Is There a Cohort or Period Effect? Consumption Rise in Taiwan, 1981-2010

Kevin Yu-Ching Hsieh 謝餘慶, IEAS (actung-2@econ.sinica.edu.tw)
An-Chi Tung 董安琪, IEAS (actung@econ.sinica.edu.tw)

November 13th, 2014

Outline

1. Questions

Q1: Do Taiwanese consume more over time?

Q2: Are there cohort//period effect?

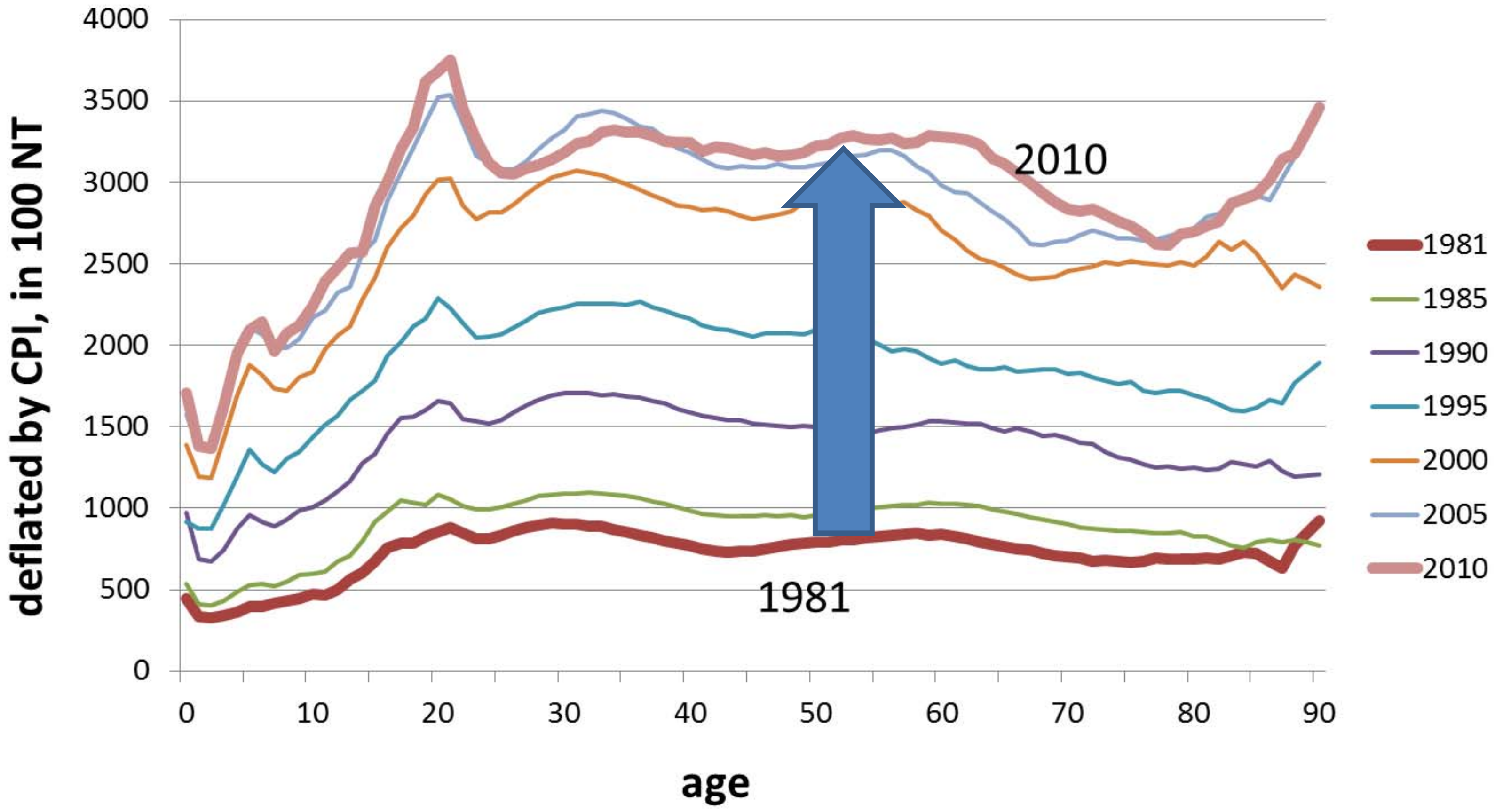
Q3: Why do we care about period/cohort effect?

Q4: How to decompose age, period, cohort effects?

Q1: Do Taiwanese consume more over time?

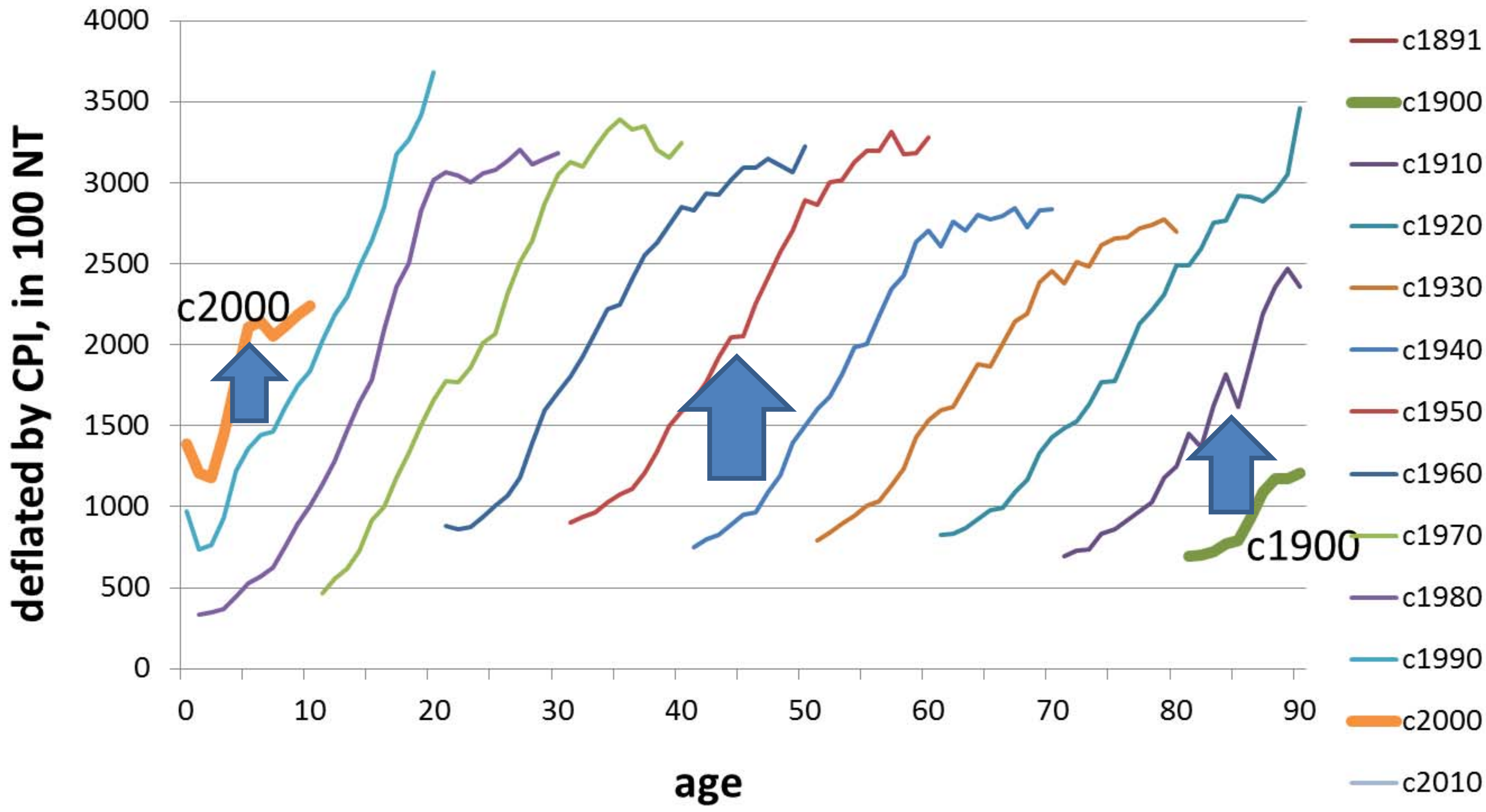
Yes!

- Rise in real per capita CF in 1981-2010



Q2: Are there cohort//period effect?

Yes!



Stronger cohort/period effects in Taiwan, as compared with others, e.g. USA (Miniaci et al, 2003)

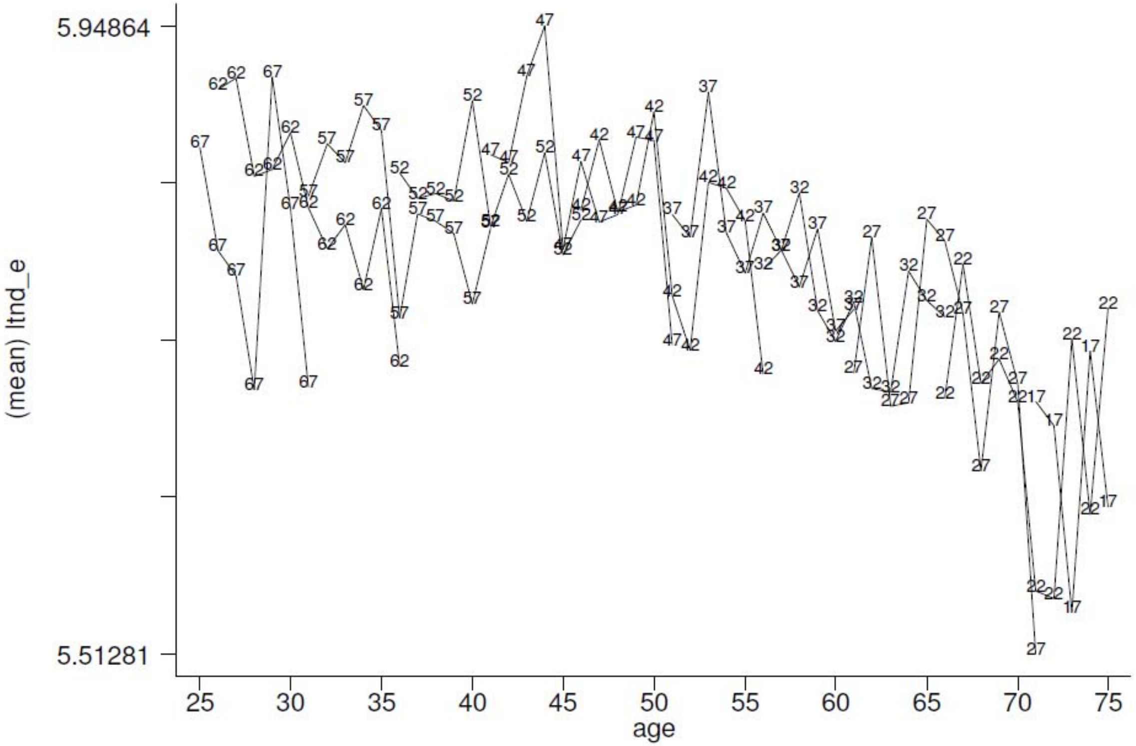


Figure 7: Log(per-capita non-durable expenditure): Cohort profile for US

Q3: Why do we want to tease out age, period, cohort effects?

For many reasons, for example,

- theoretically, cohort matters: lifecycle hypothesis is about consumption of an individual over lifetime, not about cross-section profile
- applications: in policy implications and projections, it is important to separate age, cohort and time effects

Q4: How to decompose by age, period?

There are many ways to overcome identification problem (Cohort ≡ Year – Age), here we use

– Deaton transformation

– Age-Period-Cohort Intrinsic Estimator

2. Background

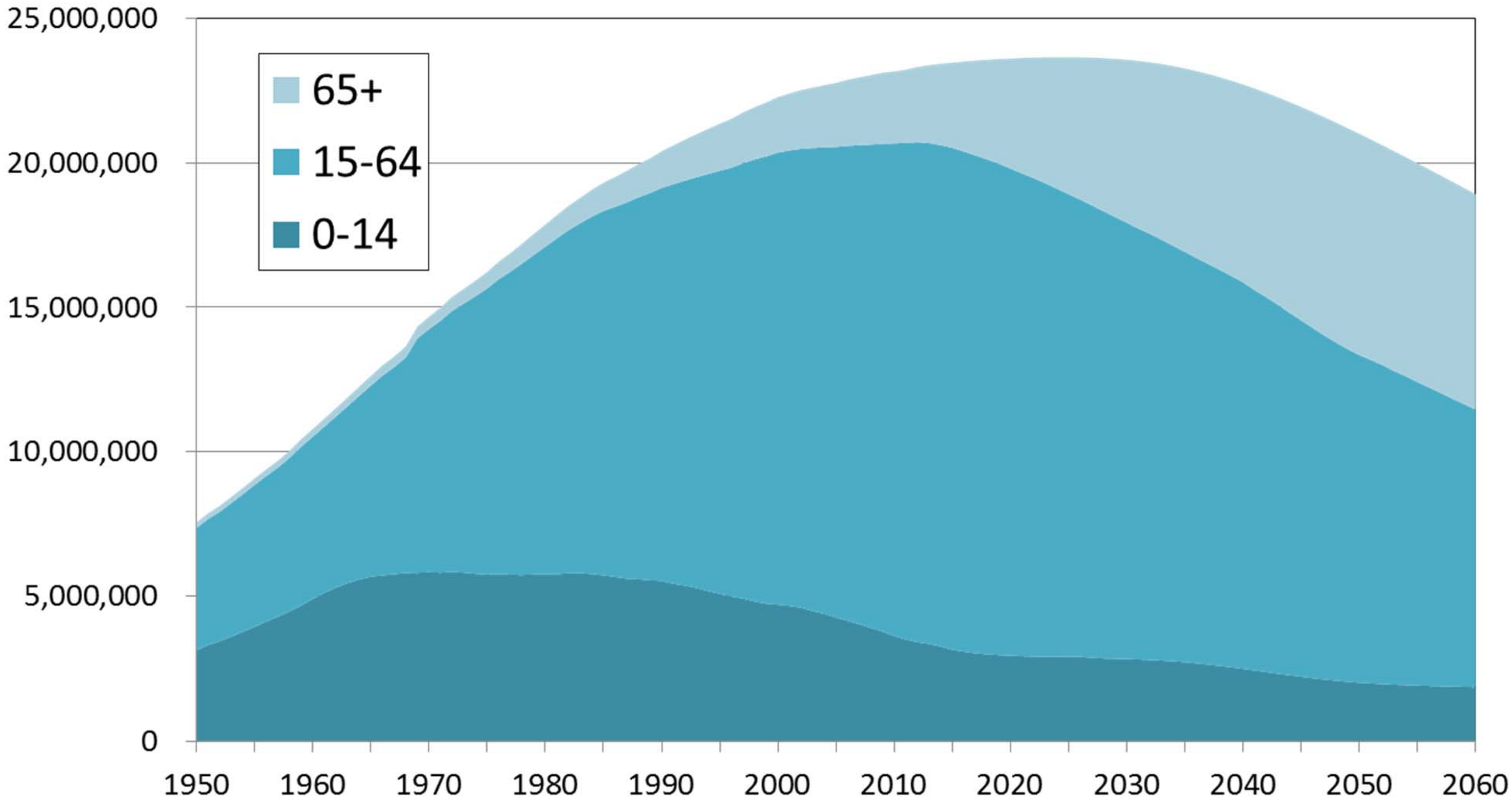
Background

- Rapid demographic transition om Taiwan
- Rapid economic growth for some decades, but has slowed down

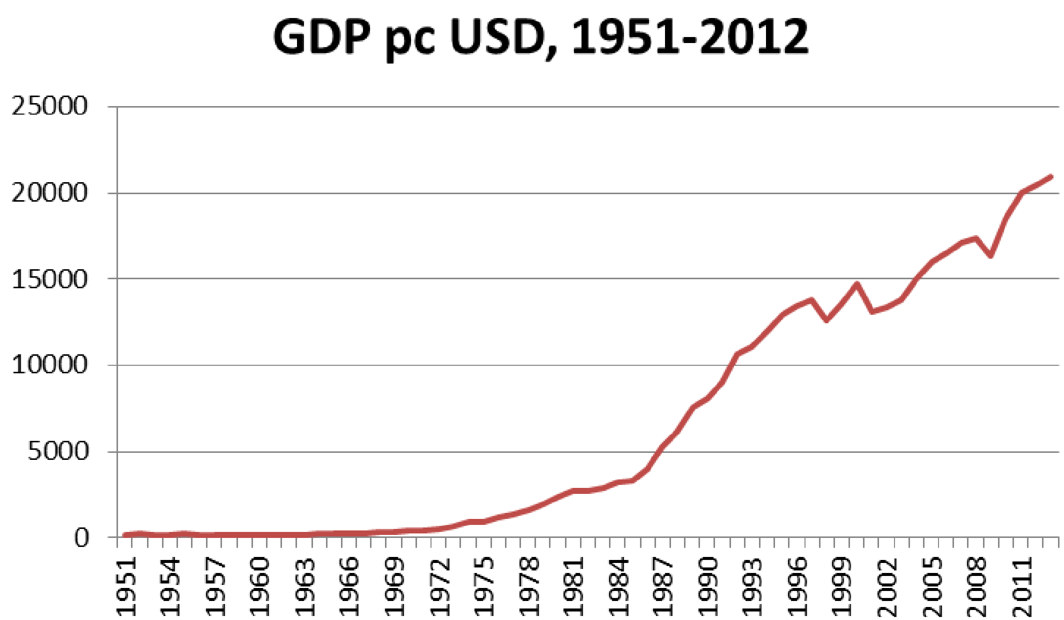
Significance

- These may have impacts on the consumption level across age, year, and cohort

Low fertility and rapid population aging



GDP growth once rapid, now slow (nominal)



year	average GDP growth
1952-1960	15.86%
1961-1970	10.19%
1971-1980	18.70%
1981-1990	9.88%
1991-2000	7.73%
2001-2012	2.38%

3. Methodological issues

- Theories
  - Lifecycle hypothesis of consumption concerns individual/cohort behavior over the lifecycle
  - The lifecycle story is not always supported empirically
- Data issue
  - NTA data may reveal more information than household data
- Alternative estimation method
  - APC analysis: Widely used in biostatistics, sociology…
  - identification problem: Cohort ≡ Year – Age
- Two models in this study
  - Economic approach: Deaton transformation (Deaton, 1997)
  - APC analysis: Intrinsic Estimator (Yang, 2007)

Age, period, and cohort effects

- Age effect
  - the age effects represent differing consumption levels associated with age in the lifecycle, e.g., education consumption of children is high
- Cohort Effect
  - a change which characterizes populations born at a particular year, but independent of the process of aging, e.g., those who were born during WWII have a lower education level on average
- Period (Year) Effect
  - variation over time associated with all age groups simultaneously, e.g., financial crisis affect everyone in year 2009

Modeling consumption

Deaton (1993, 1997)

- With no income uncertainty, the life cycle model predicts that consumption is a function of lifetime resources,

$$\ln cf = \ln g(a) + \ln W$$

where W is lifetime wealth, $g(a)$ is a function of age

- With uncertainty (θ_t is a year fixed effect), average over each age group,

$$\ln cf_{at} = \ln g(a) + \ln W_c + \theta_t$$

where, a,c,t denote age, cohort, time

- To estimate, with dummies of age A, cohort C and year Y,

$$\ln cf_{at} = t\beta + C\gamma + A\alpha + Y\psi + \varepsilon$$

Deaton (1993, 1997)

- Deaton transformation
  - one category from each set of *A*, *C*, *Y* dummies is excluded
  - time effects sum to zero
  - time effect is orthogonal to a time trend
  - with and without additional variables
- Results about (private) consumption
  - No time effect, by design
  - Cohort effects are larger the younger the cohort, as expected
  - Age effects are NOT consistent with lifecycle story, as age profile rises
- Explaining unexpected results
  - high GDP growth may lead to “a taste for rapid consumption growth”
  - earnings shock, farsighted young consumers…
  - need better results or more convincing explanations

Research design

- What if we use Deaton's method, but with individual data?
- What if we use an alternative method?

model	data	estimation
Deaton (1993)	Household data	1. Constrained regression 2. Through transformation, time effect is out
Model 1	NTA data	1. Deaton's constrained regression 2. Through transformation, time effect is out
Model 2	NTA data	APC intrinsic estimator

Identification problem in APC

Linear Model Specification

$$V_{ij} = \beta + \alpha_i + \gamma_k + \psi_j + \varepsilon_{ij}$$

- V_{ij} denotes the balur for the *i-th* age group for $i = 1,\ldots,a$ age groups at the *j-th* time period for $j = 1,\ldots, p$ time periods
- β denotes the intercept or adjusted mean
- α_i denotes the *i-th* row age effect or the coefficient for the *i-th* age group
- γ_j denotes the *j-th* column period (time) effect or the coefficient for the *j-th* time period
- ψ_k denotes the *k-th* cohort effect or the coefficient for the *k-th* cohort for $k = 1,\ldots,(a+p-1)$ cohorts, with $k=a-i+j$
- ε_{ij} denotes the random errors with expectation $E(\varepsilon_{ij}) = 0$
- Fixed effect GLIM reparameterization: $\sum_i \alpha_i = \sum_k \gamma_k = \sum_j \psi_j = 0$, or setting one of each of the categories as the reference group.

Early literature on APC

- Land (2011) has a good review
  - Ryder (1965) argued that cohort membership could be an important determinant of social
  - W. M. Mason et al. (1973) specified the APC multiple model and defined the identification problem therein
  - Glenn's critique (1976), Fienberg and Mason (1985),...
- Conventional solutions on identification problem
  - Constrained Coefficients GLIM (CGLIM) Estimator
  - Proxy Variables/Age-Period-Cohort Characteristic (APCC) Approach
  - Nonlinear Parametric (Algebraic) Transformation Approach
  - Bayesian approach…
- Still with limitations!

Intrinsic estimator

What is the Intrinsic Estimator (IE)?

- It yields a unique solution to the model and is the unique estimable function of both the linear and nonlinear components of the APC model determined by the Moore-Penrose generalized inverse. It achieves model identification with minimal assumptions.

Why is IE useful?

- The basic idea of the IE is to remove the influence of the design matrix (which is fixed by the number of age and period groups and not related to the outcome observations Y_{ij}) on coefficient estimates. This constraint produces estimates that have desirable statistical properties.
- It is estimable, unbiased, relative efficient, asymptotic consistent

Any reservation?

- Identification problem not fully solved yet!

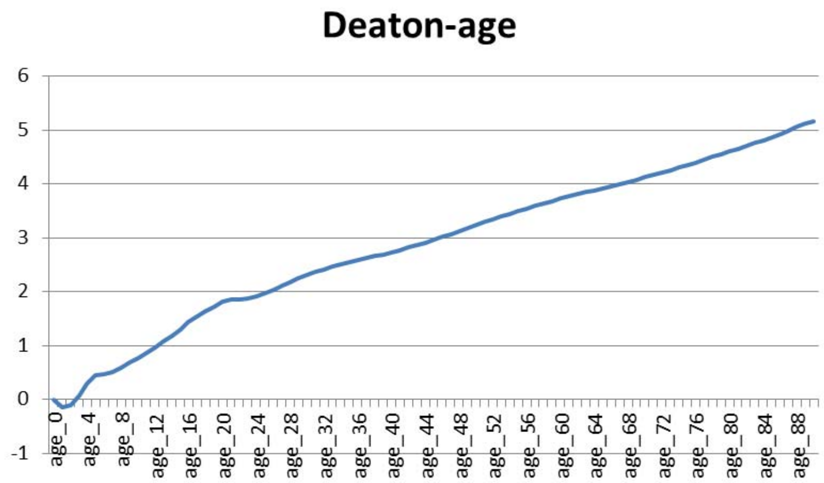
Our data

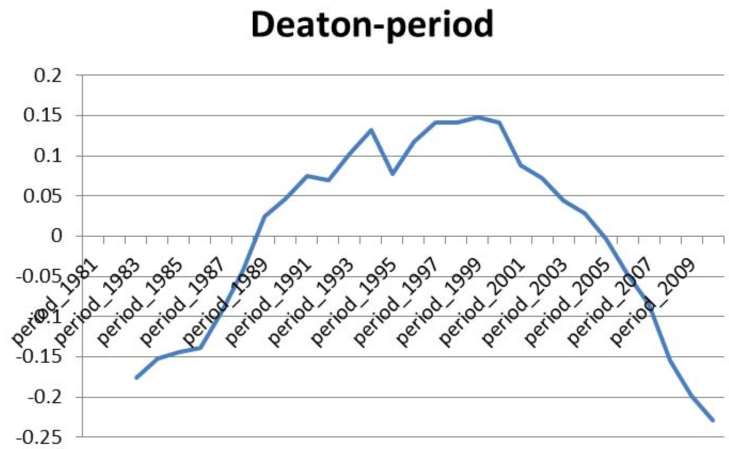
- Main sources
  - 1981-2013: Family Income and Expenditure Survey (in 2010, 14853 households are surveyed, with about 48,000 persons)
  - 1981-2012/2013: National Income Accounts
- NTA data estimated
  - 1981-2010: *CF*, *CG*, *YL*, by time and by cohort
  - 2011-2013: under construction

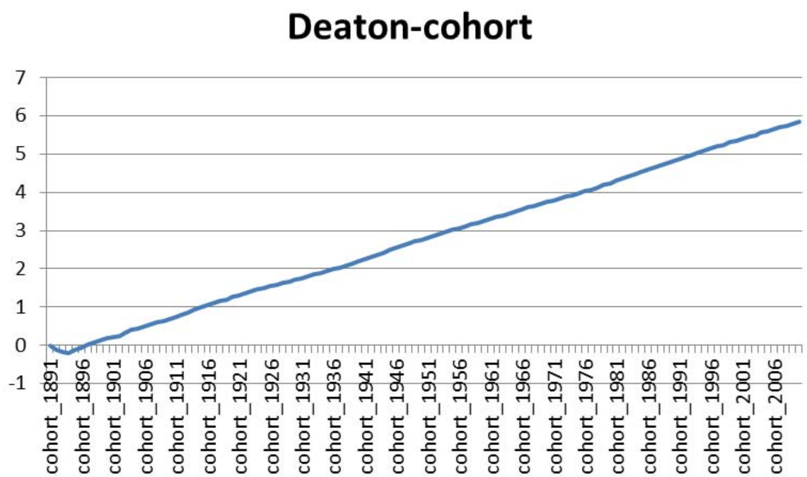
4. Discussion

- Our results vs. Deaton (1993, 1997)
  - Basic differences
    1. Deaton examines 1976-1990, we examine 1981-2010
    2. Deaton measures by household head (aged 25-75), NTA data are by individual (aged 0-90)
  - Similarities in results: for age 20-70
    1. age effect is higher for older ages
    2. cohort effect is higher for younger cohorts

Results of Model 1

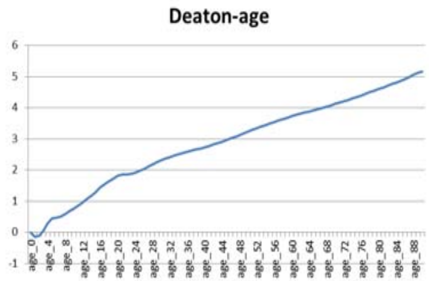




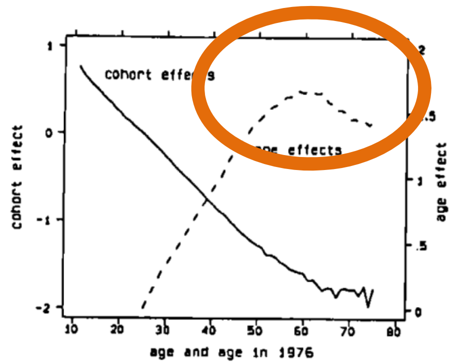


Age effects

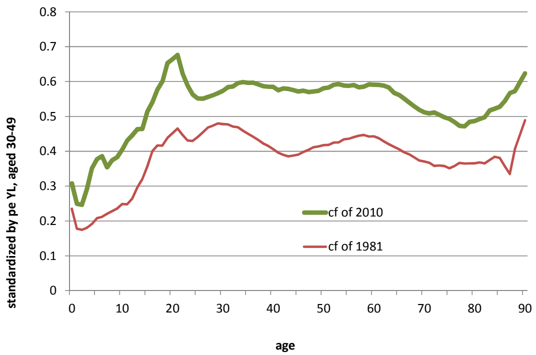
- Our age effects rises with age



- do not decline after age 60, cf. Deaton (1993)

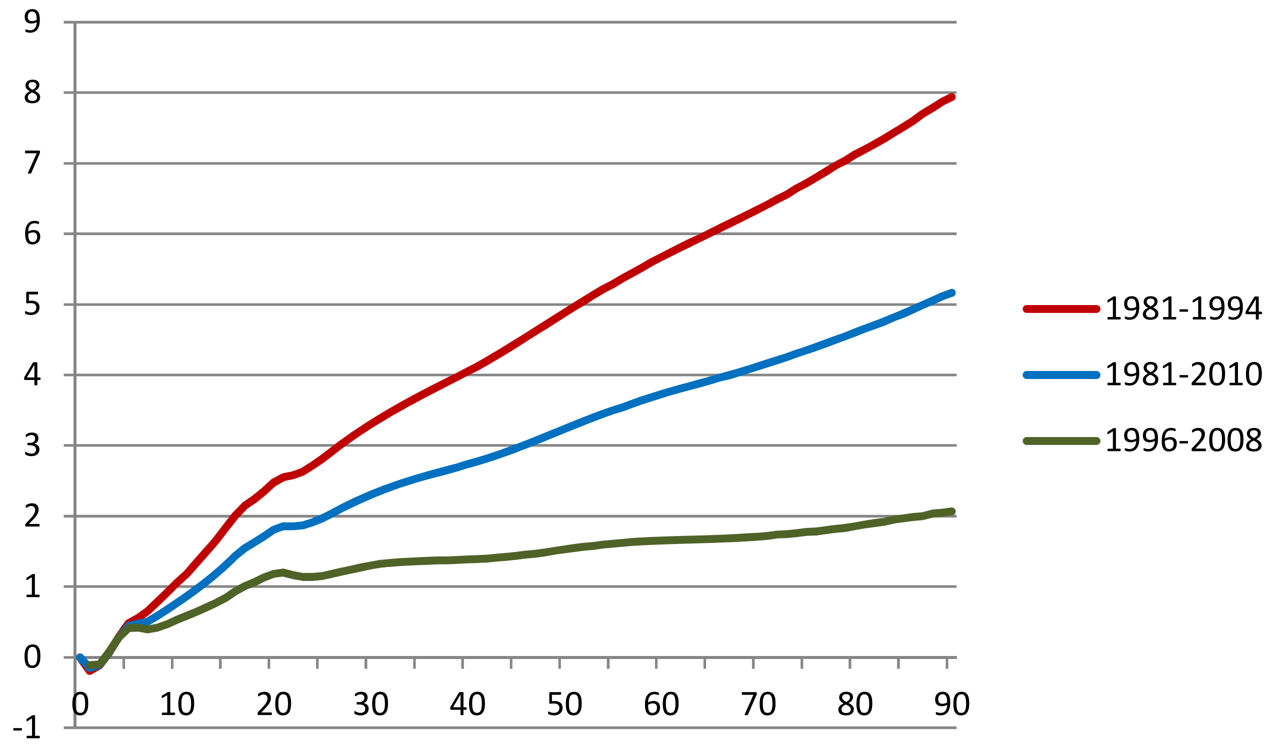


- look different from cross-section NTA results



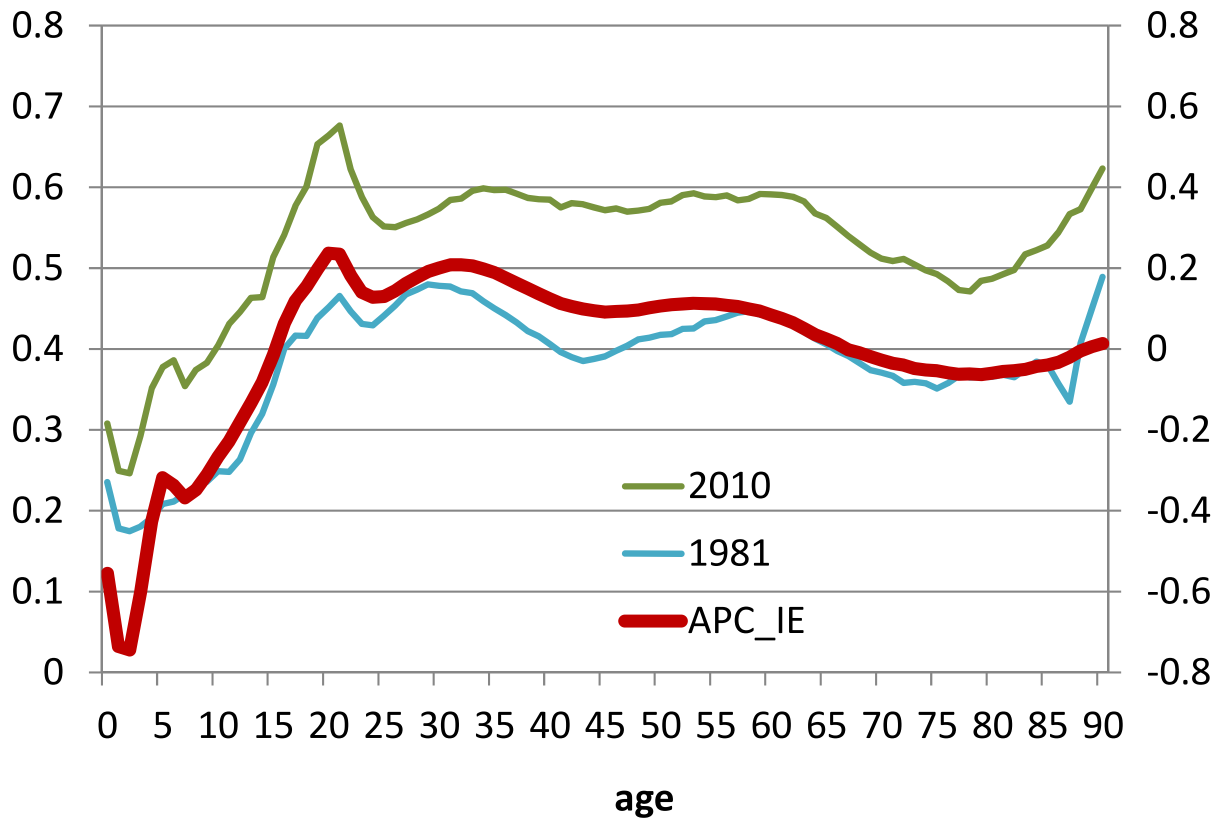
Observation period does not matter much

- Similar age pattern for different periods



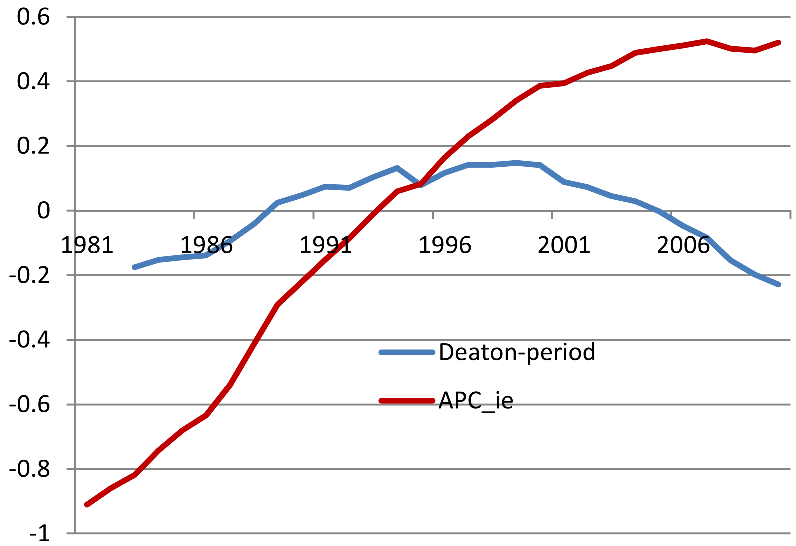
Results of Model 2

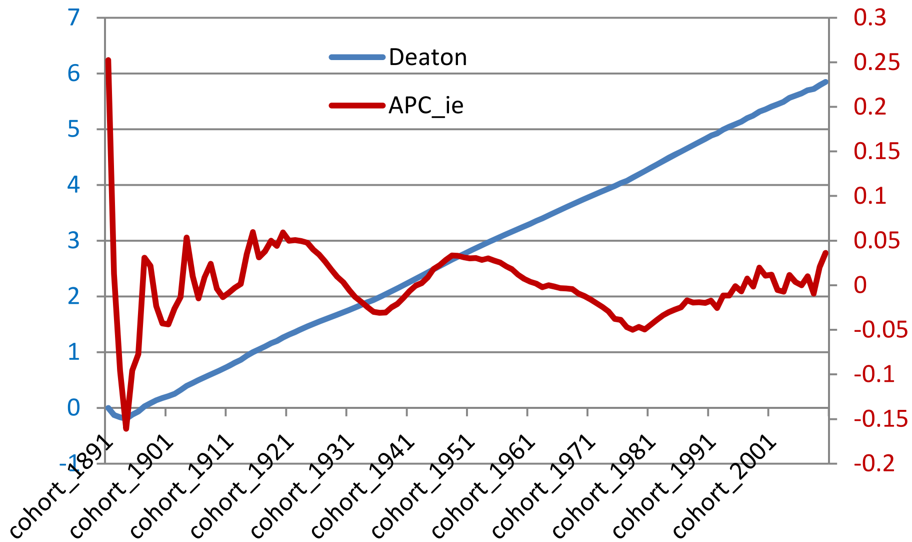
- Age effects look similar to cross-section age profile



Period effect and cohort effect

- Period effect (left panel) using APC_IE is more pronounced than using the Deaton method; but the coefficients are small
- Cohort effect (right panel) fluctuates





Summary and a further question

- Need a more clear criterion to decide which model is more reasonable
  - Model 1 is based on lifecycle hypothesis of consumption
  - Model 2 (APC_IE) shows an age profile similar to the cross-section result

5. Concluding remarks

Q1: Do Taiwanese consume more over time?

- Yes

Q2: Are there cohort//period effect?

- Yes

Q3: Why do we care about period/cohort effect?

- Cross-section results may contain cohort and period effects
- Caution is needed in policy implication and projection based on cross-section results

Q4: How to decompose age, period, cohort effects?

- Deaton approach, APC_IE,…

Future work

- Test which method is better
  - theoretical relevance
  - out-of-sample test
  - forecasting employing age, cohort and period effects
- Model modifications
  - extra variables
  - relationship with *YL* and *CG*
  - by components: *CFH* and *CGH* may be substitutes, so are *CFE* and *CGE*
- Explore why Taiwanese consume more over time

Thanks for coming.

Comments are welcome.