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Bachelor of Science in Wirtschaftswissenschaften

Macroeconomics II: Behavioural Macro
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Part IV
Wealth distributions and redistribution

14 Origins of wealth distributions

14.1 Some facts

- See a video on the wealth distribution in the USA
- See the evolution of the wealth distribution of a cohort in the USA
  - National Longitudinal Survey of Youth (born between 1957-64)
  - Cohort originally included 12,686 respondents ages 14-22 when first interviewed in 1979
  - https://www.nlsinfo.org/content/cohorts/nlsy79
Figure 28 Empirical wealth distribution of the 1979 cohort in the NLSY from 1986 to 2008
14.2 Determinants of wealth distributions

Questions and (some) answers

- How can we understand wealth distributions theoretically and empirically?

- What are theoretical mechanisms that allow us to understand that some have more wealth than others?
  - born rich (inheritance)?
  - saved a lot over time (preference)?
  - high labour income (intelligent and income-oriented)?
  - luck on the labour market (always had good paying jobs, never lost the job)?
  - wealthy because old (life-cycle considerations)?

- Can we construct economic models that explain wealth distributions (and their dynamics) in a quantitatively satisfactory way?
15 A simple model

15.1 The setup

- The idea (see Bossmann, Kleiber and Wälde, 2007)
  - Individuals live in a 2-period OLG general equilibrium world
  - The economy evolves in a deterministic way at the aggregate level (as in ‘Makro I’)
  - There are no aggregate shocks (no TFP shocks as in section 13.1.3)
  - Two novel features
    - Idiosyncratic shocks: Labour income is uncertain (ability when born and skills when entering the labour market are random)
    - Bequests: Individuals inherit wealth when born and leave bequests
- The formal structure for an individual $i$
  
  - First-period budget constraint
    \[ w_t l_{it} + b_{it} + g_t = c_{it}^y + s_{it} \]  
    \( (51) \)
    * $b_{it}$ denotes after tax inheritance received from the parent
    * $w_t l_{it}$ stochastic income depending on (deterministic)
    * wage $w_t$ per efficiency unit and the
    * random ability of the individual $l_{it}$
    * $g_t$ is the uniform lump-sum transfer received from the government in case that it levies a tax on bequests
    * $s_{it}$ savings
  
  - The distribution for individual ability
    \[ E(l_{it}) = \tilde{l} \equiv 1, \quad \text{var}(l_{it}) = \sigma^2, \quad \text{cov}(l_{ir}, l_{is}) = 0 \text{ for } r \neq s. \]  
    \( (52) \)
    * $l_{it}$ are identically and independently distributed (iid)
    * Hence, mean and variance are the same for all $t$ (identically distributed) and ...
    * Covariance is zero (independently distributed)
    * Without loss of generality, we set $\tilde{l} = 1$
Second-period constraint

\[ s_{it} [1 + r_{t+1}] = c_{it+1}^o + (1 + \tau) b_{it+1}, \quad (53) \]

- \( r_{t+1} \) is the second period certain (!) interest rate
- \( c_{it+1}^o \) is second period consumption
- \( \tau \) is the proportional tax rate on
- bequests \( b_{it+1} \)

Preferences

- Individuals enjoy consumption and bequests ("warm-glow" motive)

\[ U_{it} = U \left( c_{it}^y, \ c_{it+1}^o, \ b_{it+1} \right) \quad (54) \]

- They choose consumption \( c_{it}^y \) when young, \( c_{it+1}^o \) when old, and the bequest \( b_{it+1} \) passed on to the child
- Utility depends on the amount \( b_{it+1} \) the child receives after tax
- Joy-of-giving idea: "consumers leave bequests simply because they obtain utility directly from the bequest"
- Next generation also has index \( i \) such that \( i \) is the "name" of a family/dynasty
15.2 Equilibrium

- Optimal behaviour
  
  - After some (not complicated but time-consuming) steps,
  - employing a Cobb-Douglas utility function

  \[ U_{it} = \alpha \ln c_{it}^y + (1 - \alpha) \left[ \beta \ln c_{it+1}^g + (1 - \beta) \ln b_{it+1} \right] \]

  - and defining wealth as \( a_{it+1} \equiv s_{it} \), we get

  \[ a_{it+1} = (1 - \alpha)w_l l_{it} + \frac{(1 - \alpha)(1 - \beta)(1 + r_t)}{1 + \tau} a_{it} + \frac{\tau(1 - \alpha)(1 - \beta)(1 + r_t)}{1 + \tau} k_t \]  

  which shows that wealth of dynasty \( i \) in period \( t + 1 \) depends on

  * wealth \( a_{it} \) of previous generation (via bequests \( b_{it} \))
  * aggregate capital stock \( k_t \) per worker (via government transfers \( g_t \)) and
  * individual skills \( l_{it} \) (via labour income)
Macroeconomic equilibrium and microeconomic dynamics

- Employ a simplifying assumption which is common to very many macroeconomic models
- At the aggregate level, the economy is in a steady state, i.e.
  \[ k_t = \bar{k}, \; r_t = \bar{r}, \; w_t = \bar{w} \]  
  are constant over time
- At the microeconomic level, there is still idiosyncratic risk via ability \( l_{it} \) of individual/dynasty \( i \)
- Some family \( i \) becomes richer over time, some family becomes poorer, some remain at more or less the same level
• The evolution of wealth

  – Fundamental wealth equation for family $i$

    \[ a_{it+1} = c_3 l_{it} + c_4 a_{it} + c_5 \]  
    \hspace{1cm} (57)

  – $c_3$ to $c_5$ are abbreviations for parameters and constant variables ($w, r, k$) as shown in (55)

  – ($c_1$ and $c_2$ were used earlier in paper)

  – This is the reduced form of the model – no further simplification possible
15.3 The distribution of wealth

- What does this model tell us about the evolution of wealth of one family $i$?
  - Not very much
  - As individual skills are uncertain, so is individual wealth
  - Wealth evolves over time, it can rise, it can fall, almost anything can happen
  - Model makes hardly any prediction about the realization of wealth at some future point in time $t$
  - But we do know something about the probability that wealth is within a certain range – and we can compute expected wealth

- Simple but powerful principle
  - A very simple example which has the same properties: playing dice (Würfel)
  - Before someone throws one die, one cannot say a lot about the realization (apart from numbers between 1 and 6)
  - But one can say something about the probability to throw between 3 and 5, or to throw 1 (or other)
  - This is the case with all models containing some source of uncertainty – they make predictions about probabilities or - more generally - distributional properties
• What does this model tell us about inequality?
  
  – This depends on how we define inequality
  – Various measures are available: variance, standard deviation, coefficient of variation, wealth held by richest x%, ratios of percentiles and so on
  – We start with a simple measure: variance
  – [The coefficient of variation (standard deviation divided by the mean) would have the advantage of being scale-independent]
From individual probabilities to cross-sectional distributions

- So far, we only discussed, for some future point in time $t$,
  * probability of an individual to have wealth within a certain range
  * expected wealth of a person
  * variance of wealth of a person

- We also want to know what the expected wealth level is for a group of people

- Imagine we look at many individuals that all start with the same initial wealth level $a_{i0} = a_{\text{low}}$ (we look at “the poor”) or $a_{i0} = a_{\text{high}}$ (we look at “the rich”)

- Employing a law of large numbers, one can show that
  * the probability of an individual to have wealth within a certain range also gives the share of individuals of this group within this certain range
  * expected wealth of a person also gives average wealth of this group
  * variance of wealth of a person also gives variance of wealth of this group
  * we obtain a distribution of wealth for a cross-section of individuals for any point in time

- To illustrate, think about playing dice
15.4 The mean and variance of the wealth distribution

- Let us now compute the variance and coefficient of variation (for which we need the mean) for the wealth distribution for one dynasty $i$.

- We compute the wealth level $a_{it}$ of an individual $i$ at $t > 0$ by solving the difference equation (57).

- We obtain (Wälde, 2012, ch. 2.5.3) wealth $a_{it}$ as a function of parameters, time $t$, the initial wealth level $a_{i0}$ and luck, i.e. the realization of skills $l_{is}$ for family $i$ at each point in time between 0 and $t - 1$,

$$
    a_{it} = c_5 \sum_{s=0}^{t-1} c_4^s + c_4^t a_{i0} + c_3 \sum_{s=0}^{t-1} c_4^{t-1-s} l_{is} 
$$

- What does this tell us?

  - If we knew $l_{is}$ already in 0, we could perfectly predict (no uncertainty) what the wealth level $a_{it}$ is in $t$.
  - As we do not know the $l_{is}$, $a_{it}$ is unknown.
  - Initial wealth $a_{i0}$ matters and $c_4$ is a measure of social mobility: the lower $c_4$, the less social background (“wealth of parents”) matters (see Charles and Hurst, 2003).
  - Apart from $a_{i0}$, why are some people rich and some are poor? The rich were lucky, the poor were not: $a_{it}$ is basically the sum of past luck $l_{is}$.

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• Is there “equality of chances”? 
  – Same equation as (58) above

\[
a_{it} = c_5 \sum_{s=0}^{t-1} c_s + c_4 a_{i0} + c_3 \sum_{s=0}^{t-1} c_s c_4^{t-1-s} l_{is} \tag{59}
\]
  – If uncertain skills \( l_{is} \) come from the same distribution for all individuals, there is an “equality of chances” in this economy
  – If social background also affects luck, there is no equality of chances
  – Examples for absence of equality of chances
    * the share of students at university coming from parents with a university degree is larger than the share of parents with a university degree in society
    * the share of ethnic group \( A \) in government is larger than the share of this group in society
• Computing the mean

– Define expected wealth as $\mu_{it} = E_0 a_{it}$ (compare the definition in (50))
– In words, $\mu_{it}$ is the expected wealth of dynasty $i$ for some future point in time $t$
  when we form expectations at 0
– Apply this to (58) and get

$$\mu_{it} = c_5 \sum_{s=0}^{t-1} c_4^s + c_4^t a_{i0} + c_3 \sum_{s=0}^{t-1} c_4^{t-1-s}$$

where we use $E(l_{it}) = \bar{l} \equiv 1$ from (52)
– Why does the expected wealth level still depend on the dynasty, i.e. why is there an
  index $i$ in $\mu_{it}$? Because of initial wealth $a_{i0}$ of dynasty $i$
– After some steps (see web appendix of the paper - which is not part of the contents
  of this lecture), we get a very intuitive result

$$\mu_{it} = (a_{i0} - \bar{k}) c_4^t + \bar{k}$$

– Expected wealth in $t$ depends on initial wealth $a_{i0}$, wealth per capita, $\bar{k}$, in the
  economy and the social mobility parameter $c_4$
– In the presence of equality of chances

* “family background” does not matter, \( E(l_{it}) = \bar{l} \equiv 1 \)
* wealth regresses to the mean \( \bar{k} \) from (56)
* initial wealth matters from generation to generation, but not in the long run

– This is a relatively “optimistic model” with respect to inequality

* Race, gender, country of origin, family background do not play a role
* Hard to believe?
* Empirically hard to support?
• Computing the variance

  – We are interested in the variance of wealth $a_{it}$ as given in (59)

    $$a_{it} = c_5 \sum_{s=0}^{t-1} c_s^t + c_4^t a_{i0} + c_3 \sum_{s=0}^{t-1} c_4^{t-1-s} l_{is}$$

  – Note that we can look at $a_{it}$ as a standard random variable

    * It is true that $a_{it}$ changes from one point in time to the next

    * When we are interested in the variance (or any other moment), we hold time $t$ fixed and use standard rules for standard random variables

  – We therefore need to understand the variance of a sum of parameters and random variables
• Computing the variance (cont’d)

  – Starting from (59)

  \[ a_{it} = c_5 \sum_{s=0}^{t-1} c_s^t + c_4^t a_{i0} + c_3 \sum_{s=0}^{t-1} c_4^{t-1-s} l_{is}, \]

  we get (using knowledge from Statistik I and II)

  \[
  \begin{align*}
  \text{var} (a_{it}) &= \text{var} \left( c_5 \sum_{s=0}^{t-1} c_s^t + c_4^t a_{i0} + c_3 \sum_{s=0}^{t-1} c_4^{t-1-s} l_{is} \right) \\
  &= 0 + 0 + c_3 \text{var} \left( \sum_{s=0}^{t-1} c_4^{t-1-s} l_{is} \right) \\
  &= c_3 \sum_{s=0}^{t-1} \left( c_4^{t-1-s} \right)^2 \text{var} (l_{is})
  \end{align*}
  \]

  where the second equality employed that the variance of a constant is zero and the second equality used (52), especially the covariance of zero

  – Using (52) further and Wälde (2012, ch. 2.5.1), we find

  \[
  \text{var} (a_{it}) = c_3 \sigma^2 \sum_{s=0}^{t-1} \left( c_4^{t-1-s} \right)^2 = c_3 \sigma^2 \frac{1 - c_4^{2t}}{1 - c_4^2}
  \]

  which tells us that the variance increases over time (but approaches a constant)
15.5 What do we learn from this?

- Imagine we have a real world distribution (reminder)

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**Figure 29** *Empirical wealth distribution of the 1979 cohort in the NLSY (1986 to 2008)*
• We can then ask the following question
  
  – Can we understand this increase in inequality to be consistent with ’equality of chances’?
  – [Let us imagine we consider ’equality of chances’ to be important – think of “all men are created equal” or “All human beings are born free and equal in dignity and rights”]
  – More precisely speaking: if each generation has iid ability $l_{it}$
    * (a) can we replicate this empirical evolution of wealth in our model?
    * (b) can we do so with realistic parameter values?
  – If not, what is the source of large inequality and why is ’equality of chances’ being violated?

• We can ask further questions
  
  – What would happen to the wealth distribution if we had a social security system or if we had a (progressive) tax system? Would the wealth distribution become more equal?
  – Is there a trade-off between average wealth (imagine society wants to become richer) and inequality? (Think about the Kuznets curve in economic development.)
  – ... and much more ...
16 Conclusion

- Basic questions
  - Why are some people rich and some people poor? Why do some people even die with debt, i.e. with negative wealth?
  - What is the role of personality, family background, social background, education and work life?
  - Which role does the tax and redistribution system play?

- Framework of analysis
  - We got to know a simple but powerful analytical framework that allows to think about these questions
  - With its two-period structure, it allows for many analytical findings
  - It seems a useful framework to answer questions in principle
  - For a careful explanation of data, a many-period structure (probably with life-cycle features) would be more promising
• Real world relevance?
  
  – Hard to deny
  – Think about discussions about rising inequality of all sorts in many OECD and G7 countries
  – Think about the outcome of (pre-) elections and a referendum in the US and the UK
  – For more background and a starting point, see OECD (2015, 2008) or Wälde (2016)
Part V

Summary

17 General idea of the lecture

- This was a lecture on behavioural macroeconomics
- The lecture had the following structure
  - Emotional economics
  - Behavioural economics
  - How behavioural macroeconomics could look like
  - Wealth distributions and redistribution
• Structure was chosen as the field of behavioural macro is developing
  
  – We first look at behavioural foundations
  
  – Then we look at macroeconomic models (unemployment, growth, business cycles) and discuss their extension to allow for behaviour features
  
  – Wealth distribution chapter is pure macro (so far) – empirical economists (Dynan, Skinner and Zeldes, 2004) argue that behavioural features are required

• Good example of “research-based teaching”, a concept favoured by JGU
18 Big messages

- What are the messages that should survive from this lecture?
  - Every detail of the course for the rest of everybody’s life ;-) 
  - Strong belief that psychological research is extremely useful for understanding economic questions 
  - Strong(er) belief that economic methods are even more useful to further develop psychological thinking 
  - Example of interdisciplinary research where every discipline learns something from the other discipline 

- The most striking insight from emotional and behavioural economics 
  - Models of time inconsistency 
  - Individuals make plans – and they do not stick to them 
  - This is because individuals keep being surprised by their changes in preferences (the present-bias parameter $\beta$)
What is THE issue in macroeconomics?

- Inequality in GDP per capita and in its average growth rates over decades around the world
- Yes, there is inequality in wealth distributions within a country
- Yes, there is unemployment
- But none of this is as strong as inequality in GDP per capita
• Do we need economics to solve these problems?
  
  – Yes and no – where the no is stronger
  – Yes as we need methods to meaningfully run a country, to manage a market economy, to internalize externalities, to control competition by reducing market power of firms that are too large
  – But – in most cases – reasonable methods are known
  – So: no, we need rethinking of human beings
  – We need more sharing, more compassion, more thinking in terms of groups than thinking in individual terms – so keep in mind \( u = u\left(c_{\text{me}}, c_{\text{the others}}\right)\)
  – How this works: Know Thyself
References


