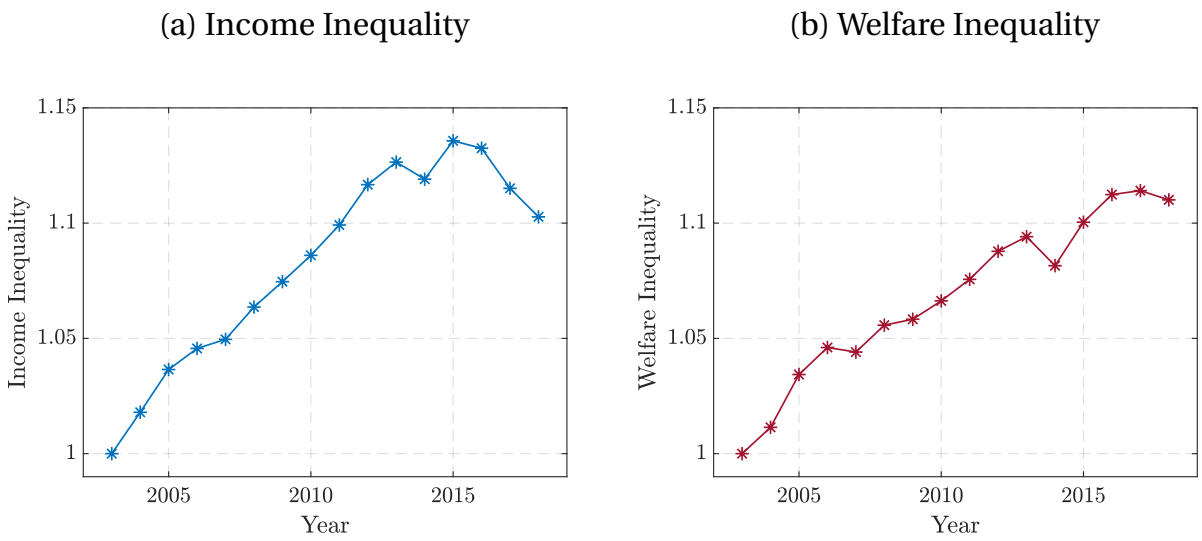


Figure 6: Income and Welfare Inequality between 2003 and 2018

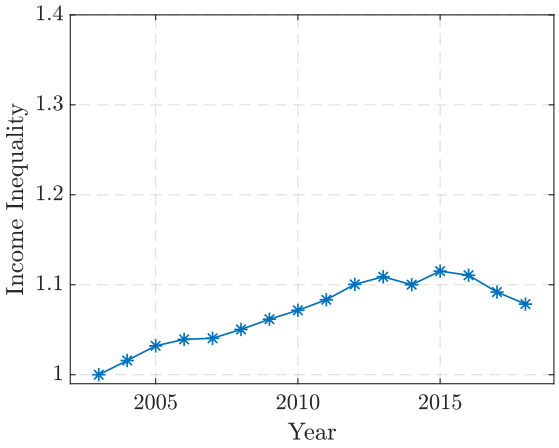
Notes: We plot income and welfare inequality using the entire distribution of wages in the CPS Outgoing Rotation Group. Activity-specific prices are constructed as described in section 4. Income inequality is defined as the variance of the natural log of income. Similarly, welfare inequality is the variance of the natural log of the consumption composite. The values in 2003 are normalized to one.

for by the changes in wages.

The rise in wage dispersion increases welfare inequality through two channels. The first one is standard as wage dispersion raises income inequality. The second one is new to our model. Since luxuries are more goods-intensive and poor households can not afford them in large quantities, a rise in income inequality implies that the variation across households in the consumption of luxury activities becomes larger. Therefore welfare inequality rises. The rise in welfare inequality is more than 20 percent larger compared to figure 6.b. This suggests that changes in activity prices have dampened welfare inequality. Figure 8 supports this claim by showing the contribution of prices to income inequality and welfare inequality.

Price Effect In figure 8, we simulate the model with time-varying prices but keep the wage distribution fixed at the 2003 distribution. Price changes contributed to rising income inequality over the sample period. But the implied increase in income inequality was very small compared with the contribution of wages. The effect of prices on welfare inequality, on the other hand, was large and negative. The evolution in activity prices be-

(a) Income Inequality



(b) Welfare Inequality

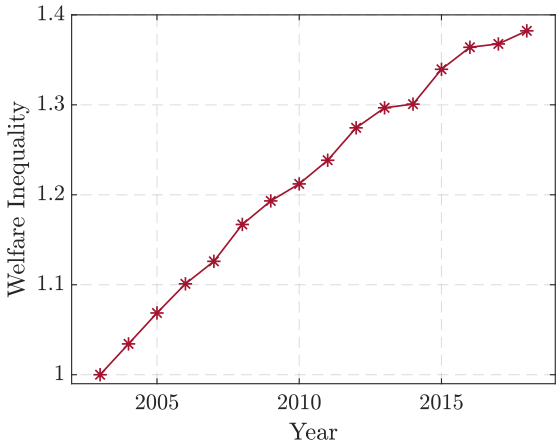


Figure 7: Effect of Wage on Income and Welfare Inequality

Notes: Same as figure 6, but we keep activity prices at 2003 levels and only change wages over the sample period.

tween 2003 and 2018 therefore dampened welfare inequality. Overall, the positive effect of wages on welfare inequality dominated the negative effect of activity prices and led to an increase in welfare inequality.

In figure 9, we further decompose the total effect of price changes on welfare inequality into the contribution of individual prices. Similar to figure 8, we simulate the model by keeping the 2003 wage distribution fixed, but only vary the price of one activity at a time.[11] It is clear that the change in the price of luxury leisure has reduced welfare inequality the most. The price of luxury leisure has increased over the sample period (figure E.1). From figure 3 this increase leads households to substitute from luxury leisure to other less goods-intensive activities. Hence the differences in the consumption of activity bundles between rich and poor households becomes smaller and welfare inequality declines.

Thus far, we have assumed all households face the same goods prices. Households may face different prices because they use a different type or different quality of goods to produce the same activity. For instance, rich households are more likely to eat at a fine dining restaurant while poor households are more likely to eat at a fast food restaurant. Recent studies using scanner data have found substantial price dispersion for similar goods. This

[11] Because we normalize the price of home luxuries to one throughout the whole paper, there are only three cases.

dispersion is observable both across stores and within a store over short periods of time, through the use of sales and discounts (Aguiar and Hurst (2007a) and Kaplan and Menzio (2015)). Incorporating such price heterogeneity is likely to generate even larger effects of prices on welfare inequality.

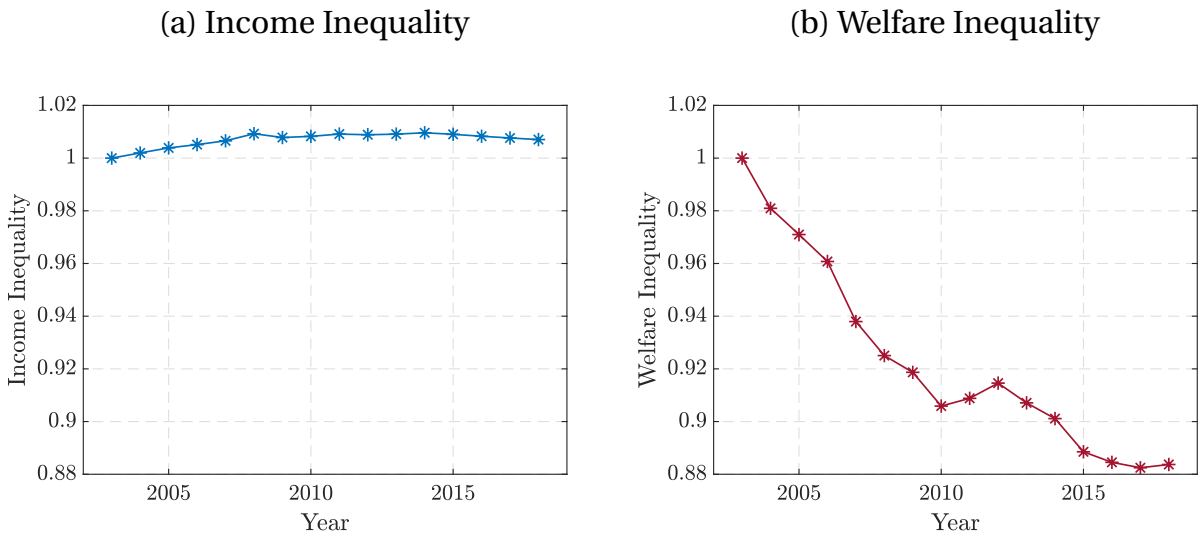
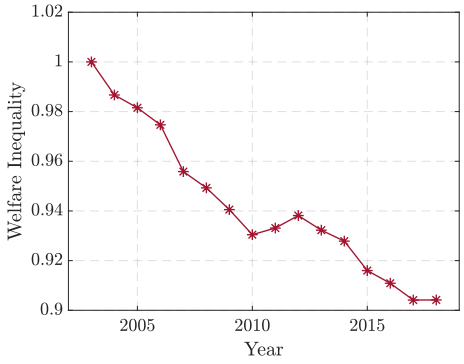


Figure 8: Effect of Prices on Income and Welfare Inequality

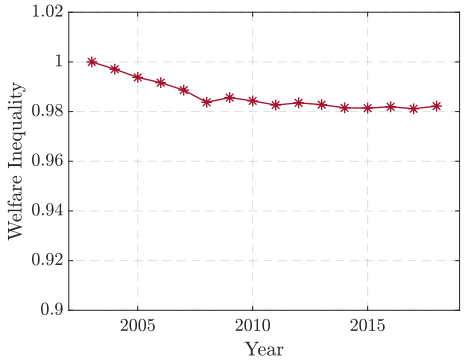
Notes: Same as figure 6, but we keep the 2003 distribution of wages and only change activity prices over the sample period. As a result, wages in a given year are now normalized by the price of home luxuries in 2003.

Comparison between Wage and Price Effects To further explore the quantitative contribution of wages and prices on the evolution of income and welfare inequality, table 10 reports the percentage changes in income and welfare inequality. Total income inequality in the cross-section increased by about 14 percent between 2003 and 2015 and declined by 3 percent between 2015 and 2018. Over the entire sample period, wage changes led to an increase in income inequality by 7.85 percent compared with a total increase of 10.27 percent. Welfare inequality increased by 11 percent over this period. Wage changes led to an increase in welfare inequality of 38 percent, while price changes of all activities combined led to a decline in welfare inequality of 12 percent.

(a) Only p_{LL} varies



(b) Only p_{HN} varies



(c) Only p_{LN} varies

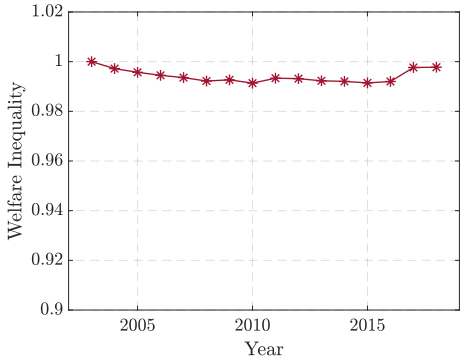


Figure 9: Effect of Individual Price on Welfare Inequality

Notes: Same as figure 6, but we keep the 2003 distribution of wages and only change one activity price at a time. As a result, wages in a given year are now normalized by the price of home luxuries in 2003. LL stands for leisure luxuries, HN for home necessities, and LN for leisure necessities.

6.2 Effect of Activities

The discussion in section 6.1 has shown that the presence of luxuries and necessities are important in propagating the effects of wage and price changes on welfare inequality. To further explore this point, we reduce the model to a three-activity model and exclude the consumption of a particular activity. To do so, we renormalize the utility weights, α_i, such that they sum to one in every version of the three-activity model. All other parameters are kept at their benchmark values. We are interested in understanding whether the absence of a certain activity increases or decreases welfare inequality relative to the four-activity model.

Figure 10 plots changes in welfare inequality between the three-activity model and the

Table 10: Percentage Changes in Income and Welfare Inequality

	A. Total Inequality					
	Income Inequality			Welfare Inequality		
Period	Total	Wage	Price	Total	Wage	Price
2003–15	13.57 %	11.51 %	0.90 %	10.04 %	33.95 %	-11.15 %
2015–18	-2.90 %	-3.28 %	-0.20 %	0.88 %	3.19 %	-0.54 %
2003–18	10.27 %	7.85 %	0.70 %	11.01 %	38.22 %	-11.63 %

Notes: We report the percentage change in income and welfare inequality measured as the variance of log income and log welfare for different subperiods of the sample. The Total column reports the total percentage change when both prices and wages vary. The Wage column reports the percentage change when we keep all activity prices fixed at 2003 values and wages vary over time. The Price column reports the percentage change when we keep wages fixed at the 2003 distribution and activity prices vary over time.

four-activity model over the sample period. The absence of luxuries, especially leisure luxuries (for example, dining out, vacations) compresses welfare inequality in the cross-section. In contrast, the absence of necessities, especially leisure necessities (for example, watching TV) increases welfare inequality. These findings are driven by the estimated weights of goods, κ_i, in the activity production function. Since luxuries are more goods-intensive, low-wage households consume fewer of them compared with high-wage households. In the absence of luxury activities, the welfare difference between poor and rich households becomes smaller. In contrast, necessities are time-intensive activities. Low-wage households consume more necessities since their opportunity costs of time are low. In the absence of necessities, they have to switch to the consumption of goods-intensive luxuries. These activities are hard to produce for low-wage households, as such households cannot afford enough goods to enjoy similar amounts of luxury activities to high-wage households. As a result, welfare inequality increases in the absence of necessities. Conversely, this suggests that the presence of luxuries increases welfare inequality and the presence of necessities reduces welfare inequality.

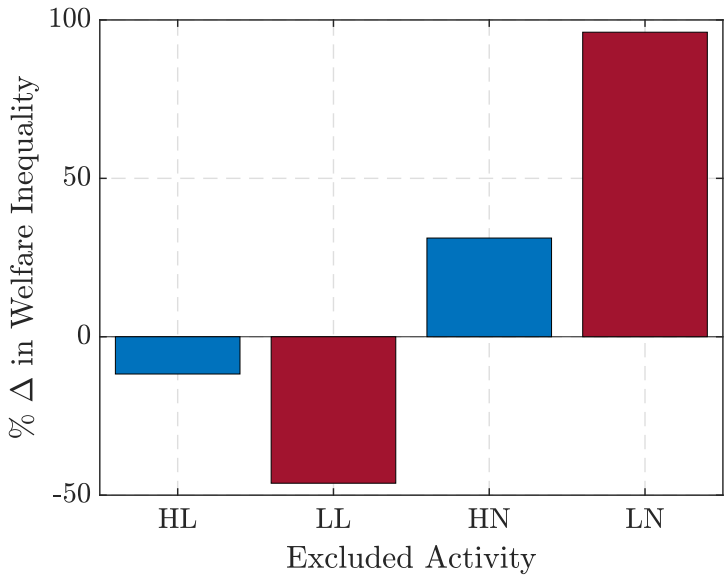


Figure 10: Impact of Luxuries and Necessities on Welfare Inequality

Notes: We plot the average percentage change in welfare inequality relative to the baseline model in four counterfactual scenarios. Each time, we reduce the model to a three-activity model by excluding the consumption of a particular activity c_{ij}. We recompute welfare inequality between education groups in a given year using average wages and prices between 2003 and 2018.

7. Conclusion

We developed and estimated a model in the spirit of Becker (1965) in which households derive utility from different consumption activities by combining time and goods. To estimate the model, we combined detailed activity-level data on time use and consumption expenditures and assigned them to particular consumption activities. Based on the correlations between activity inputs and wages, we classified activities into two types: luxuries and necessities. Luxuries are activities for which time and expenditure shares rise with wage and income; necessities are activities for which time and expenditure shares decline with wage and income. The estimation results allowed us to explore the effects of changes in wages and activity prices on allocations. As wage rises, households shift their time and expenditures from necessities to luxuries since necessities are time-intensive activities and luxuries are goods-intensive activities. An activity-price increase causes a decline in the time and expenditure share allocated to that activity, while the production inputs allocated to all the other activities increase. The key to these results is the high substitutability among activities, as implied by the estimation.

We applied the model to assess the impact of changes in wages and activity prices on welfare inequality over the sample period 2003–18. We found that over this period, the rise in the price of leisure luxuries has reduced welfare inequality while the rise in wage dispersion has increased it. Overall, the positive effect of wages dominated the negative effect of activity prices and led to an increase in welfare inequality.

We presented a parsimonious model that formalizes Becker's (1965) notion in order to study the impact of wage and activity-price changes on allocations and welfare. There are many important extensions of our analysis. For example, the rich structure of our framework could be useful in analyzing the substantial changes in the allocations of time and expenditures within an activity and among activities before and after retirement. Similarly, one could study allocation differences between households with and without children in the cross-section. The presence of children may require a substantial increase in the amount of home-necessity activities that households have to produce. We leave these questions for future research.

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Online Appendix (Not for Publication)

A Data for Estimation

A.1 American Time Use Survey 2003–18

Following Aguiar et al. (2013), we divided the total time for every individual surveyed in the American Time Use Survey (ATUS) into nine categories. These categories can be aggregated into three main time-use categories: market work, home activities, and leisure activities. Home activities include core home production, homeownership activities, obtaining goods and services, and caring for others. Leisure activities include watching TV, socializing, eating and personal care, and hobbies and entertainment.

Table A.2 summarizes the underlying ATUS activity codes for these categories. The ATUS indicates whether a time diary was recorded on a weekday or on a weekend or holiday. To obtain a representative estimate of the weekly hours allocated to one activity, we weighted weekday records by five-sevenths and weekend or holiday records by two-sevenths.

A.2 Consumer Expenditure Survey 2003–18

The Consumer Expenditure Survey (CEX) consists of two components with separate questionnaires and independent samples. We used the interview-panel survey in which consumer units (CU) are interviewed once every three months over five consecutive quarters. The survey therefore records consumption expenditures for every CU over one year. The data for the interview panel are released in eight major data files for each wave separately. For this study, we make use of the FMLI and MTBI files.

To select households into our sample, we use the FMLI files, which contain CU characteristics, CU income, and the earnings of the reference person and their spouse. Income data are collected during the second and fifth interviews. We used information collected in the fifth interview to approximate labor income and the labor-force status of the CU. We defined a CU to be "in the labor force" if the reference person or their spouse reports in their fifth interview that they worked at least one week during the last twelve months. If the information from the fifth interview is missing, we used the information collected in

Table A.1: ATUS 2003-18 Categorization

Activity	Description of Activities
1. Market Work	Working, Work-Related Activities, Work and Work-Related Activities n.e.c., Travel Related to Working, Travel Related to Work-Related Activities, Travel Related to Work n.e.c.
2. Home Activities	
2.1 Core Home Production	Housework, Food & Drink Prep., Presentation & Clean-up, Interior Maintenance, Repair & Decoration, Vehicles, Appliances, Tools, Toys, Household Management, Travel Related to Household Activities
2.2 Homeownership Activities	Interior Maintenance; Repair & Decoration, Exterior Maintenance; Repair & Decoration; Lawn, Garden & Houseplants; Travel Related to Exterior Maintenance; Repair & Decoration; Travel Related to Lawn, Garden & Houseplant Care
2.3 Obtaining Goods & Services	Consumer Purchases, Professional & Personal-Care Services, Household Services, Government Services & Civic Obligations, Travel Related to Consumer Purchases, Travel Related to Using Professional and Personal-Care Services, Travel Related to Using Household Services, Travel Related to Using Govt Services & Civic Obligations
2.4 Others Care	Caring for Household (HH) Adults, Helping Household Adults, Caring for & Helping HH Members, n.e.c., Caring for Non-HH Adults, Helping Non-HH Adults, Caring for & Helping Non-HH Members, n.e.c., Travel Related to Caring for HH Adults, Travel Related to Helping HH Adults, Travel Related to Caring for & Helping HH Members, Travel Related to Caring for Non-HH Adults, Travel Related to Helping Non-HH Adults, Travel Related to Caring for & Helping Non-HH Members, n.e.c.
3. Leisure Activities	
3.1 Watching TV	Television and Movies (not Religious), Television (Religious)
3.2 Socializing	Socializing and Communicating, Attending or Hosting Social Events, Playing Games, Waiting Assoc. with Socializing & Communicating, Waiting Assoc. with Attending/Hosting Social Events, Telephone Calls, Travel Related to Socializing and Communicating, Travel Related to Attending or Hosting Social Events, Travel Related to Telephone Calls
3.3 Eating and Personal Care	Grooming, Personal Activities, Personal-Care Emergencies, Personal Care, n.e.c., Eating and Drinking, Travel Related to Personal Care, Travel Related to Eating and Drinking
3.4 Hobbies and Entertainment	Animals and Pets; HH & Personal Mail & Messages (except E-mail); HH & Personal E-mail and Messages; Relaxing and Leisure; Arts and Entertainment (Other than Sports); Waiting Associated with Socializing, Relaxing, and Leisure; Socializing, Relaxing, and Leisure, n.e.c.; Sports, Exercise, and Recreation; Travel Related to Care for Animals and Pets (not Vet Care); Travel Related to Relaxing and Leisure; Travel Related to Sports, Exercise, & Recreation

Table A.2: ATUS 2003-18 Categorization: Activity Codes

Activity	ATUS Activity Code
1. Market Work	05-01, 05-02, 05-99, 18-05-01, 18-05-02, 18-05-99
2. Home Activities	
2.1 Core Home Production	02-01, 02-02, 02-03 (excl. 02-03-01), 02-07, 02-08, 02-09 (excl. 02-09-03), 02-09-04, 02-99, 18-02-01, 18-02-02, 18-02-03, 18-02-07, 18-02-08, 18-02-09, 18-02-99
2.2 Homeownership Activities	02-03-01, 02-04, 02-05, 18-02-04, 18-02-05
2.3 Obtaining Goods and Services	07, 08 (excl. 08-04), 09,10, 18-07, 18-08 (excl. 18-08-04), 18-09, 18-10
2.4 Others Care	03-04, 03-05, 03-99, 04-04, 04-05, 04-99, 18-03-04, 18-03-05, 18-03-99, 18-04-04, 18-04-05, 18-04-99
3. Leisure Activities	
3.1 Watching TV	12-03-03, 12-03-04
3.2 Socializing	12-01, 12-02, 12-03-07, 12-05-01, 12-05-02, 16, 18-12-01, 18-12-02, 18-16
3.3 Eating and Personal Care	01-02, 01-04, 01-05, 01-99, 11, 18-01, 18-11
3.4 Hobbies and Entertainment	02-06, 02-09-03, 02-09-04, 12-03 (excl. 12-03-03 and 12-03-04), 12-03-07, 12-04, 12-05 (excl. 12-05-01 and 12-05-02), 12-99, 13, 18-02-06, 18-12 (excl. 18-12-01 and 18-12-02), 18-13

the second interview.

A.3 Combining the ATUS and CEX

Sample Selection. We limited the sample in both the ATUS and CEX to reference persons between age twenty-one and age sixty-five, excluding students and retirees. We also restricted the sample to households with at least one spouse reported as being in the labor force. In the ATUS, this includes individuals who are employed, absent from work, or unemployed either on layoff or looking for a job. This left us with 114,936 observations across all survey years in the ATUS.

The CEX only reports the number of weeks the reference person or their spouse has worked within the last twelve months. If either the reference person or their spouse reports having worked at least one week, we included them in our sample. We imposed additional

restrictions on household income before calculating expenditure shares. First, we dropped all households with zero or negative household income. Next, we dropped households with income in the bottom and top 5 percent of the sample in every survey year. We lost 17,135 observations because of this restriction. The final CEX sample contains 148,152 observations.

Linking the ATUS and CEX. To create consistent expenditure and time-use shares associated with each activity, we started with the time-use activity categories discussed in section A.1 and mapped the associated consumption-expenditure categories to the time-use categories as closely as possible. The CEX releases detailed expenditure information in its MTBI files. Consumption and investment expenditures are organized by Universal Classification Code (UCC). The files contain approximately six hundred different UCCs, with one record for every CU purchase in a given month. The Bureau of Labor Statistics (BLS) provides summary-level variables that aggregate a certain set of UCCs. These summary variables serve as a guideline for classifying expenditure categories. For every summary variable, we checked the underlying UCCs and, if necessary, refined the categorization. Table A.3 describes the expenditures associated with each category, while table A.4 documents the corresponding UCCs.

In addition to consumption expenditures, the CEX also collects information on purchases and sales of assets. We classified the purchase and investment of housing and vehicles as separate categories, for reasons explained below. Note that the investment categories only contain outlays related to the acquisition of new assets. We matched expenditures associated with maintaining or repairing housing or vehicles that the CU already owns with a corresponding time-use category.

We excluded investment expenditures for two reasons. First, they cannot be linked to a specific time-use category. Second, our static model cannot be used to analyze investment decisions. Similarly, we excluded education and medical-care time and expenditures as we view them as human capital investments. We excluded time spent on civic and unclassified activities because these activities cannot be linked to any expenditure categories. Expenditures spent on transportation usage cannot be separated into transportation costs associated with activities. We therefore excluded them as well. We refer to the expendi-

tures included in our analysis as core expenditures. Over the sample period, our measure of core expenditures accounts for slightly over one-half of all consumption expenditures reported in the CEX.

The ATUS and the CEX cannot be linked at the household level. We therefore linked them by education in every year. We partitioned the observations based on four educational-attainment categories: less than high school, high school, some college, or college and above. In both the ATUS and the CEX, the highest level of educational attainment of the reference person determines which educational bin we assigned the household to.

Table A.3: CEX 2003-18 Categorization

Activity	Description of Expenditures
1. Market Work	Office furniture for home use; suits and uniforms for men and women; personal digital assistants; meals received as pay; occupational expenses
2. Home Activities	
2.1 Core Home Production	Utilities, fuels, and public services (excl. telephone services); household textiles (excl. bedroom linens); furniture (excl. mattresses and new springs); major appliances; small appliances; nonpermanent carpet squares; blinds; clocks; lamps; decorative items; kitchen utensils; household services; rental of furniture; rental of household and office equipment for nonbusiness use; management fees; other apparel products and services (excl. watches and jewelry, clothing rental); food at home (excl. food or board at school); other household expenses (excl. computers and software for nonbusiness use)
2.2 Homeownership	Maintenance, repairs, and other expenses (excl. homeowner's insurance, parking, and management fees); floor coverings (excl. nonpermanent carpet squares); installed and noninstalled wall-to-wall carpeting; building an attic, installing a pool, or finishing a basement
2.3 Obtaining Goods and Services	Clothing for men and women (excl. suits and uniforms, nightwear, sports coats, active sportswear, other sportswear, and costumes); clothing for boys and girls (excl. nightwear, active sportswear, and costumes); clothing for children (excl. sleeping garments); footwear; clothing rental
2.4 Other Care	Care for invalids or elderly persons; adult-care centers; care in nursing home (net outlay)
3. Leisure	

3.1 Watching TV	Cable services; TVs; video streaming; satellite dishes; repair, rental, and installation of TV and satellite equipment
3.2 Socializing	Catered affairs; live entertainment; party supplies; telephone services and devices; watches; jewelry; dating services
3.3 Eating and Personal Care	Personal-care appliances and services; rental and repair of personal-care appliances; food and beverages during out-of-town trips; alcoholic beverages; dining out at restaurants
3.4 Hobbies and Entertainment	Trip expenditures on lodging; satellite-radio services; video, radio, and sound equipment; records, CDs, videos, and audio tapes; streaming audio files; outdoor equipment; sport coats, sportswear, and costumes; travel items; rental or purchase of trailer-type campers, boats, or aircraft; reading (excl. encyclopedias); miscellaneous entertainment outlays; pets, toys, and playground equipment; musical instruments; photographic equipment; event fees and admission; computers and software for nonbusiness use; tobacco and smoking supplies

Table A.4: CEX 2003-18 UCC codes

Activity	**Universal Classification Codes (UCCs)**
1. Market Work	320901 360110 360901 380510 380902 690115 800700 900002
2. Home Activities	

2.1 Core Home Production	230117 230118 250111 250112 250113 250114 250211 250212 250213 250214 250221 250222 250223 250224 250901 250902 250903 250904 250911 250912 250913 250914 260111 260112 260113 260114 260211 260212 260213 260214 270211 270212 270213 270214 270411 270412 270413 270414 270901 270902 270903 270904 280110 280130 280210 280220 280230 280900 290120 290210 290310 290320 290410 290420 290430 290440 300111 300112 300211 300212 300221 300222 300311 300312 300321 300322 300331 300332 300411 300412 320110 320111 320120 320210 320220 320231 320233 320310 320320 320330 320340 320350 320360 320370 320420 320511 320512 320521 320522 320902 320903 320904 340310 340420 340510 340520 340530 340620 340630 340901 340903 340904 340907 340908 340911 340912 340914 340915 420110 420120 440110 440120 440130 440150 440210 440900 690220 690241 690242 690243 690244 690245 790210 790230 990900
2.2 Homeownership	230112 230113 230114 230115 230121 230122 230123 230131 230132 230133 230134 230141 230142 230150 230151 230152 230901 230902 240111 240112 240113 240121 240122 240123 240211 240212 240213 240214 240221 240222 240223 240311 240312 240313 240321 240322 240323 320161 320162 320163 320410 320611 320612 320613 320621 320622 320623 320631 320632 320633 330511 340410 790690 990920 990930 990940 990950
2.3 Obtaining Goods and Services	360210 360311 360312 360330 360340 360410 360511 360512 360513 370110 370120 370130 370211 370213 370220 370311 370312 370313 370314 370903 380110 380210 380311 380312 380313 380320 380331 380332 380333 380420 380430 380901 390110 390120 390210 390221 390222 390223 390321 390322 390901 400110 400210 400220 400310 410110 410120 410130 410901 440140
2.4 Other Care	340906 340910 570220
3. Leisure Activities	
3.1 Watching TV	270310 310110 310120 310130 310140 310240 310334 340610 340902 690320 690330

3.2 Socializing	190902 270101 270102 270103 270104 270105 320232 430110 430120 680310 680320 680904 690210
3.3 Eating and Personal Care	640130 640420 650110 650210 650310 650900 190903 190904 200900 790310 790320 790330 790410 790420
3.4 Hobbies and Entertainment	210210 270311 310210 310220 310230 310311 310312 310313 310314 310320 310330 310333 310340 310341 310342 310350 320150 340905 360120 360350 360902 370902 370904 380340 380903 390230 390902 430130 520901 520902 520903 520904 520905 520906 520907 590111 590112 590211 590212 590220 590230 590310 590410 600110 600121 600122 600127 600128 600132 600138 600141 600142 600143 600144 600210 600310 600410 600420 600430 600901 600902 610110 610120 610130 610140 610210 610230 610320 610900 620111 620115 620121 620122 620211 620212 620221 620222 620310 620320 620330 620410 620420 620903 620904 620905 620906 620908 620909 620912 620916 620919 620921 620922 620926 620930 630110 630210 680905 690111 690112 690113 690114 690116 690310 690340 690350 690230

Notes: UCCs change across survey waves. In every quarter, some UCCs might be discontinued while new ones might be added to the survey. In addition, new UCCs might not be represented in all quarters. This table reports the UCCs for all survey waves combined.

B Data Analysis

Appendix B.5 repeats the analysis without time imputations and performs the analysis separately for time diaries recorded on weekdays and those recorded on weekends. The estimated correlations between time use and wage are very similar to those using the imputed values for weekdays and weekends. The exceptions are for core home production, home ownership, and socializing. These activities are negatively correlated with wages for weekdays and positively correlated with wages for weekends (see tables B.22 and B.23). This finding is not surprising, since higher wages are associated with longer market working hours on weekdays and thus the majority of time spent by high-wage earners on core home production, home ownership, and socializing occurs on the weekend. Overall, the negative correlations on weekdays for core home production and socializing dominate the positive correlations on weekends and the positive correlation on weekends for home ownership dominates the negative correlation on weekdays. These results also highlight the importance of analyze time use in the weekly frequency.

Table B.5: Time-Use Regressions: Summary Statistics

	Home Activities			
	(1)	(2)	(3)	(4)
	Core Hm	Hm Own	Obt Gds Svs	Oth Care
Mean	8.29	1.69	4.66	0.95
Std Dev	6.31	3.36	4.23	2.30
p10	2.67	0.28	1.69	0 .23
p25	3.80	0.47	2.11	0.31
p50	6.62	0.77	3.12	0.46
p75	10.78	1.44	5.75	0.71
p90	15.85	3.21	9.48	1.35
Min	0.25	0.00	0.00	0.00
Max	80.30	71.85	71.39	75.88
N	96,768	96,768	96,768	96,768
	Leisure Activities			
	(1)	(2)	(3)	(4)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
Mean	13.77	6.03	12.89	8.12
Std Dev	8.01	5.60	4.27	6.17
p10	5.57	2.29	8.66	2.94
p25	8.25	2.76	10.36	4.15
p50	12.18	3.81	12.28	6.31
p75	17.26	7.17	14.65	10.05
p90	23.51	12.72	17.59	15.45
Min	0.00	0.00	1.85	0.00
Max	79.65	74.99	76.69	79.97
N	96,768	96,768	96,768	96,768

Notes: Summary statistics for the dependent variable used in time-use regressions. Time use is expressed as a fraction of total time spent on all activities.

Table B.6: Expenditure Regressions: Summary Statistics

	Home Activities			
	(1)	(2)	(3)	(4)
	Core Hm	Hm Own	Obt Gds Svs	Oth Care
Mean	49.33	2.86	4.51	0.04
Std Dev	16.80	8.30	5.14	1.09
p10	27.82	0.00	0.00	0.00
p25	37.32	0.00	0.18	0.00
p50	48.83	0.00	3.13	0.00
p75	60.81	1.76	6.70	0.00
p90	71.70	7.51	11.04	0.00
Min	0.00	0.00	0.00	0.00
Max	99.96	96.06	73.75	85.11
N	176,481	176,481	176,481	176,481
	Leisure Activities			
	(1)	(2)	(3)	(4)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
Mean	3.94	8.05	14.28	13.61
Std Dev	4.38	6.18	10.81	11.55
p10	0.00	1.85	2.12	1.48
p25	0.45	4.00	6.66	4.95
p50	3.15	6.92	12.32	11.02
p75	5.55	10.72	19.59	19.47
p90	8.65	15.26	28.20	28.85
Min	0.00	0.00	0.00	0.00
Max	87.60	92.17	98.37	98.96
N	176,481	176,481	176,481	176,481

Notes: Summary statistics for the dependent variable used in expenditure regressions. Expenditures are expressed as a fraction of total expenditures for all activities.

Table B.7: Time-Use Regressions: Home Activities and Wage

	(1)	(2)	(3)	(4)
	Core Home	Oth Care	Obt Gds Svs	Home Own
Ln Wage	-0.18***	-0.05***	0.08***	0.02***
	(0.01)	(0.00)	(0.00)	(0.00)
Age	0.04***	-0.01***	-0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Age^2	-0.00***	0.00***	0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Male	-0.91***	0.08***	-0.13***	0.42***
	(0.01)	(0.00)	(0.01)	(0.00)
Married	-0.06***	-0.02***	-0.06***	0.06***
	(0.01)	(0.00)	(0.01)	(0.00)
Black	-0.06***	0.02***	0.07***	-0.07***
	(0.01)	(0.00)	(0.01)	(0.01)
Nb. Child	-0.02***	-0.05***	-0.12***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Year	0.01***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
N	96,754	96,754	96,754	96,754

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Linear probability model. Data come from the American Time Use Survey between 2003 and 2018. The dependent variable is a weighted average of hours per weekday and weekend spent on each activity as a fraction of the total time spent on market work; on the four home activities of (1) core home production, (2) homeownership activities, (3) obtaining goods and services, and (4) other care; and on the four leisure activities of (1) watching TV, (2) socializing, (3) eating & personal care, and (4) hobbies & entertainment.

Table B.8: Time-Use Regressions: Home Activities and Income

	(1)	(2)	(3)	(4)
	Core Home	Oth Care	Obt Gds Svs	Home Own
Ln Income	-0.09***	-0.03***	0.04***	0.00
	(0.01)	(0.00)	(0.01)	(0.00)
Age	0.03***	-0.01***	-0.01***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Age^2	-0.00***	0.00***	0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Male	-0.91***	0.07***	-0.14***	0.44***
	(0.01)	(0.00)	(0.01)	(0.00)
Married	-0.02***	-0.01***	-0.08***	0.06***
	(0.01)	(0.00)	(0.01)	(0.00)
Black	-0.06***	0.02***	0.08***	-0.07***
	(0.01)	(0.00)	(0.01)	(0.01)
Nb. Child	-0.03***	-0.05***	-0.12***	-0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Year	0.01***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
N	84,748	84,748	84,748	84,748

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Linear probability model. Data come from the American Time Use Survey between 2003 and 2018. The dependent variable is a weighted average of hours per weekday and weekend spent on each activity as a fraction of the total time spent on market work; on the four home activities of (1) core home production, (2) homeownership activities, (3) obtaining goods and services, and (4) other care; and on the four leisure activities of (1) watching TV, (2) socializing, (3) eating & personal care, and (4) hobbies & entertainment.

Table B.9: Time-Use Regressions: Leisure Activities and Wage

	(1)	(2)	(3)	(4)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
Ln Wage	-1.00***	-0.09***	0.17***	0.26***
	(0.02)	(0.01)	(0.01)	(0.01)
Age	-0.08***	-0.16***	-0.17***	-0.11***
	(0.01)	(0.01)	(0.01)	(0.01)
Age^2	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Male	2.32***	0.37***	0.66***	0.90***
	(0.02)	(0.01)	(0.01)	(0.02)
Married	-0.54***	-0.22***	-0.18***	-0.38***
	(0.02)	(0.02)	(0.02)	(0.02)
Black	0.82***	0.15***	0.22***	-0.07***
	(0.03)	(0.02)	(0.02)	(0.02)
Nb. Child	-0.76***	-0.32***	-0.55***	-0.50***
	(0.01)	(0.01)	(0.01)	(0.01)
Year	0.02***	0.00	0.00***	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
N	96,754	96,754	96,754	96,754

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Linear regression model. Data come from the American Time Use Survey between 2003 and 2018. The dependent variable is a weighted average of hours per weekday and weekend spent on each activity as a fraction of the total time spent on market work; on the four home activities of (1) core home production, (2) homeownership activities, (3) obtaining goods and services, and (4) other care; and on the four leisure activities of (1) watching TV, (2) socializing, (3) eating & personal care, and (4) hobbies & entertainment.

Table B.10: Time-Use Regressions: Leisure Activities and Income

	(1)	(2)	(3)	(4)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
Ln Income	-0.71***	-0.04***	0.10***	0.20***
	(0.02)	(0.01)	(0.01)	(0.02)
Age	-0.13***	-0.17***	-0.17***	-0.10***
	(0.01)	(0.01)	(0.01)	(0.01)
Age^2	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Male	2.12***	0.34***	0.64***	0.89***
	(0.02)	(0.01)	(0.02)	(0.02)
Married	-0.33***	-0.21***	-0.23***	-0.45***
	(0.03)	(0.02)	(0.02)	(0.02)
Black	0.75***	0.18***	0.25***	-0.06**
	(0.04)	(0.02)	(0.02)	(0.03)
Nb. Child	-0.76***	-0.31***	-0.55***	-0.50***
	(0.01)	(0.01)	(0.01)	(0.01)
Year	0.01***	0.00	0.01***	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
N	84,748	84,748	84,748	84,748

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Linear regression model. Data come from the American Time Use Survey between 2003 and 2018. The dependent variable is a weighted average of hours per weekday and weekend spent on each activity as a fraction of the total time spent on market work; on the four home activities of (1) core home production, (2) homeownership activities, (3) obtaining goods and services, and (4) other care; and on the four leisure activities of (1) watching TV, (2) socializing, (3) eating & personal care, and (4) hobbies & entertainment.

Table B.11: Time-Use Regressions: Home Activities and Average Household Wage

	(1)	(2)	(3)	(4)
	Core Hm	Oth Care	Obt Gds Svs	Hm Own
Ln Income p.c.	-0.04***	-0.01***	0.01***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.03***	-0.01***	-0.01***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Age^2	-0.00***	0.00***	0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Male	-0.90***	0.07***	-0.13***	0.42***
	(0.01)	(0.00)	(0.01)	(0.00)
Married	-0.18***	-0.05***	-0.02*	0.06***
	(0.01)	(0.00)	(0.01)	(0.01)
Black	-0.03***	0.03***	0.06***	-0.07***
	(0.01)	(0.00)	(0.01)	(0.01)
Nb. Child	-0.01***	-0.05***	-0.13***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Year	0.00***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
N	79,785	79,785	79,785	79,785

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Linear regression model. Data come from the American Time Use Survey between 2003 and 2018. The dependent variable is a weighted average of hours per weekday and weekend spent on each activity as a fraction of the total time spent on market work; on the four home activities of (1) core home production, (2) homeownership activities, (3) obtaining goods and services, and (4) other care; and on the four leisure activities of (1) watching TV, (2) socializing, (3) eating & personal care, and (4) hobbies & entertainment.

Table B.12: Time-Use Regressions: Leisure Activities and Average Household Wage

	(1)	(2)	(3)	(4)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
Ln Income p.c.	-0.24***	-0.03***	0.02***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)
Age	-0.10***	-0.15***	-0.13***	-0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
Age_sq	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Male	2.11***	0.34***	0.67***	0.90***
	(0.02)	(0.02)	(0.02)	(0.02)
Married	-1.11***	-0.26***	-0.06**	-0.20***
	(0.03)	(0.02)	(0.02)	(0.03)
Black	0.94***	0.18***	0.21***	-0.12***
	(0.04)	(0.02)	(0.02)	(0.03)
Nb. Child	-0.79***	-0.34***	-0.58***	-0.52***
	(0.01)	(0.01)	(0.01)	(0.01)
Year	0.00	-0.00	0.01***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
N	79,785	79,785	79,785	79,785

Standard errors in parentheses. $^{*}\ p < .10$, $^{**}\ p < .05$, $^{***}\ p < .01$

Notes: Linear regression model. Data come from the American Time Use Survey between 2003 and 2018. The dependent variable is a weighted average of hours per weekday and weekend spent on each activity as a fraction of the total time spent on market work; on the four home activities of (1) core home production, (2) homeownership activities, (3) obtaining goods and services, and (4) other care; and on the four leisure activities of (1) watching TV, (2) socializing, (3) eating & personal care, and (4) hobbies & entertainment.

Table B.13: Expenditure Regressions: Home Activities and Wage

	(1)	(2)	(3)	(4)
	Core Home	Oth Care	Obt Gds Svs	Home Own
Ln Wage	-5.40***	0.00	0.31***	1.02***
	(0.06)	(0.00)	(0.02)	(0.03)
Age	0.52***	-0.00	-0.20***	-0.04***
	(0.03)	(0.00)	(0.01)	(0.02)
Age^2	-0.00***	0.00**	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Male	-0.20**	-0.01**	-0.84***	-0.46***
	(0.09)	(0.01)	(0.03)	(0.05)
Married	0.91***	0.03***	0.01	0.43***
	(0.10)	(0.01)	(0.03)	(0.05)
Black	3.61***	-0.02*	0.58***	-0.67***
	(0.15)	(0.01)	(0.05)	(0.07)
Nb. Child	2.17***	-0.01**	0.49***	-0.19***
	(0.04)	(0.00)	(0.01)	(0.02)
Year	-0.08***	-0.00***	-0.05***	-0.03***
	(0.01)	(0.00)	(0.00)	(0.01)
N	130,360	130,360	130,360	130,360
adj. R^2	0.114	0.001	0.038	0.030

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Thee table reports the results from the linear regression model. The data come from the Consumer Expenditure Survey between 2003 and 2018. The dependent variable is the ratio of activity-related expenditures to the core expenditures. The four home activities are (1) core home production, (2) other care, (3) obtaining goods and services, and (4) home-ownership. Control variables include age; age squared; dummy variables for gender, marital status, and race; number of children; and the year of the survey.

Table B.14: Expenditure Regressions: Home Activities and Income

	(1)	(2)	(3)	(4)
	Core Hm	Oth Care	Obt Gds Svs	Hm Own
Ln Income	-8.41***	0.01**	0.48***	1.44***
	(0.06)	(0.00)	(0.02)	(0.03)
Age	0.78***	-0.00**	-0.21***	-0.08***
	(0.03)	(0.00)	(0.01)	(0.01)
Age^2	-0.01***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Male	-0.54***	-0.01**	-0.70***	-0.40***
	(0.07)	(0.01)	(0.02)	(0.04)
Married	6.08***	0.02***	-0.38***	-0.40***
	(0.09)	(0.01)	(0.03)	(0.05)
Black	2.75***	-0.02**	0.56***	-0.55***
	(0.12)	(0.01)	(0.04)	(0.07)
Nb. Child	1.95***	-0.00*	0.48***	-0.14***
	(0.04)	(0.00)	(0.01)	(0.02)
Year	-0.04***	-0.00***	-0.05***	-0.03***
	(0.01)	(0.00)	(0.00)	(0.00)
N	176,481	176,481	176,481	176,481
adj. R^2	0.159	0.001	0.038	0.032

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: The table reports the results from the linear regression model. The data come from the Consumer Expenditure Survey between 2003 and 2018. The dependent variable is the ratio of activity-related expenditures to the core expenditures. The four home activities are (1) core home production, (2) other care, (3) obtaining goods and services, and (4) homeownership activities. Control variables include age; age squared; dummy variables for gender, marital status, and race; number of children; and the year of the survey.

Table B.15: Expenditure Regressions: Leisure Activities and Wage

	(1)	(2)	(3)	(4)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
Ln Wage	0.07***	-0.37***	2.10***	1.33***
	(0.02)	(0.02)	(0.04)	(0.05)
Age	0.04***	0.14***	-0.38***	0.09***
	(0.01)	(0.01)	(0.02)	(0.02)
Age^2	-0.00**	-0.00***	0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Male	-0.09***	-0.46***	2.34***	0.34***
	(0.02)	(0.03)	(0.06)	(0.06)
Married	-0.31***	0.47***	-2.37***	0.14*
	(0.03)	(0.04)	(0.06)	(0.07)
Black	0.90***	1.86***	-1.31***	-5.10***
	(0.04)	(0.06)	(0.09)	(0.10)
Nb. Child	-0.31***	-0.43***	-2.15***	-0.87***
	(0.01)	(0.02)	(0.03)	(0.03)
Year	0.01***	0.02***	0.24***	-0.07***
	(0.00)	(0.00)	(0.01)	(0.01)
N	130,360	130,360	130,360	130,360
adj. R^2	0.020	0.019	0.133	0.046

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: The table reports the results from the linear regression model. The data come from the Consumer Expenditure Survey between 2003 and 2018. The dependent variable is the ratio of activity-related expenditures to the core expenditures. The four leisure activities are (1) watching TV, (2) socializing, (3) eating & personal care, and (4) hobbies & entertainment. Control variables include age; age squared; dummy variables for gender, marital status, and race; number of children; and the year of the survey.

Table B.16: Expenditure Regressions: Leisure Activities and Income

	(1)	(2)	(3)	(4)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
Ln Income	-0.00	-0.62***	2.91***	2.68***
	(0.02)	(0.02)	(0.04)	(0.04)
Age	0.04***	0.18***	-0.48***	-0.03
	(0.01)	(0.01)	(0.02)	(0.02)
Age^2	-0.00***	-0.00***	0.00***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Male	-0.07***	-0.38***	2.10***	0.23***
	(0.02)	(0.03)	(0.05)	(0.05)
Married	-0.28***	0.82***	-4.10***	-1.44***
	(0.03)	(0.04)	(0.06)	(0.07)
Black	0.93***	1.76***	-1.17***	-4.68***
	(0.03)	(0.05)	(0.08)	(0.09)
Nb. Child	-0.31***	-0.43***	-1.89***	-0.71***
	(0.01)	(0.01)	(0.02)	(0.03)
Year	0.01***	0.03***	0.22***	-0.10***
	(0.00)	(0.00)	(0.01)	(0.01)
N	176,481	176,481	176,481	176,481
adj. R^2	0.020	0.020	0.138	0.055

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: The table reports the results from the linear regression model. The data come from the Consumer Expenditure Survey between 2003 and 2018. The dependent variable is the ratio of activity-related expenditures to the core expenditures. The four leisure activities are (1) watching TV, (2) socializing, (3) eating & personal care, and (4) hobbies & entertainment. Control variables include age; age squared; dummy variables for gender, marital status, and race; number of children; and the year of the survey.

Table B.17: Time-Use Regressions by Demographic Groups: Home Activities

	(1) Core Hm	(2) Oth Care	(3) Obt Gds Svs	(4) Hm Own
		A. Married Couples		
Ln Wage	-0.19***	-0.05***	0.03***	0.01
	(0.01)	(0.00)	(0.01)	(0.00)
N	55,092	55,092	55,092	55,092
		B. Singles		
Ln Wage	-0.15***	-0.05***	0.16***	0.03***
	(0.01)	(0.00)	(0.01)	(0.00)
N	41,662	41,662	41,662	41,662
		C. Men		
Ln Wage	-0.04***	-0.05***	0.04***	0.02**
	(0.01)	(0.00)	(0.01)	(0.01)
N	46,397	46,397	46,397	46,397
		D. Women		
Ln Wage	-0.29***	-0.04***	0.12***	0.01**
	(0.01)	(0.00)	(0.01)	(0.00)
N	50,357	50,357	50,357	50,357
		E. Households with children		
Ln Wage	-0.22***	-0.04***	0.01	0.00
	(0.01)	(0.00)	(0.01)	(0.00)
N	51,838	51,838	51,838	51,838
		F. Households without children		
Ln Wage	-0.13***	-0.05***	0.16***	0.04***
	(0.01)	(0.00)	(0.01)	(0.01)
N	44,916	44,916	44,916	44,916

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Linear regression model. Data come from the American Time Use Survey between 2003 and 2018. The dependent variable is a weighted average of hours per weekday and weekend as a fraction of total time spent on market work, the four home activities, and the four leisure activities. The columns are (1) core home production, (2) other care, (3) obtaining goods and services, (4) home-ownership activities. Control variables include age, age^2, number of children, a dummy for Black, and year. Panels A and B also control for gender, while panels C, D, E, and F additionally control for marital status.

Table B.18: Time-Use Regressions by Demographic Groups: Leisure Activities

	(1)	(2)	(3)	(4)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
			A. Married Couples	
Ln Wage	-0.94***	-0.11***	0.10***	0.20***
	(0.02)	(0.01)	(0.02)	(0.02)
N	55,092	55,092	55,092	55,092
			B. Singles	
Ln Wage	-1.12***	-0.08***	0.22***	0.32***
	(0.03)	(0.02)	(0.02)	(0.03)
N	41,662	41,662	41,662	41,662
			C. Men	
Ln Wage	-1.44***	-0.13***	0.07***	0.25***
	(0.03)	(0.02)	(0.02)	(0.02)
N	46,397	46,397	46,397	46,397
			D. Women	
Ln Wage	-0.61***	-0.04**	0.22***	0.28***
	(0.02)	(0.02)	(0.02)	(0.02)
N	50,357	50,357	50,357	50,357
			E. Households with children	
Ln Wage	-0.86***	-0.11***	0.06***	0.14***
	(0.02)	(0.01)	(0.01)	(0.01)
N	51,838	51,838	51,838	51,838
			F. Households without children	
Ln Wage	-1.12***	-0.12***	0.25***	0.36***
	(0.03)	(0.02)	(0.02)	(0.02)
N	44,916	44,916	44,916	44,916

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Linear regression model. Data come from the American Time Use Survey between 2003 and 2018. The dependent variable is a weighted average of hours per weekday and weekend as a fraction of total time spent on market work, the four home activities, and the four leisure activities. The columns are (1) watching TV, (2) socializing, (3) eating & personal care, (4) hobbies & entertainment. Control variables include age, age^2, number of children, a dummy for Black, and year. Panels A and B also control for gender, while panels C, D, E, and F additionally control for marital status.

Table B.19: Expenditure Regressions by Demographic Groups: Home Activities

	(1)	(2)	(3)	(4)
	Core Hm	Oth Care	Obt Gds Svs	Hm Own
		A. Married Couples		
Ln Wage	-5.38***	0.01	0.25***	0.98***
	(0.08)	(0.01)	(0.03)	(0.05)
N	80,316	80,316	80,316	80,316
		B. Singles		
Ln Wage	-5.32***	0.00	0.39***	1.05***
	(0.10)	(0.00)	(0.03)	(0.05)
N	50,044	50,044	50,044	50,044
		C. Men		
Ln Wage	-5.06***	-0.01	0.21***	0.95***
	(0.09)	(0.01)	(0.03)	(0.05)
N	69,182	69,182	69,182	69,182
		D. Women		
Ln Wage	-5.75***	0.02**	0.41***	1.08***
	(0.09)	(0.01)	(0.03)	(0.05)
N	61,178	61,178	61,178	61,178
		E. Households with children		
Ln Wage	-6.10***	0.00	0.00	0.85***
	(0.10)	(0.01)	(0.03)	(0.04)
N	57,056	57,056	57,056	57,056
		F. Households without children		
Ln Wage	-4.95***	0.01	0.49***	1.16***
	(0.09)	(0.01)	(0.03)	(0.05)
N	73,304	73,304	73,304	73,304

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: The table reports the results from the linear regression model. The data come from the Consumer Expenditure Survey between 2003 and 2018. The dependent variable is the ratio of activity-related expenditures to the core expenditures. The four home activities are (1) core home production, (2) other care, (3) obtaining goods and services, and (4) homeownership activities. Control variables include age, age^2, number of children, a dummy for Black, and year. Panels A and B also control for gender, while panels C, D, E, and F additionally control for marital status.

Table B.20: Expenditure Regressions by Demographic Groups: Leisure Activities

	(1)	(2)	(3)	(4)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
			A. Married Couples	
Ln Wage	-0.03	-0.48***	1.90***	1.44***
	(0.02)	(0.03)	(0.05)	(0.06)
N	80,316	80,316	80,316	80,316
			B. Singles	
Ln Wage	0.20***	-0.24***	2.28***	1.14***
	(0.03)	(0.04)	(0.07)	(0.07)
N	50,044	50,044	50,044	50,044
			C. Men	
Ln Wage	0.11***	-0.44***	2.05***	1.36***
	(0.03)	(0.04)	(0.06)	(0.07)
N	69,182	69,182	69,182	69,182
			D. Women	
Ln Wage	0.04	-0.31***	2.13***	1.31***
	(0.02)	(0.04)	(0.05)	(0.06)
N	61,178	61,178	61,178	61,178
			E. Households with children	
Ln Wage	0.05**	-0.40***	1.87***	1.67***
	(0.02)	(0.03)	(0.05)	(0.06)
N	57,056	57,056	57,056	57,056
			F. Households without children	
Ln Wage	0.13***	-0.30***	2.24***	1.05***
	(0.03)	(0.04)	(0.06)	(0.07)
N	73,304	73,304	73,304	73,304

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: The table reports the results from the linear regression model. The data come from the Consumer Expenditure Survey between 2003 and 2018. The dependent variable is the ratio of activity-related expenditures to the core expenditures. The four leisure activities are (1) watching TV, (2) socializing, (3) eating & personal care, (4) hobbies & entertainment. Control variables include age, age^2, number of children, a dummy for Black, and year. Panels A and B also control for gender, while panels C, D, E, and F additionally control for marital status.

Table B.21: Expenditure Regressions with Transportation Costs

	A. Home Activities			
	(1)	(2)	(3)	(4)
	Core Home	Oth Care	Obt Gds Svs	Home Own
Ln Wage	-4.72***	-0.01*	0.49***	0.88***
	(0.06)	(0.00)	(0.02)	(0.03)
N	116,908	116,908	116,908	116,908
Ln Income	-6.98***	0.01*	0.74***	1.13***
	(0.05)	(0.00)	(0.02)	(0.02)
N	173,909	173,909	173,909	173,909
	B. Leisure Activities			
	(5)	(6)	(7)	(8)
	Watch TV	Social	Eat & Pcare	Hobby & Ent
Ln Wage	0.02	-0.35***	2.07***	1.09***
	(0.01)	(0.02)	(0.03)	(0.04)
N	116,908	116,908	116,908	116,908
Ln Income	-0.05***	-0.54***	2.73***	2.09***
	(0.01)	(0.02)	(0.03)	(0.03)
N	173,909	173,909	173,909	173,909

Standard errors in parentheses. $^{*}\ p < .10$, $^{**}\ p < .05$, $^{***}\ p < .01$

Notes: The table reports the results from the linear regression model. The data come from the Consumer Expenditure Survey between 2003 and 2018. The dependent variable is the ratio of activity-related expenditures to the core expenditures. The four home activities are (1) core home production, (2) other care, (3) obtaining goods and services, and (4) homeownership activities; and the four leisure activities are (5) watching TV, (6) socializing, (7) eating & personal care, and (8) hobbies & entertainment. Control variables include age; age squared; dummy variables for gender, marital status, and race; number of children; and the year of the survey.

Table B.22: Time-Use Regressions by Weekdays: Home Activities

	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
	Core Home	Core Home	Oth Care	Oth Care	Obt Gds Svs	Obt Gds Svs	Home Own	Home Own
Ln Wage	-0.30***	0.16***	-0.04***	-0.00	0.00	0.33***	-0.02***	0.13***
	(0.01)	(0.03)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Age	0.02***	0.11***	-0.01***	-0.01**	-0.02***	-0.01	0.00	0.04***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
Age^2	-0.00*	-0.00***	0.00***	0.00**	0.00***	0.00	0.00	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Male	-0.78***	-1.17***	0.02***	0.12***	-0.18***	-0.13***	0.19***	0.65***
	(0.02)	(0.03)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Married	0.04**	-0.10***	0.01	-0.01	-0.06***	0.06**	0.08***	0.22***
	(0.02)	(0.03)	(0.01)	(0.01)	(0.01)	(0.03)	(0.01)	(0.02)
Black	-0.21***	-0.39***	0.02	0.03	0.09***	-0.00	-0.08***	-0.37***
	(0.02)	(0.05)	(0.01)	(0.02)	(0.02)	(0.04)	(0.01)	(0.03)
Nb. Child	0.03***	-0.00	-0.03***	-0.08***	-0.05***	-0.18***	-0.01***	-0.02**
	(0.01)	(0.02)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Year	0.01***	0.02***	-0.00***	-0.01***	-0.01***	-0.02***	-0.00***	-0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
N	48,012	48,742	48,012	48,742	48,012	48,742	48,012	48,742
adj. R^2	0.066	0.039	0.024	0.045	0.009	0.010	0.006	0.007

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Linear regression model. Data come from the American Time Use Survey between 2003 and 2018. The dependent variable is hours per weekday or weekend spent on each activity as a fraction of total time spent on market work, the four home activities, and the four leisure activities. The four home activities are: core home production, other care, obtaining goods and services, homeownership activities. (1) includes time diaries for weekdays only, while (2) contains all time diaries recorded on weekends.

Table B.23: Time-Use Regressions by Weekdays: Leisure Activities

	(1) Watch TV	(2) Watch TV	(1) Social	(2) Social	(1) Eat & Pcare	(2) Eat & Pcare	(1) Hobby & Ent	(2) Hobby & Ent
Ln Wage	-1.05***	-0.96***	-0.15***	0.14***	0.04	0.48***	0.02	0.90***
	(0.04)	(0.06)	(0.03)	(0.05)	(0.03)	(0.03)	(0.03)	(0.05)
Age	-0.10***	-0.02	-0.15***	-0.24***	-0.20***	-0.17***	-0.11***	-0.15***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)
Age^2	0.00***	0.00	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Male	1.80***	3.78***	0.29***	0.59***	0.67***	0.61***	0.77***	1.29***
	(0.05)	(0.07)	(0.03)	(0.05)	(0.03)	(0.04)	(0.04)	(0.05)
Married	-0.55***	-0.88***	-0.32***	-0.10*	-0.21***	0.15***	-0.47***	-0.56***
	(0.05)	(0.07)	(0.03)	(0.06)	(0.04)	(0.04)	(0.04)	(0.06)
Black	1.04***	1.94***	0.18***	0.29***	0.14***	0.37***	-0.13**	-0.63***
	(0.07)	(0.10)	(0.05)	(0.08)	(0.05)	(0.06)	(0.05)	(0.08)
Nb. Child	-0.68***	-1.08***	-0.23***	-0.53***	-0.58***	-0.59***	-0.44***	-0.67***
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)
Year	0.03***	0.05***	0.00	-0.01	-0.00	0.01**	-0.01**	-0.02***
	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)
N	48,012	48,742	48,012	48,742	48,012	48,742	48,012	48,742
adj. R^2	0.077	0.101	0.026	0.028	0.060	0.039	0.036	0.047

Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Notes: Linear regression model. Data come from the American Time Use Survey between 2003 and 2018. The dependent variable is hours per weekday or weekend spent on each activity as a fraction of total time spent on market work, the four home activities, and the four leisure activities. The four leisure activities are: watching TV, socializing, eating & personal care, hobbies & entertainment. (1) includes time diaries for weekdays only, while (2) contains all time diaries recorded on weekends.

C Model Solution

The utility function for household j is given by

$$\begin{aligned} U(c_{1j},...c_{nj}) &= log\left(\sum_i \alpha_i c_{ij}^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}} \\ c_{ij} &= \left(\kappa_i x_{ij}^{\frac{\xi_i-1}{\xi_i}} + (1-\kappa_i)(\ell_{ij}+\bar{\ell}_i)^{\frac{\xi_i-1}{\xi_i}}\right)^{\frac{\xi_i}{\xi_i-1}}. \end{aligned}$$

The budget constraint is

$$\sum_i p_i x_{ij} = w_j(1-\sum_i \ell_{ij}). \tag{7}$$

Each household maximizes utility subject to the budget constraint. Let λ_j be the Lagrangian multiplier. The FOCs are as follows:

$$\frac{\partial U}{\partial c_{ij}}\frac{\partial c_{ij}}{\partial x_{ij}} = \lambda_j p_i \tag{8}$$

$$\frac{\partial U}{\partial c_{ij}}\frac{\partial c_{ij}}{\partial \ell_{ij}} = \lambda_j w_j. \tag{9}$$

Taking the ratio between these two equations gives

$$\frac{\ell_{ij}+\bar{\ell}_i}{x_{ij}} = \left(\frac{p_i}{w_j}\right)^{\xi_i}\left(\frac{1-\kappa_i}{\kappa_i}\right)^{\xi_i}. \tag{10}$$

Simple manipulation of the definition of c_{ij} gives

$$c_{ij} = x_{ij}\kappa_i^{\frac{\xi_i}{\xi_i-1}}\left[1+\frac{1-\kappa_i}{\kappa_i}\left(\frac{\ell_{ij}+\bar{\ell}_i}{x_{ij}}\right)^{\frac{\xi_i-1}{\xi_i}}\right]^{\frac{\xi_i}{\xi_i-1}}. \tag{11}$$

Plugging equation (10) into the above equation gives

$$c_{ij} = x_{ij}\kappa_i^{\frac{\xi_i}{\xi_i-1}}\left[1+\left(\frac{1-\kappa_i}{\kappa_i}\right)^{\xi_i}\left(\frac{p_i}{w_j}\right)^{\xi_i-1}\right]^{\frac{\xi_i}{\xi_i-1}}. \tag{12}$$

Define $M_{ij} \equiv \kappa_i^{\frac{\xi_i}{\xi_i-1}}\left[1+\left(\frac{1-\kappa_i}{\kappa_i}\right)^{\xi_i}\left(\frac{p_i}{w_j}\right)^{\xi_i-1}\right]^{\frac{\xi_i}{\xi_i-1}}$. Therefore $c_{ij} = M_{ij}x_{ij}$.

From equation (8), we can derive the following equation between activity i and activity

1:

$$\frac{\frac{\partial U}{\partial c_{1j}}\frac{\partial c_{1j}}{\partial x_{1j}}}{\frac{\partial U}{\partial c_{ij}}\frac{\partial c_{ij}}{\partial x_{ij}}} = \frac{p_1}{p_i}. \tag{13}$$

Plugging in the partial derivatives gives

$$\frac{\alpha_1\kappa_1 c_{1j}^{\frac{-1}{\rho}}\left(\frac{c_{1j}}{x_{1j}}\right)^{\frac{1}{\xi_1}}}{\alpha_i\kappa_i c_{ij}^{\frac{-1}{\rho}}\left(\frac{c_{ij}}{x_{ij}}\right)^{\frac{1}{\xi_i}}} = \frac{p_1}{p_i}. \tag{14}$$

Plugging $c_{ij} = M_{ij}x_{ij}$ into the above equation gives x_{ij} as a function of x_{1j}:

$$x_{ij} = \left(\frac{p_1}{p_i}\right)^{\rho}\left(\frac{\alpha_i\kappa_i}{\alpha_1\kappa_1}\right)^{\rho}\frac{M_{ij}^{\frac{\rho}{\xi_i}}}{M_{1j}^{\frac{\rho}{\xi_1}}}\left(\frac{M_{1j}}{M_{ij}}x_{1j}\right). \tag{15}$$

Equation (15) can be simplified as

$$\frac{x_{ij}}{x_{1j}} = \left(\frac{p_1}{p_i}\right)^{\rho}\left(\frac{\alpha_i\kappa_i}{\alpha_1\kappa_1}\right)^{\rho}\frac{M_{ij}^{\frac{\rho-\xi_i}{\xi_i}}}{M_{1j}^{\frac{\rho-\xi_1}{\xi_1}}}. \tag{16}$$

Define $N_{i1j} \equiv \left(\frac{p_1}{p_i}\right)^{\rho}\left(\frac{\alpha_i\kappa_i}{\alpha_1\kappa_1}\right)^{\rho}\frac{M_{ij}^{\frac{\rho-\xi_i}{\xi_i}}}{M_{1j}^{\frac{\rho-\xi_1}{\xi_1}}}$. Then, $x_{ij} = N_{i1j}x_{1j}$. This and equation (10) give ℓ_{ij} as a function of x_{1j}:

$$\ell_{ij} + \bar{\ell}_i = \left(\frac{p_i}{w_j}\right)^{\xi_i}\left(\frac{1-\kappa_i}{\kappa_i}\right)^{\xi_i}N_{i1j}x_{1j}. \tag{17}$$

The budget constraint can be rewritten as follows:

$$x_{1j}\sum_i p_i\frac{x_{ij}}{x_{1j}} = w_j\left(1 - \sum_i(\ell_{ij} + \bar{\ell}_i)\right) + w_j\sum_i\bar{\ell}_i. \tag{18}$$

$$x_{1j}\sum_i p_i N_{i1j} = w_j\left[1 - \sum_i\left(\frac{p_i}{w_j}\right)^{\xi_i}\left(\frac{1-\kappa_i}{\kappa_i}\right)^{\xi_i}N_{i1j}x_{1j}\right] + w_j\sum_i\bar{\ell}_i. \tag{19}$$

Solving for x_{1j} from the above equation gives

$$x_{1j} = \frac{w_j + w_j\sum_i\bar{\ell}_i}{\sum_i p_i N_{i1j} + w_j\sum_i\left(\frac{p_i}{w_j}\right)^{\xi_i}\left(\frac{1-\kappa_i}{\kappa_i}\right)^{\xi_i}N_{i1j}}. \tag{20}$$

x_{ij} can then be solved from equation (16), and ℓ_{ij} can be solved from equation (10).

D Income Elasticity and Intertemporal Elasticity of Substitution

In this appendix, we use a general form of utility function to analyze the relationship between income elasticity and intertemporal elasticity of substitution. To ease the notation, we abstract from the indecies for households. A household's utility is defined over the consumption of n activities $c_i \; \forall \; i = 1, ..., n$. The utility function is given by $U(c_1, ...c_n)$. Following Becker (1965), each activity is produced by combining time ℓ_i with a market good x_i through the production function $f^i(x_i, \ell_i)$. Let p_i be the price of x_i and w be the market wage, the household's maximization problem is given by:

$$\begin{aligned} & \max U(c_1, ...c_n) \\ s.t. \qquad & c_i = f^i(x_i, \ell_i) \\ & \sum_i p_i x_i = w(1 - \sum_i \ell_i). \end{aligned}$$

Let λ_j be the Lagrangian multiplier for the budget constraint. The FOCs are as follows:

$$\frac{\partial U}{\partial c_i}\frac{\partial c_i}{\partial x_i} = \lambda p_i \tag{21}$$

$$\frac{\partial U}{\partial c_i}\frac{\partial c_i}{\partial \ell_i} = \lambda w. \tag{22}$$

Taking the ratio between these two equations gives

$$\frac{\partial c_i/\partial \ell_i}{\partial c_i/\partial x_i} = \frac{w}{p_i}. \tag{23}$$

From our definition, whether an activity is luxury or necessity is related to the income elasticity of time and good inputs for that activity. These elasticities are captured by the responses of x_i and ℓ_i to the changes in the marginal value of total expenditure λ, holding constant the wage w and the price vector $(p_1, ...p_n)$. Following Aguiar et al. (2012), we define $w-$constant elasticity of ℓ_i and x_i as follows:

$$\epsilon^i_{x\lambda} = \frac{\partial x_i}{\partial \lambda}\frac{\lambda}{x_i}, \quad \epsilon^i_{\ell\lambda} = \frac{\partial \ell_i}{\partial \lambda}\frac{\lambda}{\ell_i}. \tag{24}$$

For the ease of notation, we also define the elasticity of the output of activity c_i with respect to time and good as:

$$\epsilon^i_{c\ell} = \frac{\partial c_i}{\partial \ell_i}\frac{\ell_i}{c_i}, \quad \epsilon^i_{cx} = \frac{\partial c_i}{\partial x_i}\frac{x_i}{c_i}. \tag{25}$$

If the proposed utility is used as period utility in a dynamic model, the utility is additively separable across periods. From Aguiar et al. (2012), the intertemporal elasticity of substitution for an activity is given by:

$$\gamma^i = -\frac{\partial U/\partial c_i}{c_i \partial^2 U/\partial^2 c_i}. \tag{26}$$

Differentiating equation (21) with respect to λ gives:

$$\frac{\partial c_i}{\partial x_i}\sum_{s=1}^{n}\left[\frac{\partial^2 U}{\partial c_i \partial c_s}\left(\frac{\partial c_s}{\partial x_s}\frac{\partial x_s}{\partial \lambda}+\frac{\partial c_s}{\partial \ell_s}\frac{\partial \ell_s}{\partial \lambda}\right)\right]+\frac{\partial U}{\partial c_i}\left(\frac{\partial^2 c_i}{\partial^2 x_i}\frac{\partial x_i}{\partial \lambda}+\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}\frac{\partial \ell_i}{\partial \lambda}\right)=p_i. \tag{27}$$

Using equations (21) and (24), the above equation can be rewritten as:

$$\frac{\partial c_i}{\partial x_i}\sum_{s=1}^{n}\left[\frac{\partial^2 U}{\partial c_i \partial c_s}\left(\epsilon^s_{cx}\epsilon^s_{x\lambda}+\epsilon^s_{c\ell}\epsilon^s_{\ell\lambda}\right)c_s\right]+\frac{\partial U}{\partial c_i}\left(\frac{\partial^2 c_i}{\partial^2 x_i}\epsilon^i_{x\lambda}x_i+\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}\epsilon^i_{\ell\lambda}\ell_i\right)=\frac{\partial U}{\partial c_i}\frac{\partial c_i}{\partial x_i}. \tag{28}$$

Dividing both sides by $\frac{\partial^2 U}{\partial^2 c_i}\frac{\partial c_i}{\partial x_i}c_i$:

$$\sum_{s=1}^{n}\left[\frac{\partial^2 U/\partial c_i \partial c_s}{\partial^2 U/\partial^2 c_i}\left(\epsilon^s_{cx}\epsilon^s_{x\lambda}+\epsilon^s_{c\ell}\epsilon^s_{\ell\lambda}\right)\frac{c_s}{c_i}\right]+\frac{\partial U/\partial c_i}{c_i \partial^2 U/\partial^2 c_i}\frac{x_i}{\epsilon^i_{cx}c_i}\left(\frac{\partial^2 c_i}{\partial^2 x_i}\epsilon^i_{x\lambda}x_i+\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}\epsilon^i_{\ell\lambda}\ell_i\right)=\frac{\partial U/\partial c_i}{c_i \partial^2 U/\partial^2 c_i}, \tag{29}$$

$$\sum_{s=1}^{n}\left[\frac{\partial^2 U/\partial c_i \partial c_s}{\partial^2 U/\partial^2 c_i}\left(\epsilon^s_{cx}\epsilon^s_{x\lambda}+\epsilon^s_{c\ell}\epsilon^s_{\ell\lambda}\right)\frac{c_s}{c_i}\right]-\gamma^i\frac{x_i}{\epsilon^i_{cx}c_i}\left(\frac{\partial^2 c_i}{\partial^2 x_i}\epsilon^i_{x\lambda}x_i+\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}\epsilon^i_{\ell\lambda}\ell_i\right)=-\gamma^i. \tag{30}$$

Equation (30) relates income elasticities $\epsilon^i_{x\lambda}$ and $\epsilon^i_{\ell\lambda}$ to IES γ^i.

Differentiating (23) with repect to λ:

$$\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}\frac{\partial x_i}{\partial \lambda}+\frac{\partial^2 c_i}{\partial^2 \ell_i}\frac{\partial \ell_i}{\partial \lambda}=\frac{w}{p_i}\left(\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}\frac{\partial \ell_i}{\partial \lambda}+\frac{\partial^2 c_i}{\partial^2 x_i}\frac{\partial x_i}{\partial \lambda}\right) \tag{31}$$

Using equation (23) and manipulating the results give:

$$\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}\epsilon^i_{x\lambda}x_i+\frac{\partial^2 c_i}{\partial^2 \ell_i}\epsilon^i_{\ell\lambda}\ell_i=\frac{\partial c_i/\partial \ell_i}{\partial c_i/\partial x_i}\left(\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}\epsilon^i_{\ell\lambda}\ell_i+\frac{\partial^2 c_i}{\partial^2 x_i}\epsilon^i_{x\lambda}x_i\right) \tag{32}$$

Using equation (25) and rearranging terms:

$$\epsilon^i_{x\lambda}\left(\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}x_i - \frac{\epsilon^i_{c\ell}x_i^2}{\epsilon^i_{cx}\ell_i}\frac{\partial^2 c_i}{\partial^2 x_i}\right) = \epsilon^i_{\ell\lambda}\left(\frac{\epsilon^i_{c\ell}x_i}{\epsilon^i_{cx}}\frac{\partial^2 c_i}{\partial x_i \partial \ell_i} - \frac{\partial^2 c_i}{\partial^2 \ell_i}\ell_i\right) \tag{33}$$

Hence,

$$\epsilon^i_{x\lambda} = \epsilon^i_{\ell\lambda}\frac{\frac{\epsilon^i_{c\ell}x_i}{\epsilon^i_{cx}}\frac{\partial^2 c_i}{\partial x_i \partial \ell_i} - \frac{\partial^2 c_i}{\partial^2 \ell_i}\ell_i}{\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}x_i - \frac{\epsilon^i_{c\ell}x_i^2}{\epsilon^i_{cx}\ell_i}\frac{\partial^2 c_i}{\partial^2 x_i}}. \tag{34}$$

Equations (30) and (34) gives $2n$ equations with $2n$ unknowns $\epsilon^i_{x\lambda}$ and $\epsilon^i_{\ell\lambda}$ $\forall\ i = 1, ..., n$. Solving this system of equations gives $\epsilon^i_{x\lambda}$ and $\epsilon^i_{\ell\lambda}$ as functions of the IES γ^s for $s = 1, ..., n$. $\epsilon^i_{x\lambda}$ and $\epsilon^i_{\ell\lambda}$ are also affected by the parameters in the utility function and activity production function. Hence they are also related to the elasticity of substitution between time and good for an activity and the elasticity of substitution between activities.

Next we examine two special cases of the preferences. The first case assumes that $U(c_1, ..., c_n)$ is separable in activities and the production function f^i is linear homogeneous $\forall i$. This case is the same as that is studied in Aguiar et al. (2012). Hence

$$\epsilon^i_{x\lambda} = \epsilon^i_{\ell\lambda} = -\gamma^i. \tag{35}$$

The second case assumes separability of $U(c_1, ..., c_n)$ but does not assume homogeneity of f^i. In this case, equation (34) still holds. In equation (30), all cross-derivative terms disappear since $U(c_1, ..., c_n)$ is separable:

$$(\epsilon^s_{cx}\epsilon^s_{x\lambda} + \epsilon^s_{c\ell}\epsilon^s_{\ell\lambda}) - \gamma^i\frac{x_i}{\epsilon^i_{cx}c_i}\left(\frac{\partial^2 c_i}{\partial^2 x_i}\epsilon^i_{x\lambda}x_i + \frac{\partial^2 c_i}{\partial x_i \partial \ell_i}\epsilon^i_{\ell\lambda}\ell_i\right) = -\gamma^i. \tag{36}$$

Plugging equation (34) into equation (36) gives:

$$\epsilon^i_{x\lambda} = -\frac{\gamma^i}{\epsilon^i_{cx} + \epsilon^i_{c\ell}\left(\frac{\frac{\epsilon^i_{c\ell}x_i}{\epsilon^i_{cx}}\frac{\partial^2 c_i}{\partial x_i \partial \ell_i} - \frac{\partial^2 c_i}{\partial^2 \ell_i}\ell_i}{\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}x_i - \frac{\epsilon^i_{c\ell}x_i^2}{\epsilon^i_{cx}\ell_i}\frac{\partial^2 c_i}{\partial^2 x_i}}\right) - \gamma^i\frac{x_i}{\epsilon^i_{cx}c_i}\left(x_i\frac{\partial^2 c_i}{\partial^2 x_i} + \ell_i\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}\frac{\frac{\epsilon^i_{c\ell}x_i}{\epsilon^i_{cx}}\frac{\partial^2 c_i}{\partial x_i \partial \ell_i} - \frac{\partial^2 c_i}{\partial^2 \ell_i}\ell_i}{\frac{\partial^2 c_i}{\partial x_i \partial \ell_i}x_i - \frac{\epsilon^i_{c\ell}x_i^2}{\epsilon^i_{cx}\ell_i}\frac{\partial^2 c_i}{\partial^2 x_i}}\right)} \tag{37}$$

$\epsilon^i_{x\lambda}$ is given by equation (37) and $\epsilon^i_{\ell\lambda}$ can then be solved from equation (34).

To summarize, when U is separable and f^i is linear homogeneous, $\epsilon^i_{x\lambda}$ and $\epsilon^i_{\ell\lambda}$, given by equation (35), are only determined by the IES of the same activity; when U is separable

and f^i is not linear homogeneous, $\epsilon^i_{x\lambda}$ and $\epsilon^i_{\ell\lambda}$, given by equations (34) and (37), are only determined by the IES and the production function of the same activity; when U is not separable and f^i is not linear homogeneous, $\epsilon^i_{x\lambda}$ and $\epsilon^i_{\ell\lambda}$, given by equations (30) and (34), are determined by the IES and the production function of all activities.

E Estimation

E.1 Changes in Wages and Prices

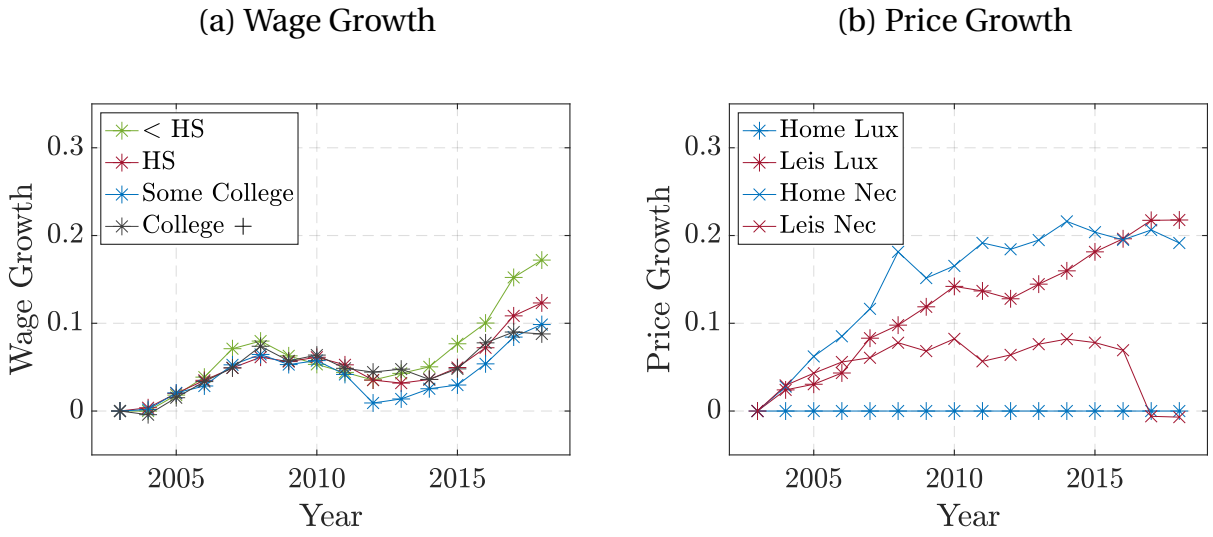


Figure E.1: Wage and Price Growth

Notes: Data for wages come from the Current Population Survey– Outgoing Rotation Group (CPS-ORG) between 2003 and 2018. Data for prices come from the detailed Consumer Price Indices provided by the Bureau of Labor Statistics between 2003 and 2018. Home Lux is the price index for home luxuries, Leis Lux is the price index for leisure luxuries, Home Nec is the price index for home necessities, and Leis Nec is the price index for leisure necessities. Both wages and prices are normalized by the price index of home luxury goods every year.

Since only relative prices matter for allocations, we normalize wages and prices by the price index of home luxuries every year. Figure E.1 plots the growth rate of the normalized wages and prices. Wages, relative to the price of home luxuries, grew until the onset of the Great Recession and then declined between 2008 and 2013. Since then, wage growth has been more dispersed across education groups. Prices of home necessities and leisure luxuries, relative to the price of home luxuries, grew by 20 percent over the sample period, while the relative price of leisure necessities increased from 2003 to 2015 and then dropped to its

2003 level. These movements imply that price indices were significantly more dispersed in 2018 than at the beginning of the sample period.

E.2 Robustness: Estimation with Education-Specific Prices

Table E.24: Parameter Estimates with Education-specific Prices

	(1) Home Luxury	(2) Leis Luxury	(3) Home Necessity	(4) Leis Necessity
Elast. Time & Goods	$\hat{\xi}_{HL}$	$\hat{\xi}_{LL}$	$\hat{\xi}_{HI}$	$\hat{\xi}_{LI}$
	1.656	0.512	1.057	1.357
	(0.026)	(0.034)	(0.023)	(0.021)
Expenditure Shares	$\hat{\kappa}_{HL}$	$\hat{\kappa}_{LL}$	$\hat{\kappa}_{HI}$	$\hat{\kappa}_{LI}$
	0.086	0.971	0.054	0.032
	(0.003)	(0.010)	(0.001)	(0.001)
Nonhomotheticity	$\hat{\bar{\ell}}_{HL}$	$\hat{\bar{\ell}}_{LL}$	$\hat{\bar{\ell}}_{HI}$	$\hat{\bar{\ell}}_{LI}$
	0.091	-0.189	2.667	1.462
	(0.009)	(0.003)	(0.059)	(0.051)
Utility Weights	$\hat{\alpha}_{HL}$	$\hat{\alpha}_{LL}$	$\hat{\alpha}_{HI}$	$\hat{\alpha}_{LI}$
	0.161	0.043	0.435	0.360
	(0.001)	(0.001)	(0.001)	(0.001)
Elast. b/w Activities	$\hat{\rho}$			
	2.891			
	(0.035)			

Notes: The table reports the means of the bootstrapped distributions for the preference parameters of the model described in section 3 (bootstrapped standard errors are in parentheses). Prices are education specific.

E.3 Robustness: Estimation with Restricted Parameter Values

Table E.25: Parameter Estimates of a Model with $\bar{\ell}_i = 0$, $\xi_i = \hat{\xi}, \forall \xi$

	(1) Home Luxury	(2) Leis Luxury	(3) Home Necessity	(4) Leis Necessity
Elast. Time & Goods	$\hat{\xi}$			
	2.205			
	(0.056)			
Expenditure Shares	$\hat{\kappa}_{HL}$	$\hat{\kappa}_{LL}$	$\hat{\kappa}_{HI}$	$\hat{\kappa}_{LI}$
	0.097	0.147	0.271	0.100
	(0.001)	(0.002)	(0.006)	(0.001)
Utility Weights	$\hat{\alpha}_{HL}$	$\hat{\alpha}_{LL}$	$\hat{\alpha}_{HI}$	$\hat{\alpha}_{LI}$
	0.026	0.339	0.357	0.277
	(0.020)	(0.006)	(0.051)	(0.030)
Elast. b/w Activities	$\hat{\rho}$			
	0.277			
	(0.101)			

Notes: The table reports the means of the bootstrapped distributions for the preference parameters in an alternative model. It corresponds to the model described in section 3, except that the nonhomothetic term $\bar{\ell}_i$ is set to zero for all activities and the elasticity between time and goods ξ is no longer activity specific. Bootstrapped standard errors are in parentheses.

Table E.26: Parameter Estimates of a Model with $\bar{\ell}_i = 0$

	(1) Home Luxury	(2) Leis Luxury	(3) Home Necessity	(4) Leis Necessity
Elast. Time & Goods	$\hat{\xi}_{HL}$	$\hat{\xi}_{LL}$	$\hat{\xi}_{HI}$	$\hat{\xi}_{LI}$
	1.502	1.492	0.523	1.239
	(0.304)	(0.281)	(0.357)	(0.249)
Expenditure Shares	$\hat{\kappa}_{HL}$	$\hat{\kappa}_{LL}$	$\hat{\kappa}_{HI}$	$\hat{\kappa}_{LI}$
	0.157	0.188	0.862	0.112
	(0.068)	(0.045)	(0.208)	(0.005)
Utility Weights	$\hat{\alpha}_{HL}$	$\hat{\alpha}_{LL}$	$\hat{\alpha}_{HI}$	$\hat{\alpha}_{LI}$
	0.055	0.242	0.479	0.225
	(0.045)	(0.089)	(0.222)	(0.095)
Elast. b/w Activities	$\hat{\rho}$			
	0.722			
	(0.361)			

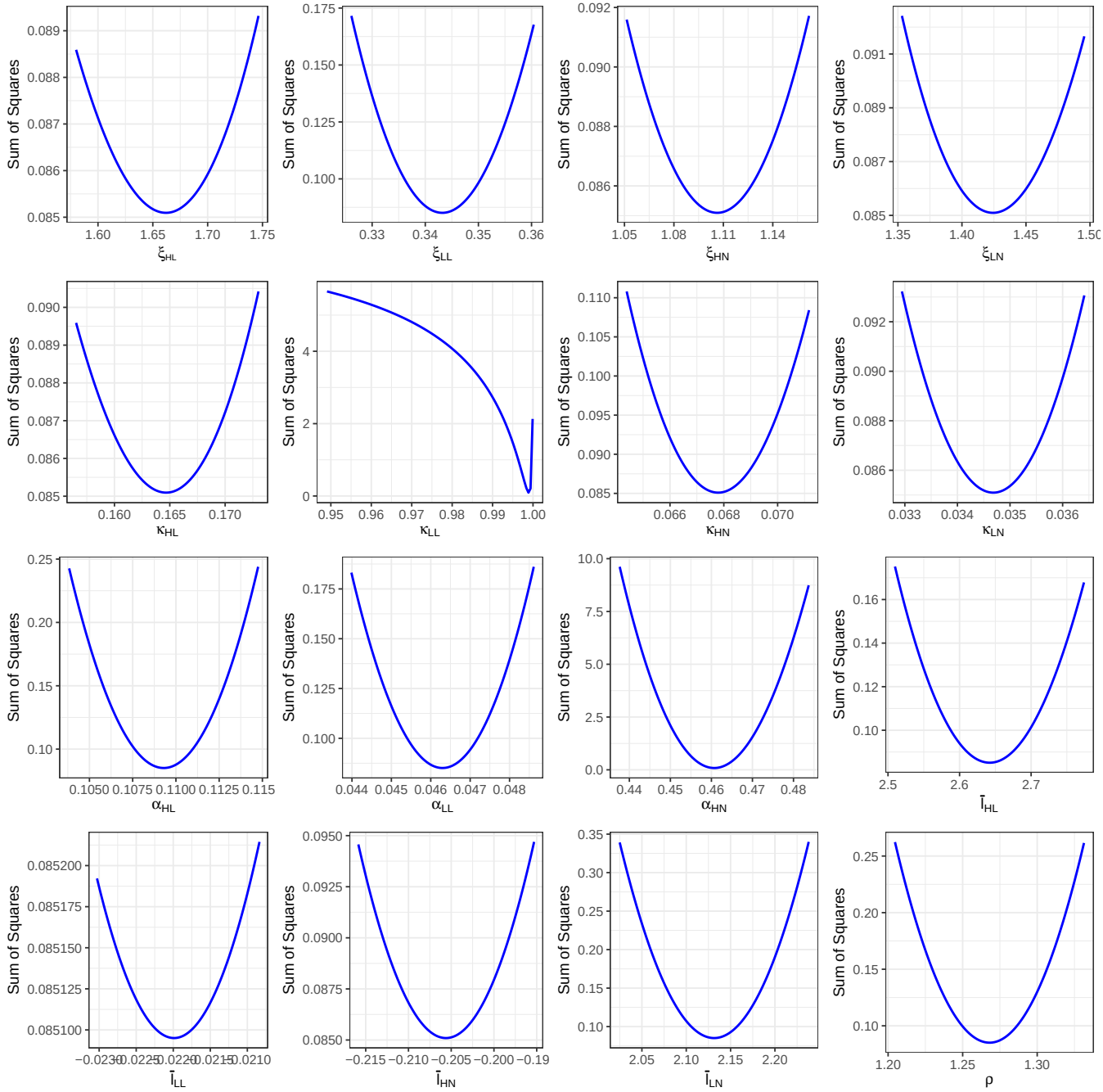
Notes: The table reports the means of the bootstrapped distributions for the preference parameters of a model with homothetic preferences. It corresponds to the model described in section 3, except that the nonhomothetic term $\bar{\ell}_i$ is set to zero for all activities. Bootstrapped standard errors are in parentheses.

Table E.27: Parameter Estimates of a Model with 2 Categories

	(1) Home	(2) Leisure
Elast. Time & Goods	$\hat{\xi}_H$	$\hat{\xi}_L$
	1.288	3.650
	(0.014)	(0.059)
Expenditure Shares	$\hat{\kappa}_H$	$\hat{\kappa}_L$
	0.165	0.193
	(0.001)	(0.002)
Nonhomotheticity	$\bar{\ell}_H$	$\bar{\ell}_L$
	0.567	-0.456
	(0.007)	(0.002)
Utility Weights	$\hat{\alpha}_H$	$\hat{\alpha}_L$
	0.852	0.148
	(0.005)	(0.005)
Elast. b/w Activities	$\hat{\rho}$	
	0.936	
	(0.027)	

Notes: The table reports the means of the bootstrapped distributions for the preference parameters of a model with 2 categories: home production and leisure. Bootstrapped standard errors are in parentheses.

Figure E.2: Identification of Parameters



Notes: Each subplot depicts the value of the objective function when a given parameter value changes in a neighborhood of its estimated value.