

MAX PLANCK UCL CENTRE

COMP2 PSYCH

International Max Planck Research School

Symposium and Advanced Course on Computational Psychiatry and Ageing Research

International Max Planck Research School COMP2PSYCH

# **Explaining Heterogeneity in Panel Models with Individual Parameter Contribution (IPC) Regression**

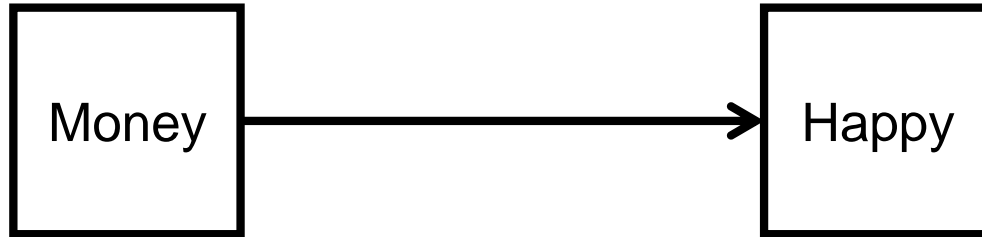
Manuel Arnold

# Does money make people happy?

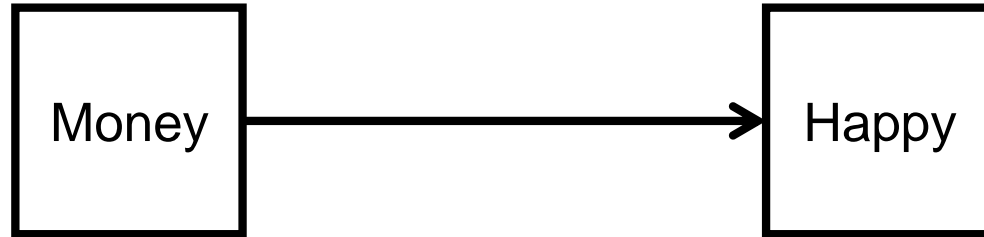
Money

Happy

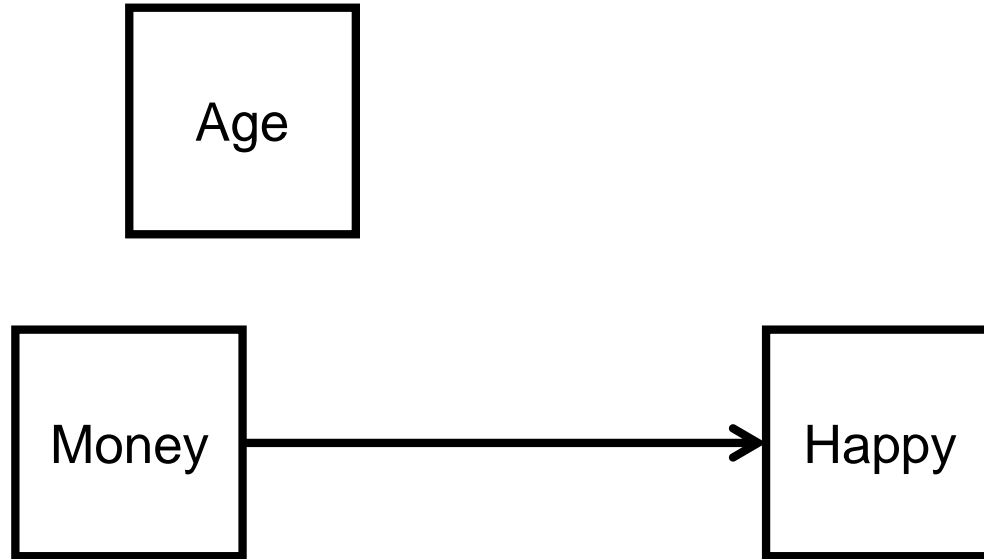
# Linear regression model



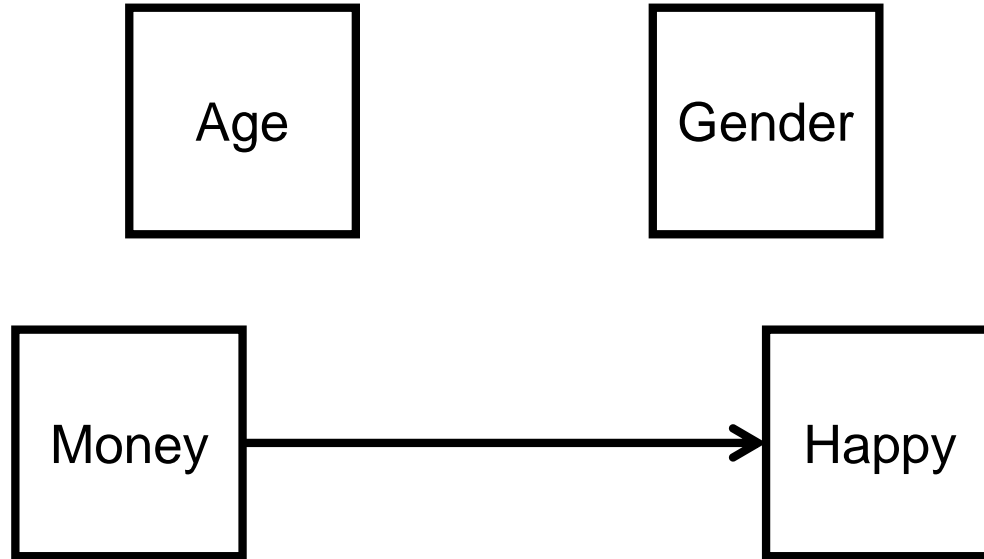
**Is the effect the same for everyone?**



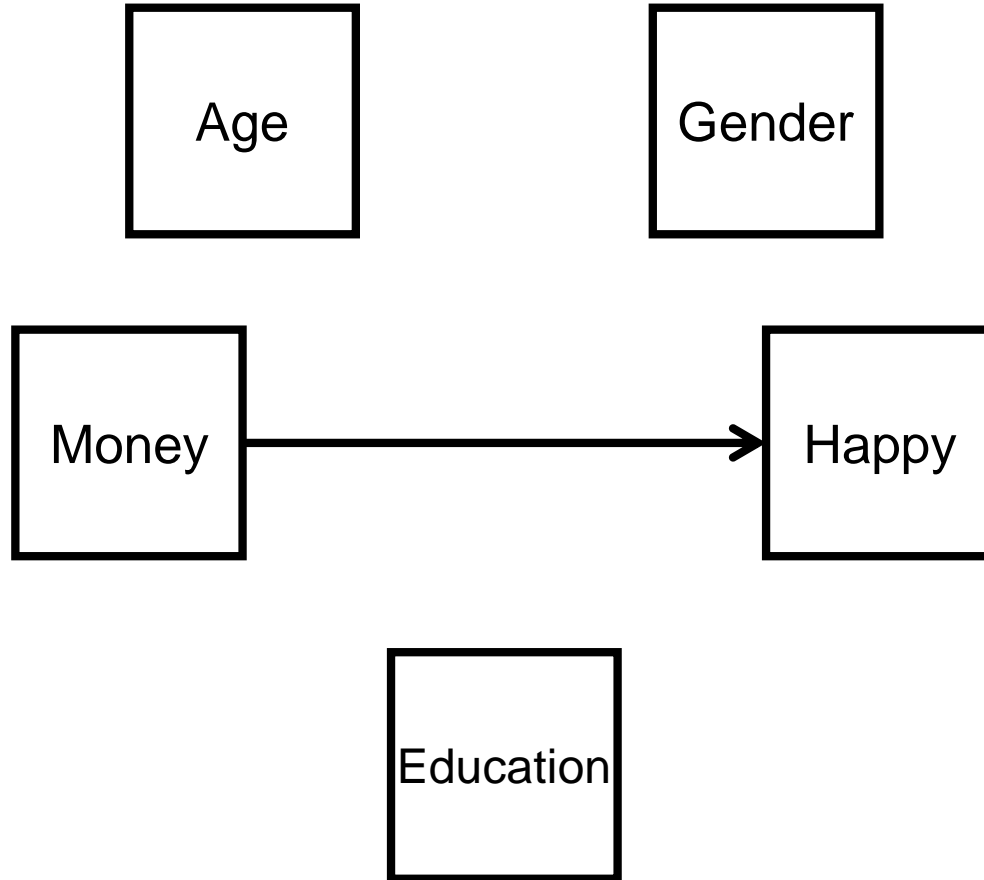
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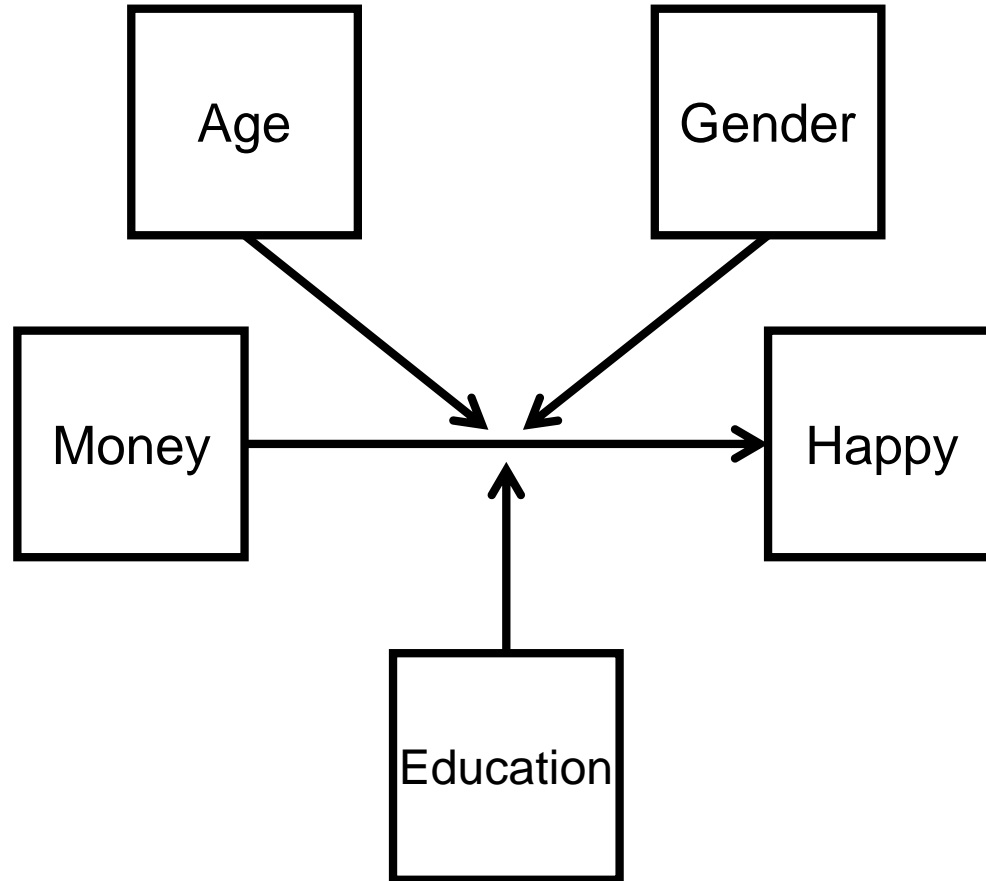
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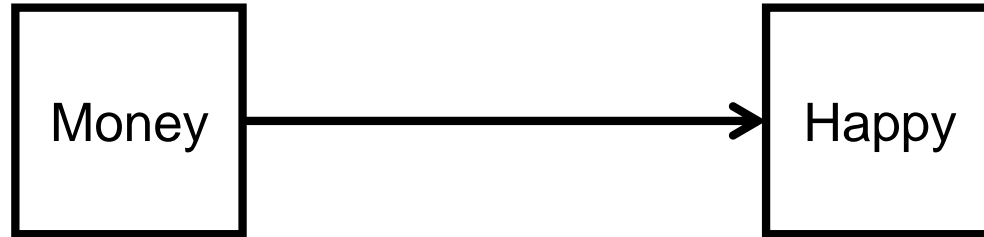


# Test for differences with moderators





## Another problem: causality



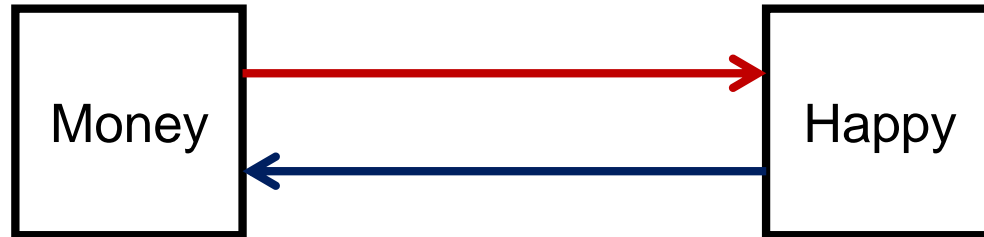
## Another problem: causality

A higher income leads to more happiness.



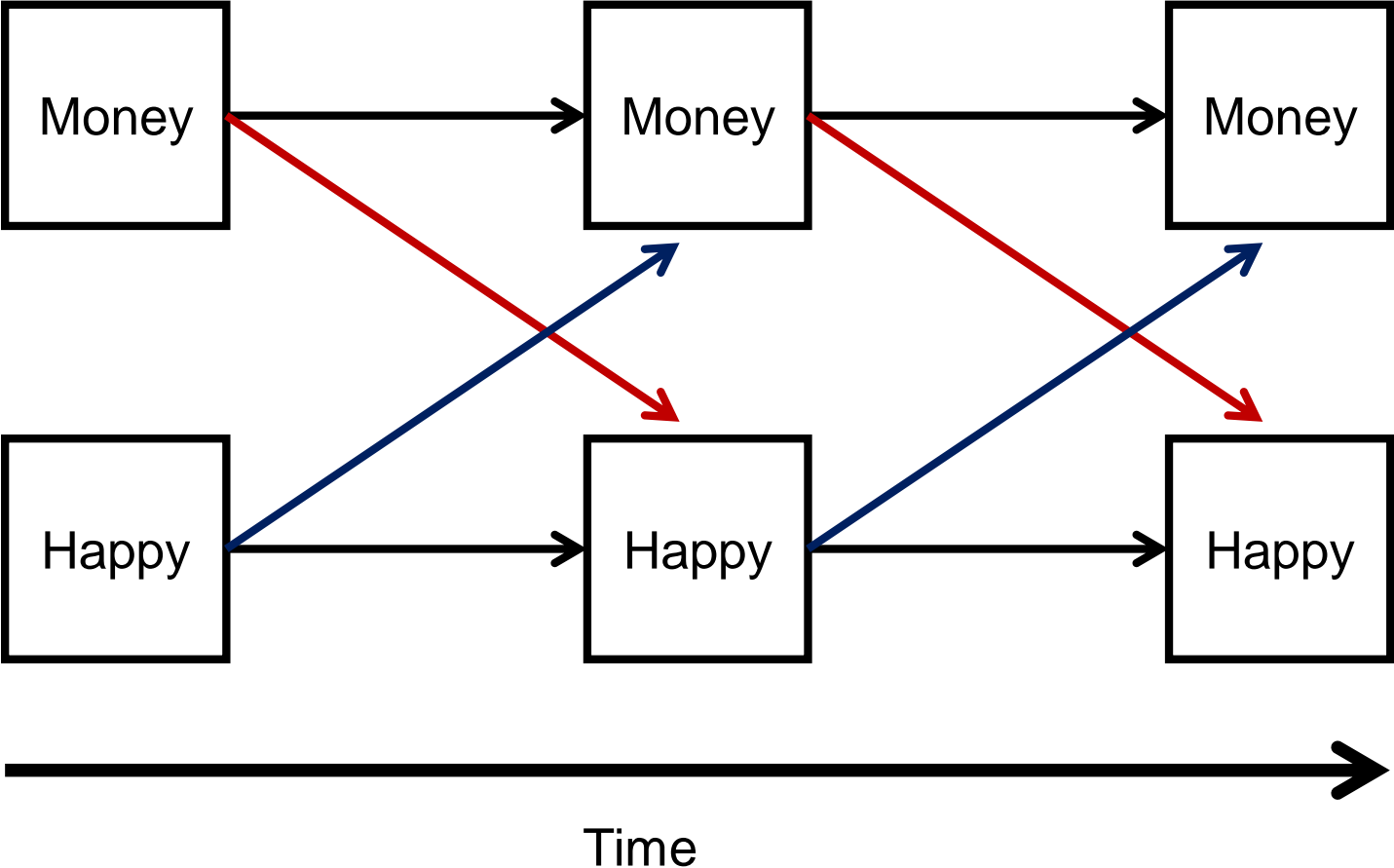
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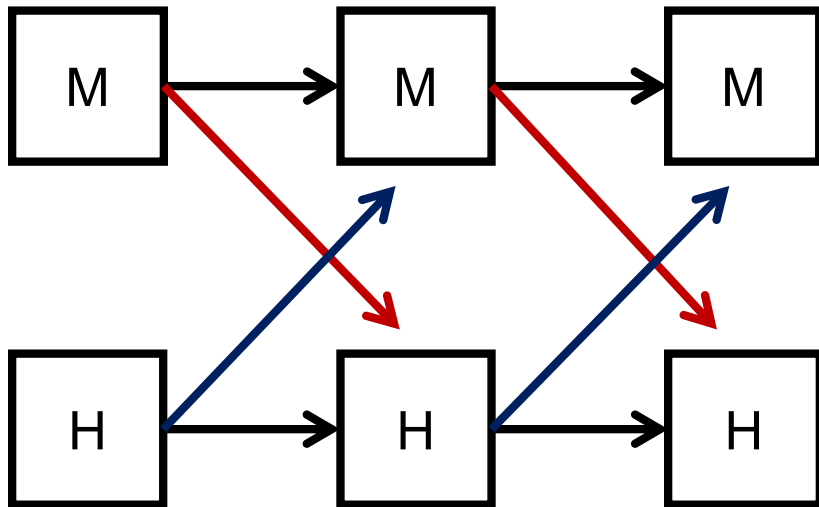


Happier people earn more money.

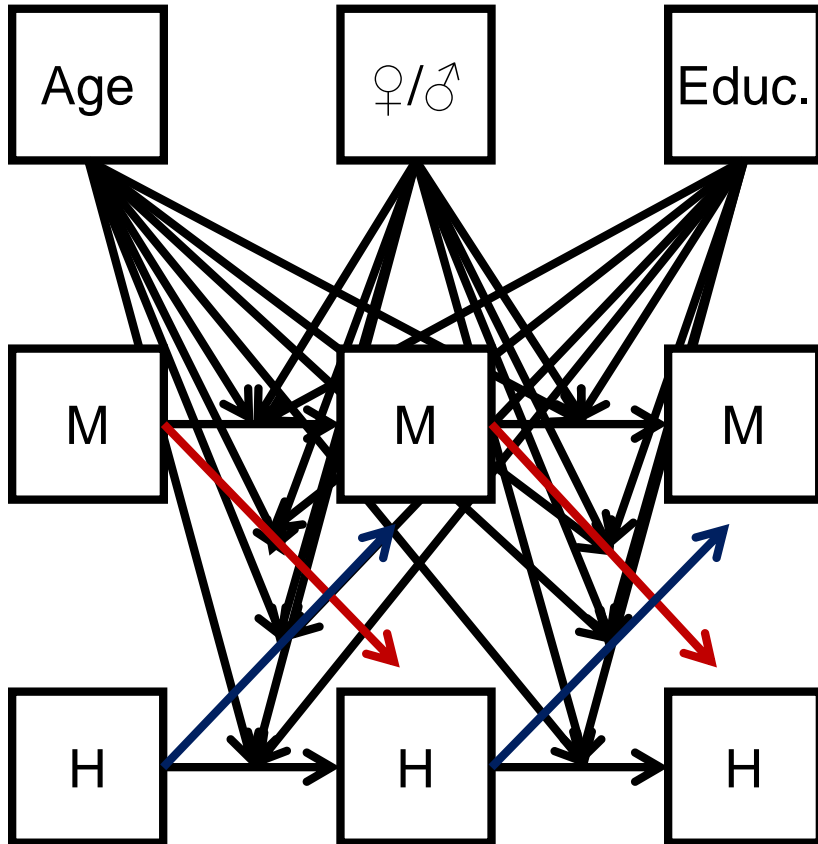
# Autoregressive cross-lagged panel models



# Adding moderators to the panel model?

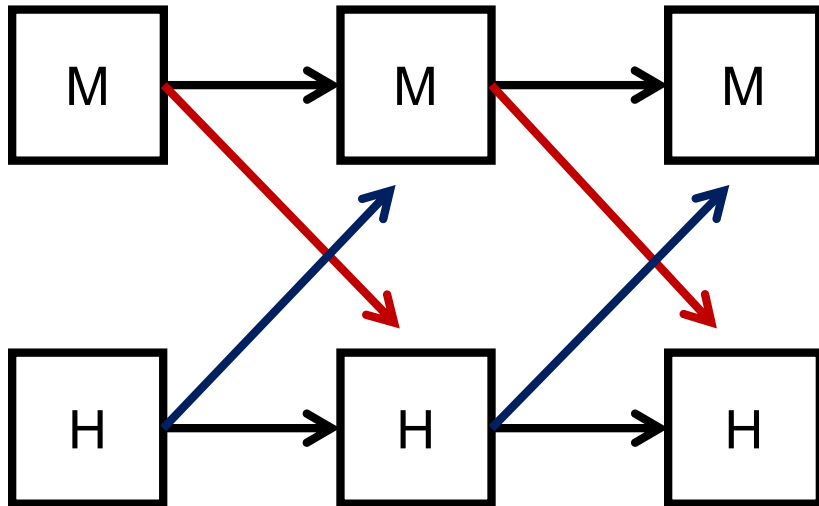


# Adding moderators to the panel model?



- Problems:
  - Increases model complexity drastically.
  - Nonlinear (multiplicative) relationships between variables.

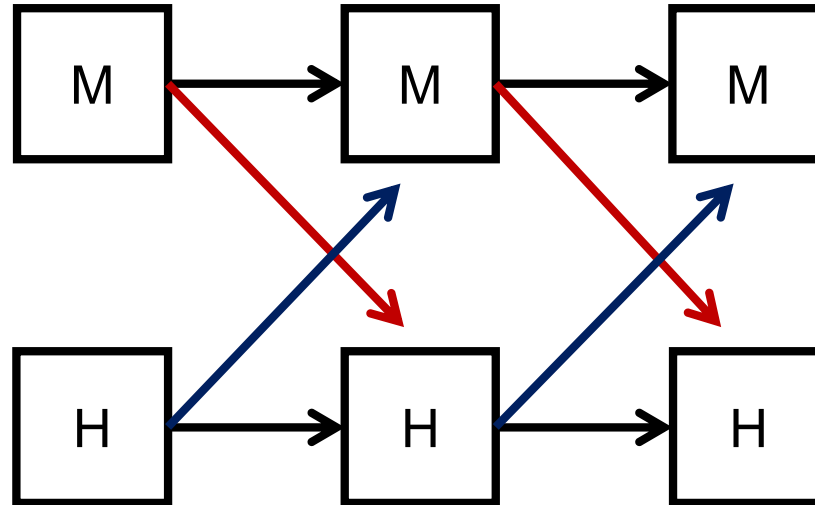
# Solution: IPC regression



- Individual parameter contribution (IPC) regression (Oberski, 2013) separates
  - estimation of the theory-driven model
  - and investigation of individual and group-specific differences.
- We will use IPC regression to investigate  $M \rightarrow H$ .

1. Fit a model

## IPC Regression: 3 Step Procedure





1. Fit a  
model



2.  
Calculate  
IPCs

## IPC Regression: 3 Step Procedure

- These contributions approximate individual-specific parameter values.
- Each individual contributes to every parameter estimate of the first-step model.
- We obtain a new data set consisting of these contributions.

# IPC Regression: 3 Step Procedure

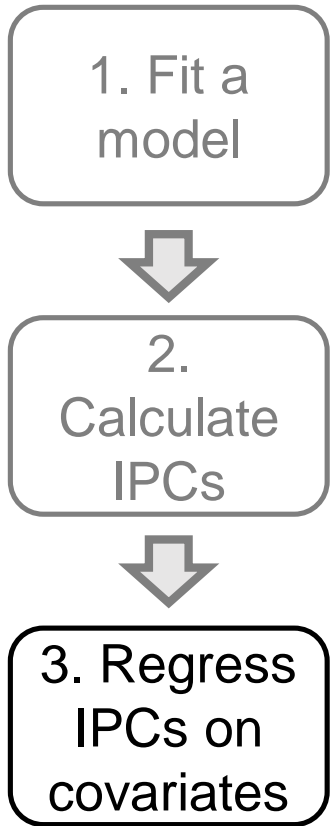
1. Fit a model



2. Calculate IPCs

		Parameters		
		M→H	H→M	...
Individuals	1	0.28	0.11	...
	2	1.76	0.44	...
	3	1.69	0.02	...
	4	0.54	0.47	...
	5	0.37	-1.03	...
	⋮	⋮	⋮	⋮

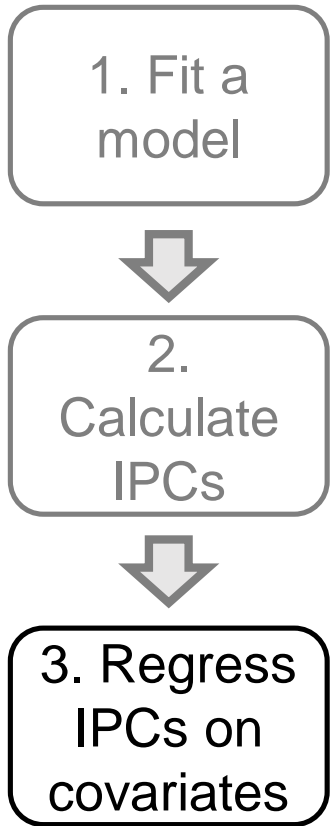
# IPC Regression: 3 Step Procedure



- Regress the IPCs of  $M \rightarrow H$  on age, gender, and education.
- Regression output:

	<b>Estimate</b>	<b>Std. Error</b>	<b><i>p</i></b>
Intercept	0.160	0.189	0.396
Age	0.001	0.002	0.651
Gender	0.227	0.062	< 0.001
Education	-0.001	0.011	0.909

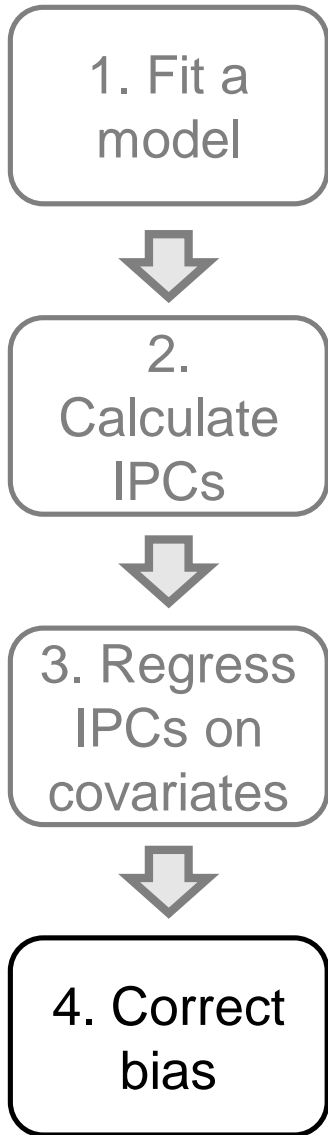
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# IPC Regression: 3+1 Step Procedure



- IPC Regression can be slightly biased in panel models or other complex models.
- The bias depends on the size of the individual or group-specific differences.
- Bias can be corrected by re-calculating the IPCs in homogenous subgroups of the data.
  - Similar to the Fisher scoring algorithm.

# Summary: IPC regression

- Separates estimation from investigation of heterogeneity.
- As easy as linear regression.
- Encompasses all models estimated with maximum likelihood (structural equation models, regression models etc.).

**Thank you for your attention!**