Why Aren’t Developed Countries Saving?

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Abstract

National saving rates differ enormously across developed countries. But these differences obscure a common trend, namely a dramatic decline over time. France and Italy, for example, saved over 23 and 19 percent of national income in 1970, but only 9 and 4 percent respectively in 2008. Japan saved almost 33 percent in 1970, but only 7 percent in 2008. And the U.S. saved around 11 percent in 1970, but only 1 percent in 2008. What explains these international and intertemporal differences? Is it demographics, government spending, productivity growth or preferences?

For the U.S. and France, whose saving behavior we study, our answer is preferences. American and French societies are placing increasing weight on the welfare of those currently alive, particularly contemporaneous older generations. This conclusion emerges from estimating two models in which society makes consumption and labor supply decisions in light of uncertainty over future government spending, productivity, and social preferences. The two models differ in terms of the nature of preference uncertainty and the extent to which current society can control future societies’ spending and labor supply decisions.

Key Words: national saving, discount factor, simulated method of moments.

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1 Introduction

National saving rates differ enormously across developed countries. But these differences mask a common decline over time. Table 1 documents this remarkably dramatic trend. It shows national saving rates for the U.S., Japan, U.K., France, Italy, Spain and Canada from 1970 through 2008. With the exception of Canada, each country’s saving rate plummeted over this period. France, for example, saved 23.7 percent of income in 1970. In 2008 it saved only 9.1 percent. Italy saved 19.2 percent of its income in 1970, but only 4 percent rate in 2008. And the U.S. saved 10.8 percent of its income in 1970, but essentially nothing in 2008.

What explains these differences across countries and over time? Is it demographics, preferences, government spending, productivity, or other factors? To address this question, we treat society as maximizing a social welfare function that incorporates time-varying intertemporal and intratemporal preferences. The intertemporal preferences capture society’s impatience in spending its resources, and the intratemporal preferences capture its weighting of different age groups at a point in time. The model also features changes in demographics, public spending, and multifactor productivity. Each period’s consumption and leisure decisions are made in light of uncertain future levels of productivity and public spending as well as uncertain future social preferences.

We model social preference-uncertainty in two ways. In model 1, social decision makers are viewed as infinitely lived, but experience shocks to their future preferences. In model 2, social decision makers change through time and can have different preferences, raising the problem of time consistency. In model 1, today’s society makes consumption and leisure decisions in light of its uncertain future preferences. In model 2, today’s society has stable preferences about the future, but is unable to control the decisions of future societies except, indirectly, via the amount of capital it leaves behind.

We use the method of moments to estimate the two models for the U.S. and France. All four sets of results point to the same culprit for the declines in national rates of saving, namely
changing social time preference placing increasing weight on immediate gratification. They also suggest that social decision makers are varying through time; i.e., that social choices are made in light of the time inconsistency problem.

The paper first reviews some of the literature on postwar declines in national saving rates. It then lays out the model, describes the data and estimation method, discusses moment selection, presents results, conducts policy experiments, and concludes.

2 Related Studies

Economists have long noted the alarming decline in national saving rates across the world. Boskin and Kotlikoff [3], Kotlikoff [13], and Summers and Carroll [21] document this phenomenon for the U.S., and Gramlich [10] provides a literature review on the effect of budget deficits on national saving in the U.S. In the mid 1990s, Gokhale et al. [9] developed a detailed cohort data set to study the decline in U.S. national saving. The study decomposes postwar changes in U.S. national saving into four determinants: cohort-specific consumption propensities, the distribution of resources across generations, government spending, and demographics. The authors conclude that the decline in the U.S. saving reflects ongoing intergenerational redistribution from young and future generations toward older generations. Chen et al. [4, 5] use calibrated life-cycle and single-agent models to study Japan’s postwar saving behavior and trace its high and then declining values to demographic factors and Japan’s particular realized time-path of productivity shocks.

In this study we estimate a structural model of the economy and national saving on U.S. and French data. Our model looks like a standard single-agent model, but with the agent’s tastes changing over time in an unexpected and potentially time-inconsistent manner. But it can also be viewed as the maximand collectively chosen in the political process by overlapping, self-interested generations.

A parallel strand of literature has been analyzing the effect of global financial imbalances on national saving: Mendoza et al. [16], for example, study the effect of financial integra-
tion when countries differ with respect to financial market development. Using a model with infinitely-lived single agents, they conclude that financial integration induces countries with deeper financial markets to reduce saving and accumulate a large stock of net foreign liabilities. Although financial imbalances may have contributed to the decline in saving rates, the literature on this topic ignores crucial home-grown factors. Within a country, successive generations are fundamentally interconnected via intergenerational and intragenerational transfers. The latter are likely to affect national saving directly. Our results suggest that these home-grown factors are crucial for determining national saving rates.

Finally, our paper contributes to the broader literature on time discounting: see Frederick et al. [8] for an excellent survey. The authors assess alternative intertemporal choice models, and review the attempts to estimate discount rates. These attempts display a notable variation across studies, both micro and macroeconomic. The novelty of our approach is to include intertemporal and intratemporal preferences in one framework, and to allow the former to be uncertain.

3 The Model

3.1 Model 1: Uncertain Future Preferences

The economy’s single good is produced via

$$Y_t = Z_t K_t^\alpha \left( A_t \sum_{a=0}^{100} e_{a,t} P_{a,t} n_{a,t} \right)^{1-\alpha},$$

where $\alpha$ is capital share in production, $A_t = (1+\mu)A_{t-1}$ captures labor-augmenting technical progress, occurring at rate $\mu$, $Z_t$ is time-$t$ multifactor productivity, $e_a$ is the earning ability (efficiency units) of an individual age $a$, and $P_{a,t}$ counts the population age $a$ at time $t$. Each individual has one unit of time available each period, i.e., $n_{a,t} \in [0, 1]$. 
The economy’s capital stock, $K$, evolves according to

$$K_{t+1} = (1 - d)K_t + Z_t K_t^\alpha \left( \sum_{a=0}^{100} e_a P_{a,t} n_{a,t} \right)^{1 - \alpha} - \sum_{a=0}^{100} P_{a,t} c_{a,t} - G_t, \quad (2)$$

where $d$ is the depreciation rate, $c_{a,t}$ and $n_{a,t}$ are the consumption and labor supply of age-$a$ agents at time $t$, and $G_t$ is total government spending. The term $e_a$ captures the earnings ability (efficiency units) of age-$a$ workers. This term is zero for workers under age 15 and over age 75; otherwise, normalized $e_a$ satisfies

$$e_a = \left( \frac{1}{60} \left( e^{4.47 + 0.0033(a - 15) - 0.000067(a - 15)^2} \right) \right). \quad (3)$$

Multifactor productivity, $Z_t$, deviate around stationary long-term values according to the following processes:

$$\ln Z_t = (1 - \rho_Z) \ln \bar{Z} + \rho_Z \ln Z_{t-1} + \varepsilon_t, \text{ with } \varepsilon_t \sim N(0, \sigma_{\varepsilon_t}^2), \quad (4)$$

Government spending $G_t$, is assumed to be an AR(1) around a trend growth path $gt$

$$\ln G_t = (1 - \rho_G) gt + \rho_G \ln G_{t-1} + \eta_t, \text{ with } \eta_t \sim N(0, \sigma_{\eta_t}^2). \quad (5)$$

We assume that contemporaneous generations are interconnected via their decisions on how much to take from and give to each other and under what circumstances. These decisions may be influenced by several factors, including a limited degree of intergenerational altruism which induces them to share risk with future generations via their fiscal institutions (see Altonji et al. [1]). In this rich framework, it is difficult to quantify what a generation owns without understanding their future net claims on other generations through the fiscal system (see Green and Kotlikoff [11]). Ultimately, the outcome will depend on the relative bargaining power of the different generations.

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1 For details see Fehr et al. [7].
This interaction of generations through the political system can lead to a variety of results: adult generations may expropriate young and future generations by simply consuming up more of the economy’s resources than they might otherwise do and leaving less around for next period. But even in this case, there will be natural limits on the extent of expropriation, either because selfish adult generations have some limited altruism or simply because adults will be alive for several periods and they will want to consume in the future as well as in the present. And in the future, the young generations will be in a position to exert a greater influence on societal decisions. This complex dynamics includes all parties alive in their attempt to reach a bargain about how to weigh the welfare of current and future generations.

Our model maps the complexity of these interactions into a parsimonious reduced form: we assume that generations bargain with each other to achieve a Pareto optimum. The solution to this bargain can be modelled as the maximization of the weighted sum of different generations’ utilities, where the weights are determined by threat points, i.e., the outside options available to different generations if the agreement is not achieved. To characterize this solution, we allow for age-specific weights as well as for a time preference factor in the society preference function. These parameters provide enough degrees of freedom to treat generations differently both at a point in time and over time.

Due to this overlapping bargaining, the current selfish generations make decisions about their own consumption that take account of and, thus, plan for, consumption of all future generations. Once these decisions are made, they can be decentralized, i.e., implemented via taxes and transfers that place agents on budget constraints, which, given their preferences, lead them to behave according to the solution of the bargaining problem.

At any point in time, the weight applied to contemporaneous agents’ utilities in the social welfare function depends on their ages. Current consumption and labor supply decisions are made in light of uncertainty about future productivity, government spending, and rates of time preference.
Society’s expected utility at time $t$ is

$$V_t = \sum_{a=0}^{100} P_{a,t} \theta_a u(c_{a,t}, n_{a,t}) + \sum_{\tau=t+\tau-1}^{\infty} \prod_{s=t}^{t+\tau-1} \beta_s \left( \sum_{a=0}^{100} P_{a,t+\tau} \theta_a u(c_{a,t+\tau}, n_{a,t+\tau}) \right),$$

where the $\theta_a$ parameters are age-utility weights, the function $u(., .)$ is assumed to be of addilog form:

$$u(c, n) = \frac{c^{1-\gamma} - 1}{1 - \gamma} + b \frac{(1 - n)^{1-\sigma} - 1}{1 - \sigma},$$

and $\beta_s$, is the time-$s$ discount factor. Society knows $\beta_t$, but is uncertain about future values of $\beta_s$ for $s > t$. Because today’s society controls all future allocations, the issue here is one of uncertain future desires, not changing decision makers; i.e., the problem here involves preference uncertainty, not time inconsistency. The discount factor obeys

$$\ln \beta_t = (1 - \rho_\beta) \ln \beta + \rho_\beta \ln \beta_{t-1} + \epsilon_t \sim N(0, \sigma_{\epsilon_t}^2).$$

As with $Z_t$ and $g_t$, the $\beta_t$ follows an autoregressive progress that fluctuates around a long-run stationary value, and its lagged value represents another state variable. The rate $\rho_\beta$ determines $\beta$’s convergence, on average, to its long-run value, $\overline{\beta}$. An initial value for $\beta$ that lies significantly above $\overline{\beta}$ coupled with a fast convergence (a small value of $\rho_\beta$) is indicative of society placing less weight over time on future consumption and leisure when deciding how much to consume and how much leisure to enjoy in the present.

Finally, age-utility weights are modeled via a third-order polynomial, i.e.,

$$\theta_a = \lambda_0 + \lambda_1 * age + \lambda_2 * age^2 + \lambda_3 * age^3.$$

$^2$For details see Maliar and Maliar [14].
Society solves the following program:

\[
V_t(Z_t, g_t, \beta_t, K_t) = \max_{C_{a,t}, n_{a,t}} \left\{ \sum_{a=0}^{100} \theta_a P_{a,t} u(c_{a,t}, n_{a,t}) + \right.
\]
\[+ \beta_t E_t \left[ V_{t+1}(Z_{t+1}, g_{t+1}, \beta_{t+1}, K_{t+1}) \right] \}
\]

(10)

for all \( a \in [0, \ldots, 100] \), subject to (2). The solution satisfies

\[
c_{a,t}^{-\gamma} = \frac{\theta_{a+1}}{\theta_a} \beta_t E_t c_{a+1,t+1}^{-\gamma} (1 + r_{t+1}),
\]

(11)

\[
(1 - n_{a,t})^{-\sigma} = \frac{e_a w_t}{b} c_{a,t}^{-\gamma},
\]

(12)

\[
\frac{c_{a,t}}{c_{a+1,t}} = \left[ \frac{\theta_a}{\theta_{a+1}} \right]^{\frac{1}{\gamma}},
\]

(13)

where \( r_t \) and \( w_t \) are time-\( t \) marginal products of capital and labor.

We solve this as well as model 2 via backward induction taking 2100 as the terminal year. Using a later terminal year makes little difference to parameter estimates. Expectations are formed using Gaussian quadrature.

### 3.2 Model 2: Time-Inconsistent and Uncertain Future Preferences

In this model, today’s society has stable preferences and knows for sure how it will value future consumption and leisure allocations. But it doesn’t directly control future allocations. Instead, each period’s allocations are made by the prevailing society (the decision makers in charge in the period at hand) based on time-preference rates that will generally differ from those of current society. The precise levels of such future time-preference factors are unknown to current society. But current society knows that these preference factors will evolve according to (8). It also knows that its sole manner of influencing future allocations is via the amount of capital it transmits to the next society, which, in turn, influences what
the next society will leave to the following society, and so on.

Formally, each society selects an allocation strategy taking the strategies of other societies as given. This strategy is a map from the state $\mathbf{r}_t = \{t, Z_t, G_t, \beta_t, K_t\}$ to the choice variables $\{c_{a,t}, n_{a,t}\}$ for $a \in [0, .., 100]$. The fixed point in the strategy space, which guarantees that all strategies are optimal given the strategies of the other players, is a Nash equilibrium.

Time-$t$ society chooses $\{c_{a,t}, n_{a,t}\}$ for all $a \in [0, .., 100]$ to maximize

$$W_t = \sum_{a=0}^{100} P_{a,t} \theta_a U (c_{a,t}, n_{a,t}) + \sum_{\tau=1}^{\infty} \beta_t^\tau \left( \sum_{a=0}^{100} P_{a,t+\tau} \theta_a U (c_{a,t+\tau}(\mathbf{r}_{t+\tau}), n_{a,t+\tau}(\mathbf{r}_{t+\tau})) \right),$$

subject to (2) and conditional on its state variables $\mathbf{r}_t$. Note that $c_{a,t+\tau}(\mathbf{r}_{t+\tau})$ and $n_{a,t+\tau}(\mathbf{r}_{t+\tau})$ denote the optimal choice that the time-$(t + \tau)$ future society will make contingent on the prevailing state variables $\mathbf{r}_{t+\tau}$.

We also solve this problem recursively, starting at date $T$. First we work out the society $T$’s allocation decisions as functions of the state variables in the last period, $\mathbf{r}_T$. Next, we determine society $(T - 1)$’s allocation decisions as functions of $\mathbf{r}_{T-1}$. In making its decisions, the $(T - 1)$ society considers not only its welfare from period $(T - 1)$ allocations, which it directly controls, but also the expected value of its future welfare (discounted using its own time-preference rate) from period $T$ decisions made by society $T$. The $(T - 2)$ society has a similar problem to that of the $(T - 1)$ society except that it must consider how two future societies will allocate consumption and leisure and so on.

We use Monte Carlo simulations to determine how a society prevailing at time $s$ makes its decisions. Specifically, for given state variables at time $s$, $\mathbf{r}_s$, and each candidate time-$s$ allocation (consumption and leisure choices), we form the average of current and future realized utility outcomes generated by the simulations to determine how much expected utility the candidate allocation generates. The allocation with the highest expected utility constitutes the optimal time-$s$ decision. The Monte Carlo simulations entail taking draws
of future paths of time-preference rates, productivity levels, and levels of scaled government consumption and using the previously determined allocation decisions of future societies to determine the consumption and leisure values that will be chosen along any path. Again, we assess a shift in social time preference in terms of the degree to which the long-run value of $\beta$ lies below its initial value as well as the speed at which societal time preference converges, on average, to its long-run value.

4 Data

Our U.S. data consists of a) 1950-2008 annual National Income and Product Account (NIPA\(^3\)) observations on GDP, national income, taxes on production and imports less subsidies,\(^4\) real GDP,\(^5\) personal consumption expenditures,\(^6\) and government discretionary spending,\(^7\) b) annual U.S. Census counts of population by age for 1950-2004,\(^8\) and c) U.S. Census projections of population by single age for 2005-2100.\(^9\) Our French macro data for 1970 through 2008 come from the OECD Statistics,\(^10\) from which we extracted the same economic measures as for the U.S. The country’s single-age demographic data come from special tabulations of the 2006 release of United Nations’s World Population Prospects: The 2006 Revision [20]. The UN projects populations only through 2050. We employed a fourth-order time polynomial in addition to a one-lagged age-group variable in interpolating from our 1950-2050 data to form the 1995-2050 population accounts for the 80+ and the single-age population counts from 2051 through 2100.\(^{11}\) Data for both countries on the total number

\(^3\)http://www.bea.gov/national/nipaweb [26].
\(^4\)NIPA Table 1.7.5. [26].
\(^5\)Chain-weighted, reference year 2000 and seasonally adjusted at annual rates (http://www.bea.gov/histdata/NIyear.asp, NIPA Table 1.1.6 [27]).
\(^6\)Consumption of households and non-profit institutions serving households (NIPA Table 1.1.5 [26]).
\(^7\)Government final consumption expenditure consists of expenditure incurred by general government on both individual consumption goods and services and collective consumption services (NIPA Table 3.10.5 [26]).
\(^8\)http://www.census.gov/population/www/projections/natdet.html, Table NP-D1-A [25].
\(^11\)Given the data points, the aim of interpolation is to find the polynomial that fits exactly through the observed points. In practice, we generated a model that included a fourth order polynomial in time plus a
of hours worked were obtained from the Conference Board Total Economy Database.\footnote{http://www.conference-board.org/data/economydatabase/ [22].}

For each country, we measure national income, private consumption, and government spending at producer prices\footnote{We obtained the series net of taxes on production and imports less subsidies.} and use the GDP deflator to convert to reals. The national saving rate is measured as the ratio of national income net of consumption (private and government) to national income.

5 Estimation

To limit the number of parameters to be estimated, we assume a 5 percent annual rate of depreciation. Our 1950 value of $K$ come from the Bureau of Economic Analysis' series on fixed reproducible tangible capital.\footnote{www.census.gov/compendia/statab/2010/tables/10s0707.xls [29]. The net foreign asset position was obtained by substracting the foreign investments in the country from the investments abroad. Data was obtained from Bureau of Economic Analysis (archive records on International Investment Position of the United States: 1843-1970 [28]).} For France, we used the OECD series on "Fixed assets by activity and by type of product" to obtain the 1970 value of total fixed capital.\footnote{http://www.oecd-ilibrary.org/economics/data/detailed-national-accounts/fixed-assets-by-activity-and-by-type-of-product_data-00009-en?isPartOf=/content/datacollection/na-dna-data-en [19]. OECD data for France on total fixed assets covers the period 1978-2009. We obtained the 1970 value by cubic interpolation, using the correspondent Net National Income value as reference point.}

The government spending trend was calibrated to fit the level and slope of the discretionary government spending series. Rather than jointly estimate the persistence coefficient $\rho_g$ and standard deviation $\eta_t$ for the government expenditure shock in (5) together with other model parameters, we obtain estimates of these parameters from a AR(1) of total final government expenditure (see Appendix table 2). The data for the two AR(1)s, for the U.S. and France, come from NIPA and OECD.Stat, respectively.

We use the Simulated Method of Moments (SMM) (McFadden [15] and Pakes and Pollard [20]) to estimate the parameters

\[
\phi_0 = \{\gamma, \sigma, \beta_0, \beta, \rho_{\beta}, \sigma_{\varepsilon}, \alpha, b, \bar{Z}, \rho_Z, \sigma_{\varepsilon}, \mu, \lambda_0, \lambda_1, \lambda_2, \lambda_3\}.
\]
We estimate the parameters of the discount-factor process conditional on twenty different assumed initial (1950, for the U.S. and 1970 for France) values of \( \beta \) and choose the one that generates the data for which SMM results best fit their empirical counterparts.\(^{16}\)

Table 3 lists our choice of moments. For all our control variables (consumption, hours worked and national income), we consider measures of variability, correlation and persistence: that is, we match the variances, covariances, and lagged autocorrelations. To this set of second-order moments, we add the remaining first-order moments, namely the mean of each time series.

In implementing SMM, we simulate \( N = 200 \) paths of the economy and collect for each path the simulated values of each variable\(^{17}\). We compute the set of moments conditional on the initial values of the state variables \( \nabla_0 \) and on the parameters \( \phi_0 \) and minimize \( J_T - \) the weighted sum of squared deviations of simulated moments from their empirical counterparts, where

\[
J_T = \arg\min_{\phi} [m_T - \frac{1}{N} m_N(\nabla_0, \phi_0)]W[m_T - \frac{1}{N} m_N(\nabla_0, \phi_0)],
\]

where \( m_T \) represents data moments and \( m_N(\nabla_0, \phi_0) \) is the set of moments of each of the \( N \) simulated paths of the artificial economy. \( W \) is the weighting or distance matrix that almost surely converges to \( W = S^{-1} \), where \( S \) is the limit, as \( NT \to \infty \), constant full-rank matrix of the covariance of the estimation errors.\(^{18}\)

For a given number \( N \) of path, as \( T \to \infty \), if the weighting matrix \( W \) is chosen optimally,

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\(^{16}\)We choose this method of estimating the initial value \( \beta \) for the following reason. As indicated, the current value of \( \beta \) is a continuous state variable. But in running our dynamic program, we limit our grid for \( \beta \) to twenty possible values. Were we instead to attempt to estimate \( \beta \) for 1950 along with other parameters in \( \phi_0 \), we would compute a value different from that on our grid, i.e., treating \( \beta \) as a continuous, rather than discrete, unknown parameter would be inconsistent with the assumptions underlying the dynamic program used to calculate \( \beta \).

\(^{17}\)Using more paths than 200 to compute moments didn’t change results materially.

\(^{18}\)As described in Andrews [2], an optimal weighting matrix is obtained as the inverse of the variance-covariance matrix of the moment conditions evaluated at a set of first-step estimates, in which \( W \) is set equal to the identity matrix. This matrix is consistently estimated using the estimator proposed by Newey and West [17], which places more weight on moments that are more precisely estimated. Implementing this method entails fitting the moments of the simulated series to their real data counterparts under the condition of \( W = I \) and then using estimates from this stage to form the weighting matrix \( W = S^{-1} \) for use in a second and final stage estimation of (15).
then
\[ T \left[ m_T - \frac{1}{N} m_N(\nabla_0, \phi_0) \right] W \left[ m_T - \frac{1}{N} m_N(\nabla_0, \phi_0) \right] \rightarrow \chi^2(j - k), \]

where \( j \) is the number of moments and \( k \) is the number of estimated parameters.

6 Findings

Tables 4 and 5 present, for each country, the two models’ simulated moments together with their empirical counterparts. A quick glance shows that the simulated and actual moments are close. Statistically, the goodness of fit between the two series is assessed by a \( \chi^2 \) test or the corresponding p-value. Each model easily passes the \( \chi^2 \)-test, with \( \chi^2 \) values well below the 1 percent critical value of 6.635. Based on the p-values, model 2 provides a slightly more reliable fit for both the U.S. and France.

Figures 1 through 4 display both the actual and simulated profiles of the decision variables, together with 95 percent confidence intervals.\(^{19}\) Most simulated profiles lie inside the confidence intervals and appear generally consistent with the data.\(^{20}\) In the U.S., simulated national saving rates are similar for both models and accord fairly well with the actual rates. For France, the two models’ simulated saving rates are also in fairly close agreement, although model 2 does less well than model 1 in predicting observed behavior.

Tables 7 and 8 present our parameter estimates, which are economically reasonable across models and countries. Consider model 1. The estimates for \( \sigma \) (the leisure elasticity of substitution) are 5.35 for the U.S. and 5.86 for France; the estimates of \( \mu \) (the rate of labor-augmenting technical change) are close to 2 percent for the U.S. and 3 percent for France. The respective estimates of \( \alpha \) (capital’s share) are 0.16 and 0.22; and the respective estimates of \( \rho_Z \) (the autoregressive coefficient for multifactor productivity) are 1.26 and 1.24.\(^{21}\) The

\(^{19}\)Private consumption, total hours worked in the economy and national income data are expressed in trillions of US dollars (\( 1.5 \times 10^{12} \)).

\(^{20}\)This is remarkable given the set of moments that we used to estimate the model: by adopting the SMM in conjunction with our macroeconomic data, we were forced to use a single first-order moment for each time series, namely the mean. Nonetheless, the additional rich set of second-order moments were eventually sufficient to allow the simulated profiles to reproduce the real ones quite accurately.

\(^{21}\)Note that a value above 1 is to be expected given that we are have not detrended the data.
The results for model 2 are similar. The autoregressive coefficient for multifactor productivity ($\rho_Z$) in model 2 is very close to the estimated value for model 1 for both the U.S. (1.26 vs. 1.15) and France (1.242 vs. 1.245). On the other hand, $\gamma$ (the consumption elasticity of substitution) while still smaller for the U.S. (0.55) than for France (2.35), is less than half the value estimated in model 1 (1.15). Capital share $\alpha$ remains around 0.1 percent for the U.S. and almost double that value for France. The rate of labor-augmenting technical change ($\mu$) is estimated at 1.3 percent for the U.S., while for France it remains around 3 percent as for model 1. Finally, the leisure elasticity of substitution ($\sigma$) for the U.S. is 8.13, while for France is around 5.

The initial discount factor, $\beta_0$, exceeds its long-run value, $\bar{\beta}$, for each country. Hence, over time, each country places less weight on the well being of those coming in the future. For the U.S., the discount factor’s initial value is 6.8 percent higher than its long-run value for model 1 and 8.9 percent for model 2. For France, the long-run decrease in the discount factor is 6.2 percent for both models. As shown below, these seemingly small changes in discount rates have important implications for national saving in both countries.

Figures 5 and 6 plot model 1’s and 2’s respective age-specific utility weights for each country. As expected, the weights rise with age through middle age for both countries and for both models. For the U.S., in model 1, the weights peak and then start to rise again around age 85. In model 2, the weights continue to rise with age. For France, the profiles

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Note that for France the values of $\beta_0$ and $\bar{\beta}$ both exceed 1. Given that the model we are estimating has a finite horizon (year 2100), this presents no problem with respect to an explosive value of the expected utility maximand. Furthermore, given secular growth in consumption, we would expect a discount factor above 1. As discussed in Jonsson and Klein [12] and Cooley and Prescott [6], a discount factor in excess of 1 can be consistent with long-run secular growth and in finite horizon utility. One simply needs to normalize the model for labor-augmenting technical change and note that the normalized discount factor is less than 1; i.e., that the normalized model has a finite maximand. Instead of adopting this approach, we preferred to estimate the labor-augmenting technical change rate separately as a parameter.
then decline, apart from an increase at very old ages. The increasing utility weights at older ages for the U.S. is expected given the secular rise in the relative consumption of the elderly, particularly their relative healthcare consumption, which is reported in Gokhale, Kotlikoff, and Sabelhaus (1996).

7 Analyzing Our Findings

This section does some counterfactual experiments to understand the U.S. and French decline in national saving rates. Specifically, we consider how national saving rates in the U.S. and France would have changed over time had a) the countries not increased their time preference (placed a declining weight on future relative to current well being), b) placed a different set of relative weights on the consumption and leisure of different age groups, c) not experienced changes in the age-composition of the population, and d) not experienced changes in government spending relative to national income. In each of these experiments we modify particular model parameters and then recalculate our dynamic programming solution starting 92 years out (in 2100). We then consider how saving rates with the modified set of parameters compares over our sample period with the saving rates predicted by our model. Based on these experiments, we find that an increase in time preference, leading to a lower weighting of future relative to current wellbeing, is the principal reason that the U.S. and France are saving at much lower rates.

7.1 Time-discounting

Consider the upper left charts in Figures 7 through 10. The saving rates labeled "Simulated Data" and shown in solid are those generated by our models. The dotted plotted data referred to as "Discount Factor Fixed at 1950 (1970, for France)" show how each country’s saving rate would have evolved had the discount factor remained at its initial level (1950 for the U.S. and 1970 for France.) According to both models, saving rates would have been either substantially or dramatically higher had American and French societies not become so
focused on immediate gratification. Under model 1, the U.S. saving rate is almost 50 percent higher in 2008 with a fixed $\beta$ than it is with a declining $\beta$, which is the baseline case. For model 2, the year-2008 fixed-$\beta$ saving rate is almost twice as large than with the declining-rate. For France, model 1’s fixed-$\beta$ simulation produces a year-2008 rate of saving that is more than two times as high, compared with the baseline value, while model 2’s saving rates are almost eight times larger. So, for both countries, their respective societies appear to care increasingly more about contemporaneous generations rather than future generations, with direct spillover to saving rates.

One response to these findings is that estimating a declining $\beta$, i.e., a smaller weight placed on future welfare, was virtually guaranteed given that we’re fitting declining national saving rates and that a declining value of $\beta$ can easily track this. Our response is that we aren’t fitting year-by-year saving rates levels. Instead, we’re fitting only the saving rate mean across the sample years together with the means and second order moments for the other variables as listed in Table 3. In addition, there are other factors in the model that might have explained the decline in national saving rates, producing estimates of $\bar{\beta}$ above those for $\beta_0$. These include the countries’ changing demographics, trends in government spending, trends in multifactor productivity growth and the interactions of these trends with the levels of the utility-function parameters and other model parameters. In what follows we show the impact of these other factors on the saving rates. None of these factors contribute nearly as much to the decline in saving rates as does time-discounting with the exception, for France, of changes in government spending.

### 7.2 Age-Weighting

In our models, the $\theta_a$ parameters, plotted in figures 5 and 6, captures the age-specific utility weights. Due to data and computational limitations, we did not attempt to estimate time-varying changes in the age-specific utility weights. Instead, to investigate the potential importance of the age-pattern of these weights in influencing changes over time in national
saving, we consider the following counterfactuals. How would national saving rates in the
two models have differed through time had the utility weights either a) been uniform across
all age groups and b) had the age-weights gradually increased over the sample period?

The dotted lines in the upper right charts of Figures 7 through 10, referenced as "Uniform
Age-Specific Utility Weights" present saving rates under the first scenario. They show
somewhat lower saving rates in the early years for both countries in both models, but don’t
alter the downward time trend. What explains the initially lower saving rates? With
constant age-specific utility weights, the old generations are no longer consuming more than
the young. And the current society does not need to save extra resources to insure the
consumption of future elderly. This causes saving rates to drop, especially so in the period
1950-1970 for the U.S.

In our second exercise, we treat the age-specific utility weights as lying on a straight
line. We take this line to be flat in the initial sample year (1950 for the U.S. and 1970 for
France), but then tilt it gradually through 2008 such that in the last year the utility weight
for the 100 year-olds is three times larger than the utility weight for zero year-olds. Our
results are very similar to those arising from simply assuming a flat line in all periods. I.e.,
the model generates a decline in national saving regardless of the shape of the age-utility
weights profile.

7.3 Demographics and Ageing

The age compositions in the two countries changed somewhat over the sample years. The
share of young Americans (0-17 years old) was 31 percent in 1950 and 24.7 percent in 2008.
The share of the elderly (65 and older), in contrast, rose from 8.5 percent to 13.2 percent.
For France, the share of young population is smaller than in the U.S. both in 1970 (29.3
percent vs. 34.0 percent) and in 2008 (21.9 percent vs. 24.7 percent); the French share
of the elderly has increased over time by only 2 percent but it is still lower than for the
U.S. both in 1970 (10.2 percent versus 14.2 percent) and in 2008 (13.2 percent versus 16.3
percent). The lower left graphs in figures 7 through 10, entitled "Population Shares Fixed at 1950 (1970, for France) Values" show how each country's saving rate would have evolved had the shares of different age-groups remained fixed at their initial levels (1950 for the U.S. and 1970 for France). The aggregate population counts for each year are those in the actual data, but the share of each age-group on the total population is held fixed at its initial level. Hence, this experiment does not focus on population growth, but captures the specific effects of population ageing. Interestingly, for both countries the saving rates would have been slightly lower had age-shares stayed constant. The intuition for this result is simple: the estimated utility weights imply that the elderly are those who consume more. With constant population shares, the current society expects to have fewer elderly in the future. Accordingly, less national saving is required to satisfy the consumption of the future old population, causing initial saving rates to drop.

7.4 Government Spending

The share of government spending in national income is substantially higher today in both countries than in the past. In the U.S. the government spending as a percentage of national income increased from 13 percent in 1950 to more than 18 percent in 2008. The respective percentages for France are 16 percent in 1970 and 24 percent in 2008. Does this explain the decline in saving rates for U.S. and France? To address this question we ran an experiment where the share of government spending to national income is held constant at its initial value (again, 1950 for the U.S. and 1970 for France). The saving rates for this scenario are represented in figures 7 through 10 in the lower right charts via the dotted lines labeled as "Government Spending Share Fixed at 1950 Value" for the U.S. and "Government Spending Share Fixed at 1970 Level" for France. Due to the economy's intertemporal budget, a higher level of government consumption implies a negative income effect, leading society to reduce household consumption and leisure. This could substantially reduce the direct effect of more government spending on reducing national saving. This turns out to be the case for
the U.S.: in our experiment the reduction in government spending is almost perfectly offset by an increase in household consumption, leading to an unchanged year-2008 saving rate in both models.

The opposite holds for France. Under model 1, the French saving rate is almost 50 percent higher in 2008 with a fixed government spending share than it is with an increasing one – the baseline case. Under model 2, the French year-2008 saving rate is more than three times as high with a fixed-share. This is not surprising as French society is characterized by a higher $\beta$ (the long-run value of the discount factor) and $\gamma$ (the consumption elasticity of substitution). This entails that the French society values future consumption more than the U.S. The fact that France weights more the future leads current generations to save more resources for the future ones: this ultimately offsets the negative income effect. A quick glance at the bottom right charts in figures 9 and 10 shows that the impact of government spending on the saving rates for France, despite being remarkably large, is still small compared to the effect of time discounting, which remains the principal reason why France is saving at much lower rates now than it did in the past.

8 Conclusions

National saving rates have declined dramatically in developed countries in recent decades. This paper estimates two models for the U.S. and France, with both models featuring uncertain future rates of social time-preference. In one model, current social decision makers always remain in charge but are unsure about their future preferences. In the other, social decision makers change through time and today’s decision makers can only indirectly influence future social decision makers via the amount of capital they leave for their successors. Parameter estimates from both models show that shifts in societal preferences, which have placed ever greater weight on immediate relative to future gratification, are the principal reason that the U.S. and France are saving at much lower rates now than they did in the past. Of course, most future consumption and leisure will be done by future generations.
Hence, our results are indicative of increasing intergenerational selfishness.

References

[19] OECD 2010, Detailed National Accounts: Fixed assets by activity and by type of


# TABLES AND FIGURES

## Table 1. Net national saving rate (%) for selected years

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Source: OECD Statistics, June 2010 [15].

## Table 2. Government Spending AR(1) Parameters

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## Table 3. Choice of Moments

- $Y_t$, $\sigma_{\ln(Y_t)}$, $\text{corr}(Y_t, c_t)$,
- $\bar{c}$, $\sigma_{\ln(c_t)}$, $\text{corr}(Y_t, n_t)$,
- $\bar{n}$, $\sigma_{\ln(n_t)}$, $\text{corr}(c_t, n_t)$,
- $\bar{s}$, $\text{corr}(Y_t, Y_{t-1})$, $\text{corr}(Y_t, Y_{t-2})$,
- $\text{corr}(c_t, c_{t-1})$, $\text{corr}(n_t, n_{t-1})$,
- $\text{corr}(c_t, c_{t-2})$, $\text{corr}(n_t, n_{t-2})$.

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Note: Net national saving rate was calculated as the ratio of net savings to net national income, both evaluated in producer prices (adjusted for taxes less subsidies on production and imports). Net savings were calculated as the difference between net national income and the sum of consumption of households and non-profit institutions serving households and final consumption expenditure of general government. All series have been deflated by the correspondent GDP deflator.
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Standard errors are in parenthesis below each parameter. 
(*), (**), (***), and (****) indicate significance at 10%, 5%, and 1% respectively.
Figure 1. Simulated and Actual Series - Model 1, U.S.

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