Marketization and Marriage in a Task-Based Model of Home Production *

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Abstract

In recent decades, the U.S. has experienced a decline in marriage rates, driven almost entirely by those without a college degree. In this paper, we study the role of economic forces—growth, marketization of home production, and the gender wage gap—in shaping the gains from marriage relative to singlehood across education groups. We propose a novel task-based model of home production in which individuals are heterogeneous in their skill across home production tasks and home production tasks are differentially substitutable in the market. Marriage boosts home production efficiency by allowing spouses to specialize in tasks according to their comparative advantage. When households outsource a greater share of home production tasks to the market, they become less likely to marry. Marketization erodes the gains from marriage fastest for low-skilled couples, because they specialize in tasks that are more substitutable in the market. In our calibrated model, Hicks-neutral productivity growth alone explains a large number of long-run trends: rising marketization, a hump-shaped pattern of marriage and U-shaped pattern of female employment with respect to aggregate income, and a recent decline in marriage that is concentrated among the less educated.

JEL Codes: D13, J12, J16, O14.

Keywords: Marketization, marriage, home production, service economy, education.

*The views expressed herein are solely those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of San Francisco or the Federal Reserve System.

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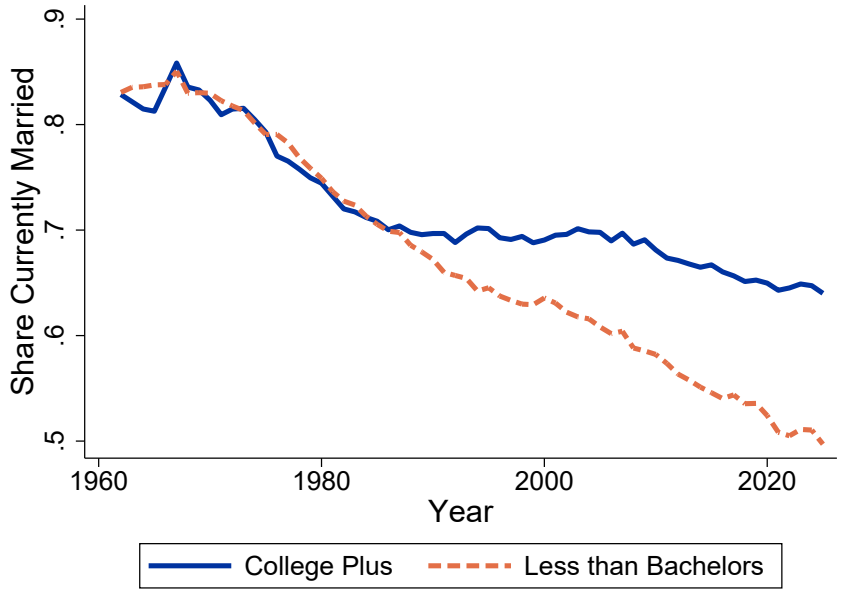
1 Introduction

In 2019, the United States' GDP per capita was higher than at any prior point in history. That same year, the Pew Research Center found that the US marriage rate had hit a 140-year low (LaGorce, 2026). The United States is far from the only country to experience record-high economic activity and record-low family formation. Aggregate income continues to rise around the world, but a large number of countries are now in the midst of a "relationship recession," with a declining share of adults who are married or cohabitating (Burn-Murdoch, 2025). Yet a decline in marriage has not always accompanied economic growth; in many OECD countries, the marriage rate rose alongside GDP at earlier stages of development (Moro et al., 2017). What is it that drives the recent de-coupling of economic growth and marriage?

While marriage is a personal decision, it is also an economic one. Couples who marry or cohabitate go from two distinct households to just one, with assets, earnings, and housework responsibilities typically pooled between partners. In Becker (1973)'s canonical framework of marriage, the economic benefits of forming a two-person household relative to remaining single stem from intra-household specialization between market work and home production. Traditionally, women specialized relatively more in home production and men in market work. Marriage rates have declined substantially in the United States dating back to the 1970s. This decline is consistent with two major changes in the household economy: the narrowing gender wage gap, which reduces gains from gender-based specialization, and the increasing availability of market substitutes for home production, which allows both married and single households to source more household services from the market.

However, the decline in marriage has been more pronounced among those without a college degree since 1980 (see Figure 1). This widening education gap is difficult to reconcile with the standard framework in which home production is treated as a homogeneous activity.

Figure 1: Share of Adults (25-59) Married



Notes: Data from CPS ASEC (Flood et al., 2025a). Sample consists of men and women ages 25-59 who report whether they are currently married. Individuals who report at least 4 years of college are considered "College Plus."

Because the opportunity cost of performing home production rises with wages, higher-wage households have stronger incentives to substitute market goods and services for household time. Holding the composition of home production fixed, marketization should therefore erode the gains from marriage at least as strongly among the college educated (Cerina et al., 2021; Bar et al., 2018; Greenwood et al., 2016).

In this paper, we enrich a standard model of household consumption and time allocation between market and home production to account for heterogeneity in home production tasks. Following Boerma and Karabarbounis (2021), we allow individuals to differ in their productivity across home production tasks. In addition, we let households decide to perform each task domestically or purchase a substitute from the market. We introduce market substitutes in our task-based model of home production in the way that Acemoglu and Restrepo (2018) model automation under the task-based model of market production: as technology advances, market-supplied home production substitutes replace personal home production time in a growing share of tasks. We show through quantitative experiments that

the model can explain recent trends in the marriage market, including the widening college gap in marriage.

In the first part of our paper, we document two motivating facts which inform the modeling choices. First, we show that single individuals source more of their home production from the market, compared to married people. This is consistent with the logic of the Beckerian framework that marriage gains stem from giving spouses access to each other's (otherwise non-tradeable) time at home. Second, we assign a skill ranking across home production tasks based on college attainment of workers in the closest substitute market occupation. We find that the composition of home production differs by skill level: people with a college degree spend a higher share of their total home production time on higher skill tasks. This pattern is not explained by the presence of children. This suggests that highly educated people may have a comparative advantage in high skill tasks at home.

Motivated by these facts, we propose a task-based model of home production. Households in our model value both market consumption, like food and electronics, and home production, which combines a continuum of tasks like cooking, cleaning, and household management. The key decision of the household is how to allocate home production tasks. The household can always perform a given task internally, using the time of household members. An advantage of marriage is that it allows the household to assign the task to either spouse, depending on whose opportunity cost of performing the task is lower. Alternatively, the household can delegate the task to the market. If the household assigns the task to the market, they purchase market output in the form of *home production substitutes*, and can redirect their time to other tasks or to market labor.

The task-based model provides a microfoundation for multiple concepts that are central to the economics of marriage and time use. Couples' ability to directly substitute one spouse's home production time for the other's allows for Beckerian specialization, both between home and market production and between different home production tasks. The option to

outsource each home production task to the market generates a marketization margin, where households can reduce the overall time burden of home production and instead supply labor to market production, as in Ngai and Petrongolo (2017). And because we allow for all market output—both goods and services—to be transformed into home production substitutes, our model captures the force in Greenwood et al. (2005), in which technological progress in consumer durables translates into time savings within the household.

Linking these concepts through a unified model allows us to analyze how they interact. We focus on the interplay between the marketization margin and the Beckerian gains from marriage. Our model makes a clear prediction: *ceteris paribus*, as the price of home production substitutes falls and households delegate a greater share of tasks to the market, the economic gain from marriage falls too. The economics of this result are simple. The benefit of marriage is that it allows for the reallocation of home production time: one spouse may move their time out of home production and into the market, the other may do the opposite, and both spouses focus their home production time on tasks where they are most efficient. The rise of market substitutes means that this home production time comprises only a small share of households' total time use, so the gains from reallocating home production time are small. Where men and women once economized on home production by trading time within the household, they now trade with the market instead.

To connect changes in the economic gain from marriage with realized marriage rates in the population, we close the model with a frictionless marriage market that follows the structure of Choo and Siow (2006). In the marriage market, women and men of different skill levels decide whether to marry one another or stay single in a discrete-choice framework. The probability of marriage relative to singlehood between a woman and man of any skill combination is a logistic function of the economic gain from marriage and a marriage amenity term that acts as a residual. This structure allows for marriage rates to differ by skill level.

When we allow for multiple categories of home production tasks, the task-based model

rationalizes divergent marriage trends by education. In line with the evidence that the composition of home production differs systematically by skill level, we assume that home production consists of both routine and skill-intensive tasks. Low-skilled workers focus their home production time on routine home production, while the high-skilled focus on skill-intensive home production. We make the key assumption that routine home production tasks are more *marketizable* than skill-intensive ones. By "more marketizable," we mean that the elasticity of substitution between home production time and market-provided home production substitutes is greater for routine tasks than for skill-intensive tasks. Under this assumption, the falling price of home production substitutes has asymmetric effects by skill. Low-skilled workers' time is replaced within the household at a faster rate than high-skilled workers'. The upshot is that marketization erodes the gains from marriage most quickly for low-skilled couples and causes their marriage rate to steeply decline, even as marriage remains relatively stable for high-skilled couples.

In the final part of the paper, we conduct quantitative experiments to examine how two long-running trends in advanced economies—technological progress and rising demand for female labor—impact marriage and time-use patterns through the lens of our model. We first calibrate the model so that our benchmark parametrization matches wage, time-use, and marriage patterns across skill and gender groups in the early 21st century. Then we separately vary two exogenous parameters: Hicks-neutral total factor productivity for market production, and the weight on female labor in market production.

The main finding from our quantitative experiments is that in our calibrated model, Hicks-neutral productivity growth alone explains many salient trends in marriage and time use. The productivity growth experiment reproduces the pattern from Figure 1: marriage declines at late stages of development, corresponding roughly to the US from 1970 onward, and its decline is concentrated among the less educated. Over a wider range of productivity levels, the model generates a non-monotonic hump shape of marriage with respect to GDP per capita, which Moro et al. (2017) document empirically in 16 OECD countries. This is

not the only non-monotonic empirical regularity captured by the model. It also replicates the U shape of female employment with respect to development first documented by Goldin (1994). We examine the composition of economic activity under this experiment to show that home production and marketization are crucial for understanding these trends.

Our productivity growth experiment does generate a few patterns that are at odds with the data. Most notably, it implies rising male employment rates and flat or falling female/male wage ratios, when the opposite is true in reality. To capture real-world trends and to serve as a complement to the productivity growth experiment, we also explore the effects of rising demand for female labor. In our model, female labor demand rises through shifting weights in the production function for market output, but our experiment captures labor demand shifters more generally, such as falling discrimination. As expected, rising female labor demand raises female employment, reduces male employment, and narrows the gender wage gap. It also reduces marriage rates as predicted by Becker (1973), by diminishing the scope for specialization through marriage. Our quantitative experiments lead us to believe that Hicks-neutral productivity growth and rising female labor demand together can explain the bulk of recent trends in the marriage market. In future versions of this paper, we plan to quantify the contribution of each channel.

The remainder of the paper is divided as follows. Section 2 describes how our paper relates to the existing literature, and Section 3 presents the facts that motivate our analysis. Section 4 lays out our task-based model that rationalizes these facts and formalizes the relationship between marketization and marriage. In Section 5 we calibrate the model to data moments from the early 21st century, and in Section 6 we run our quantitative experiments. Section 7 concludes and describes the next steps we hope to take with this paper.

2 Related Literature

This paper relates to two literatures: one on family economics and marriage, and the other on home production and marketization.

A central idea in the economics of marriage is that household formation generates economic gains through specialization and joint production. In the canonical framework of Becker (1973), differences in the market and home productivities of men and women create comparative advantage and therefore gains from marriage. Subsequent quantitative and empirical work has examined how technological and economic change alters these gains and, in turn, family formation. On the quantitative side, Greenwood et al. (2016) develops a unified model of household technology, marriage, divorce, education, and married female labor supply. On the empirical side, Moro et al. (2017) relates structural transformation to marriage patterns, Autor et al. (2019) documents that adverse shocks to men's labor-market opportunities reduce their marriage-market value and family formation, and Shenhav (2021) studies how variation in the gender wage gap affects marriage, spouse quality, and women's labor-market behavior. Together, this work provides evidence that changes in relative economic opportunities matter for household formation. Our paper asks how these changes interact with another major transformation in the household economy: the increasing availability of market substitutes for home production.

A separate literature studies the role of home production and marketization in structural transformation and labor supply. The movement of household production into the market has been shown to be quantitatively important for the shift of employment and production from manufacturing to services, as well as the rise of female labor force participation (Ngai and Petrongolo, 2017; Cerina et al., 2021; Bridgman and Valentinyi, 2026; Cortes and Tessada, 2011). Existing work, however, typically treats home production as a single composite activity, with market services substituting for household time through a common elasticity.

We document that the composition of home production differs systematically by education: college- and non-college-educated individuals perform different types of home production tasks. Motivated by this evidence, we model home production as a collection of heterogeneous tasks that differ in both household productivity and the availability of market substitutes. Marketization can therefore change not only the quantity of home production, but also its composition and the gains from specialization within the household.

Our approach builds on recent work that opens up heterogeneity within home production. Boerma and Karabarbounis (2021) allows households to differ in their productivity in home production, while Fried et al. (2025) explicitly models home production as a collection of heterogeneous tasks. We adopt a task-based framework in the spirit of Acemoglu and Restrepo (2018), but apply it within the household: tasks can be performed by either spouse or sourced from the market. In this framework, marketization is analogous to automation, reallocating tasks away from household members and thereby changing the gains from specialization within marriage.

3 Motivating Facts

In this section, we document two motivating descriptive facts which inform model ingredients. First, we show that relative to married households, single households source more of their home production from the market. This fact is consistent with market-home specialization gains from marriage and it also suggests that greater marketization of home services would reduce the marital surplus by making singlehood more attractive.

Second, we document that the composition of home production tasks performed by college- vs. non-college-educated individuals is systematically different. More educated individuals spend a greater share of their home production time on tasks which require a higher skill level (the measurement of skill requirements of home production tasks is described below).

This evidence suggests that individuals are heterogeneous in their ability for different types of home production and this shapes the type of home production they perform. In our model, heterogeneity in the availability of market substitutes for different home production tasks will generate different effects on the gains from marriage for high- and low-skill households.

Fact 1: Single Households Marketize More Home Production

We define marketization as the share of total expenditure on home production and home production substitutes which are obtained from the market. The shadow price of home production is an individual's wage. Our measure of marketization for a household consisting of persons i and j is:

$$m_{ij} = \frac{P_S S}{w_i h_i + w_j h_j + P_S S} \tag{1}$$

where $P_S S$ is total expenditure on home production substitutes, w_i and w_j are the household members' wages, and h_i and h_j are the household members' time allocation spent on home production. In the case of a single household, one wage and one time allocation are set to 0.

A key challenge is that no data set in the US provides detailed consumption expenditures and time use together.[1] Additionally, the existing time use surveys are at the individual level and do not provide time allocations of both partners within a married household. To document marketization patterns, we thus have to source each ingredient from a different data set. We calculate average wages, home production substitutes expenditure, and time use within broad cells representing household types. There are four types of single households, by gender (male or female) and education (college or non-college), as well as four types of married households (by college/non-college status of the male and female partner). In addition, we distinguish households in which there is no child under age 18 from households in which there is a child, to account for differences in household expenditure patterns due to

[1]The PSID includes very broad consumption and time use categories.

life cycle factors. In total, there are 16 distinct household types.

For each of these cells, we calculate $P_S S$ as the average expenditure on home production substitutes in the Consumer Expenditure Survey (CEX) for 2010-2014. We use the 2003-2019 American Time Use Survey (ATUS) to calculate home production hours, where we consider activities labeled as "Household Activities" and "Caring for and Helping Household Members" as home production time (Flood et al., 2025b).[2] Finally, we calculate the mean hourly wage by gender and education among full-time, full-year workers using the 2010 5-year American Community Survey (Ruggles et al., 2025).[3]

Figure 2 displays the marketization share calculated using equation 1 across different household types. Single households exhibit greater marketization across all education levels and presence/absence of children. Marketization also tends to be higher among the college-educated, but the education differences among married households are small compared to among singles.

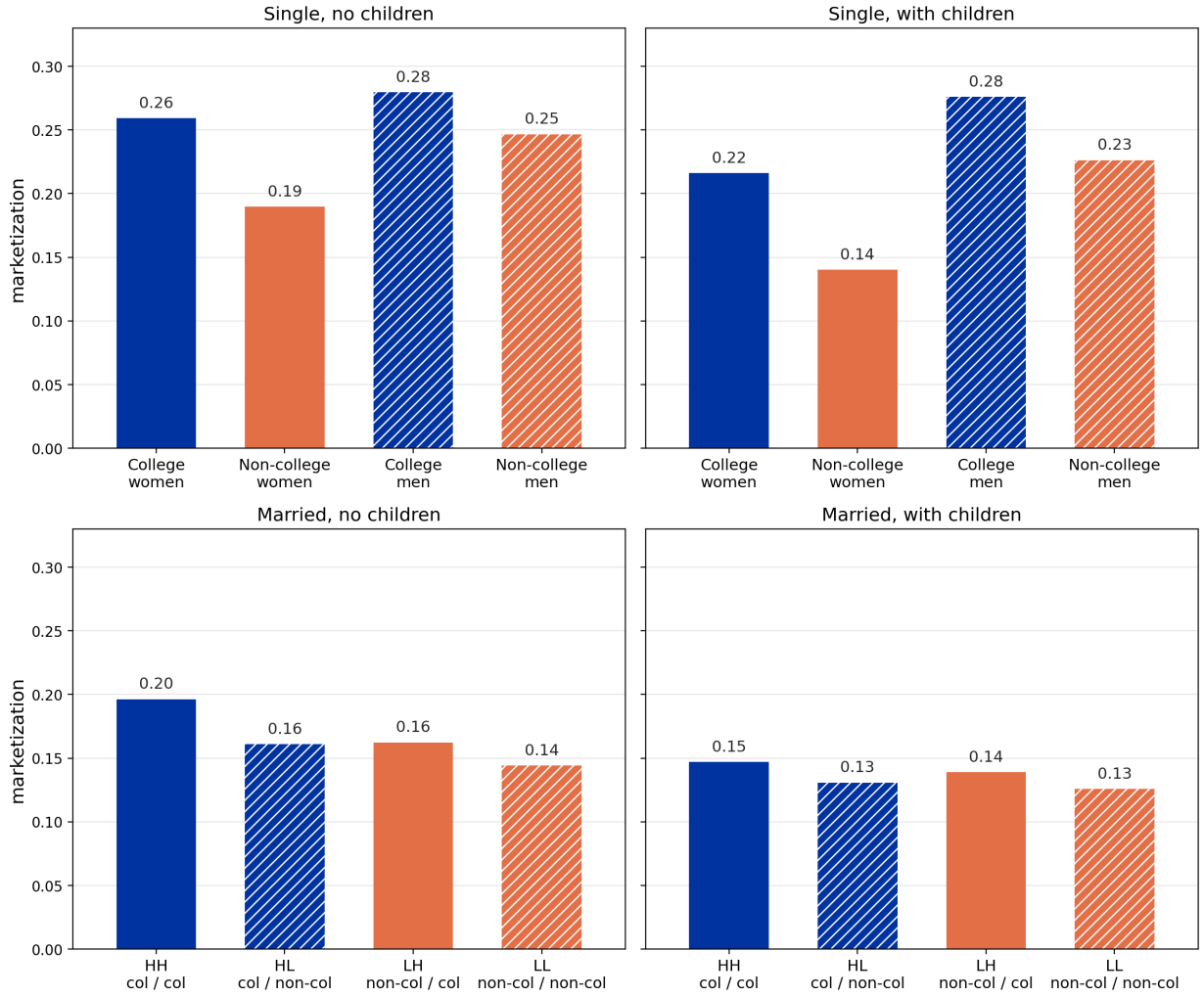
Fact 2: College Educated Individuals Perform Higher Skill Home Production

The second motivating fact is that the composition of home production tasks varies across skill levels: educated individuals tend to spend more of their home production time on high-skill tasks. This fact clearly requires a skill ranking of home production tasks. We develop a novel skill ranking of home production tasks based on the logic that each home production task has an analogous market occupation that either serves as a market substitute, or involves performing a similar function. This follows a similar logic as Boerma and Karabarbounis

[2]Subcategories include: Housework; Food and Drink Preparation, Presentation, and Clean-up; Interior Maintenance, Repair, and Decoration; Exterior Maintenance, Repair, and Decoration; Lawn, Garden, and Houseplants; Animals and Pets; Vehicles; Appliances, Tools, and Toys; Household Management; Caring for and Helping Household Children; Activities Related to Household Children's Education; Activities Related to Household Children's Health; Caring for Household Adults; and Helping Household Adults.

[3]Mean wages are calculated across 4 cells capturing education and gender, whereas mean expenditure and hours are calculated across 16 cells which also vary by household composition.

Figure 2: Marketization of Home Production by Household Type



Notes: Marketization as defined by equation 1 for different household types. Expenditure on home production substitutes comes from the 2010-2014 CEX; categories included are displayed in Table 6. Hours spent on home production come from the 2003-2019 ATUS. Wages by gender and education are calculated among full-time, full year workers in the 2010 5-year ACS.

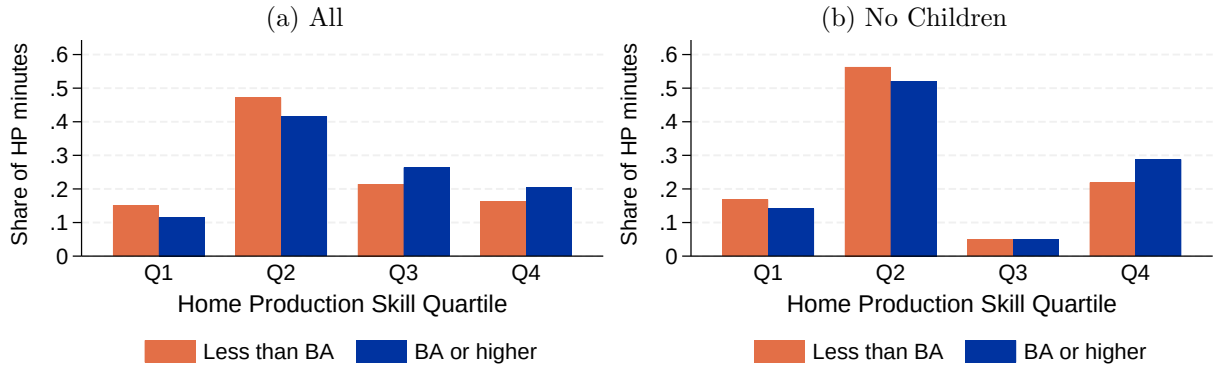
(2021).

We take the 63 home production activities in the ATUS (excluding waiting activities) and map each task to an occupation from the classification of Autor and Dorn (2013) which either is a market substitute for the activity or performs similar tasks. The mapping between home production activities and occupations is displayed in Table 7. We then calculate the share of workers in that occupation who have a college degree, in the ACS pooled between 2003 and 2019. We rank the home production tasks in increasing college share of the associated occupation. Weighting by total time spent on the activity between 2003 and 2019 in the

ATUS, we assign each home production activity its midrank.

This ranking of home production tasks by skill level assumes that the relative skill required or complexity of different home production tasks is the same as the relative college share of the associated occupations. We do not require the assumption that "Interior cleaning" performed at home has the same skill level as its market occupation, "Housekeepers, maids, butlers, and cleaners," but rather that if "Housekeepers, maids, butlers, and cleaners" have a lower college share than "Child care workers," then "Interior cleaning" has a lower skill requirement than "Reading to or with household children."

Figure 3: Distribution of Home Production Minutes Across Task Skill Quartiles



Notes: Data from the American Time Use Survey 2003–2019 (Flood et al., 2025b). Sample is respondents ages 25–54 with positive home production time. Panel (b) restricts to respondents with no household member under 18.

Figure 3 shows the distribution of home production time across skill quartiles for college and non-college individuals. Panel (a) is constructed using all people age 25-54 who report non-zero home production time in the ATUS between 2003 and 2019, whereas Panel (b) uses only the subsample who do not have a child under the age of 18. The distribution of home production time over task skill requirements for college educated first-order stochastically dominates that for non-college individuals. While many childcare-related tasks fall into the third quartile, the overall pattern is preserved even among individuals who do not have a child, suggesting that this pattern generalizes beyond childcare.

One concern may be that the difference in the distribution of home production time for college and non-college in Figure 3 is driven by demographic composition correlated with

education. To mitigate this concern, we run the following regression:

$$\text{Mean HP Midrank}_i \;=\; \alpha \;+\; \beta\,\text{College}_i \;+\; \mathbf{X}_i'\gamma \;+\; \varepsilon_i,$$

where Mean HP Midrank$_i$ is the mean home production skill midrank of individual i (weighting by time spent on each activity they perform). The sample again includes people aged 25-54 in the 2003-2019 ATUS who report non-zero home production minutes. X_i controls for age, marital status, and other demographics, gender, and the presence of children. The results are reported in Table 1. Each column reports the results for a different subsample. The findings across all sub-samples are similar: having a college degree is associated with a higher skill composition of home production performed.

Table 1: Correlation between Education and Mean Home Production Skill Midrank

	(1) All	(2) Women	(3) Men	(4) No children
BA or higher	0.052***	0.055***	0.048***	0.047***
	(0.002)	(0.002)	(0.003)	(0.004)
Observations	98,334	58,014	40,320	31,997
R^2	0.041	0.041	0.042	0.012
Mean of dep. var.	0.536	0.526	0.548	0.503
Sex	Yes	—	—	Yes
Marital status	Yes	Yes	Yes	Yes
Age bins	Yes	Yes	Yes	Yes
Any children	Yes	Yes	Yes	—

Notes: Sample is ATUS respondents ages 25–54, 2003–2019, reporting positive home production time on the diary day, weighted by `wt06`. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4 Model

We now develop a model that rationalizes the facts we documented above about marketization and specialization in home production. The main innovation of the model is that home

production combines a continuum of heterogeneous tasks, with the option for tasks to be outsourced to the market.

4.1 Environment

The economy is populated by four types of workers who live in eight types of households. Workers are either high-skilled or low-skilled and either female or male. A worker may live in a household with another worker of the opposite gender, or they may be single. We denote households by ij, where $i \in \{h, \ell, 0\}$ indexes the woman in the household and $j \in \{h, \ell, 0\}$ indexes the man in the household. An index of $i = 0$ indicates the absence of a woman (a single man), and likewise an index of $j = 0$ indicates the absence of a man (a single woman). The measure of workers of each type is exogenous; we denote the measure of gender-g skill-s workers by N_g^s and normalize the total measure of workers to one. The endogenous measure of households of type ij is ρ_{ij}, which we micro-found below in a Choo and Siow (2006)-style marriage market.

Each worker is endowed with L units of labor. They divide L between market labor L_Y that is used to produce market output Y, and home production labor L_{HP} that is used to complete tasks within the home. Market output Y is produced by perfectly competitive firms that use labor as their only factor of production. It can be used either as market consumption C, or it can be transformed by competitive firms into home production substitutes S, which households can purchase from the market to reduce the measure of tasks that must be completed within the home. Market output Y and home production substitutes S are both traded in the market at common prices, but home production labor cannot be directly exchanged across households.

4.2 Preferences

Household ij has homothetic CES preferences over market consumption C_{ij} and home production H_{ij}:

$$U_{ij} = \left[\alpha^{1/\rho} C_{ij}^{\frac{\rho-1}{\rho}} + (1-\alpha)^{1/\rho} H_{ij}^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}. \tag{2}$$

The household acquires market consumption C_{ij} by purchasing market output Y. Meanwhile, home production combines a routine task aggregator R_{ij} and a skill-intensive task aggregator Q_{ij}:

$$H_{ij} = \left[\beta^{1/\sigma} R_{ij}^{\frac{\sigma-1}{\sigma}} + (1-\beta)^{1/\sigma} Q_{ij}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}. \tag{3}$$

We discuss household production of R_{ij} and Q_{ij} in detail in the next sub-section.

4.3 Production

4.3.1 Market Output

Market output Y is produced using a market labor composite L_Y that is a nested CES combining high-skilled and low-skilled labor in the outer nest, and male and female labor of a given skill level in the inner nest. Production of Y has constant returns to scale and total factor productivity A:

$$\begin{aligned} Y &= AL_Y \\ L_Y &= \left[\phi^{\frac{1}{\lambda}} \left(L_Y^h\right)^{\frac{\lambda-1}{\lambda}} + (1-\phi)^{\frac{1}{\lambda}} \left(L_Y^\ell\right)^{\frac{\lambda-1}{\lambda}}\right]^{\frac{\lambda}{\lambda-1}} \\ L_Y^s &= \left[\zeta_s^{\frac{1}{\eta}} \left(L_{fY}^s\right)^{\frac{\eta-1}{\eta}} + (1-\zeta_s)^{\frac{1}{\eta}} \left(L_{mY}^s\right)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, \end{aligned} \tag{4}$$

where L_Y^s denotes market labor of skill level $s \in \{h, \ell\}$ and L_{gY}^s denotes market labor of skill level s and gender $g \in \{f, m\}$.

The perfectly competitive market sector takes wages of every gender-skill group w_g^s as

given. The price of market output is $P_Y = w/A$, where the aggregate wage composite satisfies:

$$\begin{aligned} w &= \left[\phi(w^h)^{1-\lambda} + (1-\phi)(w^\ell)^{1-\lambda}\right]^{\frac{1}{1-\lambda}} \\ w^s &= \left[\zeta_s(w_f^s)^{1-\eta} + (1-\zeta_s)(w_m^s)^{1-\eta}\right]^{\frac{1}{1-\eta}}. \end{aligned} \tag{5}$$

Home Production Substitutes Besides market output Y, we assume that there exist two perfectly competitive market substitute sectors, one that substitutes for routine tasks (S_R), and another that substitutes for skill-intensive tasks (S_Q). These sectors directly transform market output Y into units of S_R and S_Q that are sold as a replacement for household labor in home production tasks. This assumption captures households' ability to use both services (household cleaners, tax professionals) and goods (appliances, personal computers) to reduce the time burden of home production. One unit of Y can be transformed into A_R units of S_R or A_Q units of S_Q:

$$\begin{aligned} S_R &= A_R Y_R \\ S_Q &= A_Q Y_Q, \end{aligned} \tag{6}$$

so that prices are $P_{S_R} = P_Y/A_R$ and $P_{S_Q} = P_Y/A_Q$.

4.3.2 Home Production Tasks

The main innovation of our model is to introduce a task-based production function into the household in order to better understand the household allocation of labor between market and home production, the delegation of home production tasks to the market, and the benefit of joining two workers together in a household. We assume that routine home production R and skill-intensive home production Q each combine a continuum of tasks $k_R \in [0,1]$ and

$k_Q \in [0,1]$ according to a Cobb-Douglas production function:

$$\begin{aligned} R_{ij} &= \exp\left(\int_0^1 \log x_{k_R,ij} dk_R\right); \\ Q_{ij} &= \exp\left(\int_0^1 \log x_{k_Q,ij} dk_Q\right), \end{aligned} \tag{7}$$

where $x_{k,ij}$ denotes the quantity of task k used by household ij.

The household can produce a given task k by using home production labor $L_{i,HP}$ or $L_{j,HP}$, or by buying home production substitutes S_R or S_Q from the market. Within a task k, $L_{i,HP}$, $L_{j,HP}$, and the relevant market substitute S_R or S_Q are perfect substitutes for one another. Each of these is transformed into a_k units of the task quantity x_k, where a_k is an idiosyncratic productivity draw:

$$\begin{aligned} x_{k_R} &= a_{i,k_R}\ell_{i,k_R} + a_{j,k_R}\ell_{j,k_R} + a_{S_R,k_R}S_{R,k_R}; \\ x_{k_Q} &= a_{i,k_Q}\ell_{i,k_Q} + a_{j,k_Q}\ell_{j,k_Q} + a_{S_Q,k_Q}S_{Q,k_Q}, \end{aligned} \tag{8}$$

where ℓ_{i,k_R} is the labor of member i devoted to task k_R and S_{R,k_R}, S_{Q,k_Q} are respectively the units of home production substitutes purchased to complete task k_R or k_Q. If the household consists of a single person, then by assumption they cannot assign any production of task k to the labor of an absent household member, i.e. $\ell_{0,k_R} = \ell_{0,k_Q} = 0$.

We assume that idiosyncratic productivity draws a_k each follow a Fréchet distribution for household members and for the market. Draws are independent across household members and the market, and across tasks. The relevant Fréchet distribution of each draw is characterized by a scale parameter T and a shape parameter θ. For household members, we allow for the scale parameter to differ by skill $s \in \{h, \ell\}$, gender $g \in \{m, f\}$, and task type R or Q; for market substitutes, the scale parameter differs only by task type R or Q. Finally, we allow for the shape parameter θ to differ between R- and Q-type tasks. To be formal and exhaustive,

cumulative distribution functions for each idiosyncratic productivity draw are as follows:

$$\begin{aligned}
\mathbf{Pr}\left(a_{i,k_R} \leq a | i = s\right) &= \exp\left(-T^s_{f,R} a^{-\theta_R}\right); \\
\mathbf{Pr}\left(a_{j,k_R} \leq a | j = s\right) &= \exp\left(-T^s_{m,R} a^{-\theta_R}\right); \\
\mathbf{Pr}\left(a_{S_R,k_R} \leq a\right) &= \exp\left(-T_{S_R} a^{-\theta_R}\right); \\
\mathbf{Pr}\left(a_{i,k_Q} \leq a | i = s\right) &= \exp\left(-T^s_{f,Q} a^{-\theta_Q}\right); \\
\mathbf{Pr}\left(a_{j,k_Q} \leq a | j = s\right) &= \exp\left(-T^s_{m,Q} a^{-\theta_Q}\right); \\
\mathbf{Pr}\left(a_{S_Q,k_Q} \leq a\right) &= \exp\left(-T_{S_Q} a^{-\theta_Q}\right).
\end{aligned} \tag{9}$$

This parametrization allows for natural differences in household members' expected ability to perform certain tasks. For example, if high-skilled men are more productive than low-skilled men at skill-intensive home production Q, this would be reflected by the parameter condition $T^h_{m,Q} > T^\ell_{m,Q}$. Differences in the shape parameter θ across task types also allow for some tasks to be more readily reallocated between household members and the market.

Within the household, we aggregate home production labor and use of market substitutes across all tasks to obtain $L_{i,HP}$, $L_{j,HP}$, $S_{R,ij}$, and $S_{Q,ij}$.

$$\begin{aligned}
L_{i,HP} &= \int_0^1 \ell_{i,k_R} dk_R + \int_0^1 \ell_{i,k_Q} dk_Q; \\
L_{j,HP} &= \int_0^1 \ell_{j,k_R} dk_R + \int_0^1 \ell_{j,k_Q} dk_Q; \\
S_{R,ij} &= \int_0^1 S_{R,k_R} dk_R \\
S_{Q,ij} &= \int_0^1 S_{Q,k_Q} dk_Q.
\end{aligned} \tag{10}$$

The household then allocates labor $L_{i,Y} = L - L_{i,HP}$ and $L_{j,Y} = L - L_{j,HP}$ to the market.

4.4 The Household's Problem

The household ij takes as given the price of market output P_Y, the prices of market substitutes P_{S_R} and P_{S_Q}, and the wages of its household members w_i and w_j. It chooses how to allocate labor between each home production task and the market, and how to spend its earnings from market labor. Its objective is to maximize utility as defined by (2), subject to the home production functions in (3), (7), and (8), and subject to the household budget constraint. The budget constraint imposes that household expenditure on market consumption and market substitutes for home production cannot exceed household earnings from market labor:

$$P_Y C_{ij} + P_{S_R} S_{R,ij} + P_{S_Q} S_{Q,ij} \leq w_i \left(L_i - L_{i,HP}\right) + w_j \left(L_j - L_{j,HP}\right), \tag{11}$$

where absent household members supply zero labor of any kind: $L_0 = L_{0,HP} = 0$.

Since households can freely allocate labor between market and home production, we move $L_{i,HP}$ and $L_{j,HP}$ to the expenditure side of the budget constraint; they represent expenditure of household resources on internally-produced home production.

$$P_Y C_{ij} + P_{S_R} S_{R,ij} + P_{S_Q} S_{Q,ij} + w_i L_{i,HP} + w_j L_{j,HP} \leq w_i L_i + w_j L_j = E_{ij}, \tag{12}$$

where we use E_{ij} to represent the total endowment of the household.

4.5 Endogenizing ρ_{ij}: The Marriage Market

The final block of our model is the marriage market, which determines the measure of households of each type ρ_{ij} as a function of the marriage surplus. We adopt the parsimonious marriage market framework of Choo and Siow (2006), which assumes transferable utility and no search frictions. Women and men of discrete types—in our case, high- and low-skilled—sort between marriage with one another and singlehood. Transfers within each couple type, which

are in zero net supply, allow the market to clear. Since Choo and Siow (2006) thoroughly analyze the properties of this marriage market, we leave our exposition fairly brief but encourage readers to consult their article for further details.

Consider a potential marriage between a woman F of skill type i and a man M of skill type j. If the two marry, the woman receives total utility $V_{F,ij}$ and the man receives total utility $V_{M,ij}$. These are assumed to take the following form:

$$\begin{aligned} V_{F,ij} &= \overline{V}_{F,ij} + \tau_{ij} + \varepsilon_{F,ij} \\ V_{M,ij} &= \overline{V}_{M,ij} - \tau_{ij} + \varepsilon_{M,ij}. \end{aligned} \tag{13}$$

$\overline{V}_{F,ij}$ denotes the systematic utility for a type-i woman who marries a type-j man, and vice versa for $\overline{V}_{M,ij}$. The object τ_{ij} is an endogenous utility transfer from the man to the woman that adjusts to clear the market in equilibrium; τ_{ij} need not be positive. $\varepsilon_{F,ij}$ and $\varepsilon_{M,ij}$ are i.i.d. taste shocks that follow a type I (Gumbel) extreme value distribution with the CDF $F(\varepsilon) = \exp\left(-\exp\left(-\gamma\varepsilon\right)\right)$, where $1/\gamma$ is the scale parameter of the distribution.

If the two stay single, their "match" is denoted by 0 and their total respective utilities are instead $V_{F,i0}$ and $V_{M,0j}$. These have the following form:

$$\begin{aligned} V_{F,i0} &= \overline{V}_{F,i0} + \varepsilon_{F,i0} \\ V_{M,0j} &= \overline{V}_{M,0j} + \varepsilon_{M,0j}, \end{aligned} \tag{14}$$

where again $\overline{V}$ denotes the systematic component of utility and ε denotes a Gumbel-distributed taste shock.

We continue to denote by ρ_{ij} the measure of type-ij married couples, by ρ_{i0} the measure of type-i single women, and by ρ_{0j} the measure of type-j single men. Choo and Siow (2006) show that under the parametrization above, the systematic gain from marriage can be measured

from ρ_{ij}, ρ_{i0}, and ρ_{0j}. In particular, the following equation links these objects together:

$$\gamma \frac{\overline{V}_{F,ij} + \overline{V}_{M,ij} - \overline{V}_{F,i0} - \overline{V}_{M,0j}}{2} = \gamma \times \hat{V}_{ij} = \ln \rho_{ij} - \frac{\ln \rho_{i0} + \ln \rho_{0j}}{2}, \tag{15}$$

where we use $\hat{V}_{ij}$ to represent the *marriage surplus*: the systematic utility gain from marriage over singlehood. Equation (15) shows that we can directly map changes in rates of marriage and singlehood into changes in the marriage surplus. For example, the decline in the measure of married non-college households $\rho_{\ell\ell}$ relative to the measure of single non-college households $\rho_{\ell 0}, \rho_{0\ell}$ tells us that the marriage surplus $\hat{V}_{\ell\ell}$ must have declined for potential couples without a college degree.

Our goal is to quantify how much of the decline in the marriage surplus stems from economic forces, especially for the non-college educated. To make progress toward that goal, we assume that the marriage surplus $\hat{V}_{ij}$ consists of two additively separable components. The first is the economic component that captures consumption gains from marriage: the difference (in logs) between total consumption utility of the married couple, U_{ij}, and total consumption utility of the man and woman if they were single, $U_{i0} + U_{0j}$. The second is the non-economic or *amenity* component of marriage $\frac{1}{\gamma}\tilde{\Omega}_{ij}$, which captures benefits of marriage that we do not explicitly model, such as compatible beliefs and cultural attitudes towards marriage. This assumption allows us to decompose the fall in marriage, by pairing type, into economic forces and amenities:

$$\gamma \hat{V}_{ij} = \ln \rho_{ij} - \frac{\ln \rho_{i0} + \ln \rho_{0j}}{2} = \underbrace{\gamma \left[\ln U_{ij} - \ln \left(U_{i0} + U_{0j}\right)\right]}_{\text{Economic forces}} + \underbrace{\tilde{\Omega}_{ij}}_{\text{Marriage amenities}}. \tag{16}$$

The amenity component of marriage therefore acts as a residual, to account for variation in marriage rates that cannot be attributed to economic forces. Appendix B provides a micro-foundation for this form of the marriage surplus.

4.6 Equilibrium

Equilibrium consists of measures of 8 types of households, consumption and time allocations for each household type, market output and employment of every gender-skill group, prices for all goods sold in the market, and wages for each gender-skill group, such that:

1. Firms minimize production costs taking wages as given, implying the aggregate wage w defined by Equation (5), and the following demand curves for market labor:

$$\begin{aligned} L^h_{fY,D} &= \phi\zeta_h \left(\frac{w^h_f}{w^h}\right)^{-\eta} \left(\frac{w^h}{w}\right)^{-\lambda} L_Y; \\ L^h_{mY,D} &= \phi(1-\zeta_h) \left(\frac{w^h_m}{w^h}\right)^{-\eta} \left(\frac{w^h}{w}\right)^{-\lambda} L_Y; \\ L^\ell_{fY,D} &= (1-\phi)\zeta_\ell \left(\frac{w^\ell_f}{w^\ell}\right)^{-\eta} \left(\frac{w^\ell}{w}\right)^{-\lambda} L_Y; \\ L^\ell_{mY,D} &= (1-\phi)(1-\zeta_\ell) \left(\frac{w^\ell_m}{w^\ell}\right)^{-\eta} \left(\frac{w^\ell}{w}\right)^{-\lambda} L_Y. \end{aligned} \tag{17}$$

2. Households maximize utility as defined by Equation (2), subject to the home production functions in Equations (3), (7), and (8), and subject to the budget constraint in Equation (12). For household type ij, the solution to the household problem implies supply of market labor for each gender-skill group $L^s_{f,Y,ij} = \mathbf{1}\{i = s\}\left(L - L_{i,R,ij} - L_{i,Q,ij}\right)$ and $L^s_{m,Y,ij} = \mathbf{1}\{j = s\}\left(L - L_{j,R,ij} - L_{j,Q,ij}\right)$.

3. The product market for Y clears:

$$AL_Y = Y = C + \frac{S_R}{A_R} + \frac{S_Q}{A_Q} = \sum_{ij} \rho_{ij} \left(C_{ij} + \frac{1}{A_R} S_{R,ij} + \frac{1}{A_Q} S_{Q,ij}\right). \tag{18}$$

4. The labor market for each gender-skill group clears:

$$L^s_{gY,D} = \sum_{ij} \rho_{ij} L^s_{g,Y,ij} \text{ for } g \in \{f, m\}, s \in \{h, \ell\}. \tag{19}$$

5. The measure of each household type satisfies the mapping defined by Equation (15) between household measures ρ_{ij} and the marriage surplus.

6. The total measure of households containing a gender-skill type equals the total measure of that gender-skill type in the economy:

$$\sum_{j\in h,\ell,0} \rho_{hj} = N_f^h; \quad \sum_{j\in h,\ell,0} \rho_{\ell j} = N_f^\ell; \quad \sum_{i\in h,\ell,0} \rho_{ih} = N_m^h; \quad \sum_{i\in h,\ell,0} \rho_{i\ell} = N_m^\ell. \tag{20}$$

Going forward, we use market output as our numeraire so that $P_Y = 1$. This normalization then implies that the aggregate wage $w = A$, and that prices of market substitutes are $P_{S_R} = \frac{1}{A_R}, P_{S_Q} = \frac{1}{A_Q}$.

4.7 Solving the Household's Problem

Having defined equilibrium, we now focus on the household's problem in order to analyze how the household delegates tasks between household members and the market. We first note that the household's division of resources over market consumption and home production, and over routine and skill-intensive home production, satisfy standard properties of a CES demand system:

$$\begin{aligned} C_{ij} &= \alpha \left(\frac{1}{P_{ij}}\right)^{1-\rho} E_{ij}; \quad P_{H,ij}H_{ij} = (1-\alpha)\left(\frac{P_{H,ij}}{P_{ij}}\right)^{1-\rho} E_{ij} \\ P_{R,ij}R_{ij} &= \beta \left(\frac{P_{R,ij}}{P_{H,ij}}\right)^{1-\sigma} P_{H,ij}H_{ij}; \quad P_{Q,ij}Q_{ij} = (1-\beta)\left(\frac{P_{Q,ij}}{P_{H,ij}}\right)^{1-\sigma} P_{H,ij}H_{ij}. \end{aligned} \tag{21}$$

We denote the household's expenditure share on home production as $\frac{P_{H,ij}H_{ij}}{E_{ij}} = \vartheta_{H,ij}$, and the share of home production expenditure on routine tasks as $\frac{P_{R,ij}R_{ij}}{P_{H,ij}H_{ij}} = \omega_{R,ij}$.

While the household faces a common price of $P_Y = 1$ for market output, it faces ij-specific

prices for home production and hence for its overall consumption bundle:

$$\begin{aligned} P_{ij} &= \left[\alpha + (1-\alpha) P_{H,ij}^{1-\rho}\right]^{\frac{1}{1-\rho}}; \\ P_{H,ij} &= \left[\beta P_{R,ij}^{1-\sigma} + (1-\beta) P_{Q,ij}^{1-\sigma}\right]^{\frac{1}{1-\sigma}}. \end{aligned} \tag{22}$$

The household-specific prices of routine and skill-intensive home production depend on the solution to the home production task assignment problem, to which we now turn.

For the sake of exposition, we focus on assignment of routine tasks $k_R \in [0,1]$, but results apply without loss of generality to skill-intensive tasks $k_Q \in [0,1]$. Because ℓ_{i,k_R}, ℓ_{j,k_R}, and S_{R,k_R} are perfect substitutes in production of task k_R, the household assigns task k_R to the source with the lowest unit cost. The unit cost of task k_R is $\frac{w_i}{a_{i,k_R}}$ for member i, $\frac{w_j}{a_{j,k_R}}$ for member j, and $\frac{P_{S_R}}{a_{S_R,k_R}}$ for the market substitute S_R. We denote the minimized cost of k_R for household ij by $c_{k_R,ij}$:

$$c_{k_R,ij} = \min\left\{\frac{w_i}{a_{i,k_R}}, \frac{w_j}{a_{j,k_R}}, \frac{P_{S_R}}{a_{S_R,k_R}}\right\}. \tag{23}$$

Because the idiosyncratic productivity draws $a_{i,k_R}, a_{j,k_R}, a_{S_R,k_R}$ are Fréchet-distributed, $c_{k_R,ij}^{-1}$ also follows a Fréchet distribution with shape parameter θ_R and scale parameter

$$\Phi_{R,ij} = T_{i,R} w_i^{-\theta_R} + T_{j,R} w_j^{-\theta_R} + T_{S_R} P_{S_R}^{-\theta_R}. \tag{24}$$

Given this distribution of $c_{k_R,ij}^{-1}$, properties of the Fréchet and Gumbel distributions imply that

$$\mathbb{E}\left[\log c_{k_R,ij}\right] = -\frac{\gamma_E}{\theta_R} - \frac{1}{\theta_R}\log \Phi_{R,ij}, \tag{25}$$

where γ_E is the Euler-Mascheroni constant.

This result allows us to obtain the household-specific price indices $P_{R,ij}$ and $P_{Q,ij}$. These are Cobb-Douglas price indices over the continuum of tasks of each type. We exploit the law of large numbers and write the price indices in terms of a given task's expected log cost,

which we derived above:

$$\begin{aligned} P_{R,ij} &= \exp\left(\int_0^1 \log c_{k_R,ij} dk_R\right) = \exp\left(\mathbb{E}\left[\log c_{k_R,ij}\right]\right) = e^{-\gamma_E/\theta_R}\Phi_{R,ij}^{-1/\theta_R} \\ P_{Q,ij} &= \exp\left(\int_0^1 \log c_{k_Q,ij} dk_Q\right) = \exp\left(\mathbb{E}\left[\log c_{k_Q,ij}\right]\right) = e^{-\gamma_E/\theta_Q}\Phi_{Q,ij}^{-1/\theta_Q}. \end{aligned} \tag{26}$$

4.7.1 Task Shares and Expenditure Shares

For a given routine task k_R, the probability of assignment to either household member i, household member j, or market substitutes S_R satisfies the following system of equations, where we use π to represent probabilities:

$$\begin{aligned} \text{Assigned to } i\text{:} \quad \pi_{i|ij}^R &= \frac{T_{i,R} w_i^{-\theta_R}}{T_{i,R} w_i^{-\theta_R} + T_{j,R} w_j^{-\theta_R} + T_{S_R} P_{S_R}^{-\theta_R}}; \\ \text{Assigned to } j\text{:} \quad \pi_{j|ij}^R &= \frac{T_{j,R} w_j^{-\theta_R}}{T_{i,R} w_i^{-\theta_R} + T_{j,R} w_j^{-\theta_R} + T_{S_R} P_{S_R}^{-\theta_R}}; \\ \text{Assigned to } S_R\text{:} \quad \pi_{S_R|ij}^R &= \frac{T_{S_R} P_{S_R}^{-\theta_R}}{T_{i,R} w_i^{-\theta_R} + T_{j,R} w_j^{-\theta_R} + T_{S_R} P_{S_R}^{-\theta_R}}. \end{aligned} \tag{27}$$

Similar probabilities hold for assignment of skill-intensive tasks k_Q, with appropriate substitutions for scale and shape parameters.

Because all tasks of a given type are combined according to a Cobb-Douglas aggregator, the household equalizes total costs across tasks: $c_{k_R,ij} x_{k_R,ij} = P_{R,ij} R_{ij}\ \forall k_R$ and $c_{k_Q,ij} x_{k_Q,ij} = P_{Q,ij} Q_{ij}\ \forall k_Q$. This property implies that the household's use of resources on each home production source (household members and the market) depends only on its total demand for R and Q and the share of tasks assigned to each source:

$$\begin{aligned} w_i L_{i,R,ij} &= \pi_{i|ij}^R P_{R,ij} R_{ij} \qquad & w_i L_{i,Q,ij} &= \pi_{i|ij}^Q P_{Q,ij} Q_{ij} \\ w_j L_{j,R,ij} &= \pi_{j|ij}^R P_{R,ij} R_{ij} \qquad & w_j L_{j,Q,ij} &= \pi_{j|ij}^Q P_{Q,ij} Q_{ij} \\ P_{S_R} S_{R,ij} &= \pi_{S_R|ij}^R P_{R,ij} R_{ij} \qquad & P_{S_Q} S_{Q,ij} &= \pi_{S_Q|ij}^Q P_{Q,ij} Q_{ij}. \end{aligned} \tag{28}$$

Together with the expressions for π_i's and π_j's, Equation (28) characterizes the household's supply curve for market labor $L_{i,Y,ij} = L - L_{i,R,ij} - L_{i,Q,ij}$ and $L_{j,Y,ij} = L - L_{j,R,ij} - L_{j,Q,ij}$. Faced with higher wages, a household member will perform fewer home production tasks and provide more labor to the market. Lower prices for home production substitutes P_{S_R} and P_{S_Q} will also induce the household to supply more labor to the market.

4.8 The Economic Gain from Marriage

The solution to the household's problem allows us to analyze the economic component of the marriage surplus: the consumption utility of a couple ij relative to that of its two members if they were in single households $i0$ and $0j$. We note that a household's overall consumption utility is $U_{ij} = E_{ij}/P_{ij}$, and that the economic gain from marriage is therefore

$$\frac{U_{ij}}{U_{i0} + U_{0j}} = \left[\frac{w_i}{w_i + w_j} \frac{P_{ij}}{P_{i0}} + \frac{w_j}{w_i + w_j} \frac{P_{ij}}{P_{0j}} \right]^{-1}. \tag{29}$$

Marriage does not change household members' wages, but it does change the overall price index P_{ij} they each face. The economic gain from marriage is the reciprocal of the weighted average of married-to-single price ratios faced by each household member. The smaller $\frac{P_{ij}}{P_{i0}}$ and $\frac{P_{ij}}{P_{0j}}$ are, the greater the marriage gain. The weights are given by each member's contribution to the household's overall pool of resources E_{ij}, i.e. each member's relative wage.

Since households face the same price of market consumption $P_Y = 1$ regardless of marriage, any marriage-driven reduction in the price index stems from reductions in the price of home production. In particular, $\frac{P_{ij}}{P_{i0}}$ and $\frac{P_{ij}}{P_{0j}}$ can be written in terms of expenditure shares of the single household member and reductions in the respective prices of R and Q. For example,

focusing on the price reduction for married relative to single women $\frac{P_{ij}}{P_{i0}}$,

$$\begin{aligned}\left(\frac{P_{ij}}{P_{i0}}\right)^{1-\rho} &= 1-\vartheta_{i0,H}+\vartheta_{i0,H}\left(\frac{P_{ij,H}}{P_{i0,H}}\right)^{1-\rho};\\ \left(\frac{P_{ij,H}}{P_{i0,H}}\right)^{1-\sigma} &= \omega_{i0,R}\left(\frac{P_{R,ij}}{P_{R,i0}}\right)^{1-\sigma}+(1-\omega_{i0,R})\left(\frac{P_{Q,ij}}{P_{Q,i0}}\right)^{1-\sigma}.\end{aligned} \tag{30}$$

Analogous equations characterize the price reduction for men $\frac{P_{ij}}{P_{0j}}$.

Economic gains from marriage ultimately stem from marriage's capacity to reduce the price of home production. Under our task model of home production, reductions in the price of R and Q home production respectively take the form

$$\begin{aligned}\left(\frac{P_{R,ij}}{P_{R,i0}}\right)^{-\theta_R} &= \frac{T_{i,R}w_i^{-\theta_R}+T_{j,R}w_j^{-\theta_R}+T_{S_R}P_{S_R}^{-\theta_R}}{T_{i,R}w_i^{-\theta_R}+T_{S_R}P_{S_R}^{-\theta_R}};\\ \left(\frac{P_{Q,ij}}{P_{Q,i0}}\right)^{-\theta_Q} &= \frac{T_{i,Q}w_i^{-\theta_Q}+T_{j,Q}w_j^{-\theta_Q}+T_{S_Q}P_{S_Q}^{-\theta_Q}}{T_{i,Q}w_i^{-\theta_Q}+T_{S_Q}P_{S_Q}^{-\theta_Q}}.\end{aligned} \tag{31}$$

Marriage therefore generically reduces the price of home production: $\frac{P_{R,ij}}{P_{R,i0}}<1$ and $\frac{P_{Q,ij}}{P_{Q,i0}}<1$.

However, the size of the price reduction depends on the added household member's relative contribution to home production. Notably, when the household delegates a large share of home production to the market (e.g. $T_{S_R}P_{S_R}^{-\theta_R}$ is large relative to the contribution of household members), the price reduction from adding a household member is small. In the limit where market substitutes for home production become arbitrarily cheap ($P_{S_R}\to 0$ and $P_{S_Q}\to 0$), the market takes over all home production, there is no price reduction associated with marriage, and hence there is no economic gain from marriage. Indeed, the price reduction associated with marriage can be written in terms of the share of tasks delegated to the market by couples relative to singles:

$$\frac{P_{R,ij}}{P_{R,i0}}=\left(\frac{\pi_{S_R,ij}}{\pi_{S_R,i0}}\right)^{\frac{1}{\theta_R}};\quad \frac{P_{Q,ij}}{P_{Q,i0}}=\left(\frac{\pi_{S_Q,ij}}{\pi_{S_Q,i0}}\right)^{\frac{1}{\theta_Q}}. \tag{32}$$

In our "full marketization" limit case, price reductions from marriage disappear as $\frac{\pi_{S_R,ij}}{\pi_{S_R,i0}} \to 1$ and $\frac{\pi_{S_Q,ij}}{\pi_{S_Q,i0}} \to 1$. As the share of time that households devote to their own home production declines, so does the economic incentive to add a spouse to the household.

5 Calibration

Our goal is to use our task-based framework for home production to understand how economic development, which we model as growth of Hicks-neutral market productivity A, contributes to marriage trends over time and across skill groups. In our main quantitative experiment, we vary A and examine model-implied variation in marriage rates and in the share of tasks delegated to the market. This section describes the calibration procedure we use to parametrize our model before conducting that experiment. We first outline the data and the target moments we use for our calibration in Section 5.1, then give a step-by-step description of the calibration in Section 5.2.

5.1 Data and Moments

To construct target moments for our calibration, we use data from the 21st century, since these data have the greatest level of detail. Our benchmark calibration therefore resembles the US economy in the years around 2010. Our main data sources are the 2010 American Community Survey or ACS (Ruggles et al., 2025), which gives us information on workers' wages and working hours, and the 2003-2019 American Time Use Survey (ATUS), which gives us further information on working hours and on time spent on home production activities. The ACS also allows us to compute the measure of each household type. For the calibration, we focus on the working-age population aged 22-55 and we define high skill as having at least four years of college. Since our focus is the decline in heterosexual marriage, we also exclude same-sex couples from our analysis.

In total, we take four exogenous measures of persons and fifteen target moments from the data. From the ACS, we directly compute measures of each gender-skill group N_g^s as that group's share of the working-age population. We also take the measure of couples of every skill combination $\rho_{ij}, i \in \{h, \ell\}, j \in \{h, \ell\}$ from the ACS. Our last set of moments from the ACS is the ratio of each gender-skill group's average hourly wage to that of low-skilled men.

We then use the ATUS to compute target moments related to workers' allocation of time. For each of the four gender-skill groups, we take the fraction of that group's total productive time that is devoted to market labor, defining productive time as the sum of market labor time and home production time. Finally, we use the ATUS to measure the composition of home production time for every gender-skill group. In particular, we compute the share of each group's home production time that is spent on skill-intensive home production tasks. To divide household tasks between routine and skill-intensive, we associate each task with an occupation and measure "task skill" by the share of workers in the associated occupation who have a college degree, as we did in Section 3. Skill-intensive tasks are defined as those tasks with an above-median skill level. Values of all target moments are reported below in Tables 3 and 5.

5.2 Procedure

Our calibration proceeds in three steps. First, we externally impose values of several parameters. Next, we use our relative wage and time allocation moments to calibrate key parameters that characterize preferences and technology. Finally, we discipline the parameters that characterize marriage decisions by matching the measure of couples of each type, and empirical evidence on the response of marriage to exogenous movements in the gender wage gap.

Externally imposed parameters We present our externally imposed parameters in Table 2. We take some of these parameter values from the literature: the elasticity of substitution between workers of different skills (λ) from Katz and Murphy (1992) and the elasticity of substitution between male and female workers (η) in market production from Ngai and Petrongolo (2017). For the elasticity of substitution between market consumption and home production (ρ), the literature is not clear on a single value. Conceptually, this elasticity is closely related to the price elasticity between goods and services, which has estimates in the structural transformation literature ranging from 0.002 (Herrendorf et al., 2013) to 0.10 (Buera et al., 2022) or 0.25-0.63 (Comin et al., 2021). We take a value of $\rho = 0.5$ that is toward the higher end of the literature's estimates, but that clearly treats market consumption and home production as gross complements. In contrast, since the distinction between routine and skill-intensive home production is novel to this paper, little is known about the elasticity of substitution between them (σ). For now, we take the neutral stance that they are essentially combined Cobb-Douglas ($\sigma = 0.99$) and assign them equal weight in household preferences ($\beta = 0.5$).

Two key parameters of our model are the Fréchet shape parameters for productivity draws in routine and skill-intensive home production tasks, θ_R and θ_Q. These shape parameters determine how *marketizable* each type of home production task is: how readily households can substitute their own home production labor for market output to complete that task type. Indeed, within each task type, the elasticity of substitution between home time and market output is $1 + \theta$. To our knowledge, no paper has yet estimated the elasticity of substitution between home and market production for different types of home production tasks. For now, we assume that routine tasks have a greater elasticity of substitution than skill-intensive tasks ($\theta_R > \theta_Q$). That is, households would more readily outsource routine tasks like cleaning and vehicle repair to the market than skill-intensive ones like household management and child care.

To assign actual values to θ_R and θ_Q, we note that the literature has estimated the elasticity

of substitution between home time and market output more broadly, without distinguishing between routine and skill-intensive tasks. We take values of θ_R and θ_Q corresponding to the high and low end of the range of estimates, respectively. Rupert et al. (1995) present estimates for different household types that range from a unitary elasticity up to an elasticity as high as 4. We accordingly set $\theta_Q = 0.5$ (implying a slightly greater than unitary elasticity) and $\theta_R = 3$ (implying an elasticity of 4).[4]

The remaining externally-set parameters are either normalized to one, in the case of technology parameters and workers' labor endowment, or read directly from the data, in the case of each gender-skill group's population mass. The normalized technology parameters are not separately identified from the parameters that we calibrate to match relative wages and time use patterns in the next step of our procedure.

Table 2: Externally Set Parameters and Normalizations

Parameter	Value	Description
ρ	0.50	Consumption-home production elasticity
β	0.50	Weight on routine home production
σ	0.99	Routine-skill home production elasticity
λ	1.40	High-low skill labor elasticity
η	2.30	Female-male labor elasticity
θ_R	3.00	Routine-task Frechet shape
θ_Q	0.50	Skill-task Frechet shape
$T_{R,m\ell}$	1.00	Low-skill male routine normalization
T_{S_R}	1.00	Market routine-task normalization
T_{S_Q}	1.00	Market skill-task normalization
A	1.00	Benchmark market productivity
A_R	1.00	Routine-substitute productivity
A_Q	1.00	Skill-substitute productivity
L	1.00	Individual time endowment
N_F^ℓ	0.3075	Low-skill female population mass
N_F^h	0.1719	High-skill female population mass
N_M^ℓ	0.3634	Low-skill male population mass
N_M^h	0.1571	High-skill male population mass

Note: Parameter values are guided by the literature or set as a normalization. See text for details.

[4]Other papers estimate elasticities of substitution that are interior to this range. Aguiar and Hurst (2007) estimate a benchmark elasticity of 1.8, and Boerma and Karabarbounis (2021) estimate an elasticity of 2.35.

5.2.1 Calibrating Preference and Technology Parameters

We exploit the fact that labor supply and labor demand depend on the marriage market only through the measures of household types ρ_{ij}, which are observable in the data. This feature allows us to calibrate the other parameters determining labor supply and labor demand – preference and technology parameters – conditional on ρ_{ij} in the present step, and then calibrate the marriage market parameters that determine ρ_{ij} in the final step of our procedure.

This step targets 11 data moments: the ratio of wages between every gender-skill group (3 moments), the share of every gender-skill group's productive time that is devoted to market labor (4 moments), and the share of each group's home production time that is devoted to skill-intensive home production tasks (4 moments). We use these moments to discipline 11 parameters. First is the preference parameter α, which governs the overall importance of market consumption in household utility and, in equilibrium, shifts the time allocation of all groups between market labor and home production. Next are the technology parameters for market production ϕ, ζ_h, and ζ_ℓ, which respectively act as demand shifters for high-skilled market labor overall, high-skilled female market labor, and low-skilled female market labor.

The remaining technology parameters are the set of $T_{K,gs}$, the Fréchet scale parameters for skill draws in home production task type $K \in \{R, Q\}$ by workers of gender $g \in \{F, M\}$ and skill $s \in \{h, \ell\}$. Each $T_{K,gs}$ acts as a demand shifter for group gs's labor in home production task type K. Because the preference parameter α already pins down the aggregate division of time between the market and the home, we normalize $T_{R,M\ell} = 1$ for low-skilled men and calibrate the remaining $T_{K,gs}$ relative to $T_{R,M\ell}$ to capture heterogeneity in time allocations across groups.

We present all 11 parameter estimates and all 11 target moments in Table 3. By construction, the calibrated model exactly reproduces the target moments. While all moments discipline all parameters, we pair each parameter with the target moment that is most informative about its value. ϕ, ζ_ℓ, and ζ_h primarily target the wage ratios between gender-skill

groups, while the $T_{K,gs}$ parameters primarily target the time allocation of each group between the home and the market, and between task types within the home. To aid with interpretation, the table presents values of $\tilde{T}_{K,gs} = T_{K,gs}^{1/\theta_K}$. Unsurprisingly, we infer significant variation across groups in home production productivity for different task types. High-skilled women and men both have a strong comparative advantage for skill-intensive home production ($K = Q$) compared to their low-skilled counterparts. This heterogeneity allows the model to match the differences in home production time allocation that we document in Figure 3.

Table 3: Calibrated Preference and Technology Parameters with Target Moments

Parameter	Estimate	Description	Target moment	Value
α	0.2279	Market-consumption weight	Market-time share, low-skill men	0.7044
ϕ	0.5109	High-skill market-labor weight	High/low male wage ratio	1.7200
ζ_ℓ	0.2593	Female weight, low-skill labor	Low-skill female/male wage ratio	0.8212
ζ_h	0.3085	Female weight, high-skill labor	High-skill female/male wage ratio	0.7905
$\widetilde{T}_{R,F\ell}$	1.0734	Female low-skill routine productivity	Market-time share, low-skill women	0.4586
$\widetilde{T}_{R,Fh}$	1.5470	Female high-skill routine productivity	Market-time share, high-skill women	0.5094
$\widetilde{T}_{R,Mh}$	1.5680	Male high-skill routine productivity	Market-time share, high-skill men	0.7274
$\widetilde{T}_{Q,F\ell}$	0.5064	Female low-skill skill-task productivity	Skill-task time share, low-skill women	0.3635
$\widetilde{T}_{Q,Fh}$	2.5570	Female high-skill skill-task productivity	Skill-task time share, high-skill women	0.4594
$\widetilde{T}_{Q,M\ell}$	0.2768	Male low-skill skill-task productivity	Skill-task time share, low-skill men	0.4088
$\widetilde{T}_{Q,Mh}$	1.1235	Male high-skill skill-task productivity	Skill-task time share, high-skill men	0.4923

Note: Target moments from the ACS and ATUS. By construction, the model exactly matches all target moments. See text for details.

5.2.2 Calibrating Marriage Market Parameters

The final step of the calibration assigns values to the parameters that characterize the marriage market. These are γ, the elasticity of the odds ratio in Equation (15) to the economic gain from marriage, and the marriage amenity terms for each possible couple type. This step exploits the fact that we can infer the economic gain from marriage $\log(U_{ij}) - \log(U_{i0} + U_{0j})$ using the parameter values we found in the previous step. The parameter values imply price indices for home production in each household type, which we can use to compute the consumption utility of married couples relative to single households of each type, following the system of equations outlined in Section 4.8. Table 4 presents the implied gains from marriage

for every couple type. We note that the economic gain is greatest for couples in which both spouses are high-skilled. These are the same households that specialize in skill-intensive home production, where market output is less substitutable for the time input of each spouse.

Table 4: Economic Gains from Marriage, by Couple Type (Benchmark Calibration)

Couple type	$\log(U_{ij}) - \log(U_{i0} + U_{0j})$
Low-skilled woman, low-skilled man	0.2749
Low-skilled woman, high-skilled man	0.2951
High-skilled woman, low-skilled man	0.2721
High-skilled woman, high-skilled man	0.3099

Note: Calculations from system of equations in Section 4.8 with parameter values from Tables 2 and 3.

Given a value of γ, the marriage amenity terms $\tilde{\Omega}_{ij}$ can be inferred immediately from the measure of each couple type ρ_{ij} relative to the corresponding measures of single households ρ_{i0} and ρ_{0j}, using Equation (16) and the economic gains from Table 4. The non-trivial part of this step is assigning a value to γ.

γ represents the elasticity of the marriage odds ratio to economic gains from marriage. To our knowledge, there are no pre-existing estimates of this elasticity. We therefore discipline γ by adjusting it to match the response of marriage to the narrowing gender wage gap, as estimated by Shenhav (2021). Shenhav uses a shift-share instrument for female labor demand as an exogenous source of variation in the female/male wage ratio, and finds that a 10% increase in this ratio decreases the share of women who are married by approximately 5 percentage points. Through the lens of our model, an increase in the female/male wage ratio decreases the economic gains from marriage by reducing specialization along gender lines. γ determines how strongly the decline in economic gains translates into a decline in marriage.

Our procedure to estimate γ is to guess a value for it, simulate the Shenhav (2021) shock in our benchmark calibration, and iterate over guesses of γ until the model-implied response to the shock matches the empirical estimates from Shenhav. Throughout this procedure, we use the calibrated preference and technology parameters from Table 3. For each value of γ, we set the appropriate marriage amenities $\tilde{\Omega}_{ij}$ to exactly match the measure of household

types ρ_{ij} in the baseline economy. Then we simulate the Shenhav shock within our model by proportionally increasing both ζ_h and ζ_ℓ (exogenous demand shifters for female labor) and computing the new equilibrium in the labor market and the marriage market. In response to the shock, the female/male wage ratio increases and the share of women who are married declines. We take the value of γ such that the size of the marriage response relative to the wage ratio response matches with Shenhav's estimates: a 10% increase in the wage ratio is associated with a 5 percentage point drop in marriage.

We present the marriage market parameters that result from this procedure in Table 5. Given the very large response of marriage to the wage ratio estimated by Shenhav (2021), we infer a large value of γ: marriage is highly sensitive to economic gains. The inferred values of $\tilde{\Omega}_{ij}$ are those that rationalize marriage rates between each discrete type of woman and man. $\tilde{\Omega}_{\ell h}$ and $\tilde{\Omega}_{h\ell}$ are significantly lower than $\tilde{\Omega}_{\ell\ell}$ and $\tilde{\Omega}_{hh}$, which reflects that marriage is rare between women and men of different education levels, even relative to what our model would predict.

Table 5: Calibrated Marriage Market Parameters with Target Moments

Parameter	Estimate	Description	Target moment	Value
γ	20.1937	Marriage elasticity	Marriage response to 10% wage-ratio rise	−0.0500
$\widetilde{\Omega}_{\ell\ell}$	−5.3372	Low-low marriage amenity	Low-low couple mass, $\rho_{\ell\ell}$	0.1651
$\widetilde{\Omega}_{\ell h}$	−6.8945	Low-high marriage amenity	Low-high couple mass, $\rho_{\ell h}$	0.0303
$\widetilde{\Omega}_{h\ell}$	−6.3797	High-low marriage amenity	High-low couple mass, $\rho_{h\ell}$	0.0398
$\widetilde{\Omega}_{hh}$	−5.9834	High-high marriage amenity	High-high couple mass, ρ_{hh}	0.0735

Note: Target moments from the ACS and Shenhav (2021). γ is calibrated to match Shenhav's estimated response of marriage to a rise in the female/male wage ratio. $\tilde{\Omega}$'s are then inferred as residuals. See text for details.

6 Quantitative Exploration

We use our calibrated model to illustrate how Hicks-neutral productivity growth drives variation in marriage rates and time allocations in the economy. Productivity growth alone generates a hump-shaped pattern of marriage rates with respect to GDP per capita, and a

widening gap between high-skilled and low-skilled marriage rates. To help account for labor market patterns that productivity growth cannot explain, we separately consider another long-running trend of developed economies: rising demand for female market labor.

6.1 Hicks-Neutral Productivity Growth

Our main quantitative experiment is to simulate the economy's response to variation in A, which represents Hicks-neutral total factor productivity for market output Y. A was normalized to a value of one in our calibration of the circa-2010 benchmark economy. For the quantitative experiment, we vary A along a grid from a level of 0.1 to a level of 2.0, so that the economy goes from one-tenth to twice as productive as in the benchmark. For each value in the grid, we solve for the economy's equilibrium, which we use to plot productivity-driven variation in equilibrium outcomes.

Each equilibrium implies a value for total market output Y, which corresponds to GDP per capita in our model, since the population is normalized to one. In order to illustrate the implications of Hicks-neutral productivity growth along the development path, we plot all other equilibrium variables against GDP per capita on a log scale. We choose units of GDP per capita such that the benchmark economy has a GDP per capita of \$48,643, which was the nominal value of GDP per capita in 2010. Every point along the horizontal axis therefore represents the simulated economy's GDP per capita in 2010 US dollars. We draw vertical lines at levels of GDP per capita that correspond to the United States in 1900, 1970 and 2010, so that the reader can use these as reference years for different stages of development.

6.1.1 Results

Marriage Market Figure 4 displays how the economic gains from marriage, and realized marriage rates, vary with GDP per capita when both are driven by Hicks-neutral productivity growth. Figure 4a plots economic gains from marriage, $\log U_{ij} - \log(U_{i0} + U_{0j})$, for every

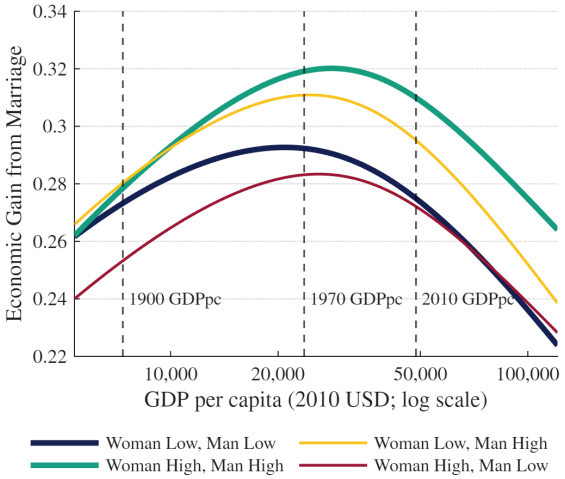
possible couple type ij. Figure 4b then plots the share of adults who are married, among the entire population and among the high- and low-skilled, respectively.

Hicks-neutral productivity growth alone is able to replicate several empirical patterns of the marriage market over the 20th and early 21st century. Our quantitative experiment reproduces the non-monotonic hump shape of marriage rates with respect to GDP per capita that Moro et al. (2017) document for 16 OECD countries from 1900 to 2000. The hump in economic gains from marriage in Figure 4a translates into the hump in realized marriage rates in Figure 4b.

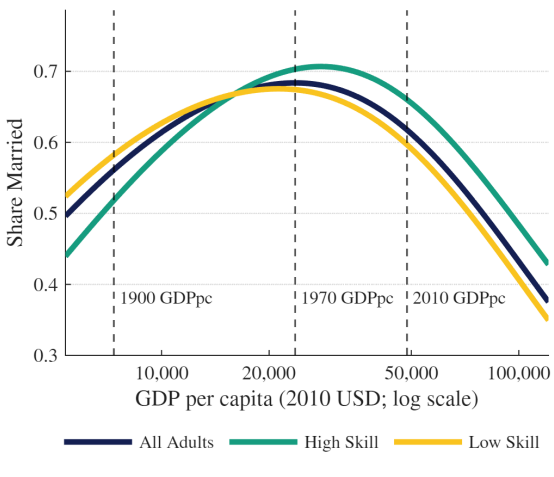
Most relevant to our motivation, productivity growth implies a decline in the overall marriage rate since 1970 and a widening gap in marriage rates between high-skilled and low-skilled adults, with the marriage decline concentrated among the low-skilled. Figure 4a shows that diverging marriage rates by skill are driven by a divergence in the economic gain from marriage. As productivity grows, so does the gap between marriage gains for couples who are both high-skilled and gains for all other couple types. This divergence stems from the rising importance of skill-intensive tasks in home production, which the next figure documents more extensively.

Figure 4: Marriage Market Effects of Hicks-Neutral Productivity Growth

(a) Economic Gains by Couple Type



(b) Realized Marriage Rates by Skill Level



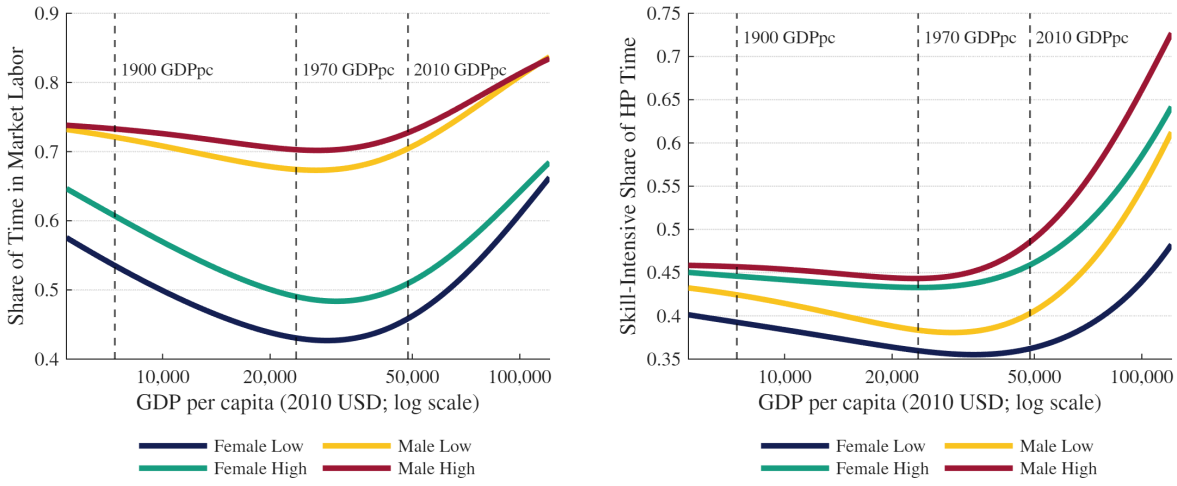
Note: Model-simulated series from varying Hicks-neutral productivity A. See text for details.

Time Allocations Figure 5 shows how Hicks-neutral productivity growth impacts time use patterns. Figure 5a illustrates the share of each gender-skill group's time that is allocated to market production, which maps closely to evolving employment rates, while Figure 5b plots the share of each group's home production time that they devote to skill-intensive tasks. At every level of productivity, men devote more time to the market than women, and high-skilled workers devote a greater share of home time to skill-intensive tasks than low-skilled workers.

Our quantitative experiment also replicates salient trends in time use patterns with respect to development. Perhaps most notably, the model generates the same U shape of female employment with respect to economic development first documented by Goldin (1994), although the trough of female employment occurs at higher levels of income in our model than in the data. Besides the employment trends, the model also implies that skill-intensive tasks become an increasingly important component of households' home production time, as more routine tasks like cleaning and cooking are delegated to the market. The rising importance of skill-intensive tasks, where high-skilled workers have a comparative advantage, contributes to the divergence of marriage trends by skill presented in Figure 4.

Figure 5: Time Allocations under Hicks-Neutral Productivity Growth

(a) Market Labor Time by Gender and Skill (b) Composition of HP Time by Gender and Skill



Note: Model-simulated series from varying Hicks-neutral productivity A. See text for details.

Home Production and Its Substitutes Figure 6 displays how the share of household resources devoted to home production, and the share of home production that they delegate to the market, both rise with Hicks-neutral productivity. This variation is key to understanding the model's non-monotonic trends in both the marriage rate and female employment.

Figure 6a plots the aggregate share of resources in the economy that are spent on home production, whether it is produced by household members or the market. With reference to Section 4.7, the series in 6a represents the aggregate counterpart of the household's $\vartheta_{H,ij}$: the share of the endowment – the total value of all workers' time – that is used either to produce home production within the home or to buy home production substitutes from the market. Because market consumption C and home production H are gross complements in household preferences, and because growth of market productivity A reduces the price of C relative to H, the aggregate share of resources used to produce H increases. As seen from Equation (30), a greater expenditure share on H increases the economic gain from marriage, all else equal. The rising importance of H in Figure 6a is what drives the upward-sloping part of the hump shape in marriage from Figure 4. It also drives the downward-sloping part of U-shaped female employment from Figure 5a: as home production becomes more important, women are initially drawn out of the market and into the home.

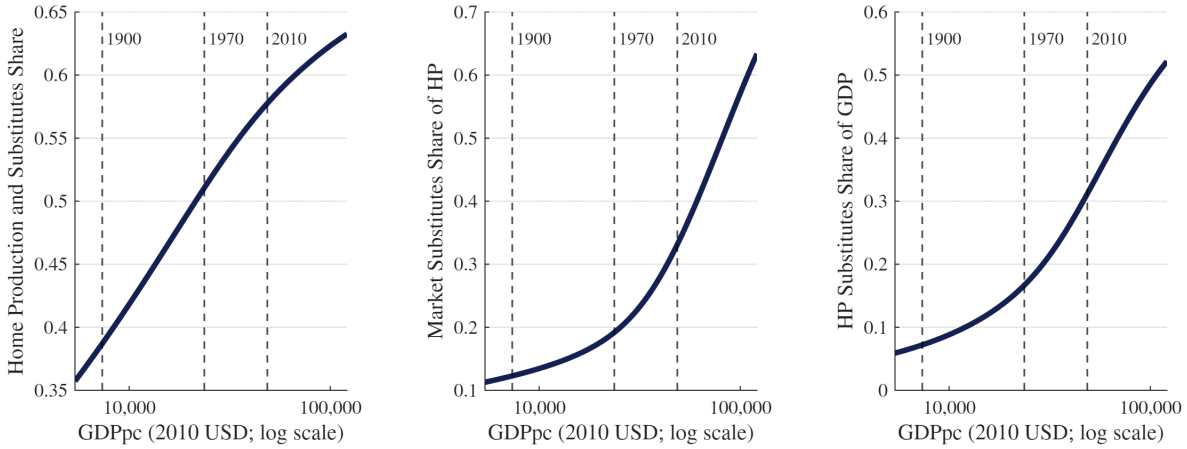
On the other hand, rising marketization contributes to the downward-sloping part of marriage and the upward-sloping part of female employment. Figure 6b shows how the share of home production tasks that are marketized, i.e. covered through purchases of market substitutes S_R and S_Q, varies with Hicks-neutral productivity. Marketization rises monotonically with respect to A, and experiences an uptick as the market becomes an increasingly cost-effective source of home production relative to workers' time. In particular, once market substitutes begin to surpass female workers as an efficient source of home production, women re-enter the market and cause female employment to rise. At the same time, Section 4.8 shows that rising marketization reduces the economic gain from marriage, because it diminishes the home production cost savings associated with marriage. When

marketization accelerates, it causes both the economic gain and the realized marriage rate to taper off and then decline, as they do in Figure 4.

In Figure 6c, we show that as the economy develops, home production substitutes become an increasingly important component of GDP: the share of market output Y devoted to S_R and S_Q rises monotonically. This trend stems from both the rising importance of home production overall (6a), and the rising marketization of home production (6b). While our model does not make any distinction between goods and services, if market substitutes for home production are taken to mostly consist of services (Ngai and Petrongolo, 2017), then the quantitative experiment also rationalizes the rising service share with respect to economic development.

Figure 6: Home Production and Substitutes under Hicks-Neutral Productivity Growth

(a) Share of Resources on HP (b) Marketized Share of HP (c) HP Substitute Share of GDP



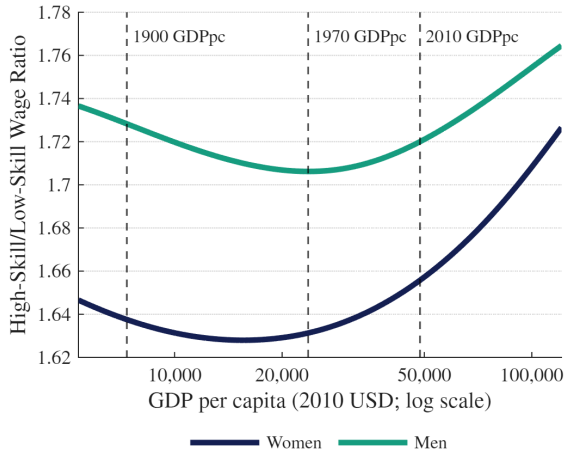
Note: Model-simulated series from varying Hicks-neutral productivity A. See text for details.

Relative Wages To close our exploration of the effects of Hicks-neutral productivity growth, in Figure 7 we display how relative wages between skill and gender groups vary in our quantitative experiment. Here, the model struggles to replicate empirical patterns from the real world. Figure 7a presents the ratio of high-skilled to low-skilled wages for both women and men. While the skill premium within both genders varies slightly with respect to A, the magnitude of the variation is very small, in contrast to the large rise in the skill

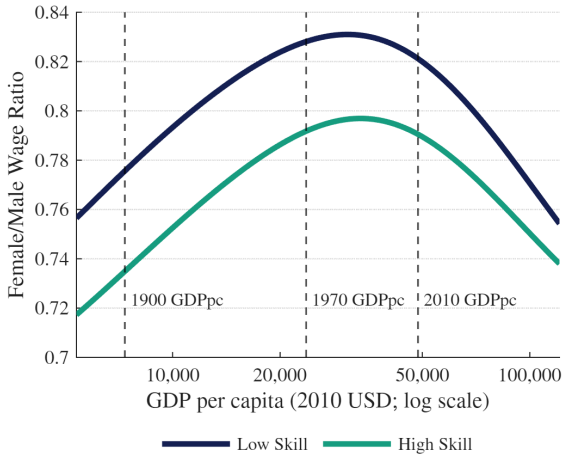
premium in the late 20th century. Figure 7b plots the ratio of female to male wages for each skill group. In the model, the gender wage gap is roughly the same in 2010 as it was in 1970, even though the gap narrowed substantially over the same time period in the real world. To show that the model can also accommodate a narrowing gender wage gap that translates into declining marriage rates (Shenhav, 2021), we also explore a quantitative experiment that shifts demand for female workers' labor in the market.

Figure 7: Skill and Gender Wage Ratios under Hicks-Neutral Productivity Growth

(a) High-Skill/Low-Skill Wage Ratio by Gender



(b) Female/Male Wage Ratio by Skill



Note: Model-simulated series from varying Hicks-neutral productivity A. See text for details.

6.2 Demand for Female Market Labor

Hicks-neutral productivity growth in our model reproduces many salient trends in the marriage market, the labor market, and the composition of economic activity. However, it falls short of capturing recent gendered developments in the economy. We noted above that the productivity growth experiment places the trough of female employment at too high a level of GDP, and that it fails to reproduce the narrowing gender wage gap. It also implies increasing employment rates for men (Figure 5a), when the opposite is true in the data. To better account for these trends with respect to gender, and to assess how they may have contributed to marriage patterns, we consider a second experiment that varies demand for

female labor in market production.

In this experiment, we proportionally vary both ζ_h and ζ_ℓ, the weights placed on high-skilled and low-skilled female labor in aggregate market labor L_Y. We vary the ζ's together from 60% to 120% of their values in the benchmark calibration, once again solving for the economy's equilibrium in every counterfactual scenario. In our model, ζ_h and ζ_ℓ are technology parameters that govern the marginal product of female labor in market production. In reality, the rise in demand for female labor likely reflects falling discrimination against women in the labor market, which better maps to a wedge between women's marginal product of labor and the wage they actually receive. We acknowledge this discrepancy, but note that both our ζ's and a female labor wedge act as demand shifters for female labor, so that our experiment captures something similar in spirit to improved gender parity.

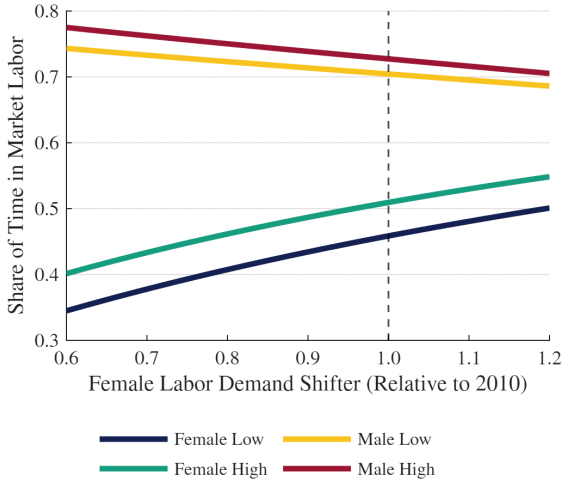
6.2.1 Results

Labor Market Our experiment confirms that rising demand for female labor replicates recent trends in the labor market by gender. Figure 8 shows how both market time and relative wages vary as we shift ζ_h and ζ_ℓ. Unsurprisingly, increased demand for female labor leads to rising female employment and falling male employment (Figure 8a), and rising female wages relative to male wages (Figure 8b).

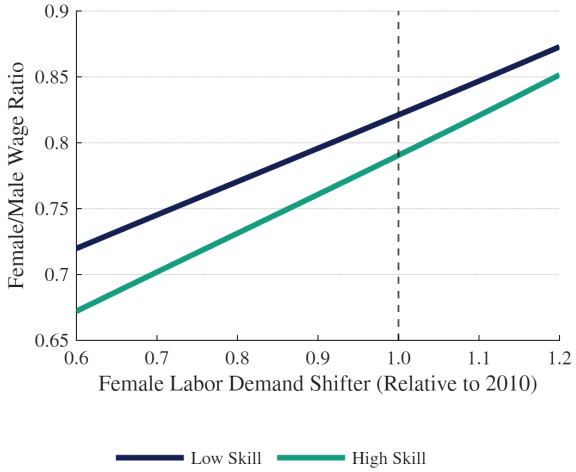
Marriage Market Figure 9 confirms that in our model, a shift of labor demand towards women leads to a decline in the economic gains from marriage and hence the overall marriage rate. The experiment bears out the prediction from Becker (1973) and the empirical finding from Shenhav (2021) that convergence of wages between genders leads to lower marriage rates. As in Becker's model, a more equal female-to-male wage ratio diminishes the scope for married women to specialize in home production and married men to specialize in market production. However, our experiment implies little divergence of marriage across skill groups. Reproducing

Figure 8: Labor Market Effects of Rising Female Labor Demand

(a) Market Labor Time by Gender and Skill



(b) Female/Male Wage Ratios by Skill Level

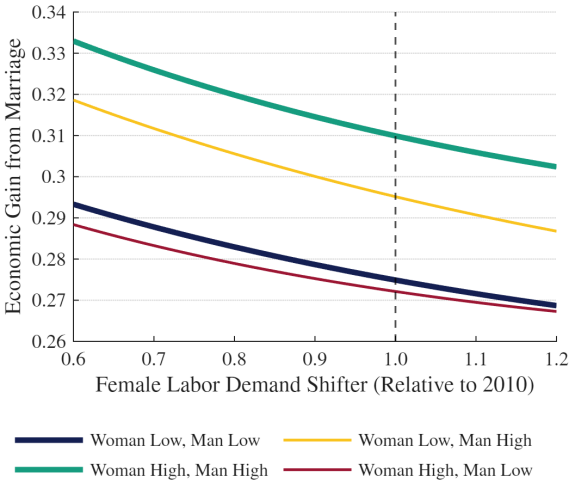


Note: Model-simulated series from varying female labor demand shifters ζ_h and ζ_ℓ. See text for details.

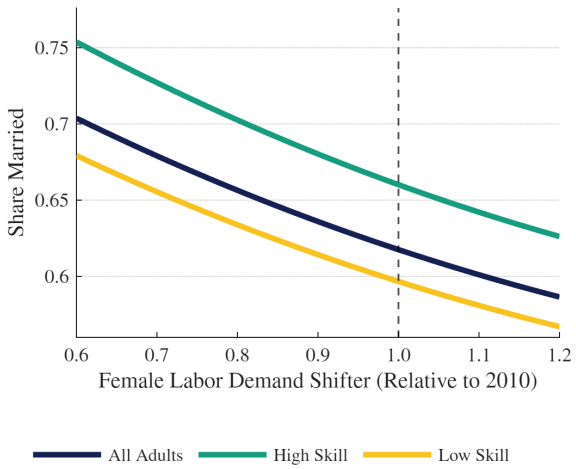
divergent marriage rates by skill would require different rates of gender convergence by skill groups (ζ_ℓ rising faster than ζ_h), or Hicks-neutral productivity growth as in Section 6.1.

Figure 9: Marriage Market Effects of Rising Female Labor Demand

(a) Economic Gains by Couple Type



(b) Realized Marriage Rates by Skill Level



Note: Model-simulated series from varying female labor demand shifters ζ_h and ζ_ℓ. See text for details.

The quantitative experiments show that in a task-based model of home production, both Hicks-neutral productivity growth and rising demand for female labor drive a reallocation of time use out of the home and into the market. As time within the home becomes less

important for home production, the gain from joining two workers into a single household—marriage—decreases. Together, the experiments show that both forces help to explain recent trends in the labor market and the marriage market. In future versions of this paper, we plan to conduct a full quantitative decomposition of the declining marriage rate and the gap in marriage rates between college and non-college adults. We hope to quantify how much of the marriage decline and the skill gap in marriage is attributable to Hicks-neutral productivity growth, how much is attributable to female labor demand, and how much depends on other forces.

7 Conclusion & Next Steps

This paper draws a link between long-running trends in American society: the increasing role of market goods and services in the home, the overall decline in marriage, and the concentration of this decline among non-college adults. We document significant differences in home production patterns between single and married households, and between adults with and without a college degree: single households source a greater share of home production from the market, and degree-holders concentrate their home production time on skill-intensive tasks. To account for these facts, and to understand how productivity growth in the market affects households' incentives to marry, we develop a task-based model of home production. When married couples can delegate home production tasks to the spouse with the lowest opportunity cost, marriage reduces the effective price of home production. The more of these tasks are outsourced to the market, the smaller the economic gain from marriage. As technological progress leads to greater marketization, the benefit from marriage disappears fastest for low-skilled workers, who specialize in easily marketized home production tasks.

The calibrated model replicates the same time trends that motivate our analysis. At late stages of development, technological progress leads to declining marriage rates overall and a widening gap in marriage rates between the high- and the low-skilled. Over a wider range of

productivity levels, the model generates the same non-monotonic patterns of marriage and time use that are observed in the data along the development path. Marriage follows a hump shape (Moro et al., 2017) and female employment follows a U shape (Goldin, 1994), with marketization driving both the decline in marriage and the rise in female employment in advanced economies. When we allow for shifts of labor demand towards women, the model implies further declines in marriage and can account for additional facts, like declining male employment and the narrowing gender wage gap.

We view this draft as presenting preliminary results for the interplay between marketization and marriage. In future versions, we hope to place greater discipline on some of the key elasticities in the model, particularly those governing substitution between the home and the market (θ_R and θ_Q) and the sensitivity of marriage to economic gains (γ). A survey may help us to quantify how readily households would delegate routine vs. skill-intensive tasks to the market. We further hope to provide a full quantitative decomposition of the role played by different channels in driving the decline of marriage.

Further extensions of the model may enrich our results. In our baseline model, women and men trade home production time for market time without frictions, but recent research shows that men seldom take on additional home production even when their relative earnings decline (Hancock et al., 2025). This draft also did not devote much attention to children, even though child-rearing takes up a significant share of home production and is an important consideration in marriage decisions. We note, however, that our main period of analysis saw a rising share of children raised in single-parent households, again concentrated among children of non-college parents (Kearney, 2022). We believe that our task-based model of home production could be applied to child-rearing to provide further insights on the decline and the "college gap" in two-parent family structure. If college-educated parents engage in more skill-intensive forms of parenting, as they do with other home production tasks, our framework may help to explain why a college gap has emerged in the child-rearing environment.

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A Data Appendix

A.1 Identifying Substitutes for Home Production Tasks in the CEX

We start by obtaining the full set of UCC codes available for the 2010-2014 CEX as well as the home production activities from the ATUS, which begin with an activity code "02" or "03" (Flood et al., 2025b). For each UCC-activity pair, we ask an LLM (Claude) the question:

Does this good or service directly substitute for someone performing the task, eliminating time needed to spend on the task by an individual?

We keep only service UCC codes; durables and goods such as frozen meals are excluded. The full set of UCC codes selected by this procedure is displayed in Table 6.

Table 6: Market substitutes for home production tasks: the CEX items in the aggregate marketization measure

UCC	Item	Survey
Childcare		
340210	Babysitting and child care	I
340211	Babysitting and child care in your own home	I
340212	Babysitting and child care in someone else's home	I
530412	Taxi fares and limousine services	D
530902	School bus	I
620121	Fees for participant sports	D
620310	Fees for recreational lessons	I
670310	Day care centers, nursery, and preschools	I
670903	Test preparation, tutoring services	I
Household management		
230902	Property management	I
340911	Management and upkeep services for security	I
340912	Management and upkeep services for security	I
340915	Home security system service fee	I
680110	Legal fees	I

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Table 6, continued

UCC	Item	Survey
680220	Checking accounts, other bank service charges	I
680902	Accounting fees	I
680903	Miscellaneous personal services	D
Pet care		
620410	Pet services	I
Adult care and helping adults		
340906	Care for elderly, invalids, handicapped, etc.	I
340910	Adult day care centers	I
530411	Taxi fares and limousine services on trips	I
570220	Care in convalescent or nursing home	I
570240	Medical care in retirement community	I
Cooking and kitchen clean-up		
190111	Lunch at fast food, take-out, delivery, concession stands, buffet and cafeteria (other than employer and school cafeteria)	D
190112	Lunch at full service restaurants	D
190113	Lunch at vending machines and mobile vendors	D
190114	Lunch at employer and school cafeterias	D
190211	Dinner at fast food, take-out, delivery, concession stands, buffet and cafeteria (other than employer and school cafeteria)	D
190212	Dinner at full service restaurants	D
190213	Dinner at vending machines and mobile vendors	D
190214	Dinner at employer and school cafeterias	D
190311	Snacks and nonalcoholic beverages at fast food, take-out, delivery, concession stands, buffet and cafeteria (other than employer and school cafeteria)	D
190312	Snacks and nonalcoholic beverages at full service restaurants	D
190313	Snacks and nonalcoholic beverages at vending machines and mobile vendors	D
190314	Snacks and nonalcoholic beverages at employer and school cafeterias	D
190321	Breakfast and brunch at fast food, take-out, delivery, concession stands, buffet and cafeteria (other than employer and school cafeteria)	D
190322	Breakfast and brunch at full service restaurants	D
190323	Breakfast and brunch at vending machines and mobile vendors	D
190324	Breakfast and brunch at employer and school cafeterias	D
190901	Food or board at school (through Q20231)	I
190902	Catered affairs	I

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Table 6, continued

UCC	Item	Survey
190903	Food on out-of-town trips	I
790430	School lunches	I
Lawn and garden		
340410	Gardening, lawn care service	I
Home, appliance and equipment maintenance		
230112	Painting and papering	I
230113	Plumbing and water heating	I
230114	Heat, a/c, electrical work	I
230115	Roofing and gutters	I
230121	Repair and replacement of hard surface flooring	I
230122	Repair and replacement of hard surface flooring	I
230123	Repair and replacement of hard surface flooring	I
230133	Wall-to-wall carpet (replacement) (owned home)	I
230134	Wall-to-wall carpet (renter)	I
230141	Repair of built-in appliances	I
230142	Repair of built-in appliances	I
230150	Repair or maintenance services	I
230151	Other repair and maintenance services	I
230152	Repair and remodeling services	I
270901	Septic tank clean. (renter)	I
270902	Septic tank clean. (owned home)	I
270903	Septic tank clean. (owned vacation)	I
270904	Septic tank clean. (rented vacation)	I
320163	Wall-to-wall carpet (replacement)(renter)	I
320624	Flooring installation, repair, replacement	I
320625	Flooring installation, repair, replacement	I
320626	Flooring installation, repair, replacement	I
340420	Water softening service	I
340610	Repair of tv, radio, and sound equipment	I
340620	Appliance repair, including service center	I
340630	Reupholstering, furniture repair	I
340901	Repairs/rentals of lawn and garden equipment, hand or power tools, other household equipment	I
340907	Appliance rental	I
340913	Repair of miscellaneous household equipment and furnishings	D
440150	Watch and jewelry repair	I
570902	Repair of medical equipment	D
620904	Rental and repair of musical instruments	I
620905	Repair and rental of photographic equipment	I
620908	Rental and repair of miscellaneous sports equipment	I
650900	Repair of personal care appliance	D
690113	Repair of computer systems for nonbusiness use	I

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Table 6, continued

UCC	Item	Survey
690310	Installation of computer	I
690320	Installation of televisions	I
690330	Installation of satellite television equipment	I
690340	Installation of sound systems	I
690350	Installation of other video equipment or sound systems	I
Cleaning, laundry and household upkeep		
270411	Trash/garb. coll. (renter)	I
270412	Trash/garb. coll. (owned home)	I
270413	Trash/garb. coll. (owned vacation)	I
270414	Trash/garb. coll. (rented vacation)	I
340310	Housekeeping services	I
340510	Moving, storage, freight	I
340520	Household laundry and dry cleaning, sent out (noncloth-ing) not coin-operated	D
340903	Other home services	I
340914	Services for termite/pest control	I
440110	Shoe repair and other shoe service	I
440130	Alteration, repair and tailoring of apparel and acces-sories	I
440210	Apparel laundry and dry cleaning not coin-operated	I
440900	Clothing storage	I
Vehicle maintenance		
480110	Tires - purchased, replaced, installed	I
480212	Vehicle products and cleaning services	D
490000	Misc. auto repair, servicing	D
490110	Body work and painting	I
490211	Clutch, transmission repair	I
490212	Drive shaft and rear-end repair	I
490221	Brake work, including adjustments	I
490231	Repair to steering or front-end	I
490232	Repair to engine cooling system	I
490300	Vehicle or engine repairs	I
490311	Motor tune-up	I
490312	Lube, oil change, and oil filters	I
490313	Front-end alignment, wheel balance, and rotation	I
490314	Shock absorber replacement	I
490316	Gas tank repair, replacement	D
490318	Repair tires and other repair work	I
490319	Vehicle air conditioning repair	I
490411	Exhaust system repair	I
490412	Electrical system repair	I
490413	Motor repair, replacement	I

Notes: This table shows 118 UCC's in the 2010-14 CEX which substitute for home production. *Survey* is the instrument BLS publishes the item from; I = Interview, D = Diary.

A.2 Mapping between Home Production Activities and Occupations

The following table shows the occupation assigned to each home production time use activity from Flood et al. (2025b). The occupation classification comes from Autor and Dorn (2013).

Table 7: Home production activities and the market occupations that perform them

ATUS activity	Market occupation	occ1990dd
0201 – Housework		
Interior cleaning	Housekeepers, maids, butlers, and cleaners	405
Laundry	Laundry and dry cleaning workers	408
Sewing, repairing, and maintaining textiles	Dressmakers, seamstresses, and tailors	666
Storing interior household items, including food	Stock and inventory clerks	365
Housework, n.e.c.	Housekeepers, maids, butlers, and cleaners	405
0202 – Food and Drink Preparation, Presentation, and Clean-up		
Food and drink preparation	Cooks	436
Food presentation	Cooks	436
Kitchen and food clean-up	Misc. food preparation and service workers	444
Food and drink preparation, presentation, and clean-up, n.e.c.	Cooks	436
0203 – Interior Maintenance, Repair, and Decoration		
Interior arrangement, decoration, and repairs	Painters (construction and maintenance)	579
Building and repairing furniture	Cabinetmakers and bench carpenters	657
Heating and cooling	Heating, air conditioning, and refrigeration mechanics	534
Interior maintenance, repair, and decoration, n.e.c.	Mechanics and repairers, n.e.c.	549
0204 – Exterior Maintenance, Repair, and Decoration		
Exterior cleaning	Janitors	453
Exterior repair, improvements, and decoration	Carpenters	567
Exterior maintenance, repair, and decoration, n.e.c.	Carpenters	567

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Table 7, continued

ATUS activity	Market occupation	occ1990dd
0205 – Lawn, Garden, and Houseplants		
Lawn, garden, and houseplant care	Gardeners and groundskeepers	451
Ponds, pools, and hot tubs	Gardeners and groundskeepers	451
Lawn and garden, n.e.c.	Gardeners and groundskeepers	451
0206 – Animals and Pets		
Care for animals and pets (not veterinary care) (2003-2007)	Animal caretakers, except farm	472
Care for animals and pets (not veterinary care) (2008+)	Animal caretakers, except farm	472
Walking, exercising, playing with animals (2008+)	Animal caretakers, except farm	472
Pet and animal care, n.e.c.	Animal caretakers, except farm	472
0207 – Vehicles		
Vehicle repair and maintenance (by self)	Automobile mechanics and repairers	505
Vehicles, n.e.c.	Automobile mechanics and repairers	505
0208 – Appliances, Tools, and Toys		
Appliance, tool, and toy set-up, repair, and maintenance (by self)	Repairers of household appliances and power tools	526
Appliances and tools, n.e.c.	Repairers of household appliances and power tools	526
0209 – Household Management		
Financial management	Bookkeepers and accounting and auditing clerks	337
Household and personal organization and planning	Secretaries and stenographers	313
Household and personal mail and messages (except e-mail)	Postal clerks, excluding mail carriers	354
Household and personal e-mail and messages	Secretaries and stenographers	313
Home security	Supervisors of guards	415
Household management, n.e.c.	Secretaries and stenographers	313
0299 – Household Activities, n.e.c.		
Household activities, n.e.c.	Housekeepers, maids, butlers, and cleaners	405
0301 – Caring for and Helping Household Children		
Physical care for household children	Child care workers	468
Reading to or with household children	Child care workers	468
Playing with household children, not sports	Child care workers	468
Arts and crafts with household children	Child care workers	468
Playing sports with household children	Recreation and fitness workers	466
Talking with or listening to household children	Child care workers	468

continued on next page

Table 7, continued

ATUS activity	Market occupation	occ1990dd
Helping or teaching household children (not education) (2003)	Child care workers	468
Organization and planning for household children	Child care workers	468
Looking after household children (as a primary activity)	Child care workers	468
Attending household children's events	Child care workers	468
Picking up or dropping off household children	Taxi cab drivers and chauffeurs	809
Caring for and helping household children, n.e.c.	Child care workers	468
0302 – Activities Related to Household Children's Education		
Homework (household children)	Kindergarten and earlier school teachers	155
Meetings and school conferences (household children)	Child care workers	468
Home schooling of household children	Primary school teachers	156
Activities related to household child's education, n.e.c.	Primary school teachers	156
0303 – Activities Related to Household Children's Health		
Providing medical care to household children	Health and nursing aides	447
Obtaining medical care for household children	Health and nursing aides	447
Activities related to household child's health, n.e.c.	Health and nursing aides	447
0304 – Caring for Household Adults		
Physical care for household adults	Personal service occupations, n.e.c.	469
Looking after household adult (as a primary activity)	Personal service occupations, n.e.c.	469
Providing medical care to household adult	Health and nursing aides	447
Obtaining medical and care services for household adult	Health and nursing aides	447
Caring for household adults, n.e.c.	Personal service occupations, n.e.c.	469
0305 – Helping Household Adults		
Helping household adults	Personal service occupations, n.e.c.	469
Organization and planning for household adults	Secretaries and stenographers	313
Picking up or dropping off household adult	Taxi cab drivers and chauffeurs	809
Helping household adults, n.e.c.	Personal service occupations, n.e.c.	469
0399 – Caring for and Helping Household Members, n.e.c.		
Caring for and helping household members, n.e.c.	Child care workers	468

Notes: The 63 home production activities in ATUS majors 02 (household activities) and 03 (caring for and helping household members), excluding waiting, each mapped to the market occupation that performs the same task for pay. The occupation codes are from Autor and Dorn (2013).

B Theoretical Appendix

Microfounding the marriage surplus We assume that the systematic component of individual utility in Equation (13) consists of log individual consumption utility and an amenity term that represents individual enjoyment from living in different household types:

$$\begin{aligned} \overline{V}_{F,ij} &= \ln U_{F,ij} + \frac{1}{\gamma}\tilde{\Omega}_{F,ij} \\ \overline{V}_{M,ij} &= \ln U_{M,ij} + \frac{1}{\gamma}\tilde{\Omega}_{M,ij} \end{aligned} \tag{33}$$

Without loss of generality, $\tilde{\Omega}_{F,i0}$ and $\tilde{\Omega}_{M,0j}$ equal 0, so the amenity value of marrying each type of spouse is relative to singlehood.

A household ij has total utility-relevant consumption denoted U_{ij}, which in the case of a married couple is split additively between spouses: $U_{F,ij} + U_{M,ij} = U_{ij}$. We describe how couples split total consumption below. We assume that besides utility-relevant consumption U, households can also make zero-sum transfers over a "courtship good" that corresponds to τ_{ij}. At the time of the marriage market, individuals view $U_{F,ij}$ and $U_{M,ij}$ as fixed through an *ex post* bargaining game that we describe next.

Upon marriage, households decide how to divide total utility-relevant consumption U_{ij} between their male and female members, subject to $U_{F,ij}+U_{M,ij} = U_{ij}$. We denote by $U_{F,i0}$ and $U_{M,0j}$ the spouses' counterfactual consumption as singles. The allocation of utility-relevant consumption is determined through an intra-household bargaining game that maximizes the joint consumption utility surplus. We assume that in the bargaining problem, each spouse's weight equals their share of utility-relevant consumption in singlehood. Specifically, the

allocation $U_{F,ij}, U_{M,ij}$ solves:

$$\begin{aligned}\max_{U_{F,ij},U_{M,ij}} &\left(\ln U_{F,ij} - \ln U_{F,i0}\right)^{\frac{U_{F,i0}}{U_{F,i0}+U_{M,0j}}} \left(\ln U_{M,ij} - \ln U_{M,0j}\right)^{\frac{U_{M,0j}}{U_{F,i0}+U_{M,0j}}} \\ &\text{s.t. } U_{F,ij} + U_{M,ij} = U_{ij}.\end{aligned} \tag{34}$$

The result of this bargaining game is that each household member's share of married consumption is proportional to their share of consumption as singles. That is, men and women experience the same relative consumption gain from marriage. In particular:

$$\begin{aligned} & U_{F,ij} = \frac{U_{i0}}{U_{i0}+U_{0j}} U_{ij};\ U_{M,ij} = \frac{U_{0j}}{U_{i0}+U_{0j}} U_{ij} \\ \iff & \frac{U_{F,ij}}{U_{i0}} = \frac{U_{M,ij}}{U_{0j}} = \frac{U_{ij}}{U_{i0}+U_{0j}}. \end{aligned} \tag{35}$$

Note that we assume that this bargaining takes place *ex-post* of marriage decisions, so that men and women cannot commit to a different consumption allocation. However, the utility transfers τ_{ij} take place *ex-ante* of marriage and therefore allow the marriage market to clear. This preserves the transferable utility property assumed by Choo and Siow (2006).

When we substitute this result into the expressions for $\overline{V}$ and $\hat{V}$, we obtain Equation (16):

$$\begin{aligned} \gamma \hat{V}_{ij} &= \gamma \frac{\overline{V}_{F,ij} + \overline{V}_{M,ij} - \overline{V}_{F,i0} - \overline{V}_{M,0j}}{2} \\ &= \gamma \frac{\ln U_{F,ij} - \ln U_{F,i0} + \frac{1}{\gamma}\tilde{\Omega}_{F,ij} + \ln U_{M,ij} - \ln U_{M,0j} + \frac{1}{\gamma}\tilde{\Omega}_{M,ij}}{2} \\ &= \gamma \frac{2\left[\ln U_{ij} - \ln\left(U_{i0}+U_{0j}\right)\right]}{2} + \frac{1}{2}\left(\tilde{\Omega}_{F,ij} + \tilde{\Omega}_{M,ij}\right) \\ &= \gamma\left[\ln U_{ij} - \ln\left(U_{i0}+U_{0j}\right)\right] + \tilde{\Omega}_{ij}. \end{aligned} \tag{36}$$