Secular Movements in U.S. Saving and Consumption

Kaiji Chen[†] Ayşe İmrohoroğlu[‡] Selahattin İmrohoroğlu[‡]

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Abstract

The U.S. national saving rate has been declining since the 1960s while the share of consumption in output has been increasing. We explore if a standard growth model can explain the secular movements observed in this time period. Our quantitative findings indicate that the standard neoclassical growth model is able to generate saving rates and consumption that are remarkably similar to the data during 1960-2004.

[*]Department of Economics, University of Oslo

[‡]Department of Finance and Business Economics, Marshall School of Business, University of Southern California, Los Angeles, CA 90089-1427.

Corresponding author: selo@marshall.usc.edu

1 Introduction

Understanding the secular movements in consumption and saving in the U.S. has been an important part of academic research as well as real interest to policy makers. Figure 1 displays the changes in the consumption output ratio and the net national saving rate in the U.S. between 1960-2004.[1] The fact that the national saving rate has been declining over time and that U.S. saves less than other countries has been a major concern to economists and policy makers.[2] Gokhale, Katlikoff, and Sabelhaus (1996) attribute the decline in the net national saving rate to the redistribution of resources, through social security and medicare, from young consumers with low marginal propensities to consume to older generations with high marginal propensities to consume. Several papers examine whether particular cohorts are responsible for the low saving rate by examining personal saving rates in the U.S.[3] Attanasio (1998) argues that cohorts born between 1925 and 1939 may be to blame for the low personal saving rate. Summers and Caroll (1987) suggest that it is the reliance of the younger generations on social security that depresses saving in the U.S. Boskin and Lau (1988a and 1988b) formulate a model based on longitudinal and cross-sectional microeconomic data together with aggregate time series and examine the importance of various factors affecting aggregate consumption and saving in the U.S. Their results suggest that it is the decline in the saving of generations born after the great depression that may be responsible for the decline in the national saving rate. Another set of papers has focused on the possible relationship between the increase in stock prices and the boom in consumer spending.[4]

[1] C/Y is the fraction of consumption in GNP, and the saving rate is net national saving as a percent of net national income. In the appendix we explain the adjustments that were made to the data to ensure consistency between the data and the model.

[2] See, for example, Bernanke (2005) and Gramlich (2005).

[3] See for example Summers, Caroll, and Blinder (1987), and Gale, Sabelhaus and Hall (1999).

[4] For example, see Parker (1999), Juster, Lupton, Smith, and Stafford (2000) who suggest that the significant capital gains in corporate equities experienced since 1984 is responsible for the decline in the personal saving rate. Backus, Henriksen, Lambert, and Chris Telmer (2005) argue that private saving rates are strongly and negatively correlated with the ratio of net worth to consumption. See Poterba (2000) for a survey.

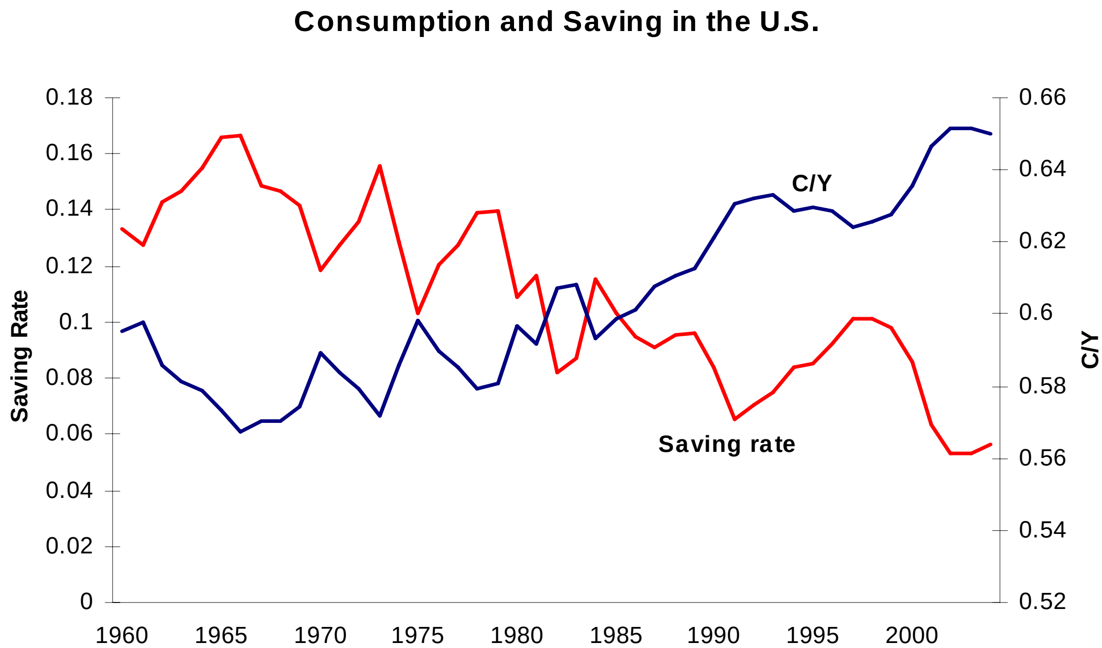

Figure 1: U.S. Data

In this paper we revisit the implications of the Neoclassical growth model on the secular movements of the net national saving rate and the consumption-output ratio in the U.S. between 1960 and 2004. Our approach is in line with the recent use of the one-sector growth model to explain 'Great Depressions'. In particular, we follow the methodology of Cole and Ohanian (1999) and Kehoe and Prescott (2002) in using an applied general equilibrium setup to account for the actual time path of the U.S. saving and consumption behavior.[5] We use the standard one-sector, neoclassical growth model with an infinitely-lived representative agent facing complete markets and calibrate the economy to the U.S. data for the 1960-2004 period. We use the population growth rate, the tax rate on capital income, the share of government expenditures in output, the depreciation rate, and the actual time series data for the TFP growth rate for that time period. We conduct deterministic simulations, as in Hayashi and Prescott (2002), and perform an 'accounting exercise' to evaluate the impact of several factors that may explain the secular movements in the saving and consumption behavior the U.S. Our results suggest that the one sector growth model can generate the secular movements in the consumption and the saving behavior remarkably well one the actual time path of TFP growth rate, population growth rate, and the depreciation rate are

[5]Related work that uses general equilibrium models to address short run issues are Ohanian (1997), Cooley and Ohanian (1997), Cole and Ohanian (2002, 2004), and all the papers in the 2002 special issue of *Review of Economic Dynamics,* entitled 'Great Depressions of the 20th Century'.

taken into account.[6] Overall, our results indicate that the decline in the population and TFP growth rates may have played an important role in the decline of the saving rate until the 1980s. After this period the decline in the TFP growth rate, population growth rate and the increase in the deprecation rate seem to be explaining most of the decline in the actual saving rate.

The paper is organized as follows. Section 2 presents the two versions of the growth model that are used to evaluate the U.S. consumption and saving behavior. Data and calibration issues are discussed in Section 3, and the quantitative findings are presented in Section 4. Concluding remarks are given in Section 5. Appendix A contains the data sources.

1.1 The Growth Model

There is a stand-in household with N_t working-age members at date t. The size of the household evolves over time exogenously. In this framework a representative household maximizes

$$\sum_{t=0}^{\infty} \beta^t N_t(\log c_t + \alpha log(1 - h_t))$$

where $c_t = C_t/N_t$ is per member consumption and $h_t = H_t/N_t$ is the fraction of hours worked per member of the household subject to

$$C_t + X_t \leq w_t H_t + r_t K_t - \tau(r_t - \delta)K_t - \pi_t,$$

where β is the subjective discount factor, α is the share of leisure in the utility function, H_t is total hours worked by all working-age members of the household, τ is the tax rate on capital income, w_t is the real wage, π_t is a lump sum tax and r_t is the rental rate of capital. Households are assumed to own the capital, K_t, and rent it to businesses. Aggregate output Y_t is divided between consumption, C_t, investment X_t, and government purchases of goods and services, G_t.

$$C_t + X_t + G_t = Y_t.$$

The law of motion for the capital stock is given by $K_{t+1} = (1 - \delta)K_t + X_t$ where δ is the depreciation rate.

The aggregate production function is given by

$$Y_t = A_t K_t^{\theta}(H_t)^{1-\theta},$$

where θ is the income share of capital and A_t is total factor productivity which grows exogenously.

[6] In Chen, İmrohoroğlu and İmrohoroğlu (2005) we show that the same framework is able to generate the high saving rate that was observed in Japan during most of this time period as well.

1.2 Government

There is a government that taxes income from capital (net of depreciation) and uses the proceeds to finance an exogenously given stream of government purchases G_t. A lump sum tax τ_t is used to ensure that the government budget constraint is satisfied each period: $G_t = \tau_t(r_t - \delta_t)K_t + \pi_t$.

1.3 Competitive Equilibrium

Given a government policy $\{G_t, \tau_t, \pi_t\}_{t=0}^{\infty}$, a competitive equilibrium consists of an allocation $\{C_t, X_t, H_t, K_{t+1}, Y_t\}_{t=0}^{\infty}$ and price system $\{w_t, r_t\}$ such that

- given policy and prices, the allocation solves the household's problem,
- given policy and prices, the allocation solves the firm's profit maximization problem with factor prices given by: $w_t = (1-\theta)A_t K_t^{\theta}(H_t)^{-\theta}$, and $r_t = \theta A_t K_t^{\theta-1}(H_t)^{1-\theta}$,
- the government budget is satisfied,
- and the goods market clears: $C_t + X_t + G_t = Y_t$.

1.4 Numerical Solution

Our numerical solution procedure follows Hayashi and Prescott (2002) by first calculating a steady-state for the Japanese economy. After obtaining the equilibrium conditions for the economy, we detrend the variables and obtain the steady-state. Next, we start from given initial conditions in 1960 and use a shooting algorithm towards the steady-state.[7]

Equilibrium Conditions: The equilibrium conditions of this model can be described in two equations below:

$$\frac{C_{t+1}}{N_{t+1}} = \frac{C_t}{N_t}\beta\left\{1 + (1-\tau_{t+1})\left[\theta A_{t+1}K_{t+1}^{\theta-1}(H_{t+1})^{1-\theta} - \delta_{t+1}\right]\right\}, \quad (1)$$

$$K_{t+1} = (1-\delta_t)K_t + A_t K_t^{\theta}(H_t)^{1-\theta} - C_t - G_t. \quad (2)$$

Detrending: There are year-to-year fluctuations with secular growth in aggregate quantities and the wage rate. For an aggregate variable z_t, its detrended version is given by: $\widetilde{z}_t = z_t / A_t^{\frac{1}{1-\theta}} N_t$. Applying this change of variables, we obtain equations

$$\widetilde{c}_{t+1} = \frac{\widetilde{c}_t}{\gamma_t}\beta\left\{1 + (1-\tau_{t+1})\left[\theta x_{t+1}^{\theta-1} - \delta_{t+1}\right]\right\},$$

$$\widetilde{k}_{t+1} = \frac{1}{\gamma_t n_t}[(1-\delta_t) + (1-\psi_t)x_t^{\theta-1}]\widetilde{k}_t - \widetilde{c}_t,$$

[7] Hayashi and Prescott (2002) contain an appendix that describes the equilibrium conditions and the calibration in detail. We summarize parts of it below.

where x_t is detrended capital-labor ratio, $(K_t/H_t)/A_t^{\frac{1}{1-\theta}}$.

Steady-state: Setting $\widetilde{z}_t = z$ for all t, we obtain the following steady-state for the model:

$$\begin{aligned} 1 &= \frac{1}{\gamma}\beta\left\{1 + (1-\widetilde{\tau})\left[\theta x^{\theta-1} - \widetilde{\delta}\right]\right\} \\ \widetilde{k} &= \frac{1}{\gamma n}[(1-\widetilde{\delta}) + (1-\psi)x^{\theta-1}]\widetilde{k} - \widetilde{c}. \end{aligned}$$

These equations are solved for the steady-state values of detrended capital and consumption where $\widetilde{\delta}$ and $\widetilde{\tau}$ are the steady-state depreciation and capital income tax rates. The steady-state saving rate is given by

$$\widetilde{s} = \frac{(\gamma n - 1)\widetilde{k}}{\widetilde{y} - \widetilde{\delta}\widetilde{k}}. \tag{3}$$

Transition to the steady-state: Starting from a given value of the initial capital stock K_0, we guess a value for the endogenous variable C_0 and use equations (1) and (2) to obtain a path for the endogenous variables C_t and K_{t+1} towards the steady-state. If this path is not achieved, we iterate on the initial guess for C_0 using this 'shooting' algorithm until convergence to the steady-state is obtained. Equipped with the equilibrium path of C_t and K_{t+1}, we can then use other equilibrium conditions to construct time paths of all aggregate quantities and prices. In particular, we compute the saving rate using[8]

$$s_t = \frac{Y_t - G_t - C_t - \delta_t K_t}{Y_t - \delta_t K_t}.$$

2 Data and Calibration

We calibrate the model economies to the 1960-2004 U.S. economy using the National Income and Product Accounts (NIPA) and Flow of Funds data. Our definition of the saving rate includes consumer durables. We define capital K as the sum of the fixed assets, consumer durables, inventory, stock of land, and net foreign assets. Output Y corresponds to GNP plus the service flow from consumer durables and government capital. Total depreciation includes depreciation of consumer durables. We explain our measurements in detail in the Appendix. The capital share parameter, θ, is set to its average value of 0.363 over this period. The subjective discount factor, β, is set to 0.9736 so that the capital output ratio is 3.0 at the final steady state.

[8] We do treat the model as a closed economy where net national saving and invsetment are identical. Figure A2 in the Appendix displays the net national saving and investment rates for the U.S. economy in this time period. As expected, after the 1980s there is a divergence between the two series indicating the current accounts deficits in the U.S. Perhaps a two country model for that time period would ne useful especially if the aim is to understand the current account deficits of that period. However, for the purposes of this model, the closed economy assumption seems sufficient.

For the steady state calculations we set the values for the share of government purchases, G_t/Y_t, and the tax rate on capital income, τ_t, equal to their average values over 1960-2004. We set the steady state values for the depreciation rate and the population growth rate equal to their values in 2004. The resulting values used for the steady state are $G/Y = 14.3\%$, $\delta = 5.2\%$, $\tau = 40\%$ and $\eta = 1\%$.[9] We set the share of leisure in the utility function to $\alpha = 2.21$. We set the growth rate of TFP at the steady state to its 1960-2004 average value of 1.2%, and assume that the steady state is reached in eighty years.[10]

Since our main question is to examine the secular movements in consumption and saving between 1960-2004, our simulations take the actual capital output ratio in 1960 as the initial condition. We use the data for actual TFP growth during this time period.[11] In addition, we use the actual time paths of the population growth rate, share of government spending in GNP, depreciation rate and the capital income tax rate between 1960 and 2004. To examine the contribution of each one of these factors to the secular trends in consumption and saving we conduct counterfactual experiments where we introduce each time series data one at a time. We use a shooting algorithm to obtain model simulations.

3 Results

We start by examining the net national saving and investment rates for the U.S. economy displayed in Figure 2. Our benchmark model conducts simulations in a closed economy framework. Examining the data for saving and investment in the U.S. reveals that this assumption has some shortcomings. Especially since the 1990s the differences between saving and investments have been widening. Keeping this caveat in mind we proceed with the simulations generated by the model economy.

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[9] Average depreciation rate for the entire time period is 4.7%. Our calculations suggest an increase in the depreciation rate since the 1990s.

[10] Between 2004 and the steady state, we all exogenous variables take their steady state values. In the sensitivity analysis we discuss the sensitivity of our results to this assumption.

[11] The TFP is calculated as

$$A_t = Y_t/K_t^{\theta}(H_t)^{1-\theta},$$

where the capital share θ is set to 0.4, Y_t is GNP, K_t is the nongovernmental capital stock inclusive of foreign capital, and H_t is aggregate hours worked. In this framework investment consists of domestic private investment and the current account surplus. Even though, we treat the model as a closed economy, we include the foreign capital in the definition of the capital stock to make sure that the TFP growth rates faced by the U.S. individuals can be accurately measured. However, it is important to note that this adjustment is quantitatively very small. None of the results are significantly altered by different measurements of TFP such as inclusion of government capital or the exclusion of foreign capital.

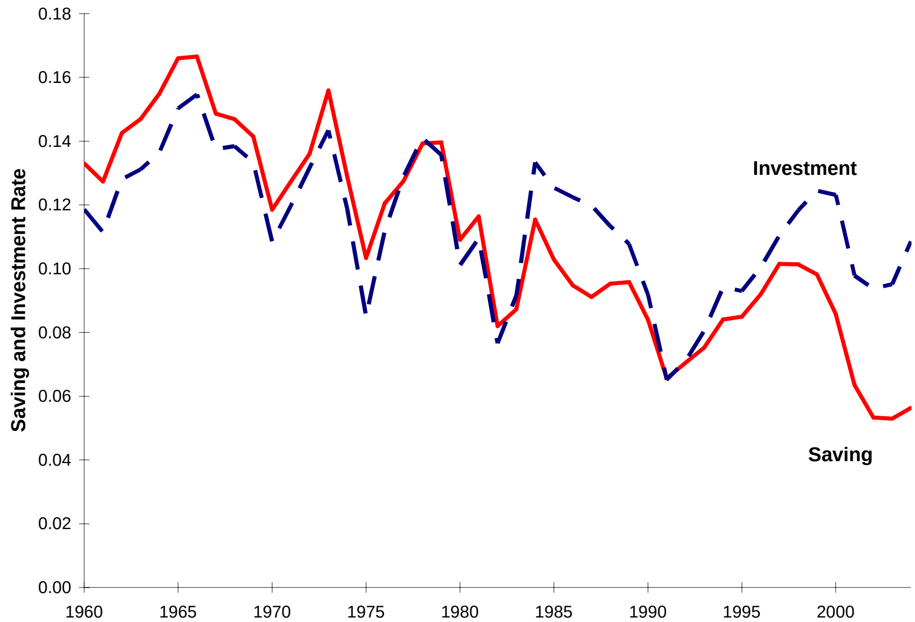

Figure 2: Saving and Investment Data

Figures 3 and 4 display some of the key properties of the model economy and compares them to the data. First panel in Figure 3 is the net national saving rate as a percent of net national product that is generated by the model as well as its counterpart in the data. In general the model does reasonably well in capturing the movements in the U.S. saving rate. Main differences between the model and the data are in early 1980s and after 1990s. The absolute percentage error between the actual and the simulated saving rate has a mean of 19% for the entire time period. The two periods where there is large differences between the observed and simulated saving rates are 1982 and 2004. The absolute percentage error in those periods are 52% and 90% respectively. For the consumption series, the absolute percentage error between the data and the model is 3% on average. It reaches a maximum of 9% in 1981. In other words, the model is able to account for 80% of the actual saving rate in the U.S.

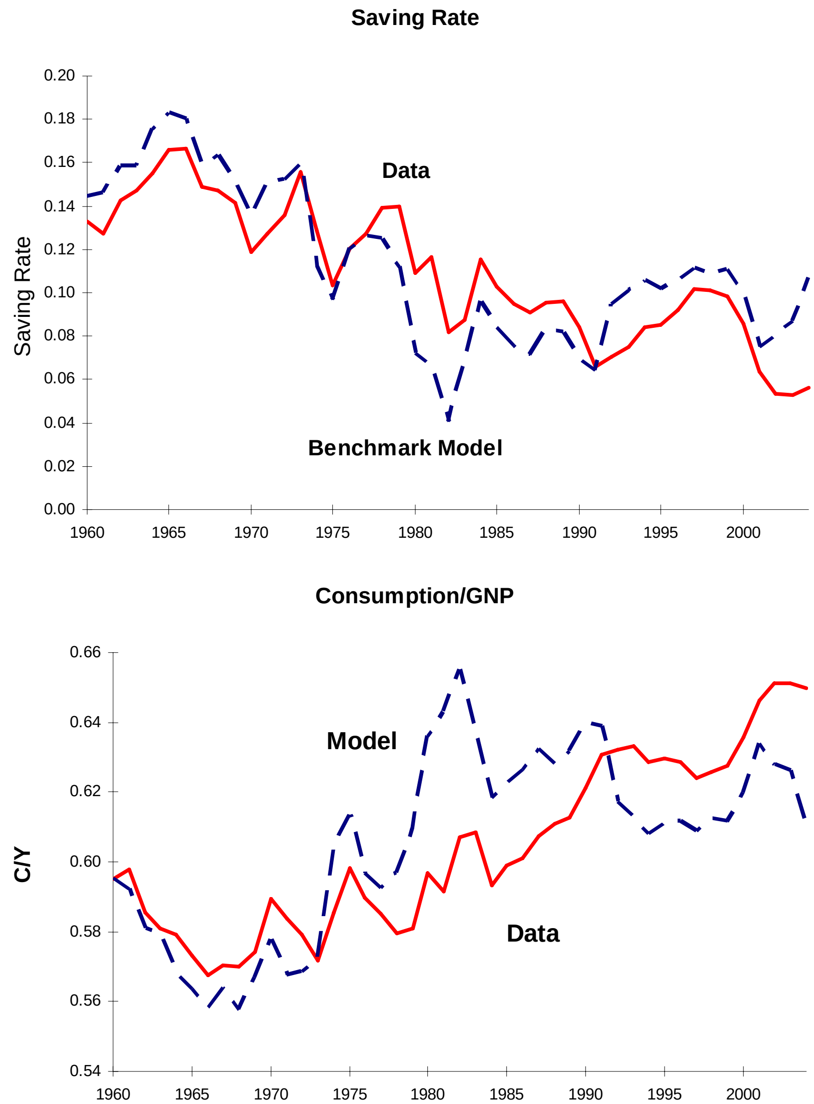

Figure 3: Properties of the Model

The first panel in Figure 4 displays the gross investment to GDP ratio in the data and in the model. Absolute percentage error between these series ranges from almost zero to 23% in 1982. The average absolute percentage error is 6%. In the data the labor input is total hours worked which is the employment rate times average hours worked. In the model we only have the hours margin so the labor variable from the model reflects the total hours worked. As a result, the model is not able to capture the gradual increase that takes place in the aggregate work.

With these caveats in mind, we can still observe that the model economy generates the decline in the saving rate, the increase in the consumption output ratio and several of the humps in both series that has been taking place in the U.S. economy in this time period.

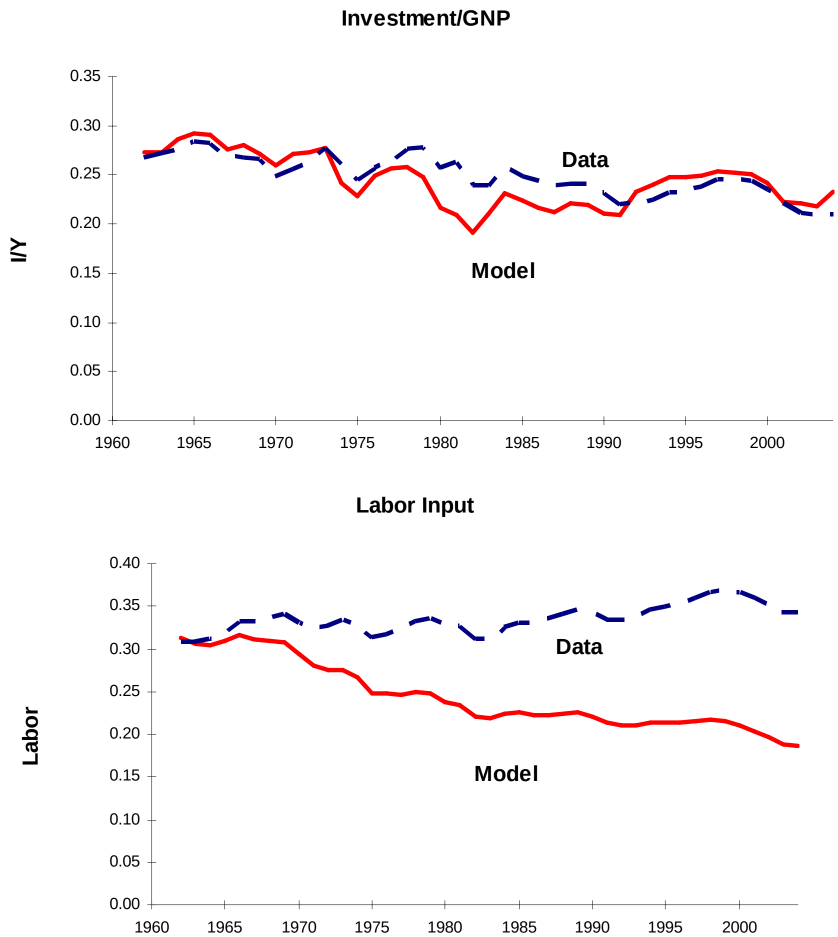

Figure 4: Properties of the Model

In order to understand the main factors behind the behavior of consumption and saving over this time period, we conduct several counterfactual experiments. In our benchmark economy, we have used time series data for the TFP growth rate, population growth rate, depreciation rate, capital income tax rate, and fraction of government expenditures on GNP. Table 1 displays the changes that took place in the exogenous variables that we have found to have an impact on the saving rate over this time period.

Table 1: **Exogenous Variables**

	Growth Rates		Average
	TFP	**Population**	**Depreciation Rate**
1960-1973	1.26	1.82	4.29%
1973-1990	0.67	1.46	4.36%
1990-1995	1.63	0.98	4.96%
1995-2004	1.21	1.28	5.31%
Long-run averages	1.10	1.47	4.61%

Both the decrease in the population growth rate and the increase in the deprecation rate that took place in this time period are expected to effect the saving rate negatively. In Figure 5 we display the quantitative impact of these two changes on the saving rate by conducting a counterfactual experiment. We set all the exogenous variables equal to their steady state values and only use the time series data for the population growth and depreciation rates. Notice that the model generated saving rate declines from 14% in 1960 to 10% in 2004. This gradual decline is caused by the decline in the population growth rate and the increase in the depreciation rate that takes place in this time period.

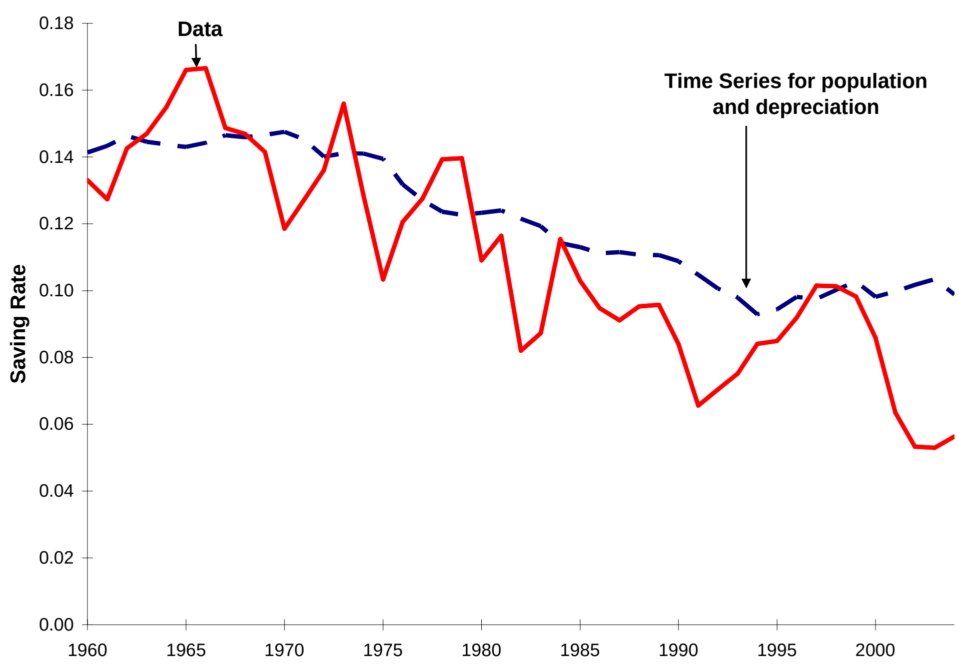

Figure 5: Impact of the population growth and the depreciation rate

Next, we examine the impact of the changes in the TFP growth rate by generating a saving rate in the model economy when the only time series data that is used in the simulations is the growth rate of TFP. Rest of the exogenous variables, population growth rate, depreciation rate, capital income tax rate and G/Y are set to their long-run averages. Figure 6 displays the result of this experiment labeled "TFP Time Series Only". Notice that during periods of high TFP growth rate such as 1960-1973 we observe relatively high saving rates. During the productivity slowdown of 1973-1990 model generated saving rate declines more than that is observed in the data. Between 1990-1995 there is an increase in the TFP growth and saving rates, although model generated saving rate is higher than the data. After 1995 both the actual and the simulated saving rates decline.

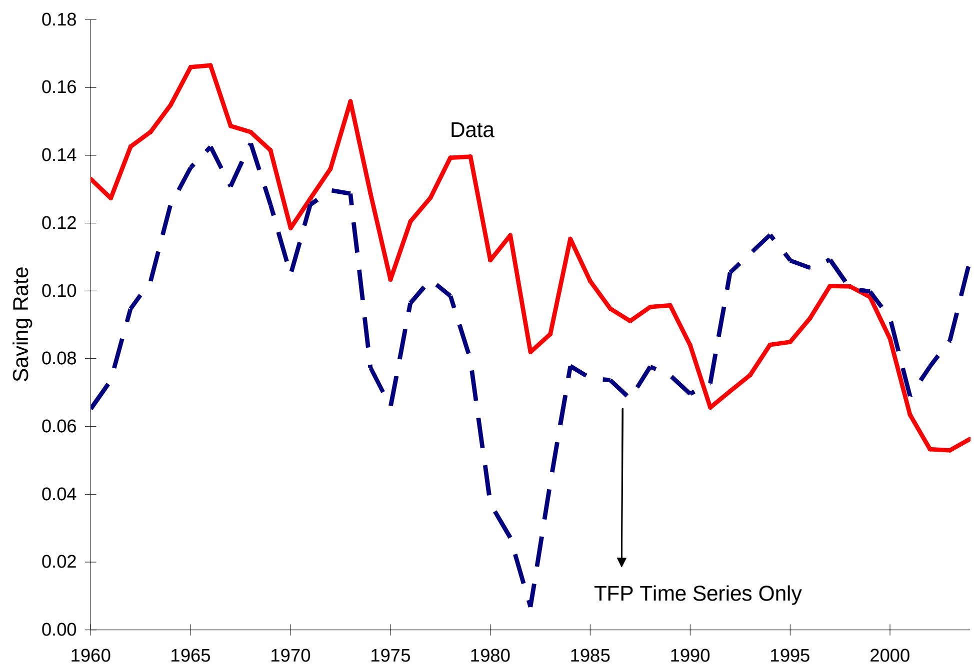

Figure 6: Role of TFP Growth

Explaining the declining saving rate in the late 1990s has been difficult especially since productivity growth in the same time period has been high.[12] Our simulations confirm that the TFP growth rate alone would not be able to explain the level of the saving rate in this period where the average saving rate in the data is 7.7% and the simulated saving rate is 9.5%. Including the time series data for all the exogenous variables, which is the benchmark simulation, yields and average saving rate of 9%. In other words, all the other exogenous variables account for a 0.5% decline in the saving rate between 1990-1995.

The model is generating a decline in the saving rate after 1995 that mimics the data

[12] Figure A1 that displays the TFP growth rate and the saving rate in the 1960-2004 period demonstrates that 1990s show low saving and high productivity growth rates.

rather well. TFP growth rate seem to play an important role in the initial decline. However, the model predicts an increase in the saving rate after 2002 that does not take place in the data. Saving rates generated by the model towards the end of the simulated period are affected by the assumption made about the period after 2004 and before the steady state. In the sensitivity analysis we examine this issue further.

3.0.1 Sensitivity of Results

Stochastic Case In order to examine the role of conducting deterministic simulations, we experiment with several simple stochastic specifications of this framework.

Non-changing Expectations

In this example, we make the extreme assumption that agents always expect the TFP growth rate to be 1.1% while getting hit with the actual TFP growth rates every period. Since after 2004 the actual growth rate is assumed to be 1.1%, as individuals get closer to this period, their expectations get closer to the realizations that take place after 2004. However, for the periods starting in 1960, they are always forming their decision rules based on the 'naive' expectation of 1.1% TFP growth. We conduct this experiment in the version of the model where all of the exogenous variables other than the TFP growth rate are set to their steady state values. This model generates the saving rate labeled as 'stochastic'. It is interesting to note that even with such an extreme assumption on expectations, the model generates a 'reasonable' saving rate for the time period. Large discrepancies between the saving rates generated by the deterministic model and the stochastic case occur in periods when the actual TFP growth rate is significantly different from the expected 1.1%, such as between 1960 and 1973 when the actual TFP growth rate is 1.26%, or in the 1990s when the TFP growth rate is higher that its long run average.

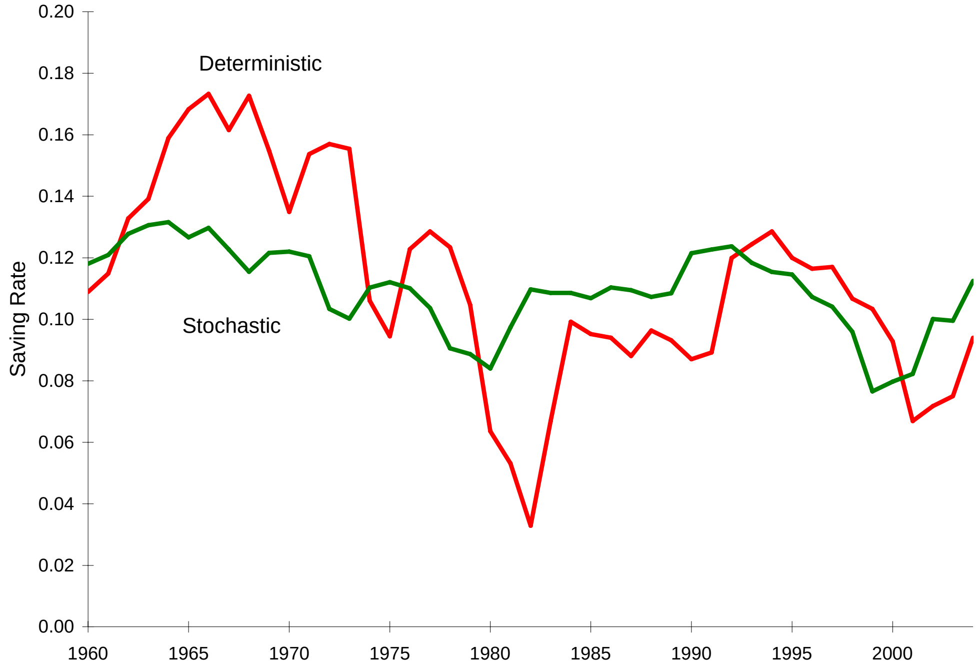

Figure 7: Role of Expectations

Adaptive Expectations

Next, we assume that agents form their expectations about what will happen to the TFP growth rates in the future based on what has happened in the past given by the following expression:

$$\gamma_{t+1}^{e} = \gamma_{t}^{e} + \lambda(\gamma_{t} - \gamma_{t}^{e})$$

where γ_{t+1}^{e} is the expected TFP growth rate for time $t+1$ and γ_t is the actual TFP growth rate at time t. With λ between 1 and 0, current expectations of future TFP growth rate reflects past expectations and an "error-adjustment" term, in which current expectations are raised (or lowered) according to the gap between actual TFP growth and previous expectations. In Figure 8 we present the simulation results for various values of λ.

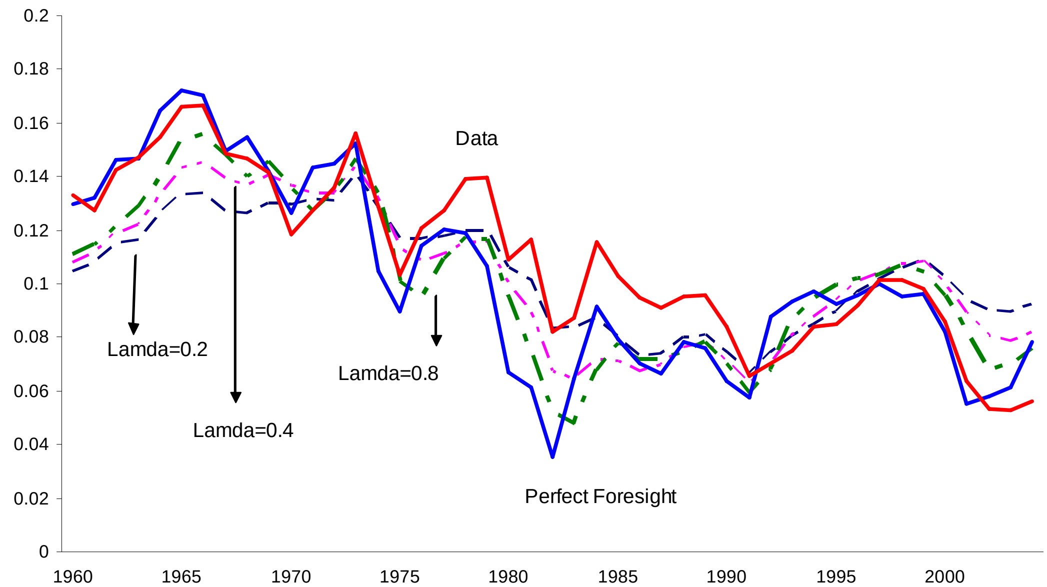

Figure 8: Adaptive Expectations

Assumptions on Future Our solution method necessitates us to assign growth rates for all our exogenous variables for the periods between 2004 and the steady state. The most quantitatively important one is the TFP growth rate. In our benchmark calculations we have used the steady state TFP growth rate after 2004 which is equal to 1.2%. This growth rate is lower than the growth rates observed in 2004 which is 3.4%. To check the sensitivity of our results to this assumption, we report simulations from a case where we assume different TFP growth rates after 2004.

In Figure 9 we show the saving rate that result from the two experiments. The series labeled "Benchmark - Lower Future TFP" refers to the benchmark simulation where we had assumed that the TFP growth rate after 2004 will equal its steady state value of 1.2%. The series labeled "High Future TFP" reports the results of a simulation where we assume the TFP growth rate between 2004 and 2020 to equal the TFP growth rate of 2004. The vertical line represents year 2004 beyond which the two simulations differ in terms of the TFP growth rate. The two series are almost identical until 1990s after which they start showing differences. Main differences between the two series are in the level of the saving rate in the 1990s as well as their paths in the future. If one assumes growth rates of TFP after 2004 to be lower than the rates observed in the years before, this results in a higher level of savings in the 1990s. In other words, our benchmark simulation is overestimating the saving rates in the 1990s by imposing the future growth rates right after 2004 to be relatively smaller. [13]

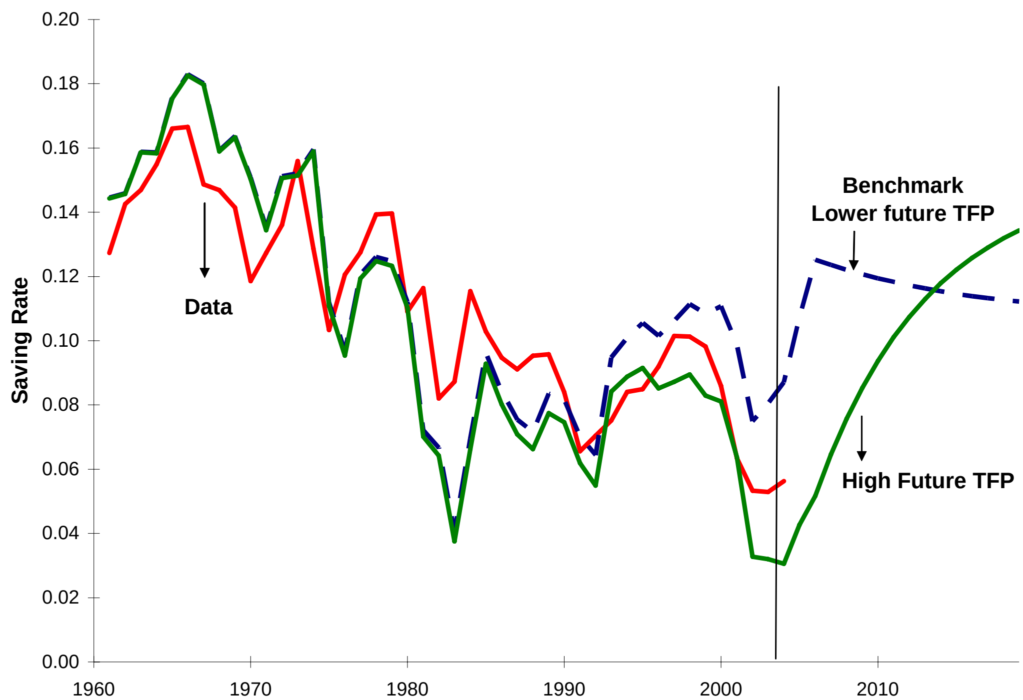

Figure 9: Role of the Future

4 Appendix

4.1 Calibration of the Benchmark Economy

In this section, we describe the detailed procedure of our calibration for the benchmark economy. We use data from the 2005 revision of National Income and Product Accounts (NIPA) and Fixed Asset Tables (FAT) of Bureau of Economic Analysis (BEA) for the years 1960-2003. The measurement of the macroeconomic aggregates follows Cooley and Prescott (1995) with special attention paid to the following issues.

Denote measured GNP as follows

$$(cs + cnd + icd) + g + i + nx + nfp = GNP = dep + NNP \tag{4}$$

[13] We have also experimented with setting the future TFP growth rates based on a 5 year moving average of the past TFP growth rates. As one would expect the saving rate generated by such a case is in between the two extremes we have displayed in Figure 9.

where cs, cnd, icd denote consumption of service flow, consumption of nondurable and expenditure on consumer durables. g denotes the sum of government consumption, denoted as gc, and gross government investment, denoted as gi. i denotes gross private investment. nx denotes net export and nfp denotes net income of foreign assets. dep denotes consumption of fixed capital.

First, we include government capital in the definition of the capital stock. Once we include service flow from government capital, sg, Equation(1) becomes

$$(cs + cnd + icd + sg) + gc + (i + gi) + nx + nfp = GNP + sg = dep + (NNP + sg) \quad (5)$$

where dgi denotes depreciation of government fixed assets. Total government consumption now becomes $g - dgi$ and $dep - dgi$ is depreciation of private fixed asset.

Second, we treat consumer durable as part of capital stock. Then Equation (2) becomes

$$\begin{aligned}(cs + cnd + csd + sg) + gc + (i + nicd + dcd + gi) + nx + nfp &= GNP + sg + csd \\ &= (dep + dcd) + \\ &\quad (NNP + sg + csd - dcd)\end{aligned}$$

where csd is service flow from consumer durable and dcd denote depreciation of consumer durable. Therefore, total private consumption becomes $(cs + cnd + csd + sg)$ and total investment investment becomes $(i + icd + gi)$ or $(i + nicd + dcd + gi)$, where $nicd$ is referred to as net investment in consumer durable and dcd denotes depreciation of consumer durable. Total depreciation becomes $(dep + dcd)$.

Third, we treat net foreign asset as part of capital stock. The above equation then becomes

$$\begin{aligned}(cs + cnd + csd + sg) + gc + (i + nicd + dcd + gi + nx + nfp) &= GNP + sg + csd \\ &= (dep + dcd) + \\ &\quad (NNP + csd + sg - dcd)\end{aligned}$$

Now total investment becomes $(i + nicd + dcd + gi + nx + nfp)$.

In summary, we define capital K as the sum of the fixed assets, consumer durables, inventory stock land, and net foreign assets. Output Y corresponds to $GNP + sg + csd$ and total depreciation corresponds to $dep + dcd$.

Following McGrattan and Prescott (2000), we assume that the rate of returns for consumer durable and government fixed assets are equal to the rate of return for non-corporate capital stock. Specifically, we have

$$\begin{aligned} i &= \frac{(\text{Accounting Returns + Imputed Returns})}{(\text{Non-corporate capital +land+inventory+Capital of Foreign Subsidiary})} \\ &= \frac{(0.0603 + 1.6803i)}{(2.976 + 0.0095/i)} \end{aligned}$$

where 0.0603 is non-corporate profit plus net interest less intermediate financial services, 1.6803 is the sum of the net stock of government capital, consumer durable, land and inventory; 2.976 is the sum of net stock of non-corporate business, government capital, consumer durable, land and inventory. 0.0095 is the net profit from foreign subsidiaries.

The above equation gives a value of i at 3.93% over the period between 1960 and 2000.

Y_{sd} and Y_{sg} are referred to as the service flows from consumer durables and government capital, which is computed following Cooley and Prescott (1995).

$$\begin{aligned} Y_{sd} &= csd = (i + \delta_d) K_D \\ Y_{sg} &= iK_G \end{aligned}$$

Then the capital share in the output function α is computed as

$$\alpha = \frac{Y_{kp} + Y_{sd} + Y_{sg}}{GNP + Y_{sd} + Y_{sg}}$$

This gives a value 0.41 for α.

Define the net saving rate as

$$\begin{aligned} s &= \frac{Y - CON - GOV - DEPR}{Y - DEPR} \\ &= \frac{(GNP + sg + csd) - (cs + cnd + csd + sg) - gc - (dep + dcd)}{(GNP + sg + csd) - (dep + dcd)} \\ &= \frac{GNP - cs - cnd - gc - (dep + dcd)}{NNP + csd + sg - dcd} \end{aligned}$$

TFP level is computed as

$$A = \frac{Y}{K^{\alpha} (H)^{1-\alpha}}$$

Table A1. Model Economy Account

		Model Expression
1	Depreciation	δK
2	Labor income	wH
3	Capital income	rK
4	Total Income	Y
5	Private Consumption	C
6	Government Consumption	G
7	Investment	I
8	Total Product	Y

Table A2. National Accounts, Average 1960-2000 Relative to GNP	
Consumption of fixed capital	0.115
Compensation of employees	0.571
Unambiguous capital income[14]	0.154
Proprietors' Income with IVA and CCadj	0.074
Indirect Business Taxes[15]	0.086
Gross national income	1.000
Personal consumption expenditures	0.635
Durable goods	0.082
Nondurable goods and services	0.553
Gross private domestic investment	0.161
Government consumption expenditures and gross investment	0.206
Consumption expenditures	0.167
Gross investment	0.039
Net foreign investment[16]	-0.002
Gross national product	1.000
Addendum	
Consumption of fixed capital, durable goods	0.062
Consumption of government fixed assets	0.024
Net stock of government fixed assets	0.671
Net stock of consumer durable goods	0.301

[14] Unambiguous capital income = Rental Income of persons with CCAdj + Corporate Profits with IVA and CCadj + Net Interest and miscellaneous payments.

[15] Indirect business taxes are equal to the sum of tax on production and imports less subsidies, business transfer, current surplus of government enterprises and statistical discrepancy.

[16] Net foreign investment is equal to net export of goods and services plus net factor payment.

Table A3. Mapping From National Accounts to Model Accounts (Excluding Gov't Capital)		
	Model	**NIPA**
1 Depreciation (δK)	0.153	
Consumption of fixed capital		0.115
Consumption of fixed capital, durable goods		0.062
Less: Consumption of government fixed assets		-0.024
		0.153
2 Labor income (wE)	0.683	
Compensation of employees		0.571
0.7×(Proprietors' income + Indirect business taxes)		0.112
		0.683
3 Capital income (rK)	0.228	
Unambiguous capital income		0.154
0.3×(Proprietors' income + Indirect business taxes)		0.048
Imputed capital services from durable goods		0.026
		0.228
4 Total income (Y)	1.064	1.064
Table A3. Mapping From National Accounts to Model Accounts (Excluding Gov't Capital)		
5 Private consumption (C)	0.641	
Personal consumption expenditure		0.635
Less: Consumption expenditure, durable goods		-0.082
Imputed capital ser. from durable goods[17]		0.026
Consumption of fixed capital, durable goods		0.062
		0.641
6 Public consumption (G)	0.182	
Government consumption exp. and gross investment		0.206
Less: Consumption of fixed capital, gov. capital		-0.024
		0.182
7 Investment (I)	0.241	
Gross domestic private investment		0.161
Personal consumption expenditure, durable goods		0.082
Net foreign investment		-0.002
		0.241
8 Total Product (Y)	1.064	1.064

[17] Imputed capital services from durable goods is equal to net stock of consumer durable goods times 8.69%.

Table A4. Mapping From National Accounts to Model Accounts (including gov't capital)		Model	NIPA
		Model	NIPA
1	Depreciation (δK)	0.177	
	Consumption of fixed capital		0.115
	Consumption of fixed capital, durable goods		0.062
			0.177
2	Labor income (wE)	0.683	
	Compensation of employees		0.571
	0.7×(Proprietors' income + Indirect business taxes)		0.112
			0.683
3	Capital income (rK)	0.286	
	Unambiguous capital income		0.154
	0.3×(Proprietors' income + Indirect business taxes)		0.048
	Imputed capital services from durable goods		0.026
	Imputed services from government fixed assets		0.058
			0.286
4	Total income (Y)	1.146	1.146
Table A4 Mapping From National Accounts to Model Accounts (including gov't capital)			
5	Private consumption (C)	0.699	
	Personal consumption expenditure		0.635
	Less: Consumption expenditure, durable goods		-0.082
	Imputed capital services from durable goods		0.026
	Imputed services from government capital[18]		0.058
	Consumption of fixed capital, durable goods		0.062
			0.699
6	Public consumption (G)	0.167	
	Government consumption expenditure		0.167
7	Investment (I)	0.280	
	Gross domestic private investment		0.161
	Personal consumption expenditure, durable goods		0.082
	Net foreign investment		-0.002
	Gross government investment		0.039
			0.280
8	Total Product (Y)	1.146	1.146

[18] Imputed services from government fixed assets is equal to net stock of government fixed assets time 8.69%.

In Figure A1 we display the growth rate of TFP and net national savings between 1961 and 2004.

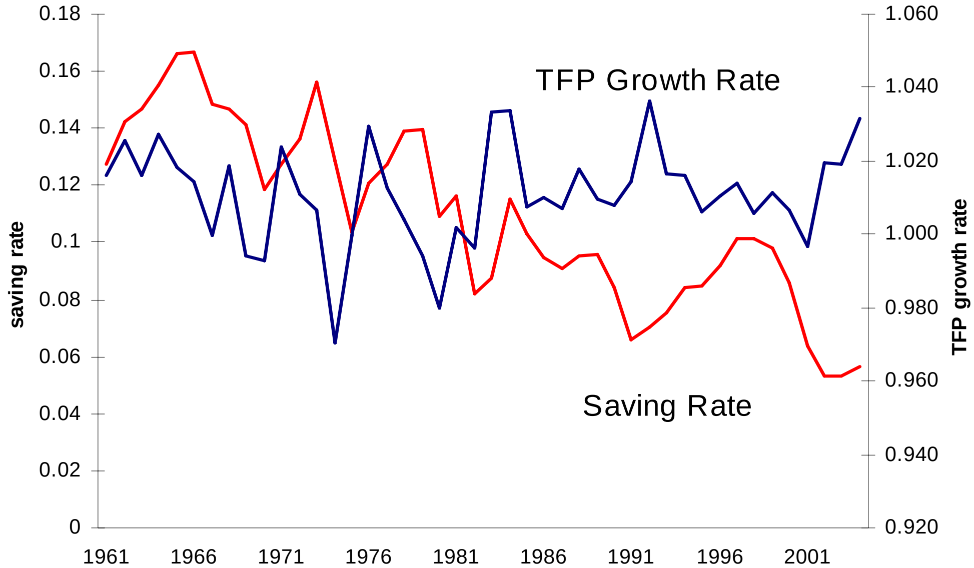

Figure A1: TFP Growth Rate and the Saving Rate

In Figure A2 we provide data net national saving rate and the net domestic investment as a fraction of net national income.

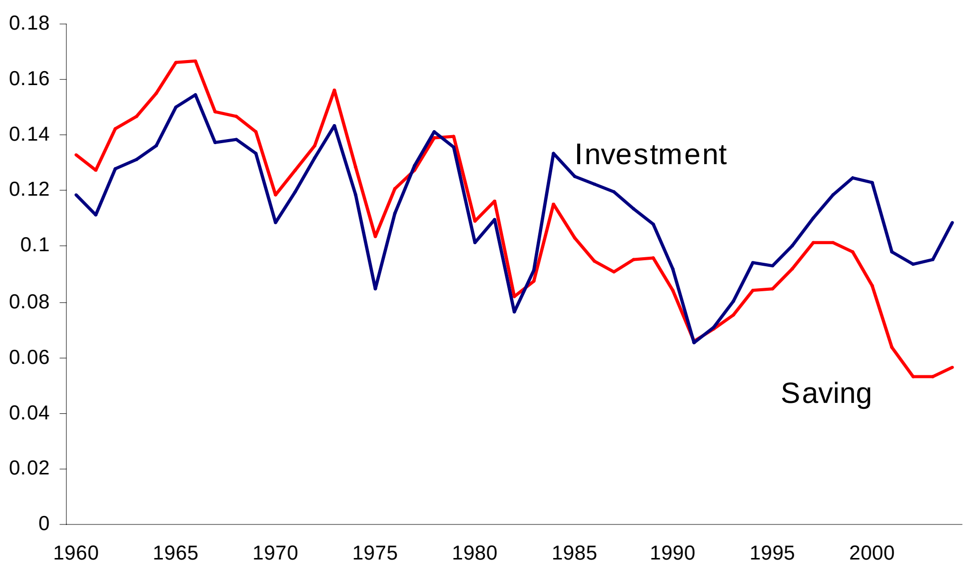

Figure A2: Saving and Investment

References

[1] Attanasio, O. (1998), "A Cohort Analysis of Saving Behavior by US Households", Journal of Human Resources, Vol 33, No3, Summer 1998, pp575-609.

[2] Auerbach, A. and L. Kotlikoff (1987), *Dynamic Fiscal Policy*, Cambridge: Cambridge University Press.

[3] Backus, D., E. Henriksen, F. Lambert, and C. Telmer{2005), "Current Account Fact and Fiction", working paper NYU.

[4] Bernanke, Ben S. (2005), "The Global Saving Glut and the U.S. Current Account Deficit", Remarks at the Sandridge Lecture, Virginia Association of Economics, Richmond, Virginia

[5] Bradford, David (1990), "What is National Saving?: Alternative Measures in Historical and International Context," in C. Walker, M. Bloomfield, and M. Thorning (eds.), The U.S. Savings Challenge, Westview Press, Boulder, pp. 31-75.

[6] Braun, A., D. Ikeda, and D. Joines (2004), "Saving and Interest Rates in Japan: Why They Have Fallen and Why They Will Remain Low", manuscript.

[7] Boskin, M., and L. Lau, 1998. "An Analysis of Postwar U. S. Consumption and Saving: Part I, The Model and Aggregation," Working Paper No. 2605, National Bureau of Economic Research, Inc.

[8] Boskin, M., and L. Lau, 1998. "An Analysis of Postwar U. S. Consumption and Saving: Part II, Empirical Results," Working Paper No. 2606, National Bureau of Economic Research, Inc., Cambridge, MA, June 1988

[9] Chen, K., A. İmrohoroğlu and S. İmrohoroğlu, (2005). "The Japanese Saving Rate", USC Working paper.

[10] Cole, H. L. and L. E. Ohanian (1999), "The Great Depression in the United States from a Neoclassical Perspective," Federal Reserve Bank of Minneapolis Quarterly Review, 23, 2-24.

[11] Cole, H. and L. Ohanian (2002), "The Great U.K. Depression: A Puzzle and Possible Resolution", *Review of Economic Dynamics*, Vol. 5, No 1, pp. 19-44.

[12] Cole, H. and L. Ohanian (2004), "New Deal Policies and Persistence of the Great Depression: A General Equilibrium Analysis", forthcoming, *Journal of Political Economy.*

[13] Cooley, T. and Ohanian, L. (1997), "Postwar British Economic Growth and the Legacy of Keynes", *Journal of Political Economy*, Vol. 105, pp. 439-472.

[14] Gale, W., J. Sabelhaus and R., E. Hall, 1999. "Perspectives on the Household Saving Rate". Brookings Papers on economic Activity. Vol 1999, no.1, pp.181-224.

[15] Gramlich, Edward M (2005). "The Importance of Raising National Saving". Speech at the Benjamin Rush Lecture, Dickinson College, Pennsylvania March 2, 2005

[16] Hayashi, F., and E. Prescott (2002), "The 1990s in Japan: A Lost Decade", *Review of Economic Dynamics,* Vol. 5 (1), 206-235.İ

[17] Juster, F. Thomas, Joseph Lupton, James P. Smith and Frank Stafford. 2000. "Savings and Wealth; Then and Now." Mimeo, University of Michigan.

[18] Kehoe, T. and E. Prescott (2002), "Great Depressions of the 20th Century", *Review of Economic Dynamics,* Vol. 5, pp. 1-18.

[19] Mendoza, E., A. Razin, and L. Tesar (1994), "Effective Tax Rates in Macroeconomics: Cross Country Estimates of Tax Rates on Factor Incomes and Consumption", *Journal of Monetary Economics,* Vol. 34 (3), 297-323.

[20] Ohanian, L. (1997), "The Macroeconomic Effects of War Finance in the United States: World War II and the Korean War", *American Economic Review*, Vol. 87, pp. 23-40.

[21] Parente, S. L. and E. C. Prescott, (2000), *Barriers to Riches,* The MIT Press Cambridge, Massachusetts.

[22] Parker, Jonathan A. 1999a. "Spendthrift in America? On Two Decades of Decline in the U.S. Saving Rate" in Ben Bernanke and Julio Rotemberg, eds., NBER Macroeconomics Annual, 1999. MIT Press, Cambridge.

[23] Poterba, J. (2000), "Stock Market Wealth and Consumption", The Journal of Economic Perspectives, Vol. 14, no.2.: 99-118.

[24] Summers, L., Caroll, C. and A. Blinder. 1987. "Why is U.S. National Saving so Low? Brookings Papers on economic Activity. Vol 1987, no. 2. pp:607-642.