Lecture 4 - Overlapping Generations Model

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Contents

In the Solow [1956] growth model, we assumed that saving was a constant fraction of GDP. Lecture 3 has shown how to use microeconomics, and optimization, in order to derive saving behavior endogenously (that is, to explain it).

This section presents a very simple version of the Diamond [1965] **overlapping-generations model**. This model is used not just to give microfoundations to the Solow [1956] model, but also to think about social security, public debt, which we shall take up in the next lectures.

1 Assumptions

1.1 Time

We assume that people in this economy live only for 2 periods. People are called "young" in the first period of their life, and "old" in the second. Thus, you should really think that the length of a period is a generation (approximately 30 years). However, instead of referring to these two periods as 0 and 1, I shall refer to them as t and $t+1$.

1.2 Demographics

People from generation t are young in period t, and old in period $t+1$. We denote their consumption when young by c_t^y and their consumption when old by c_{t+1}^o. In terms of Lecture 3, you should really think of c_t^y as c_0, and of c_{t+1}^o as c_1.

People work when young, and then receive a wage given by w_t. They retire when old, and then do not work. Their lifetime utility is logarithmic with $\beta = 1$:

$$U = \log(c_t^y) + \log(c_{t+1}^o).$$

Their intertemporal budget constraint is given by:

$$c_t^y + \frac{c_{t+1}^o}{1+R} = w_t.$$

There are always two generations living in period t: the previous period's young, born in period $t-1$, now old, consuming the return from their savings; and this period's young, newly born (in period t).

1.3 Production

For simplicity, we shall assume a Cobb-Douglas, constant returns to scale, production function:

$$Y_t = K_t^\alpha L_t^{1-\alpha}.$$

We assume that the labor force is constant and fixed to unity (this is to avoid carrying L around everywhere - from lecture 2, you should now know that everything can be expressed per capita, because of constant returns to scale), and therefore:

$$L_t = L = 1.$$

Again for simplicity, we shall assume that capital depreciates at rate $\delta = 1 = 100\%$. (that is, capital fully depreciates each period - this is not that unreasonable if you take one unit of time to represent one generation, or about 30 years - remember that the depreciation rate for one year was approximately equal to 2% to 30% depending on the type of capital involved.)

2 Solution

2.1 Calculating Saving from the Consumption Problem

Utility is logarithmic, so that the consumption of the young c_t^y and consumption of the old c_{t+1}^o are given as a function of the wage as follows (this is just an application of Lecture 3):

$$c_t^y = \frac{w_t}{2} \qquad c_{t+1}^o = (1+R)\frac{w_t}{2}.$$

Indeed, if you want to think of this model as the two periods model of Lecture 3, think that everything is as if:

$$f_0 = 0, \qquad y_0 = w_t, \qquad y_1 = 0.$$

2.2 Capital accumulation

Saving (and savings) is equal to investment, and therefore we have that:

$$S_t = I_t = w_t - c_t^y = \frac{w_t}{2}.$$

The major difference with the Solow model is that saving is here endogenous, and coming from agents' optimizing choices. In the Solow model in contrast, saving was taken as exogenous and equal to a fraction s.

The wage paid by employers, given that $L=1$, is:

$$w_t = (1-\alpha)K_t^{\alpha}L^{-\alpha} = (1-\alpha)K_t^{\alpha} = (1-\alpha)Y_t.$$

Finally:

$$\Delta K_{t+1} = \frac{w_t}{2} - \delta K_t = \frac{1-\alpha}{2}Y_t - \delta K_t.$$

This is the capital accumulation equation (or law of motion for capital) of the Solow model, with $s = (1-\alpha)/2$. The new element here of course is to get saving endogenously, from agents' optimal decisions. Note that the value for the saving rate has an economic interpretation: wages are only a fraction $1-\alpha$ of output, from lecture 1. On the other hand, savers / consumers want to smooth consumption and therefore want to save a half of that. This is why a fraction $(1-\alpha)/2$ of output is saved.

2.3 Numerical Application

Note that if $\alpha = 1/3$, then the saving rate is equal to $s = 1/3$, which happens to be (by coincdence) the Golden Rule level of saving. This does not mean that the Golden Rule level is always satisfied. This only happens by chance in this very stylized model. In particular, saving is not just because of retirement, but also because of precautionary behavior, leaving bequests or simply liking being wealthy. We will come back to these issues in future lectures, but we can look at some data on who owns wealth and how it is divided first, before we move to that.

3 Why do people save?

In the overlapping generations model of Diamond [1965], saving behavior has only one source: planning for retirement. Reality is a bit more nuanced. This section provides data which is suggestive that much of the wealth does not in fact come from young workers saving to provide for their old age.

3.1 Data from Saez and Zucman [2016]

Figure 1 from Saez and Zucman [2016] shows the composition of aggregate US household wealth from 1913 to 2013. The US tax code includes provisions which strongly encourage retirement saving in the form of retirement accounts. However, houses are also clearly a potential source of revenue for older people. (because of the flow of rents that owner-occupied housing provides, but also because there is always an option to liquidite one's house when old)

Figure 2 shows the saving rate by wealth class, which echoes the evidence on saving rate by income shown previously in Lecture 3.

Figure 3 shows the top 10% wealth share. As you can see, nearly 75% of household wealth is held by the top 10% wealth owners. This is more concentrated than labor income (the top 10% in the United States gets about 50% of pre-tax income, and much less after-tax), and therefore does not appear to be solely accounted for by saving for retirement.

Figure 4 shows the top 1% wealth share, and the top 1-10% wealth share. As you can see, the top 1% now owns nearly 40% of the wealth in the United States, while it only accounts for about 20-25% of pre-tax income. Again, it does not seem like saving for retirement is the whole story.

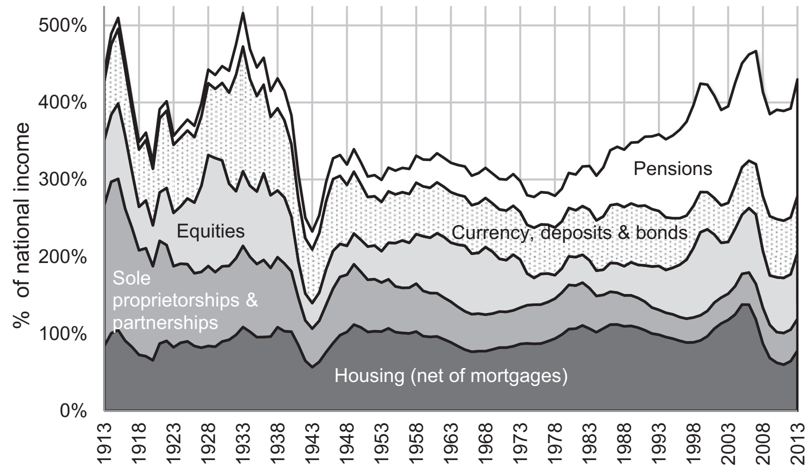

Figure 1: Aggregate US Household Wealth, 1913–2013

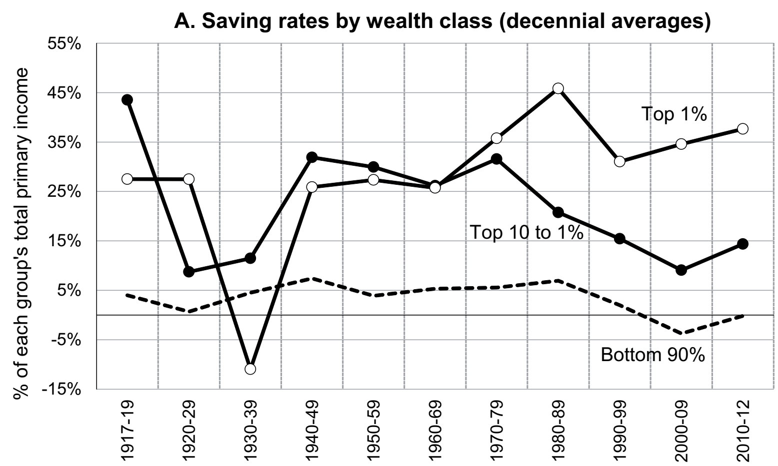

Figure 2: Saving Rate by Wealth Class

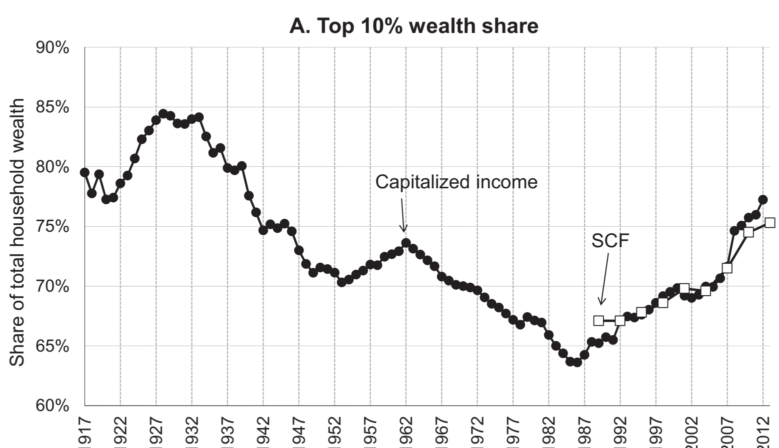

Figure 3: Top 10 per cent wealth share

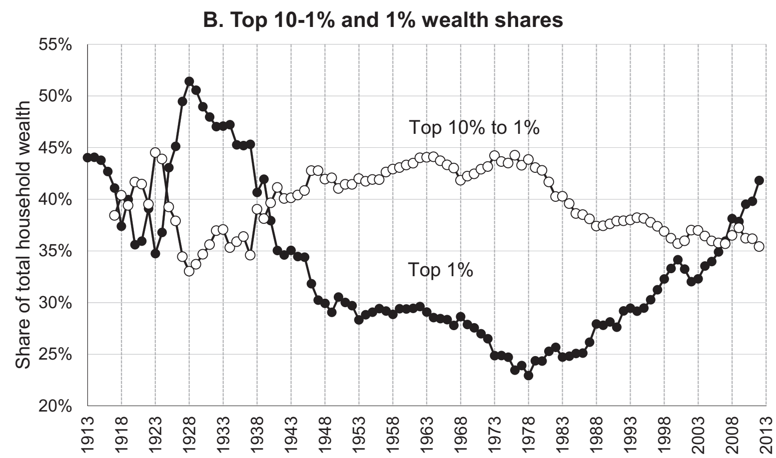

Figure 4: Top 1-10 per cent and Top 1 per cent wealth share

3.2 Saving by the high net worth

So, what leads high income and high net worth people to save so much? A number of explanations have been proposed:

1. **Leaving bequests.** One reason why people might want to save over and above what they need to provide for retirement, is to leave bequests. However, it has been shown that even high income workers without children save a lot, more than warranted by their retirement needs.

2. **Prestige.** Wealth brings prestige. Adam Smith has a great passage in The *Theory of Moral Sentiments* (1759):

   To what purpose is all the toil and bustle of the world?... lt is our vanity which urges us on... It is not wealth that men desire, but the consideration and good opinion that wait upon riches.

3. **Concern for relative wealth.** Related to this explanation is a concern not for the absolute level of wealth per se, but for a relative standing compared to others in society. This is for example echoed in an academic article by Cole et al. [1992], published in 1992:

   But think for a moment about an already very rich agent such as Donald Trump. Why does he continue to work long days, endure substantial amounts of stress, and take enormous risks? Surely it cannot be that he is savoring the prospect of going to the grocery store with a looser budget constraint next year. He seems to have more money than he could spend in several lifetimes. Even if we are wrong about Trump's net worth, there clearly seem to be wealthy individuals that continue to work very hard and take large risks to increase their net worth. It is hard to reconcile such behavior with the underlying decision making in traditional growth models. We propose that people like Trump continue to care about increasing their net worth because their utility depends not only on the absolute level of their wealth but also on their wealth relative to that of other very rich people.

4. **A final hypothesis.** An even more mundane explanation (which does not make it wrong!) has been proposed by Lee Iacocca, former CEO from Chrysler. According to him, the rich simply do not know what to do with their money:

   Once you reach a certain level in a material way, what more can you do? You can't eat more than three meals a day; you'll kill yourself. You can't wear two suits one over the other. You might now have three cars in your garage-but six! Oh, you can indulge yourself, but only to a point.

Most economists are however general skeptical of this type of explanations. (I personally am less sure) What they find puzzling is that high net worth individuals keep working even when they have achieved a sufficient amount of wealth.

All this discussion may seem like armchair theorizing. At the same time, these are probably the most important questions facing macroeconomics. They actually determine the stance that should be taken on optimal capital accumulation, the optimal level of public debt, etc. We shall come back to these issues repeatedly in the following lectures.

References

Harold L. Cole, George J. Mailath, and Andrew Postlewaite. Social Norms, Savings Behavior, and Growth. *Journal of Political Economy*, 100(6):1092–1125, December 1992. ISSN 0022-3808. doi: 10.1086/261855. URL http://www.journals.uchicago.edu/doi/abs/10.1086/261855.

Peter A. Diamond. National Debt in a Neoclassical Growth Model. *The American Economic Review*, 55(5): 1126–1150, 1965. ISSN 0002-8282. URL http://www.jstor.org/stable/1809231.

Emmanuel Saez and Gabriel Zucman. Wealth Inequality in the United States since 1913: Evidence From Capitalized Income Tax Data. *Quarterly Journal of Economics*, 131(May):519–578, 2016. doi: 10.1093/qje/qjw004.Advance.

Robert M. Solow. A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics*, 70(1):65–94, 1956. ISSN 0033-5533. doi: 10.2307/1884513. URL http://www.jstor.org/stable/1884513.