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THE RISE OF SINGLE-PERSON HOUSEHOLDS AND THE MACROECONOMIC CONSEQUENCES

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Abstract

The number of single-person households in the U.S. has steadily risen since 1960. We provide a dynamic general equilibrium model to investigate the impact of this change on aggregate savings and labor supply. Our analysis indicates that single individuals tend to save and work more than married ones with the same economic characteristics. Importantly, this finding at the individual level extends to the aggregate level: both aggregate savings and labor supply increase as the share of single-person households increases, for which the general equilibrium effect plays a crucial role.

Keywords: single-person households, within-household risk sharing, precautionary savings
JEL Classification Codes: J11, E21, E24

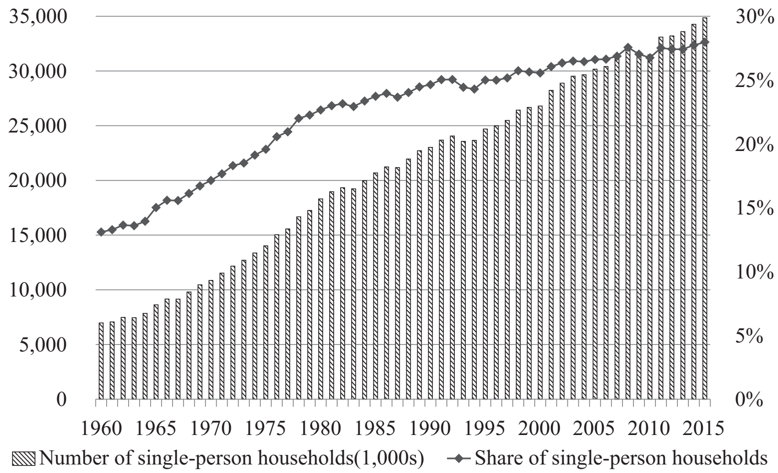
I. *Introduction*

In this paper, we study the impact of the rise of single-person households on aggregate savings and labor supply. Single-person households in the U.S. have steadily increased since 1960. Between 1960 and 2015, the number of single-person households soared to 34.9 million from 6.9 million, and their share of total households more than doubled from 13.1 to 28.0 percent (See Figure 1).[1] We show that the rise of single-person households in an economy induces substantial increases in aggregate savings and labor supply as individuals in single-person households save and work more than members of larger households.

Within-household risk sharing, originating from the availability of spousal labor supply, leads to different decisions on savings and labor supply between single-person and married-couple households. To assess the differences, we extend the Aiyagari (1994) and Huggett (1993) model by incorporating both single-person and married-couple households. We calibrate the model to match salient features of the U.S. economy, including the share of single-person households, and find that single individuals, lacking within-household insurance (spousal labor

[1] The trend of rising single-person households is even more dramatic in newly industrialized countries. For instance, the share of single-person households in South Korea increased rapidly from 15.6 percent in 2000 to 33.4 percent in 2015. In Taiwan, it jumped from 13.0 percent in 1990 to 22.0 percent in 2010.

FIGURE 1. THE NUMBER AND SHARE OF SINGLE-PERSON HOUSEHOLDS IN THE U.S.: 1960-2015



Source: U.S. Census Bureau, Current Population Survey, Annual Social and Economic Supplements.

supply), tend to save and work more than married individuals with the same economic characteristics. Importantly, this finding at the individual level extends to the aggregate level: both aggregate savings and labor supply increase as the share of single-person households increases, for which the general equilibrium effect plays a crucial role.

The literature on precautionary savings has largely ignored the provision of insurance within households,[2] and most research has been built upon the Aiyagari-Huggett setup where male-alone households accumulate assets to secure against idiosyncratic income shocks in incomplete financial markets. Theoretically, Attanasio et al. (2005) were among the first to propose a quantitative model to assess the role of spousal labor supply as insurance.[3] They find that the welfare cost of idiosyncratic income shocks is significantly mitigated once female labor supply is allowed. Blundell et al. (2008, 2016) provide empirical evidence on the crucial role of family labor supply as insurance. They claim that family labor supply accounts for insurance of 63 percent of total consumption against permanent shocks to the male's wage. Recently, Ortigueira and Siassi (2013) analyze the quantitative effects of the provision of family insurance on savings and labor supply. They find that spousal labor supply is particularly important as additional insurance for wealth-poor households, and thus abstracting from within-household risk sharing could lead to serious bias in aggregate savings and labor supply.[4]

Cubeddu and Ríos-Rull (1997) are among the first to explore the rise of single-person households in the U.S. and its impact on household savings. However, unlike our paper, which

[2] An early exception is Kotlikoff and Spivak (1981).

[3] Before Attanasio et al. (2005), Hess (2004) provided a simple two-period model that features a within-household risk sharing mechanism. He views marriage as a means to insure against income shocks and explore what sorts of economic characteristics affect a marriage's probability of survival.

[4] See also Cullen and Gruber (2000) and Engen and Gruber (2001).

takes no stance on the reason for the increasing number of single-person households, they view the change in the structure of households as a product of changes in divorce and illegitimacy, which is modeled as marital risk. In their 2003 paper, Cubeddu and Ríos-Rull emphasize the role of a stochastic process of household type in determining the main macroeconomic magnitudes.

Our paper is most closely related to Ortigueira and Siassi (2013). In contrast to their exclusive focus on two-person-households, however, we incorporate both single- and two-person households into the model, which allows us to study the impact of changes in family structure. Our modeling approach closely follows Chang and Kim (2006) who attempt to break the linkage between the micro- and macro-elasticity of labor supply.

The rest of the paper is organized as follows. We present the model in the next section and discuss how we calibrate it in Section 3. In Section 4, we analyze the steady-state results of the calibrated model and perform a model experiment to investigate the macroeconomic impact of the rising share of single-person households. Finally, we conclude the paper.

II. *Model*

1. Demographics

An economy is inhabited by a continuum of infinitely lived households, the measure of which is normalized to one. There are two types of households, single-person (male-alone and female-alone) and married-couple households. Household fertility decisions are abstracted away in the model, and married-couple households consist of a husband and a wife.[5]

2. Households

The utility of a male-alone household is as follows:

$$u_m(c,\, h) = \log c - B_m \frac{h^{1+1/\gamma}}{1+1/\gamma} \tag{1}$$

where c and h are consumption and hours worked. The parameter γ is the intertemporal substitution elasticity of leisure, and the parameter B_m governs the extent of disutility from work. The utility of a female-only household, u_f, is defined similarly.

On the other hand, the utility of a married-couple household is defined as follows (Chang and Kim (2006)):

$$u_{mf}(c,\, h_m,\, h_f) = 2\log\,(0.5c) - B_m\, \frac{h_m^{1+1/\gamma}}{1+1/\gamma} - B_f\, \frac{h_f^{1+1/\gamma}}{1+1/\gamma} \tag{2}$$

where the subscripts m and f stand for a husband ("male") and a wife ("female"), each of whom consumes an equal amount of goods, $0.5c$, regardless of the hours worked.

The only source of uncertainty is idiosyncratic shocks to labor productivity, which depends

[5] In our paper, the measure of households is different from the measure of population since married-couple households are formed by two persons.

on sex. As in Chang and Kim (2006), the labor productivity of male and female, denoted by x_m and x_f, evolve over time according to Markov processes with transition probability distribution functions $\pi_x^g(x_g'|x_g)=\Pr(x_{g,t+1}\leq x_g'|x_{g,t}=x_g)$, $g\in\{m, f\}$ where t denotes time.

3. Production

A representative firm produces goods, Y, that can be used for either consumption or investment in new capital according to a constant returns to scale technology:

$$Y=F(L, K)=L^{\alpha}K^{1-\alpha} \tag{3}$$

where L and K denote effective units of labor and capital employed, the parameter α denotes labor income share, and capital depreciates at the rate δ every period.

4. Capital Market

The capital market is incomplete in that households can hold assets only in the form of physical capital a, which yields the real rate r, and in that there is a borrowing constraint $a_t\geq\underline{a}$ for all t. Confronting idiosyncratic labor productivity shocks, households may accumulate assets in order to smooth their consumption over time. Through the capital market, the representative firm rents capital from households at a competitively determined rate.

5. Household's Optimization Problem

We assume that labor is indivisible (Rogerson (1988); Chang and Kim (2006, 2007)): an individual who decides to work provides $\bar{h}$ hours of labor to the representative firm ($h=\bar{h}$).

Single-Person Household. Consider a male-alone household that starts a period with assets a. At the beginning of the period, after observing realized labor productivity, x_m, the household chooses to work or not, whichever makes him better off. The value function of the household at the time of making the labor supply decision, V_m, is given as follows:

$$V_m(x_m, a)=\max\{V_m^e(x_m, a), V_m^u(x_m, a)\} \tag{4}$$

where V_m^e and V_m^u denote the value functions of the household when working and not working, respectively.

For a given wage and rate of interest, (w, r), V_m^e is expressed as follows:

$$V_m^e(x_m, a)=\max_{c,a'}\{u_m(c, \bar{h})+\beta\mathbf{E}[V_m(x_m', a')|x_m]\} \tag{5}$$

subject to

$$c+a'=wx_m\bar{h}+(1+r)a \tag{6}$$

$$a'\geq\underline{a} \tag{7}$$

The household maximizes discounted expected lifetime utility by choosing consumption c and savings a' under budget constraint (6) where the total resources to be used for c and a' are the sum of labor income $wx_m\bar{h}$, capital income ra', and current assets a. The value function of the male-alone household when not working, V^u_m, can be defined similarly to V^e_m.

In addition, the value functions of the female-alone household, V_f (at the time of making the labor supply decision), V^e_f (when working), and V^u_f (when not working), can also be defined similarly to the corresponding value functions of the male-alone household.

Married-Couple Household. A married-couple household can take a labor supply decision, h_{mf}, from four options: (i) both the husband and wife work, $\{\bar{h},\bar{h}\}$, (ii) only the husband works, $\{\bar{h},0\}$, (iii) only the wife works, $\{0,\bar{h}\}$, and (iv) neither works, $\{0,0\}$. The value functions corresponding to these four options are denoted by V^{ee}_{mf}, V^{eu}_{mf}, V^{ue}_{mf}, and V^{uu}_{mf}. The value function, V_{mf}, of the married-couple household that enters a period with assets, a, and observes the realized labor productivity of husband and wife, x_m and x_f, is defined as follows:

$$V_{mf}(x_m, x_f, a) = \max\ \{V^{ee}_{mf}, V^{eu}_{mf}, V^{ue}_{mf}, V^{uu}_{mf}\}$$

The value function of the household when both the husband and wife work, V^{ee}_{mf}, is expressed as below:

$$V^{ee}_{mf}(x_m, x_f, a) = \max_{c,\, a'}\{u_{mf}(c, \bar{h}, \bar{h}) + \beta \mathbf{E}[V_{mf}(x'_m, x'_f, a')\,|\,x_m, x_f]\} \tag{8}$$

subject to

$$c + a' = w\bar{h}(x_m + x_f) + (1+r)a \tag{9}$$

$$a' \geq \underline{a} \tag{10}$$

V^{ee}_{mf} is defined similarly to V^e_m.[6] The other value functions of the married-couple household, V^{eu}_{mf}, V^{ue}_{mf}, and V^{uu}_{mf}, can be defined in a similar manner.

6. Stationary Equilibrium

A stationary equilibrium consists of a set of value functions, $\{V_m(x_m, a), V^e_m(x_m, a), V^u_m(x_m, a), V_f(x_f, a), V^e_f(x_f, a), V^u_f(x_f, a), V_{mf}(x_m, x_f, a), V^{ee}_{mf}(x_m, x_f, a), V^{eu}_{mf}(x_m, x_f, a), V^{ue}_{mf}(x_m, x_f, a), V^{uu}_{mf}(x_m, x_f, a)\}$; sets of policy functions for labor supply, $\{h_m(x_m, a), h_f(x_f, a), h_{mf}(x_m, x_f, a)\}$, consumption, $\{c_m(x_m, a), c_f(x_f, a), c_{mf}(x_m, x_f, a)\}$, and savings, $\{a'_m(x_m, a), a'_f(x_f, a), a'_{mf}(x_m, x_f, a)\}$; measures of male-only, female-only, and married-couple households, $\{\Phi_m(x_m, a), \Phi_f(x_f, a), \Phi_{mf}(x_m, x_f, a)\}$; a price system, w and r; and a set of the representative firm's decision rules for production factors, K and L, such that:

1. Households optimize:
   (a) the male-only household's decision rules (h_m, c_m, a'_m) and value functions (V_m, V^e_m, V^u_m) solve the Bellman equations described in 2.5.
   (b) the female-only household's decision rules (h_f, c_f, a'_f) and value functions (V_f, V^e_f, V^u_f) solve the Bellman equations described in 2.5.
   (c) the married-couple household's decision rules $(h_{mf}, c_{mf}, a'_{mf})$ and value functions

[6] The household's labor income is from both the husband and wife.

$(V_{mf}, V^{ee}_{mf}, V^{eu}_{mf}, V^{ue}_{mf}, V^{uu}_{mf})$ solve the Bellman equations described in 2.5.

2. The representative firm maximizes its profit:

$$w=\alpha(K/L)^{1-\alpha}$$

$$r=(1-\alpha)(K/L)^{-\alpha}-\delta$$

3. The factor markets clear:

$$L=\int x_m h_m d\Phi_m+\int x_f h_f d\Phi_f+\int x_m 1(h_{mf}\in\{\{\bar{h}, \bar{h}\}, \{\bar{h}, 0\}\})d\Phi_{mf}$$
$$+\int x_f 1(h_{mf}\in\{\{\bar{h}, \bar{h}\}, \{0, \bar{h}\}\})d\Phi_{mf} \tag{11}$$

$$K=\int a d\Phi_m+\int a d\Phi_f+\int a d\Phi_{mf} \tag{12}$$

where $1\{\cdot\}$ denotes an indicator function that takes one if the argument inside the parentheses holds true, and zero otherwise.

4. The goods market clears:

$$F(L, K)+(1-\delta)K=\int(c+a')d\Phi_m+\int(c+a')d\Phi_f+\int(c+a')d\Phi_{mf} \tag{13}$$

5. The measures, Φ_m, Φ_f, Φ_{mf}, are invariant over time.

III. *Calibration*

The model period is one year. Households are not allowed to borrow ($\underline{a}$ = 0). The labor income share α is 0.64, and the intertemporal substitution elasticity of leisure γ is 0.4. The hours worked of a worker $\underline{h}$ is 1/3, and the depreciation rate is 10 percent. All these parameter values are in line with standard practices of the macro-labor literature.

The labor productivity of male and female follow the first-order auto-regressive processes in logarithm: $\log x_{g,t+1}=\rho_g \log x_{g,t}+\epsilon_{g,t+1}$, $g\in\{m, f\}$ where $\epsilon_{g,t}\sim \mathrm{N}(0, \sigma^2_g)$ for all t. We use the values estimated by Chang and Kim (2006): (ρ_m, σ_m) = (0.809, 0.348) and (ρ_f, σ_f) = (0.735, 0.401).[7] The parameters B_m = 25.5 and B_f = 40.6 are calibrated to match the employment rates of male and female, 77.3 percent and 49.7 percent, respectively. The discount factor, β = 0.956, is chosen so that the real rate of capital becomes 4 percent at equilibrium. All the values of calibrated parameters are summarized in Table 1.

As of 2012, according to Vespa et al. (2013), male-alone and female-alone households account for 12.3 percent and 15.2 percent, respectively, of all households. "Other non-family" households (unrelated people living together) account for 6.1 percent of all households, which we split into male-alone and female-alone households proportional to their relative shares.[8] In

[7] Using the individual wages from the Panel Study of Income Dynamics (PSID) for the period of 1970-1992, Chang and Kim (2006) estimated the labor productivity processes for male and female based on the self-selection model introduced in Heckman (1979).

TABLE 1. CALIBRATED PARAMETERS

Parameter	Value	Description
a	0	Borrowing limit
α	0.64	Labor income share
γ	0.4	Intertemporal substitution elasticity of leisure
$\bar{h}$	1/3	Working hours of those who are employed
δ	0.10	Depreciation rate
ρ_m	0.809	Persistence of labor productivity for male
σ_m	0.348	Standard deviation of ϵ_m for male
ρ_f	0.735	Persistence of labor productivity for female
σ_f	0.401	Standard deviation of ϵ_f for female
B_m	25.49	Disutility from working, male
B_f	40.61	Disutility from working, female
β	0.956	Discount factor
% Male-alone	15.0%	Share of male-alone households in 2012
% Female-alone	18.6%	Share of female-alone households in 2012
% Married couple	66.4%	Share of married-couple households in 2012

our benchmark economy, the share of male-alone, female-alone, and married-couple households are 15.0, 18.6, and 66.4 percent, respectively.

IV. *Quantitative Analysis*

1. Steady State

To examine how an individual's decisions on savings and labor supply at the steady state vary depending on individual characteristics—captured by state variables in our model—we draw a sample of 100 million individuals from the invariant distributions, Φ_m, Φ_f, and Φ_{mf}. Using the sample, we regress the level of savings, a', and the binary variable for the individual's labor supply decision, 1 (Employed), on marital status, labor productivity (and spouse's if applicable), current assets (a), and sex. Table 2 summarizes the results. The individual's decisions on savings and labor supply are located in the top and bottom sub-tables, respectively. In each, columns (1) and (2) list the estimates of coefficients only when singles and married individuals are included in the regression, respectively, and column (3) lists the estimates of coefficients when all individuals, regardless of marital status, are included.[9] It is straightforward to see from Table 2 (top) that regardless of marital status, individuals with a higher level of labor productivity and a greater amount of current assets save more, and among those who are married, an individual saves more when the labor productivity of his or her spouse is higher. These are common results among Aiyagari-Huggett type models. More interesting is that all else being equal, those who are married save less than those who are single (see column (3)). In our model, married individuals have an extra tool—spousal labor supply—to insure against idiosyncratic productivity shocks since the shock processes of labor productivity for male and female are independent each other and thus lowers the precautionary

[8] We assume that the other non-family households are formed by two persons.

[9] We use $0.5a'$ and $0.5a$ for the level of savings and current assets of married individuals.

Table 2. Determinants of Individual's Savings Decision

Dep: Savings	(1) Single	(2) Couple	(3) All
1(Married)	−	−	-.0387
Labor productivity	.3635	.1489	.1830
Spouse's labor productivity	−	.1489	−
Current asset	.9554	.9448	.9678
1(Male)	-.0059	0	-.0012

Dep: 1(Employed)	(1) Single	(2) Couple	(3) All
1(Married)	−	−	-.1311
Labor productivity	.3688	.3493	.3575
Spouse's labor productivity	−	-.1138	−
Current asset	-.0935	-.0941	-.1026
1(Male)	.2243	.2854	.2732

savings motive of those who are married.

From columns (1) and (2) of Table 2 (bottom), we can see that regardless of marital status, individuals with a higher level of labor productivity are more likely to work and those with a greater amount of current assets are less likely to work. These features are also shared by other Aiyagari-Huggett type models. Among those who are married, individuals are less likely to work when the labor productivity of his or her spouse is higher. This is because of the assumption that married couples pool their incomes into one shared basket out of which the husband and wife consume the same amount of goods: higher labor income of one spouse pushes up his or her consumption level, and the decreased marginal utility of consumption lowers one's incentive to work. Lastly, we learn from column (3) that all else being equal, married individuals are less likely to work since having an extra income source (spouse's labor income) might lower their incentive to work.

2. Experiment: Impact of Rising Share of Single-Person Households

We analyze the macroeconomic impact of the rising share of single-person households in total households, specifically, its impact on the level of aggregate savings and labor supply, by comparing economies that differ only in the share of single-person households: 33.6 (the calibrated model in 4.1, hereafter referred to as "the baseline"), 40.0, 45.0, and 50.0 percent.[10] Table 3 compares aggregate statistics across the steady states of these model economies.

Our earlier analysis reveals that non-married individuals tend to save and work more than married individuals. We now investigate whether these findings lead to higher levels of aggregate savings and labor supply in an economy with a higher share of single-person households. Let us start with a partial equilibrium analysis: compare columns (1), (2), (4), and (6) in Table 3 for which factor prices are fixed at the baseline values shown in (1). Aggregate savings increase as the share of single-person households increases: when the share of single-person households increases from 33.6 to 50.0 percent, aggregate savings increase by 11.5 percent from 2.286 to 2.548. It can also be verified that the increase in savings by single individuals, 0.509, is greater than the decrease in savings by married individuals, 0.247.

[10] We change the share of single-person households in the baseline while keeping the total population unchanged.

Table 3. Partial and General Equilibrium Effects of Rising Share of Single-Person Households

% of single-person HHs	33.6	40.0		45.0		50.0	
	BM	PE	GE	PE	GE	PE	GE
Statistics	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Interest rate, %	4.00	4.00	3.95	4.00	3.90	4.00	3.85
Wage	1.089	1.089	1.091	1.089	1.093	1.089	1.096
Agg. savings	2.286	2.382	2.303	2.462	2.321	2.548	2.340
- By singles	0.784	0.970	0.939	1.126	1.068	1.293	1.198
- By married ind.	1.502	1.411	1.363	1.336	1.253	1.255	1.142
Agg. labor supply	0.522	0.522	0.523	0.522	0.525	0.521	0.526
- By singles	0.103	0.128	0.128	0.149	0.150	0.171	0.173
- By married ind.	0.419	0.394	0.395	0.373	0.375	0.350	0.353

Note: "BM" column displays the results from the baseline; "PE" columns hold factor prices at the values of the baseline from the column (1); and "GE" columns allow factor prices to be freely adjustable to clear factor markets.

However, this is not the case for aggregate labor supply: the decrease in labor supply by married individuals, 0.069, is greater than the increase in labor supply by singles, 0.068, which results in an overall decrease in aggregate labor supply. Aggregate labor supply decreases slightly from 0.522 to 0.521, moving from (1) to (6). Thus, it is only aggregate savings that increase in response to the rising share of single-person households, not aggregate labor supply.

In a setting where factor prices are freely adjustable, however, interest rates decrease, and wages increase in response to increases in the share of single-person households. For instance, when the share of single-person households increases from 33.6 to 50.0 percent, interest rates decrease from 4.0 to 3.85 percent, and wages increase from 1.089 to 1.096. An increase in the share of single-person households has two conflicting effects on factor prices. Owing to single individuals' higher propensity to save, it will shift the capital supply curve to the right, exerting downward pressure on interest rates and upward pressure on wages, with more capital for each unit of labor available. However, the rising share of single-person households also means a rightward shift of the labor supply, which has effects on factor prices exactly opposite those of the rightward shift of the capital supply. In our exercises, the former effects dominate the latter; thus, interest rates decrease, and wages increase. With a lower interest rate, in a general equilibrium setting, aggregate savings increase with the share of single-person households but not as much as in a partial equilibrium setting, and a higher wage pushes up aggregate labor supply (compare (6) with (7) in Table 3). As a result, when the share of single-person households increases, both aggregate savings and labor supply increase, for which the general equilibrium effect plays a crucial role.

V. *Conclusion*

The rise of single-person households is a widely observed pattern in developed countries. Our quantitative model investigates the impact of this change on aggregate savings and labor supply. With fewer tools to insure against idiosyncratic income shocks, single individuals tend to save and work more than married individuals with the same economic characteristics. Our comparisons across model economies differing only in the share of single-person households indicate that both aggregate savings and labor supply increase in response to the rising share of single-person households. However, it turns out that were it not for higher wages resulting from the general equilibrium effect, aggregate labor supply would have shrunk since the increase in labor supply by single individuals does not dominate the decrease in labor supply by married ones in a partial equilibrium setting.

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