

Wealth inequality: data and models*

Marco Cagetti
University of Virginia

Mariacristina De Nardi
University of Minnesota and Federal Reserve Bank of Minneapolis

Abstract

In the United States wealth is highly concentrated and very unequally distributed: the richest 1% hold one third of the total wealth in the economy. Understanding the determinants of wealth inequality is a challenge for many economic models. We summarize some key facts about the wealth distribution and what economic models have been able to explain so far.

*We gratefully acknowledge financial support from NSF grants (respectively) SES-0318014 and SES-0317872. We are grateful to Marco Bassetto for helpful comments. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis, the Federal Reserve System, or the NSF.

1 Introduction

In the United States wealth is highly concentrated and very unequally distributed: the richest 1% of the households owns one third of the total wealth in the economy. Understanding the determinants of wealth inequality is a challenge for many economic models. In this paper, we summarize what is known about the wealth distribution and what economic models have been able to explain so far.

The development of various data sets in the past 30 years (in particular the Survey of Consumer Finances) has allowed economists to quantify more precisely the degree of wealth concentration in the United States. The picture that emerged from the different waves of these surveys confirmed the fact that a large fraction of the total wealth in the economy is concentrated in the hand of the richest percentiles: the top 1% hold one third, and the richest 5% hold more than half of total wealth. At the other extreme, a significant fraction of the population holds little or no wealth at all.

Income is also unequally distributed, and a large body of work has studied earnings and wage inequality. Income inequality leads to wealth inequality as well, but income is much less concentrated than wealth, and economic models have had difficulties in quantitatively generating the observed degree of wealth concentration from the observed income inequality. The question is what mechanisms are necessary to generate saving behavior that leads to a distribution of asset holdings consistent with the actual data.

In this work, we describe the main framework for studying wealth inequality, that of general equilibrium models with heterogeneous agents, in which some elements of a life-cycle structure and of intergenerational links are present. Some models consider a dynasty as a single, infinitely-lived agent,

while others consider more explicitly the life-cycle aspect of the saving decision. Baseline versions of these models are unable to replicate the observed wealth concentration. More recently, however, some works have shown that certain ingredients are necessary, and sometimes enable the model to replicate the data. Bequests are a key determinant of inequality, and careful modelling of bequests is vital to understand wealth concentration. In addition, entrepreneurs constitute a large fraction of the very rich, and models that explicitly consider the entrepreneurial saving decision succeed in dramatically increasing wealth dispersion. The type of earnings risk faced by the richest is also a potential explanation worth investigating.

Considerable work must still be done to better understand the quantitative importance of each factor in determining wealth inequality and to understand which models are most useful and computationally convenient to study it. The recent advances in modelling have however already helped in providing a more precise picture. The challenge now is improve these models even further and to apply them to the study of several problems for which inequality is a key determinant. For instance, the effects of several tax policies (in particular the estate tax) might depend crucially on how wealth is concentrated in the hands of the richest percentiles of the distribution. In the last section of this paper, we will highlight some of the areas in which models of inequality could and should be profitably employed and extended.

2 Data

We first summarize the main facts about the wealth distribution in the United States, facts provided mainly by the Survey of Consumer Finances. We will also mention some facts about the historical trends, although in this paper we

will not focus on understanding them (an area on which little work has been done).

2.1 Data sources

The main source of microeconomic data on wealth for the U.S. is the Survey of Consumer Finances (SCF)¹ which, starting from 1983, every three years collects detailed information about wealth for a cross-section of households. It also includes a limited panel (between 1983 and 1989), as well as a link to two previous smaller surveys (1962 Survey of Financial Characteristics of Consumers and the 1963 Survey of Changes in Family Finances).

The SCF was explicitly designed to measure the balance sheet of households and the distribution of wealth. It has a large number of detailed questions about different assets and liabilities, which allows highly disaggregated data analysis on each component of the total net worth of the household. More importantly, the SCF oversamples rich households by including, in addition to a national area probability sample (representing the entire population), a list sample drawn from tax records (to extract a list of high income households). Oversampling is especially important given the high degree of wealth concentration (see Davies and Shorrocks [24]) observed in the data. For this reason, the SCF is able to provide a more accurate measure of wealth inequality and of total wealth holdings: Curtin et al. [22] and Antoniewicz [5] document that the total net worth implied by the SCF matches quite well the total wealth implied by the (aggregate) Flow of Funds Accounts (although not perfectly, especially when disaggregating the various components).

¹The survey is publicly available from the Federal Reserve Board website at <http://www.federalreserve.gov/pubs/oss/oss2/scfindex.html>.

Unfortunately, the SCF does not follow households over time, unlike the Panel Study of Income Dynamics (PSID). The PSID² is a longitudinal study, which begun in 1968, and follows families and individuals over time. It focuses on income and demographic variables, but since 1984 it has also included (every 5 years) a supplement with questions on wealth. The PSID includes a national sample of low-income families, but it does not oversample the rich. As a result, this data set is unable to describe appropriately the right tail of the wealth distribution: Curtin et al. [22] show that the PSID tracks the distribution of total household net worth implied by the SCF only up to the top 2%-3% of richest household, but misses much of the wealth holdings of the top richest. Given that the richest 5% hold more than half of the total net worth in the U.S., this is an important shortcoming.

Another important data source is the Health and Retirement Study (HRS), which recently absorbed the Study of Assets and Health Dynamics Among the Oldest Old (AHEAD). This survey focuses on the older households (from before retirement and on), and provides a large amount of information regarding their economic and health condition. However, as the PSID, this survey misses the richest households.

Other data sets also contain some information on wealth and asset holdings (in particular, the U.S. Bureau of Census's Survey of Income and Program Participation, or, for the very richest, the data on the richest 400 people identified by the *Forbes* magazine). However, because of its careful sample choice, the SCF remains the main source of information about the distribution of wealth in the U.S. Due to their demographic and health data, the PSID and the HRS provide additional information for studying the wealth holdings of

²See <http://psidonline.isr.umich.edu/>.

Percentile group	Year				
	1989	1992	1995	1998	2001
0-49.9	2.7	3.3	3.6	3.0	2.8
50-89.9	29.9	29.7	28.6	28.4	27.4
90-94.9	13.0	12.6	11.9	11.4	12.1
95-98.9	24.1	24.4	21.3	23.3	25.0
99-100	30.3	30.2	34.6	33.9	32.7

Table 1: Percent of net worth held by various groups defined in terms of percentiles of the wealth distribution (taken from Kennickell [44], p. 9).

most households (except the richest), and above all for certain groups, such as the low-income families and the old.

2.2 Wealth concentration in the U.S.

The most striking aspect of the wealth distribution in the U.S. is its degree of concentration. Table 1 shows that the households in the top 1% of the wealth distribution hold around one third of the total wealth in the economy, and those in the top 5% hold more than half. At the other extreme, many households (more than 10%) have little or no assets at all.

The data in Table 1 and 2 refer to total net worth. There are many possible measures of wealth, the most appropriate one depending on the problem object of study. Net worth includes all assets held by the households (real estate, financial wealth, vehicles) net of all liabilities (mortgages and other debts); it is thus a comprehensive measure of most marketable wealth. This measure thus includes the value of most defined contribution plans (such as IRAs), but excludes the implied values of defined benefit plans and social security. Defined contribution plans can of course be important sources of income after retire-

Net worth	Year				
	1989	1992	1995	1998	2001
< \$0	7.3	7.2	7.1	8.0	6.9
\$0-\$1,000	8.0	6.3	5.2	5.8	5.4
\$1,000-\$5,000	12.7	14.4	15.0	13.1	12.8
\$25,000-\$100,000	23.2	25.4	26.4	22.9	22.0
\$100,000-\$250,000	20.2	21.6	22.1	22.6	19.2
\$250,000-\$500,000	11.0	9.3	9.3	12.0	13.0
\$500,000-\$1,000,000	5.4	4.6	5.1	6.0	7.8
\geq \$1,000,000	4.7	3.8	3.6	4.9	7.0

Table 2: Percent distribution of household net worth over wealth groups, 2001 dollars(taken from Kennickell [44], p. 9).

ment; but their measure is problematic because their value has to be imputed. To study other questions it may be useful to look at more restricted measures of wealth, that for example exclude less liquid assets (such as housing), and focus on financial wealth instead. Throughout this paper, we focus on net worth.³

The key facts about the distribution of wealth have been highlighted in a large number of studies, among others Wolff [72], [71], and Kennickell [44]. Wealth is extremely concentrated, and much more so than earnings and income, as shown by Díaz-Giménez et al. [27] and Budria et al. [63]. For instance, in 1992 the Gini index for labor earnings, income (inclusive of transfers) and wealth were respectively .63, .57, and .78 (Díaz-Giménez et al. [27]), while in 1995 they were .61, .55 and .80 (Budria et al. [63]). These two studies also

³It must be noted that the exact definition of net worth varies across studies. Therefore, the numbers we cite below when referring to other works are not directly comparable, as they may include different sets of assets. However, the general picture of a highly skewed distribution and the main trends are unchanged and do not depend on the exact measure of wealth.

Top %	1	5	10	20
Whole population				
percentage of total net worth held	30	54	67	81
Entrepreneurs				
percentage of households in a given percentile	63	49	39	28
percentage of net worth held in a given percentile	68	58	53	47

Table 3: Entrepreneurs and the distribution of wealth. SCF 1989.

report that the correlation between these three variables is positive, but far from perfect.

There is also significant wealth inequality within various age and demographic groups. For instance, Venti and Wise [68] and Bernheim et al. [8] show that wealth is highly dispersed at retirement even for people with similar lifetime incomes, and argue that these differences cannot be explained only by events such as family status, health and inheritances, nor by portfolio choice.

Several studies have also highlighted the differences in wealth holdings across different groups. There is a very large inequality in wealth holdings by race (see for example Altonji and Doraszelski [2] and Smith [65]). Wolff [72] documents that, in the 1980s and 1990s, the ratio of average net worth of blacks and whites was around 17% to 19%, and the ratio of median wealth varied, depending on the year, across much lower values, in the range of 3% to 17%. Unfortunately, relatively little work has been done to understand quantitatively the sources of this persistent difference across race groups. (See White [69] for a study of how much of current black-white income and wealth inequality can be explained by initial conditions at Emancipation.)

A large difference in wealth holdings is also between entrepreneurs and non-entrepreneurs, as shown in Table 3 (taken from Cagetti and De Nardi [16]).

Entrepreneurs⁴ are a small fraction of the population (about 10%), but hold a large share of total wealth (about 40%). Table 3 shows that entrepreneurs constitute a large fraction of the richest households: more than 60% of the households in the top 1%, and almost one-half of those in the top 5%, and they hold, respectively, 68% and 58% of the wealth held by households in those percentiles. As shown also by Gentry and Hubbard [33], Quadrini [60], and Buera [13], entrepreneurship is a key element to understand the wealth concentration among the richest households.

The observed degree of wealth concentration is thus much higher than the one of labor earnings. As we will see in the sections about the models, generating saving behavior that is consistent with these facts is not a trivial task.

2.3 Savings, bequests and wealth accumulation

In addition to income differences, wealth inequality may be driven by differences in the saving behavior, or in the intergenerational transfers received. Analyzing the empirical evidence to tell apart different potential sources of wealth inequality is more difficult.

Individual saving cannot be measured directly, but must be computed from other data, either as the first difference in wealth, or as income minus consumption. For this reason, fewer studies document the differences in saving rates across the population; these studies however suggest significant differences in saving behavior across various groups. (See Browning and Lusardi [12] for a

⁴We classify as *entrepreneurs* the households who declare owning a privately held business (or a share of one), who have an active management role in it, and who have invested a positive amount of wealth in such business. Alternative classifications give very similar results.

review of the literature.) In particular, Dynan et al. [28] show that higher-lifetime income households save a larger fraction of their income than lower-income households. Quadrini [60] documents that entrepreneurs, who tend to be among the richest households, also exhibit higher saving rates.

Bequests also play an important role in shaping wealth inequality. Kotlikoff and Summers [45] were the first to argue that life-cycle savings for retirement account for a small fraction of total capital accumulation, while intergenerational transmission of wealth accounts for the vast majority of capital formation (with a baseline estimate of around 80% of the total). Further studies have confirmed the importance of intergenerational transfers; for instance, Gale and Scholz [32] find that bequests account for about 30% of total wealth accumulation, and various other types of intended inter-vivos transfers for an additional 20%.

It is more difficult to measure the size of intended bequests relative to that of purely accidental ones, due to uncertainty about the life-span. Hurd [42] estimates a very low marginal utility from leaving bequests. Altonji and Villanueva [3] also find relatively small values for the elasticity of bequests to permanent income, although they do show that this number increases with life-time resources. Most of the bequests, however, are concentrated among the top percentiles, a group that these papers ignore. Looking at a sample of TIAA retirees (whose average wealth is higher than in the other groups), Laitner and Juster [50] find that about half of the households in their sample plan to leave estate and that the amount of wealth attributable to estate building is significant, accounting for half or more of the total for those who plan to leave bequests. While more empirical research is needed in the area, it appears that intergenerational altruism and intended bequests are a crucial element to understand the distribution of wealth, above all for the very rich.

2.4 Trends in wealth inequality

It is quite difficult to measure wealth inequality before the second half of the twentieth century. Some limited data exists (Census surveys in the nineteenth century and other records of estates), but their the interpretation is still debated. Some argue that inequality has always been high and has changed little from the end of the eighteenth century to the first decades of the twentieth (for example, Soltow [66]), while others argue for a sharp increase in inequality over the period (among others, Lindert [53]). It is however interesting to note that wealth inequality has always been substantial, and, even according to Lindert [53], by 1860 the richest 1% held approximately 30% of total wealth, an amount that remained more or less stable until the 1920's.

There is evidence that wealth inequality decreased significantly between the 1920 and the 1970s (Davies and Shorrocks [24], Wolff and Marley [73]). Wolff [71], for instance, documents that the share of total wealth held by the top 1% of individuals fell from 38% in 1922 to 19% in 1976. After that, however, wealth inequality has risen again to levels similar to those observed in earlier periods.

Wolff [70] argues that while wealth inequality fell during the 1970s, it rose sharply after 1979, with a dramatic increase over the 1980s, and then levelled off in the 1990s. For instance, the share of net worth of the richest 1% increased from 34% in 1983, to 37% in 1989 (see Wolff [72]), while there does not seem to be a clear trend after 1989 (Kennickell [44]).

Because of the purely cross-sectional nature of the SCF, it is difficult to characterize the mobility of households across the wealth distribution. Using PSID data, Hurst et al. [43] analyze the wealth dynamics between 1984 and 1994, for different socio-economic groups and for different types of asset hold-

ings, pointing out that most of the mobility occurs in the midrange deciles, while the top and bottom ones show high persistence. Unfortunately, the PSID does not allow to study what happens at the top percentile. Using the same dataset, Quadrini [60] studies the wealth mobility for entrepreneurs and non-entrepreneurs, showing that entrepreneurs are more upwardly mobile.

3 Models

In the following sections, we will describe the main class of models used to study wealth concentration. Most of these models are general-equilibrium, quantitative models with heterogeneous agents. We will distinguish these works into three sub-categories: models with infinitely-lived dynasties, models with overlapping-generations (OLG), and models that mix both of these features.

The first type of models ignore the life-cycle structure, but consider each dynasty as a single agent who lives forever. The second type explicitly introduces an age and life-cycle structure, with various degrees of intergenerational transmission of wealth and abilities. The third type relaxes the infinitely-lived dynasty assumption of the first type of models, but greatly simplifies the life-cycle structure.

Almost all the current general equilibrium, quantitative models of wealth inequality are versions of Bewley models⁵. These are incomplete-markets models in which households are ex-ante identical⁶, in the sense that they face the same stochastic labor earnings and ability processes, but are ex-post heteroge-

⁵See Ljungqvist and Sargent [55] for an exposition of the properties of these models and of their numerical solution.

⁶See Quadrini and Ríos-Rull [62] for a discussion about why we need incomplete market models to study wealth inequality.

neous because they receive different realizations of such shocks. These models are typically solved for stationary equilibria in which, over time, there is a constant distribution of people over the relevant state variables for the economy, but people move around in the distribution, and thus face considerable uncertainty. These models endogenously generate differences in asset holdings and hence a given amount of wealth concentration, as a result of the household's desire to save and the realization of the shocks. An exogenous earnings process is typically the source of these shocks, and its properties are generally estimated from the data

3.1 Earlier contributions

Before moving to the analysis of these models, it is worth mentioning some of the earlier contributions to understanding wealth inequality.

Many models were developed to study life-cycle and savings decisions. The most important to understand intergenerational linkages is Becker and Tomes [7]. Becker and Tomes were the first to model explicitly the parental decision problem, and to characterize the structure of transfers across generations, in the form of both human capital and bequests. They showed that in the presence of constraints, parental transfers are first in the form of human capital, and only after the optimal amount of human capital has been reached they do take the form of monetary transfers such as bequests. Bequests are thus a luxury good in this framework.

A few papers also tried to develop quantitative implications. Among the earlier, partial equilibrium literature, Davies [23] studies the effects of various factors, including bequests, on economic inequality in a one-period model without uncertainty. In his setup one generation of parents cares about their

children's future consumption, and there is regression to the mean between parents and children's earnings. As a consequence, the income elasticity of bequests is high and inherited wealth is a major cause of wealth inequality.

Laitner [48] adopted a partial equilibrium model with two sided altruism among generations, constraints on net worth being non negative, and random lifetime earnings. He showed that in this setup intergenerational transfers are a luxury good and that liquidity constraints are less binding for generations receiving larger transfers. He also discusses how this economy can generate realistic capital to output ratios. He does not explore the implications of his model for wealth inequality and abstracts from lifetime uncertainty and earnings uncertainty over the life cycle.

4 Infinitely-lived dynasty models

4.1 A general framework

Let us consider the simplest version of a Bewley model with infinitely-lived agents. There is a continuum of agents. All agents have identical preferences, and have the following utility function when they first enter the model economy:

$$E \left\{ \sum_{t=1}^{\infty} \beta^t u(c_t) \right\},$$

where $u(c_t)$ is the constant relative-risk aversion flow of utility from consumption. The labor endowment of each household is given by an idiosyncratic labor productivity shock z that assumes a finite number of possible values and follows a first order Markov process with transition matrix $(\Gamma(z))$. There is only one asset, a , that people can use to self-insure against earnings risk.

A constant returns to scale production technology converts aggregate capital (K) and aggregate labor (L) into aggregate output (Y).

During each period each household chooses how much to consume (c) and save for next period by holding risk free assets (a'). The household's state variables are denoted by $x = (a, z)$, where a is asset holdings carried into the period and z is the labor shock endowment.

The household's recursive problem can thus be written as

$$V(x) = \max_{(c, a')} \left\{ u(c) + \beta E \left[V(a', z') | x \right] \right\}$$

subject to

$$c + a' = (1 + r)a + zw$$

$$c \geq 0, \quad a' \geq \underline{a}$$

where r is the interest rate net of taxes and depreciation, w is the wage, and \underline{a} is a net borrowing limit⁷. For simplicity, we have not explicitly introduce taxes and government policies, but of course the setup can easily accomodate various types of taxes and transfers.

At every point in time this model economy can be described by a probability distribution of people over assets a and earnings shocks z .

A stationary equilibrium for this economy is a set of consumption and saving rules, prices, aggregate capital and labor, and invariant distribution of households over the state variables of the system such that:

1. Given prices, the decision rules solve the household's recursive problem

⁷See Bewley [10], Aiyagari [1], Huggett [40] and Ljungqvist and Sargent [55] for more exhausting descriptions of this framework and its equilibrium.

described above.

2. Aggregate capital is equal to total savings of all of the households of the economy, while aggregate labor is equal to total labor supplied by all of the households of the economy.
3. Prices, that is the interest rate and the wage rate, gross of taxes, equal the marginal product of capital, net of depreciation, and the marginal product of labor.
4. The constant distribution of people is the one induced by the law of motion of the system, which is determined by the exogenous earnings shocks and by the endogenous policy functions of the households.

4.2 Results

Quadrini and Ríos-Rull [62] nicely summarize the results obtained from this type of models until 1997 with the first three lines of Table 4.

Gini	% wealth in top		
	1%	5%	20%
U.S. data			
.78	29	53	80
Baseline Aiyagari			
.38	3.2	12.2	41.0
High variability Aiyagari			
.41	4.0	15.6	44.6
Quadrini: entrepreneurs			
.74	24.9	45.8	73.2

Table 4: Dynasty models of wealth inequality.

Most of the models in Table 4 display significantly less wealth concentration than in the data. The reasons why households save in this type of models is to create a buffer stock of assets to self-insure against earnings fluctuations. Once such buffer stock is reached, the agents don't save any more, and the model is thus not capable to explain why the rich people keep saving at very high rates. Given that that this is the key reason to save, what matters in generating wealth dispersion is temporary differences in earnings, not permanent ones. Line two and three of the table compares two identical economies, other than the fact that the second one displays much higher earnings variability than the first one (and thus higher cross-sectional earnings inequality) and show that second economy does generate a slightly more concentrated distribution of wealth.

Given the key reason to save in this framework, introducing ex-ante heterogeneity such as classes of people with different skills or education levels does not help in generating more concentration of wealth because it does not change the nature of uncertainty that people face (see Quadrini and Ríos-Rull [62] for more details.)

4.3 Extensions of the basic model

The failure of the basic model to explain wealth inequality suggests that one needs to look at other mechanisms. Two such mechanisms are entrepreneurship and preference heterogeneity.

The setup presented so far assumes implicitly that the agents are employed workers, who receive some labor income. Entrepreneurs, however, face a different decision problem, as their income is related to their business. A more recent contribution by Quadrini [61] introduces entrepreneurial choice in a dy-

nastic framework: during each period the households decide whether to be entrepreneurs or not. Quadrini finds that a calibrated version of his model can generate a much larger amount of wealth concentration in the hands of the richest. In his model, three elements are crucial to generate this result. First, the existence of capital market imperfections induces workers that have entrepreneurial ideas to accumulate more wealth to reach minimal capital requirements. Second, in the presence of costly financial intermediation, the interest rate on borrowing is higher than the return from saving, therefore an entrepreneur whose net worth is negative faces a higher marginal return from saving and reducing his debt. Third, there is additional risk associated with being an entrepreneur, hence risk averse individuals will save more. Quadrini chooses some of the parameters of his model to match moments of the distribution of wealth and he comes much closer to fitting the upper tail of the wealth distribution than the previous models, although his model still does not generate enough asset holdings in the hands of the very richest compared to the data.

Another mechanism to generate wealth inequality is heterogeneity in preferences. The decision to save depends crucially on the specific parameter values of the utility function. In particular, a higher degree of patience (summarized by a higher discount factor β) leads people to save more. In the presence of precautionary savings, a higher coefficient of risk aversion may also induce higher savings.

Krusell and Smith [46] generalize the basic framework by adding a stochastic process for the dynasty's preferences (both discount factor and risk aversion). The discount factor (or the risk aversion) changes on average every generation and is meant to recover the fact that parents and children in the same dynasty may have different preferences. Krusell and Smith find that it

is possible to find a stochastic process for the dynasties' discount factor to match the variance of the cross-sectional distribution of wealth, while uncertainty about risk aversion does not affect the results much (although, as shown by Cagetti [14], the results are very sensitive to the values for the utility parameters chosen). However, while capturing the variance, their model fails to match the extreme degree of concentration of wealth in the hands of the richest 1%. There is empirical evidence of heterogeneity in preferences, with potentially large differences across people, in particular in the discount factor (as show for instance by Lawrance [51] and Cagetti [15]), and this may play an important role in shaping wealth inequality. Given Krusell and Smith's results, however, preference heterogeneity alone does not seem sufficient to replicate the facts on wealth inequality highlighted in the previous section.

One possibility is to extend the standard functional form for the utility function. Díaz, Pijoan-Mas, and Ríos-Rull [26] study the effect of habit formation in preferences and find that introducing habit formation decreases the concentration of wealth generated by this type of models and is hence not helpful in reconciling the models with the key features of wealth concentration.

Yet another possibility is to assume directly that wealth per se enters the utility function. Carroll [20] concentrates on the fact that in the data households with higher levels of lifetime income have higher lifetime saving rates (see Dynan, Skinner and Zeldes [28] and Lillard and Karoly [52]). He shows that neither standard life-cycle, nor dynastic models can recover the saving behavior of rich and poor families at the same time. To solve this puzzle he suggests a “capitalist spirit” model, in which finitely lived consumers have wealth in the utility function. This can be calibrated to make wealth a luxury good, thus rendering nonhomothetic preferences.

5 Overlapping-generations models

5.1 A benchmark framework

We use Huggett's [40] formulation as a benchmark OLG. Each period a continuum of agents are born. They live at most N periods, and face an age-dependent survival probability s_t of surviving up to age t , conditional on surviving up to age $t - 1$. The demographic patterns are stable, so age t agents make up a constant fraction μ_t of the population at every point in time.

All agents have identical preferences, and have the following utility function when they first enter the model economy:

$$E \left\{ \sum_{t=1}^N \beta^t \left(\prod_{j=1}^t s_j \right) u(c_t) \right\},$$

where $u(c_t)$ is the constant relative-risk aversion flow of utility from consumption, and the expected value is computed with respect to the household's earnings shocks.

The labor endowment of each household is given by a function $e(z, t)$, which depends on the agent's age t , and on an idiosyncratic labor productivity shock z , that assumes a finite number of possible values and that follows a first order Markov chain with transition matrix $\Gamma(z)$.

There are no annuity markets⁸. People save to insure against earnings risk, for retirement, and in case they live a long life. People that die prematurely leave accidental bequests.

There is a constant returns to scale production technology that converts

⁸This is a very common assumption given how small the annuity market is in practice. Eichenbaum and Peled [29] show that in the presence of moral hazard people will choose to self-insure rather than use annuity markets even if the rate of return on annuities is high.

aggregate capital (K) and labor (L) into output (Y).

During each period each household choose how much to consume (c) and save for next period by holding risk free assets (a'). The household's state variables are denoted by $x = (a, z)$, where a is asset holdings carried into the period and z is the labor shock endowment.

The household's recursive problem can be written as:

$$V(x, t) = \max_{(c, a')} \left\{ u(c) + \beta s_{t+1} E \left[v(a', z', t+1) | x \right] \right\}$$

subject to

$$c + a' = (1 + r)a + e(z, t)w + T + b_t$$

$$c \geq 0, \quad a' \geq \underline{a} \quad \text{and} \quad a' \geq 0 \quad \text{if} \quad t = N$$

where r is the interest rate net of taxes and depreciation, w is the wage net of taxes, T are accidental bequests that left by all of the deceased in a period, which are assumed to be redistributed by the government to all people alive, and b_t are social security payments to the retirees. Modelling explicitly social security is important because social security redistributes a significant fraction of income from the young to the old and thus reduces the saving rate and changes the aggregate capital-output ratio.

At every point in time this model economy can be described by a probability distribution of people over age t , assets a , and earnings shocks z .

A stationary equilibrium for this economy can be defined analogously to the one described for the infinitely-lived model, with the additional requirements that during each period total lump-sum transfers received by the households alive equal accidental bequests left by the deceased, and the government budget constraint balances every period.

5.2 Results

Huggett [40] calibrates this model economy to key features of the U.S. data and uses different versions of it to quantify how much wealth inequality can be generated using a pure life-cycle model with labor earnings shocks and uncertain life span. The paper succeeds in matching the U.S. Gini coefficient for wealth, but the concentration is obtained by having too many people holding little wealth and by not concentrating enough wealth in the upper tail of the wealth distribution. The key reason of this failure is that in the data the rich (people with high permanent income) have a very high saving rate, while in the model households that have accumulated a sufficiently high buffer stock of assets and retirement saving don't keep saving until they reach huge levels of wealth. Huggett finds that relaxing the household's borrowing constraint increases the fraction of people bunched at zero or negative wealth, but does not increase much the asset holdings of the rich, and hence does not help in generating a distribution of wealth closer to the observed one.

Huggett also studies the amount of wealth inequality generated by his model at different ages and finds that, starting from age 40, the model underpredicts the amount of wealth inequality by age. This point is further studied by recent work by Hendricks [37], that focuses on the performance of the OLG model on cross-sectional wealth inequality at retirement age. Hendricks shows that, at retirement age, this version of the OLG model overstates wealth differences between earnings-rich and earnings-poor, while it understates the amount of wealth inequality conditional on similar lifetime earnings.

5.3 Bequest motives

De Nardi [25] introduces two types of intergenerational links in the OLG model used by Huggett: voluntary bequests and transmission of human capital. She models the utility from bequests as providing “warm glow” (as in Andreoni [4]). In this framework parents and their children are linked by voluntary and accidental bequests and by the transmission of earnings ability. The households thus save to self-insure against labor earnings shocks and life-span risk, for retirement, and possibly to leave bequests to their children.

Compared to Huggett, there is thus an extra term in the value function of a retired person that faces a positive probability of death:

$$V(a, t) = \max_{c, a'} \left\{ u(c) + s_t \beta E_t V(a', t + 1) + (1 - s_t) \phi(b(a')) \right\} \quad (1)$$

where

$$\phi(b) = \phi_1 \left(1 + \frac{b}{\phi_2} \right)^{1-\sigma} \quad (2)$$

The utility from leaving bequests thus depends on two parameters: ϕ_1 , which represents the strength of the bequest motive, and ϕ_2 , which measures the extent to which bequests are a luxury good. These two parameters are respectively calibrated to match Kotlikoff and Summers’s [45] data on the fraction of capital due to intergenerational transfers, and to match one moment of the observed distribution of bequests.

Table 5 summarizes her results. The first line of the table refers to the U.S. data. The second one to a version of Huggett’s model economy in which there are only accidental bequests, which are redistributed equally to all people alive every year. The third line also refers to an economy in which there are only accidental bequests, but these are received by the children of the de-

Transfer wealth ratio	Wealth Gini	Percentage wealth in the top					Percentage with negative or zero wealth
		1%	5%	20%	40%	60%	
U.S. data							
.60	.78	29	53	80	93	98	5.8–15.0
No intergenerational links, equal bequests to all							
.67	.67	7	27	69	90	98	17
No intergenerational links, unequal bequests to children							
.38	.68	7	27	69	91	99	17
One link: parent's bequest motive							
.55	.74	14	37	76	95	100	19
Both links: parent's bequest motive and productivity inheritance							
.60	.76	18	42	79	95	100	19

Table 5: OLG models of wealth inequality, from De Nardi [25]

ceased upon their parent's death, and are thus unequally distributed. This experiment shows that accidental bequests, even if unequally distributed, do not generate a more unequal distribution. This is because receipt of a bequest per se does not alter the saving behavior of the richest. This experiment also highlights the fact that the Auerbach and Kotlikoff's measure on intergenerational transfers is sensitive to the timing of transfers: if children inherit only once, when their parent dies (rather than every year as in line three), this measure generates a fraction of wealth due to intergenerational transfers that is much lower than the one computed by Huggett. The fourth line allows for a voluntary bequest motive, and shows that voluntary bequests can explain the emergence of large estates, which are often accumulated in more than one generation, and characterize the upper tail of the wealth distribution in the data. The fifth line allows for both voluntary bequests and transmission of ability and shows that a human-capital link, through which children partially

inherit the productivity of their parents, generates an even more concentrated wealth distribution. More productive parents accumulate larger estates and leave larger bequests to their children, who, in turn, are more productive than average in the workplace.

The presence of a bequest motive also generates lifetime saving profiles more consistent with the data: saving for precautionary purposes and saving for retirement are the primary factors for wealth accumulation at the lower tail of the distribution, while saving to leave bequests significantly affects the shape of the upper tail. Also, with this parameterization of the voluntary bequest motive, and consistently with the data, the rich elderly do not decumulate their assets as fast as predicted by a standard a OLG model.

De Nardi finds that ϕ_2 is a large number, so bequests are a luxury good, and that the extent to which they are a luxury good is key in generating more concentration in the hands of the richest and producing a more realistic lifetime savings profiles (many papers that do not find evidence in favor of a bequest motive, such as Hurd [42] and Hendricks [37], assume that $\phi_2 = 0$.) With this parameterization, and consistently with the data, the bequest motive to save is much stronger for the richest households, who, even when very old, keep some assets to leave to their children. The rich leave more wealth to their offspring, who, in turn, tend to do the same. This behavior generates some large estates that are transmitted across generations because of the voluntary bequests, while being quantitatively consistent with the elasticity of the savings of the elderly to permanent income that has been estimated from microeconomic data (Altonji and Villanueva [3]).

It is clear from this table that, although modeling explicitly both of these mechanisms does help to better explain the the savings of the richest, De Nardi's model is not capable of matching the wealth concentration of the rich-

est 1% of the people.

5.4 Other extensions

Heer [36] adopts a model in which richer and poorer people have different tastes for leaving bequests. His characterization of the labor income process (people can be employed or unemployed) does not generate enough income inequality compared with the data and his model does not produce large wealth concentration.

Hendricks [38] studies the effects of allowing for preference heterogeneity in a life-cycle framework with only accidental bequests. Consistently with Krusell and Smith [46], he finds that heterogeneity in risk aversion has only minimal effects on saving and wealth inequality. Moreover, he shows that time preference heterogeneity only makes a modest contribution in accounting for high wealth observations if the heterogeneity in discount factor is chosen to generate realistic patterns of consumption and wealth inequality as cohorts age.

Hubbard Skinner and Zeldes [39] focus on the effects of social insurance programs on wealth holdings of poorer people because micro data find a significant group in the population with little wealth. They show that in presence of precautionary savings the asset-based means testing of welfare programs can imply that a significant fraction of people with lower lifetime earnings do not accumulate wealth.

Gokhale et al. [34] aim at evaluating how much wealth inequality at retirement age arises from inheritance inequality. To do so, they construct an overlapping-generations model that allows for random death, random fertility, assortative mating, heterogeneous human capital, progressive income taxation

and social security. All of these elements are exogenous and calibrated to the data. The families are assumed not to care about their offspring, hence all bequests are involuntary. To solve the model, they impose that individuals are infinitely risk averse and that the rate of time preference equals the interest rate. In their framework inheritances in the presence of social security play an important role in generating intra-generational wealth inequality at retirement. The intuition is that social security annuitizes completely the savings of poor and middle-income people but is a very small fraction of the wealth of richer people, who thus keep assets to insure against life-span risk.

6 Mixtures of life-cycle and dynastic behavior

The third class of models mixes features of both life-cycle models and infinitely-lived dynasties, simplifying some aspects of either model to make them more computationally tractable.

Among these works, Laitner [49] assumes that all households save for life-cycle purposes, but only some of them care about their own descendants. There are perfect annuity markets, therefore all bequests are voluntary, and no earning risk over the life cycle, hence no precautionary savings. Laitner's model is simple to compute and provides a number of interesting insights. The concentration in the upper tail of the wealth distribution is matched by choosing the fraction of households that behave as a dynasty and also depends on the assumptions on the distribution of wealth within the dynasty, which is indeterminate in the model.

Nishiyama [58] adopts an OLG model with bequests and intervivos transfers in which households in the same family line behave strategically. As De Nardi, he concludes that the model with intergenerational transfers better

explains, although not fully, the observed wealth distribution.

Castañeda, Díaz-Giménez and Ríos-Rull [21] consider a model economy populated by dynastic households that have some life-cycle flavor: workers have a constant probability of retiring at each period and once they are retired they face a constant probability of dying. Each household is perfectly altruistic toward its household. The paper employs a number of parameters to match some features of the U.S. data, including measures of wealth inequality.

The key feature of the model that generates huge amount of wealth holdings in the hands of the richest is the productivity shocks process. This process is calibrated so that the highest productivity level is more than 100 times higher than the second highest. There thus is an enormous discrepancy between the highest productivity level and all of the others. Moreover, if one is at the highest productivity level, the chance of being 100 times less productive during the next period is more than 20%. High-ability households thus face much higher earnings risk, save at very high rates to self-insure against earnings risk, and thus build huge buffer stocks of assets.

As Quadrini [60], Cagetti and De Nardi [16] take seriously the observation that entrepreneurs, that is, households that own and manage privately-held businesses, make up for the largest fraction of rich people in the data. Cagetti and De Nardi build on Quadrini's [61] model of wealth inequality by endogenizing the firm size distribution, the interest rate at which firms borrow and lend, and the amount of borrowing as a function of the entrepreneur's collateral, and by modeling the life-cycle and the intergenerational linkages. They adopt Castañeda, Díaz-Giménez and Ríos-Rull [21] demographic structure.

Compared to Quadrini, they are able to obtain a much better fit of the upper tail of the wealth distribution. They do not choose any of the parameter of their model to generate this result, which should hence be interpreted as a

check of the goodness of the model. The key reason why their model succeeds in generating this large amount of wealth concentration is linked to the fact that, while entrepreneurs could invest capital at a higher rate of return, the presence of borrowing constraints and collateral requirements makes the entrepreneur to save to exploit the high rate of return even when the entrepreneur becomes “rich”. In their parameterization there is only one level of entrepreneurial ability, and all of the heterogeneity in firm size and asset holdings is due to the interaction between the borrowing constraints and the stochastic evolution of entrepreneurial and working ability, which make firms grow slowly over time. This key intuition does not depend on the demographic structure assumed, and would also hold in a dynastic model. Cagetti and De Nardi chose to formulate it in an economy with more realistic life-cycle features to study the effects of government policies such as estate taxation.

7 Future directions

In the previous sections, we have discussed if and to what extent the current economic models have been able to explain the determinants of wealth inequality in the United States. While the baseline versions of the standard economic models badly fail to replicate the degree of wealth concentration observed in the data, some extensions have had a much greater success.

As we learn more about the determinants of wealth concentration, we can start applying new frameworks to study many economic problems for which inequality is a key element. In what follows, we will briefly discuss some of these areas. The discussion, of course, is by no means complete.

7.1 Human capital

All quantitative models of wealth inequality that we are aware of take human capital as exogenous. As documented by Huggett et al. [41], modelling human capital investment in presence of heterogeneous learning abilities and exogenous shocks is important to reproduce the data on earnings inequality over the life cycle. This approach could also allow a better measuring of how much earnings inequality is due to differences in initial conditions, for example in terms of learning abilities, and how much is due to subsequent shocks over the life cycle. As we have seen, the implications in terms of saving behavior and wealth inequality of permanent and transitory differences in earnings ability are very different, with one having very little effect, while the other having a potentially much bigger effect on wealth inequality. Modeling human capital explicitly would also allow a better measurement of the relative importance of human capital formation relative to bequests in generating wealth inequality, in the spirit of Becker and Tomes [7], above all when human capital acquisition is limited by imperfect financial markets (as for instance in the analysis of Heckman et al. [35]). For these reasons it would be worthwhile to study saving decisions and wealth inequality in a framework that also considers human capital accumulation and disentangles the permanent and transitory sources of inequality as in Huggett et al. [41].

7.2 Portfolio choice

The models we have discussed typically assume only one riskless asset, or at most two with the addition of entrepreneurial investment. An important issue, however, is portfolio choice. Households' portfolio are very heterogeneous, with differences also by age or income (see for instance Bertaut and Starr-

McCluer [9], Poterba and Samwick [59], and Banks et al. [6]).

A few papers have started to study portfolio choice with heterogeneous agents in a life-cycle setting. For example, Campbell et al. [18] and Campbell and Viceira [19] have shown that the fraction of risky assets in the portfolio should decrease with age as people move closer to retirement.

Moreover, a large fraction of total wealth for most households is in the form of housing, a relatively illiquid, indivisible type of investment with particular risk and tax characteristics. While standard finance models focused on other types of risky assets, recent works have explicitly modeled the peculiar characteristics of housing. For instance, Yao and Zhang [74] show that inclusion of housing dramatically changes the fraction of risky and riskless assets held in a portfolio, and Flavin and Yamashita [31] examine the life-cycle pattern of portfolio composition induced by the lumpy housing investment.

In the data, households with different wealth levels hold completely different portfolios. In order to understand the aggregate impact of these microeconomic portfolio decisions on aggregate investment and equilibrium prices, it is vital to consider how wealth is distributed in the population, and in particular, to understand the saving and portfolio of all households, including the richest ones, who hold a disproportionate share of total wealth. The models of wealth inequality presented in this paper may help shed light on these issues.

7.3 Public policy: adequacy of savings

Wealth inequality is also vital to understand policy and redistributive issues. While wealth inequality is often seen per se as a negative aspect that must be addressed by redistributive policies, a different question is whether the observed levels of wealth for most households outside of the richest percentiles

are in fact in some way suboptimal and inadequate.

There has been some debate on the adequacy of savings. Some economists believe that the wealth holding for many (or most) households are too low. Most of these works are based on some form of myopia or inconsistency in preferences, as for instance in Lusardi [56] or in the hyperbolic discounting models such as Laibson et al. [47]. Given this lack of foresight or of commitment, households tend to save less than optimally, and thus government intervention may improve welfare.

Other works, however, have shown that the currently observed levels of wealth are consistent with a rational, optimizing life-cycle model of wealth accumulation. For instance, Engen et al. [30] show that the amount of savings of most households (except those at the bottom quartile of the wealth distribution) is similar if not larger than that implied by a standard life-cycle model of wealth accumulation with social security and retirement benefits, while Scholz et al. [64] argue that, even for most households in the bottom of the distribution, the wealth deficit, relative to the optimal target, is generally small.

The key element of these works is the current level of social security benefits and other transfers after retirement. While the individual decisions may be optimal given those policies, an entirely different questions is whether the current amount of social security is optimal, and whether aggregate welfare may be improved by different schemes and different saving program incentives such as IRAs. There is a vast literature on this topic, and the question remains, to a large extent, unresolved. We will not try to summarize the various positions, but we point out that careful quantitative models of wealth inequality can help shed light on the issue.

7.4 Public policy: tax reforms

An area of public policy that crucially depend on wealth inequality is taxation, in particular for those taxes that tend to fall on the richest households, such as estate and progressive income taxes.

Given the current exemption levels, a very small fraction of people pays any estate tax (approximately 2% of estates are taxed), and the aggregate revenue for the tax is a relatively small .3% of GDP. However, the households that pay the tax are also those who do most of the saving and hold a large fraction of total wealth. Therefore, their behavior may have a large effect on the aggregates in the economy.

Reforms of these taxes are now being actively debated. To understand the impact of such reforms, it is vital to understand how many and in which way these rich households are affected. Quantitative models that carefully analyze the determinants of wealth inequality are thus key to study the problem. Using such models, Meh [57] studies changes in the degree of tax progressivity in Quadrini's [61] model, and Cagetti and De Nardi [17] study estate and income taxation in their setup. Cagetti and De Nardi [17] find that, in such models, tax reforms act through many different channels, and in addition to considering the partial equilibrium effects on individual decisions, the aggregate effects depends also on the general equilibrium effect on rates of return and on the subsequent changes in other taxes required to balance the budget.

7.5 Macroeconomics and the representative agent

When analyzing the effects of aggregate shocks, macroeconomics typically assumes a representative agent. This allows a considerable simplification, at the cost of ignoring the effect of heterogeneity in the population. While heterogene-

ity may be irrelevant for studying some macroeconomic problems, Browning et al. [11] have argued that in certain cases the behavior of an economy with many agents is significantly different from that of a representative agent one. However, few works so far have been able to address the issue. The difficulty lies in the fact that with heterogeneity and aggregate shocks, the distribution of people over state variables may change over time, and, at least in theory, one needs to keep track of the distribution as an additional state variable. The Bewley-type of models studied so far consider steady states without aggregate shocks, in which therefore the distribution is constant. But in the presence of aggregate shocks this is not true anymore.

Krusell and Smith [46] were the first to solve a model with aggregate productivity shocks and heterogeneous agents. They find that in their model heterogeneity does not matter for aggregate movements, a result partly confirmed also by Storesletten et al. [67], who extend their setup to a life-cycle economy. In this economy, heterogeneity may have consequences for mobility and individual welfare, but does not affect the aggregate movements due to the business cycle. It is exactly because of this irrelevance that these authors are able to solve their models numerically. When the distribution has little effect on the aggregates, it ceases to be a significant state variable, and one need only keep track of its mean, or at most its variance.

While they generate wealth inequality, these models fail to replicate the extreme degree of wealth concentration and the fraction of wealth held by the richest percentiles. As argued before, the behavior of this group may be quite different from that of the median households. Entrepreneurship, for instance, may imply different responses of investment and savings to aggregate shocks. Incorporating the insights of the models that study wealth concentration into a setup with aggregate shocks is therefore an open question. This extension

provides a considerable computational challenge. It is necessary to solve the decision problem for a large number of agents (as in a standard Bewley model), while at the same time keeping track of the distribution of wealth (a function) as a state variable. As computational power increases and new algorithms are developed, more and more of these problems may start to be tackled.

References

- [1] S. Rao Aiyagari. Uninsured idiosyncratic risk and aggregate saving. *Quarterly Journal of Economics*, 109(3):659–684, August 1994.
- [2] Joseph G. Altonji and Ulrich Doraszelski. The role of permanent income and demographics in black/white differences in wealth. Yale University, Economic Growth Center Discussion Papers, 2002.
- [3] Joseph G. Altonji and Ernesto Villanueva. The marginal propensity to spend on adult children. NBER Working Paper 9811, July 2003.
- [4] James Andreoni. Giving with impure altruism: Applications to charity and ricardian equivalence. *Journal of Political Economy*, 97:1447–1458, 1989.
- [5] Rochelle L. Antoniewicz. A comparison of the household sector from the flow of funds accounts and the survey of consumer finances. Mimeo, October 2000.
- [6] James Banks, Richard Blundell, and James P. Smith. Understanding differences in household financial wealth between the united states and great britain. *Journal of Human Resources*, 38(2):241–279, Spring 2003.
- [7] Gary Becker and Nigel Tomes. Human capital and the rise and fall of families. *Journal of Labor Economics*, 4(3):S1–S39, July 1979.
- [8] B. Douglas Bernheim, Jonathan Skinner, and Steven Weinberg. What accounts for the variation in retirement wealth among U.S. households? *American Economic Review*, 91(4):832–857, September 2001.
- [9] Carol Bertaut and Martha Starr-McCluer. Household portfolios in the United States. In Luigi Guiso, Michael Haliassos, and Tullio Jappelli, editors, *Household Portfolios*, pages 181–217. MIT Press, 2002.
- [10] Truman F. Bewley. The permanent income hypothesis: A theoretical formulation. *Journal of Economic Theory*, 16(2):252–292, December 1977.
- [11] Martin Browning, Lars Peter Hansen, and James Heckman. Micro data and general equilibrium models. In John Taylor and Michael Woodford, editors, *Handbook of Macroeconomics*, volume 1A, pages 543–633. Elsevier, 1999.
- [12] Martin Browning and Annamaria Lusardi. Household saving: Micro theories and micro facts. *Journal of Economic Literature*, 24:1797–1855, December 1996.
- [13] Francisco Buera. A dynamic model of entrepreneurship with borrowing constraints. Mimeo, 2004.
- [14] Marco Cagetti. Interest elasticity in a life-cycle model with precautionary savings. *American Economic Review*, 91(2):418–421, May 2001.
- [15] Marco Cagetti. Wealth accumulation over the life cycle and precautionary savings. *Journal of Business and Economic Statistics*, 21(3):339–353, July 2003.

- [16] Marco Cagetti and Mariacristina De Nardi. Entrepreneurship, frictions, and wealth. Federal Reserve Bank of Minneapolis Staff Report 322, September 2003.
- [17] Marco Cagetti and Mariacristina De Nardi. Taxation, entrepreneurship and wealth. Federal Reserve Bank of Minneapolis Staff Report 340, July 2004.
- [18] John Cambell, Joao Cocco, Francisco Gomez, and Pascal Maenhout. Investing retirement wealth: A life cycle model. Mimeo, March 1999.
- [19] John Y. Campbell and Luis Viceira. *Strategic Asset Allocation*. Oxford University Press, New York, NY, 2002.
- [20] Christopher D. Carroll. Why do the rich save so much? In Joel B. Slemrod, editor, *Does Atlas Shrug? The Economic Consequences of Taxing the Rich*, pages 466–484. Harvard University Press, Cambridge, 2000.
- [21] Ana Castañeda, Javier Díaz-Giménez, and José-Victor Ríos-Rull. Accounting for the U.S. earnings and wealth inequality. *Journal of Political Economy*, 111(4):818–857, August 2003.
- [22] Richard T. Curtin, F. Thomas Juster, and James N. Morgan. Survey estimates of wealth: An assessment of quality. In Lipsey and Tice [54], pages 473–548.
- [23] James B. Davies. The relative impact of inheritance and other factors on economic inequality. *Quarterly Journal of Economics*, 9(3):471–498, 1982.
- [24] James B. Davies and Anthony F. Shorrocks. The distribution of wealth. In A.B. Atkinson and F. Bourguignon, editors, *Handbook of Income Distribution*, pages 605–675. Elsevier, 2000.
- [25] Mariacristina De Nardi. Wealth inequality and intergenerational links. *Review of Economic Studies*, 71(3):743–768, July 2004.
- [26] Antonia Díaz, Josep Pijoan-Mas, and José-Victor Ríos-Rull. Habit formation: Implications for the wealth distribution. *Journal of Monetary Economics*, 50(6):1257–1291, August 2002.
- [27] Javier Díaz-Giménez, Vincenzo Quadrini, and José-Victor Ríos-Rull. Dimensions of inequality: Facts on the U.S. distributions of earnings, income and wealth. *Federal Reserve Bank of Minneapolis Quarterly Review*, 21(2):3–21, Spring 1997.
- [28] Karen Dynan, Jonathan Skinner, and Stephen Zeldes. Do the rich save more? *Journal of Political Economy*, 112(2):397–444, April 2004.
- [29] Martin Eichenbaum and Dan Peled. Capital accumulation and annuities in an adverse selection economy. *Journal of Political Economy*, 95(2):334–354, April 1987.
- [30] Eric M. Engen, William G. Gale, and Cori R. Uccello. The adequacy of household saving. *Brookings Papers on Economic Activity*, (2):65–187, 1999.
- [31] Marjorie Flavin and Takashi Yamashita. Owner-occupied housing and the composition of the household portfolio. *American Economic Review*, 92(1):345–362, 2002.

- [32] William G. Gale and John Karl Scholz. Intergenerational transfers and the accumulation of wealth. *Journal of Economic Perspectives*, 8(4):145–160, Fall 1994.
- [33] William M. Gentry and R. Glenn Hubbard. Entrepreneurship and household savings. NBER working paper 7894, September 2000.
- [34] Jagadeesh Gokhale, Laurence J. Kotlikoff, James Sefton, and Martin Weale. Simulating the transmission of wealth inequality via bequests. *Journal of Public Economics*, 79(1):93–128, 2000.
- [35] James Heckman, Lance Lochner, and Cristopher Taber. Explaining rising wage inequality: Explorations with a dynamic general equilibrium model. *Review of Economic Dynamics*, 1(1):1–58, 1998.
- [36] Burkhard Heer. Wealth distribution and optimal inheritance taxation in life-cycle economies with intergenerational transfers. Mimeo. University of Cologne, Germany, 1999.
- [37] Lutz Hendricks. Accounting for patterns of wealth inequality. Mimeo. Iowa State University, 2004.
- [38] Lutz Hendricks. How important is preference heterogeneity for wealth inequality? Mimeo. Iowa State University, 2004.
- [39] R. Glenn Hubbard, Jonathan Skinner, and Stephen P. Zeldes. Precautionary saving and social insurance. *Journal of Political Economy*, 103(2):360–399, 1995.
- [40] Mark Huggett. Wealth distribution in life-cycle economies. *Journal of Monetary Economics*, 38(3):469–494, December 1996.
- [41] Mark Huggett, Gustavo Ventura, and Amir Yaron. Human capital and earnings distribution dynamics. Mimeo, 2003.
- [42] Michael D. Hurd. Mortality risk and bequests. *Econometrica*, 57(4):779–813, July 1989.
- [43] Erik Hurst, Ming Ching Luoh, and Frank P. Stafford. Wealth dynamics of American families, 1984-94. *Brookings Papers on Economic Activity*, (1):267–337, 1998.
- [44] Arthur B. Kennickell. A rolling tide: Changes in the distribution of wealth in the U.S., 1989-2001. Mimeo, September 2003.
- [45] Laurence J. Kotlikoff and Lawrence H. Summers. The role of intergenerational transfers in aggregate capital accumulation. *Journal of Political Economy*, 89(4):706–732, August 1981.
- [46] Per Krusell and Anthony Smith, Jr. Income and wealth heterogeneity in the macroeconomy. *Journal of Political Economy*, 106(5):867–896, October 1998.
- [47] David I. Laibson, Andrea Repetto, and Jeremy Tobacman. Self control and retirement savings. *Brookings Papers on Economic Activity*, 1(1):91–172, 1998.
- [48] John Laitner. Random earnings differences, lifetime liquidity constraints, and altruistic intergenerational transfers. *Journal of Economic Theory*, 58(2):135–170, 1992.

- [49] John Laitner. Secular changes in wealth inequality and inheritance. *The Economic Journal*, 111(474):691–721, 2001.
- [50] John Laitner and Thomas F. Juster. New evidence on altruism, a study of ttaa-cref retirees. *The American Economic Review*, 86(4):893–908, 1996.
- [51] Emily Lawrance. Poverty and the rate of time preference: Evidence from panel data. *Journal of Political Economy*, 99:54–77, 1991.
- [52] Lee A. Lillard and Lynn A. Karoly. Income and wealth accumulation over the life-cycle. Manuscript, RAND Corporation, 1997.
- [53] Peter H. Lindert. When did inequality rise in Britain and America? *Journal of Income Distribution*, 9:11–25, 2000.
- [54] Robert E. Lipsey and Helen Stone Tice, editors. *The Measurement of Saving, Investment and Wealth*, volume 52 of *Studies in Income and Wealth*. University of Chicago Press, 1989.
- [55] Lars Ljungqvist and Thomas J. Sargent. *Recursive Macroeconomic Theory*. MIT Press, Boston, MA, 2000.
- [56] Annamaria Lusardi. Explaining why so many households do not save. Mimeo, January 2000.
- [57] Cesaire Meh. Entrepreneurship, inequality and taxation. Working Paper, Bank of Canada, 2003.
- [58] Shinichi Nishiyama. Bequests, inter vivos transfers, and wealth distribution. *Review of Economic Dynamics*, 5(4):892–931, October 2002.
- [59] James M. Poterba and Andrew A. Samwick. Household portfolio allocation over the life-cycle. NBER Working Paper 6185, 1997.
- [60] Vincenzo Quadrini. The importance of entrepreneurship for wealth concentration and mobility. *Review of Income and Wealth*, 45(1):1–19, March 1999.
- [61] Vincenzo Quadrini. Entrepreneurship, saving, and social mobility. *Review of Economic Dynamics*, 3(1):1–40, January 2000.
- [62] Vincenzo Quadrini and José-Victor Ríos-Rull. Models of the distribution of wealth. *Federal Reserve Bank of Minneapolis Quarterly Review*, 21(2):1–21, Spring 1997.
- [63] Santiago Budria Rodriguez, Javier Díaz-Giménez, Vincenzo Quadrini, and José-Victor Ríos-Rull. Updated facts on the U.S. distributions of earnings, income, and wealth. *Federal Reserve Bank of Minneapolis Quarterly Review*, 26(3):2–35, Summer 2002.
- [64] John Karl Scholz, Ananth Seshadri, and Surachai Khitatrakun. Are americans saving optimally for retirement? NBER working paper 10260, January 2004.
- [65] James P. Smith. Racial and ethnic differences in wealth in the health and retirement study. *Journal of Human Resources*, 30:S158–S183, 1995. Supplement.

- [66] Lee Soltow. Wealth inequality in the United States in 1798 and 1860. *Review of Economic and Statistics*, 66:444–451, 1984.
- [67] Kjetil Storesletten, Chris Telmer, and Amir Yaron. Asset pricing with idiosyncratic risk and overlapping generations. Mimeo, June 1999.
- [68] Steven F. Venti and David A. Wise. The cause of wealth dispersion at retirement: Choice or chance? *American Economic Review*, 88(2):185–191, May 1988.
- [69] Kirk White. Initial conditions at emancipation: the long run effect on black-white wealth and income inequality. Mimeo, September 2003.
- [70] Edward N. Wolff. Estimates of wealth inequality in the U.S., 1962-1983. *Review of Income and Wealth*, 33:231–256, 1987.
- [71] Edward N. Wolff. Changing inequality of wealth. *American Economic Review*, 82(2):552–558, may 1992.
- [72] Edward N. Wolff. Recent trends in the size distribution of household wealth. *Journal of Economic Perspectives*, 12(3):131–150, Summer 1998.
- [73] Edward N. Wolff and Marcia Marley. Long term trends in U.S. wealth inequality: Methodological issues and results. In Lipsey and Tice [54], pages 765–844.
- [74] Rui Yao and Harold H. Zhang. Optimal consumption and portfolio choices with risky housing and borrowing constraints. *Review of Financial Studies*, 2004. Forthcoming.