

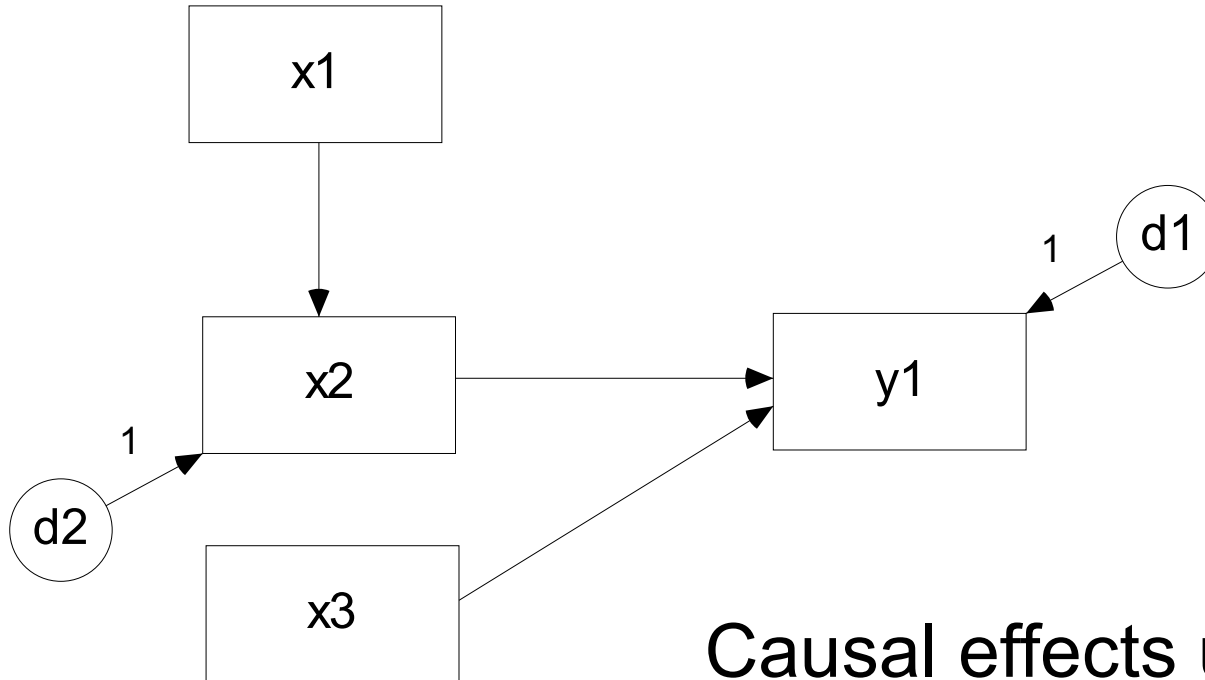
Recursive and non-recursive models

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Recursivity

- All models considered so far are 'recursive'
- A recursive model is one where all causal effects are uni-directional and disturbances are uncorrelated
- A non-recursive model contains one or more 'feedback loops' or 'reciprocal' effects

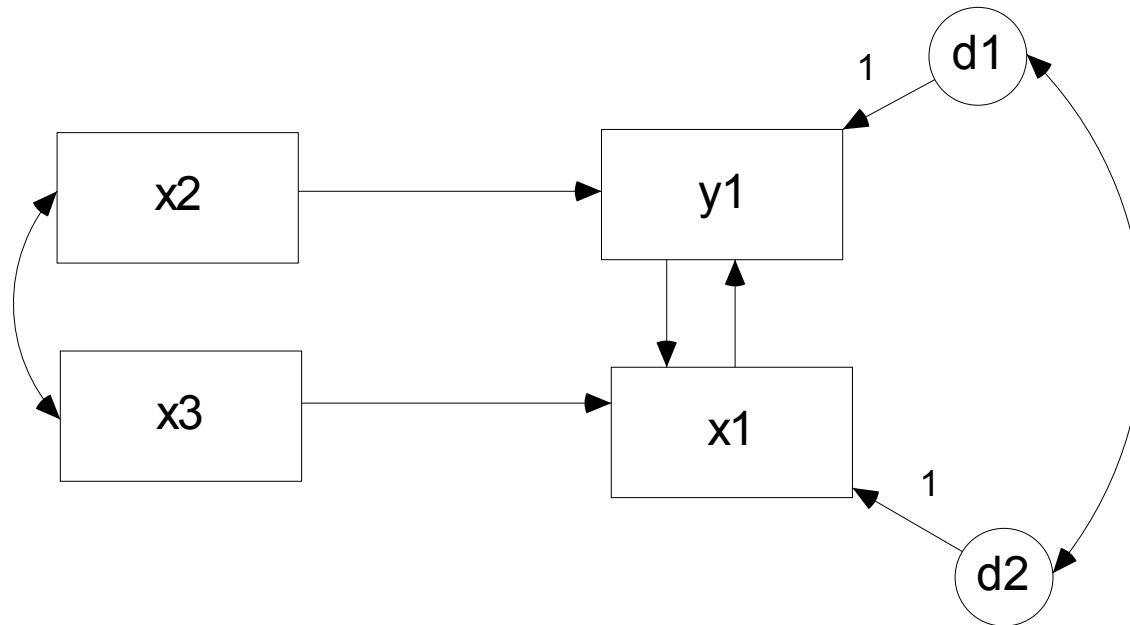
Recursive Model



Causal effects uni-directional

Disturbances uncorrelated

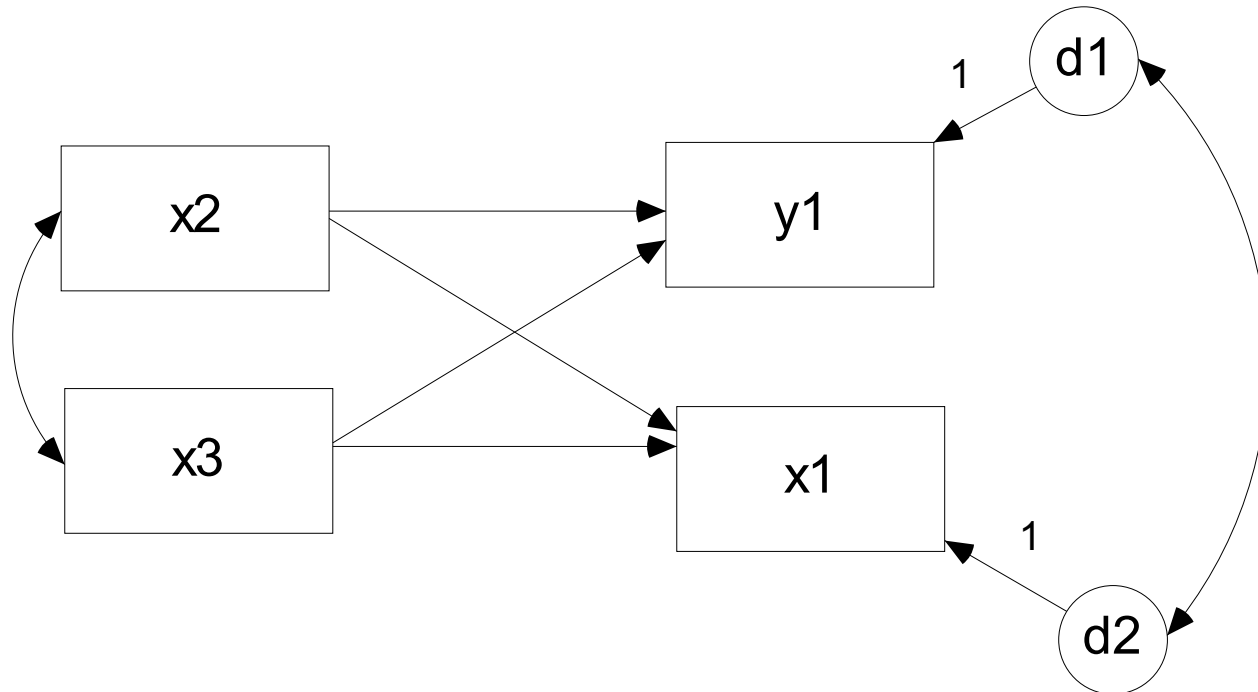
Non-recursive model



Reciprocal causal effects

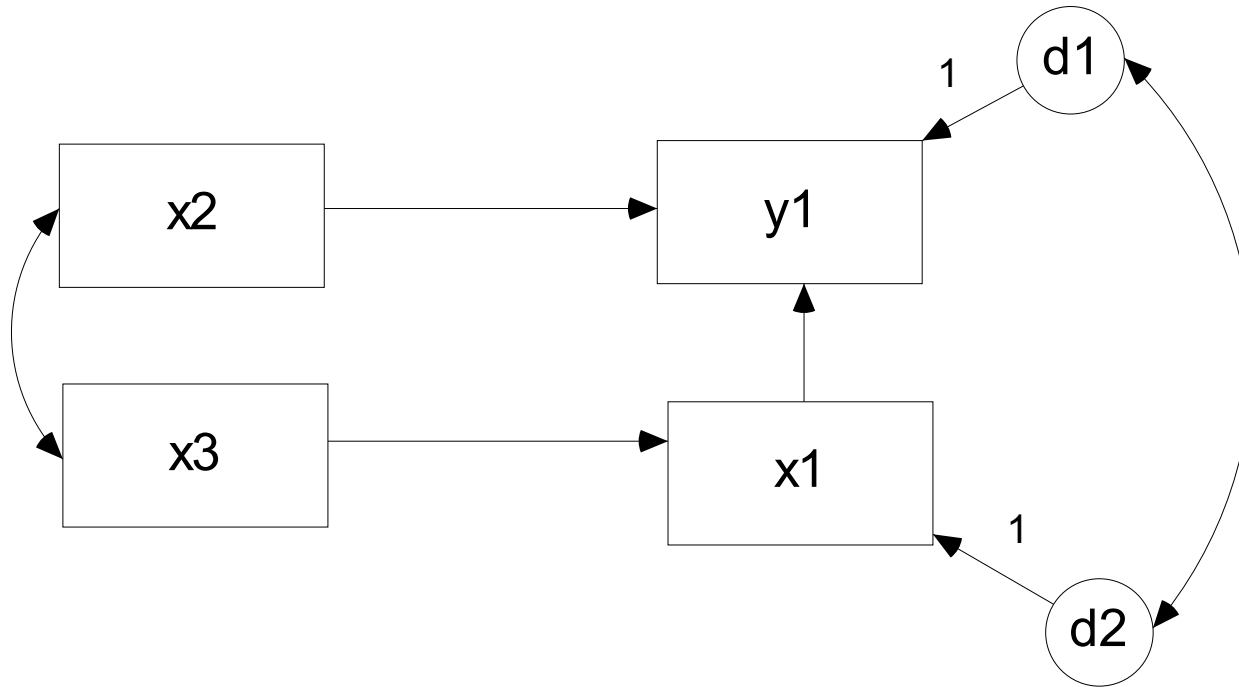
Disturbances correlated

Partially recursive I



No direct effects amongst endogenous = recursive

Partially recursive 2



Direct effects amongst endogenous = non-recursive

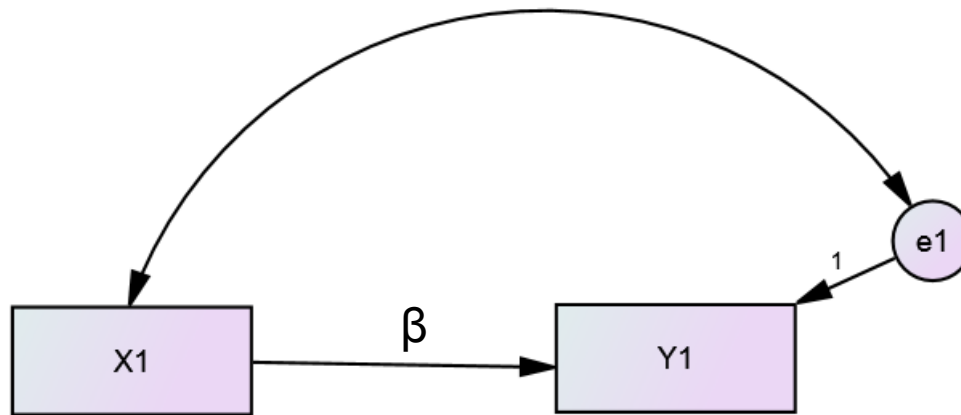
Recursivity

- Recursive models always identified, simple to estimate
- Non-recursive models more flexible
- But can pose problems for identification
- Require additional variables for identification

Non-recursive models

- Just because a model is identified does not mean the parameter estimates are correct
- Consistent estimation of reciprocal paths requires some strict (and often implausible) assumptions to be met
- E.g. the exogenous variable used to identify of synchronous parameters must meet be an 'instrumental variable'

Endogenous regressor

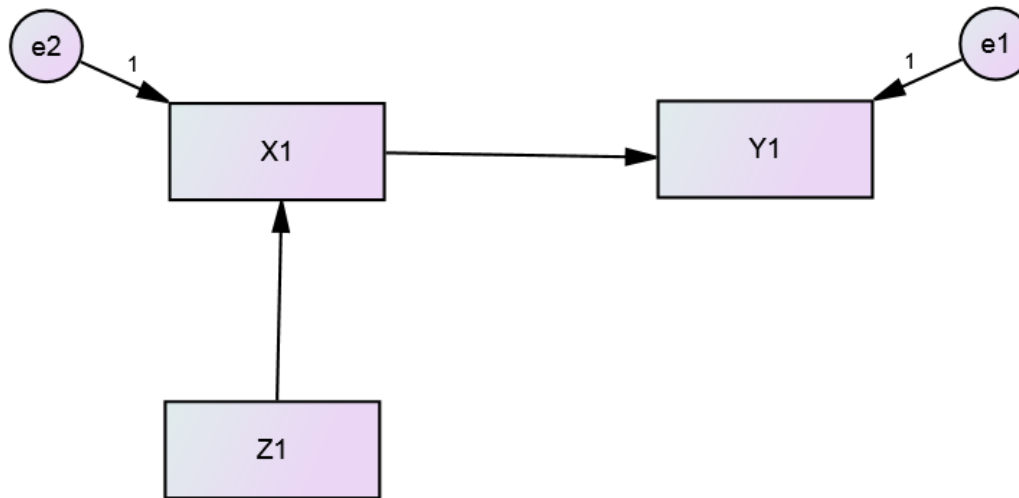


- OLS assumes error term uncorrelated with predictors
- Correlation can arise from unobserved variables and from simultaneous causal relationship
- To interpret β as causal effect, we need instrumental variable for X_1

Instrumental Variables (IV)

- An IV is a variable which introduces exogenous variability into an endogenous regressor
- The IV, Z , must directly cause the endogenous regressor but not the outcome
 - $\text{Cov}(Z,u)=0$, $\text{Cov}(x_K,Z)\neq 0$
- Random assignment to treatment & control conditions in RCT is a good instrumental variable

Instrumental variable

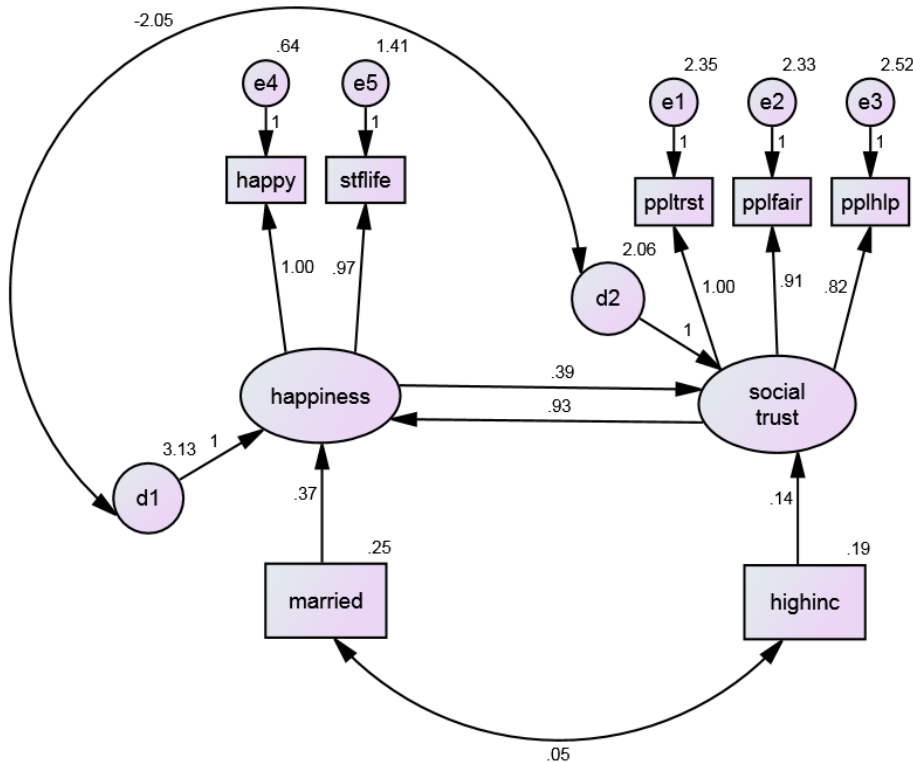


- Z1 causes X1
- Z1 only causes Y1 via effect on X1

Instrumental Variables - examples

- Vietnam lottery draft for effect of Vietnam war on later outcomes (Angrist and Krueger 1991)
- Proximity of nearest college for education on earnings (Card 1995)
- Variation in amount of compulsory schooling for effects of education on earnings (Hammon & Walker 1995)

Non-recursive SEM



Chi2=16; df=10; p<0.098;
RMSEA=.020; CFI=.997

Does happiness cause trust or trust cause happiness?

- Direct paths in both directions between happiness and trust
- Model unidentified without exogenous predictors (income and marital status)
- Are these valid instrumental variables?

Data: European Social Survey 2004, GB only

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www.ncrm.ac.uk

