A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

A Dynamic Model of Health, Education, and Wealth with Credit Constraints and Rational Addiction

Rong Hai and James J. Heckman

December 2015

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Introduction

Differences between structural estimation and reduced form estimation:

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Introduction

Differences between structural estimation and reduced form
estimation:

- Reduced form economists don't know what "reduced
  form" means

Introduction

Differences between structural estimation and reduced form
estimation:

- Reduced form economists don't know what "reduced
  form" means
- Reduced form economists are obsessed with finding
  exogenous sources of variation, and structural economists
  rely only on functional form for identification

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Introduction

Differences between structural estimation and reduced form estimation:

- Reduced form economists don't know what "reduced form" means
- Reduced form economists are obsessed with finding exogenous sources of variation, and structural economists rely only on functional form for identification
- Both parts of this statement are too extreme, but there is also some truth to them
- Most of my discussion will be about identification, but first some other concerns

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Modeling Concerns

Human capital accumulation equation is unconventional and in ways that seem unnecessary and that unnecessarily increase the size of the state space.

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Modeling Concerns

Human capital accumulation equation is unconventional and in ways that seem unnecessary and that unnecessarily increase the size of the state space.

Human capital is a function of other stocks only:

$$\Psi_t = \Psi\left(h_t, e_t, k_t, ..\right)$$

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Modeling Concerns

Human capital accumulation equation is unconventional and in
ways that seem unnecessary and that unnecessarily increase the
size of the state space.

Human capital is a function of other stocks only:

$$\Psi_t = \Psi\left(h_t, e_t, k_t, ..\right)$$

Tradition:

$$\Psi_t = \Psi\left(\Psi_{t-1}, h_t, d_{et}, d_{kt}, ..\right)$$

(eg, Heckman , 1976)

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Modeling Concerns

Advantages of tradition:

1. Allows for permanent effects of temporary health problems (eg, Almond, Currie)
2. Gives more meaning to "human capital:" actual object rather than just a function
3. Only human capital must be stored as a state variable; not schooling and experience
4. Further reductions in size of state space by modelling Ψ as a Poisson process (Flynn -> Kennan -> me)

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Modeling Concerns

Model of Intergenerational Transmission: Parents provide exogenous benefits to child, child grows up, but child never has children

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Modeling Concerns

Model of Intergenerational Transmission: Parents provide exogenous benefits to child, child grows up, but child never has children

- Cost of children of children is not part of the budget constraint of the child
- If children having children were part of the model, it would be apparent that both parental characteristics and parental benefits would not be exogenous

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Modeling Concerns

Decision to model variation in subjective discount rates across people:

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Modeling Concerns

Decision to model variation in subjective discount rates across people:

$$
\begin{aligned}
\rho_{it} &= \alpha_0 + \alpha_h h_{it} + \alpha_n \theta_{ni} + \alpha_c \theta_{ci} \\
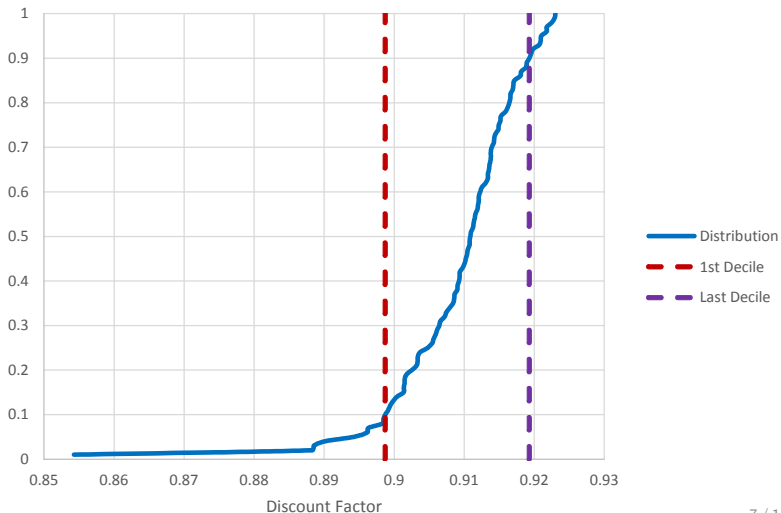\theta_n &\sim iidN(0,1) \\
\theta_c &\sim iidN(0,1)
\end{aligned}
$$

(Approximation)

$$h_{it} \sim iidN(0,1).$$

Note: $\widehat{\alpha}_h = 0.0052$

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Modeling Concerns

Distribution of Discount Factors

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Modeling Concerns

Implications:

1. Not an important source of variation
2. What is allowing for such precise estimates of α when there is no meaningful variation and nothing is directly observed?

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Modeling Concerns

1. Bad effects of smoking (other than cost and smelly breath) mostly much later in life, so young adults ignore them:

$$\left(\frac{1}{1+\rho}\right)^{30} = 0.92^{30} = 0.08$$

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Modeling Concerns

1. Bad effects of smoking (other than cost and smelly breath) mostly much later in life, so young adults ignore them:

$$\left(\frac{1}{1+\rho}\right)^{30} = 0.92^{30} = 0.08$$

2. Lack of motivation for choice of particular variables to include in model.

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

Decompose identification into three parts:

1. Parameters associated with exogenous explanatory variables
2. Variance parameters and other parameters
3. Implications of endogenous explanatory variables

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Identification Concerns

$$
\begin{aligned}
y_i &= X_i\beta + u_i, \quad i = 1, 2, .., n \\
u_i &\sim iid\left(0, \sigma^2\right)
\end{aligned}
$$

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

$$
\begin{aligned}
y_i &= X_i\beta + u_i, \quad i = 1, 2, .., n \\
u_i &\sim iid\left(0, \sigma^2\right)
\end{aligned}
$$

Identification of β_j depends upon covariation of y_i and X_{ij} holding constant other explanatory variables; identification of σ^2 depends upon the sample variance of residuals

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

$$
\begin{aligned}
y_i &= X_i\beta + u_i, \quad i = 1, 2, .., n \\
u_i &\sim iid\left(0, \sigma^2\right)
\end{aligned}
$$

Identification of β_j depends upon covariation of y_i and X_{ij} holding constant other explanatory variables; identification of σ^2 depends upon the sample variance of residuals

Look at Table B4

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

$$
\begin{aligned}
y_i &= X_i\beta + u_i, \quad i = 1, 2, .., n \\
u_i &\sim iid\left(0, \sigma^2\right)
\end{aligned}
$$

Identification of β_j depends upon covariation of y_i and X_{ij}
holding constant other explanatory variables; identification of
σ^2 depends upon the sample variance of residuals

Look at Table B4

Two types of moments:

1. $\overline{y}, \overline{X}$
2. $n^{-1}\sum_i y_i X_{ij}$ for some (but not all) j

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

$$
\begin{aligned}
y_i &= X_i\beta + u_i, \quad i = 1, 2, .., n \\
u_i &\sim iid\left(0, \sigma^2\right)
\end{aligned}
$$

Identification of β_j depends upon covariation of y_i and X_{ij} holding constant other explanatory variables; identification of σ^2 depends upon the sample variance of residuals

Look at Table B4

Two types of moments:

1. $\overline{y}, \overline{X}$
2. $n^{-1}\sum_i y_i X_{ij}$ for some (but not all) j

Type 1 moments identify nothing.
Type 2 moments identify nothing of interest.

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

- Some moments involve wrong variables (eg, wealth instead of changes in wealth for ρ)

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

- Some moments involve wrong variables (eg, wealth instead of changes in wealth for ρ)
- Discussion of identification has some problems with how instruments work

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

- Some moments involve wrong variables (eg, wealth instead of changes in wealth for ρ)

- Discussion of identification has some problems with how instruments work

- Some of the arguments in identification argument depend on moments that are not included in Table B4 (eg, wealth and health)

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

- Some moments involve wrong variables (eg, wealth instead of changes in wealth for ρ)

- Discussion of identification has some problems with how instruments work

- Some of the arguments in identification argument depend on moments that are not included in Table B4 (eg, wealth and health)

- No second moments

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Identification Concerns

- Some moments involve wrong variables (eg, wealth instead of changes in wealth for ρ)

- Discussion of identification has some problems with how instruments work

- Some of the arguments in identification argument depend on moments that are not included in Table B4 (eg, wealth and health)

- No second moments

- These problems are all easy to solve using the appropriate covariation of variables within observations across people

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

Implications of Endogenous Variables: Need exogenous
variation

1. There is limited (and mostly incorrect) discussion of
   available instruments and how they aid in identification

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

Implications of Endogenous Variables: Need exogenous
variation

1. There is limited (and mostly incorrect) discussion of
   available instruments and how they aid in identification
2. There are no variables in the model that one can make a
   good case are exogenous
   - Only ones suggested in paper are parent characteristics

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Identification Concerns

Implications of Endogenous Variables: Need exogenous
variation

1. There is limited (and mostly incorrect) discussion of
available instruments and how they aid in identification

2. There are no variables in the model that one can make a
good case are exogenous

   • Only ones suggested in paper are parent characteristics
   • Other potential instruments might include objects like
     local labor market conditions, local variation in cigarette
     prices, local observed variation in school quality, etc. Use
     of these would require using moments at observation level.

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Really Nice Feature

Model has cognitive and non-cognitive skills affecting smoking
behavior

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Really Nice Feature

Model has cognitive and non-cognitive skills affecting smoking
behavior

Model has non-cognitive skills imperfectly measured by, among
other things, teenage sexual behavior

A Dynamic
Model of
Health,
Education,
and Wealth
with Credit
Constraints
and Rational
Addiction

Rong Hai and
James J.
Heckman

Introduction

Modeling
Concerns

Identification
Concerns

Really Nice
Feature of
Model

Really Nice Feature

Model has cognitive and non-cognitive skills affecting smoking behavior

Model has non-cognitive skills imperfectly measured by, among other things, teenage sexual behavior

Model explains why people like to smoke after sex