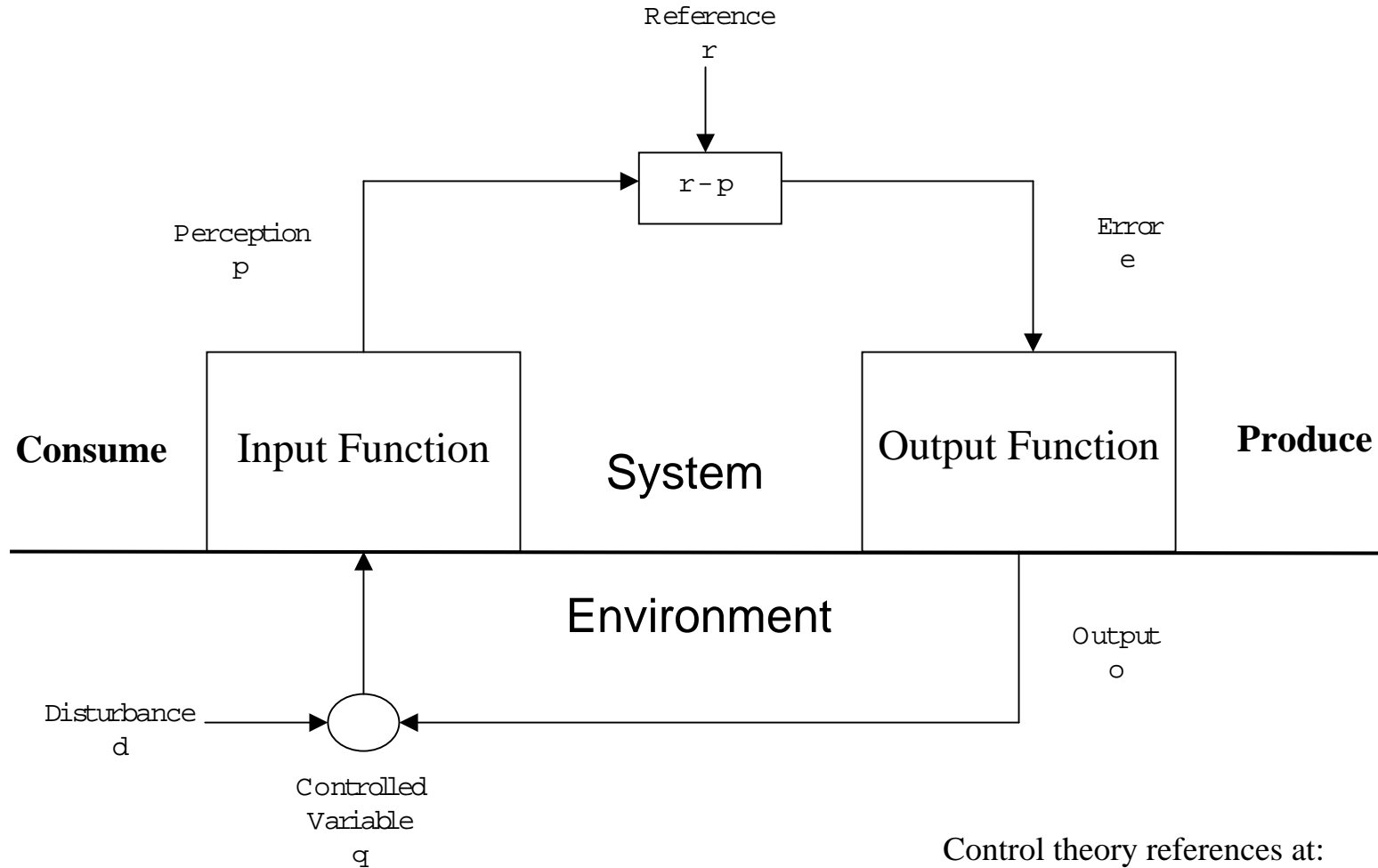


# Closed Loop Economics: Human Nature Writ Large

Richard S. Marken  
Senior Behavioral Scientist  
RAND Corporation

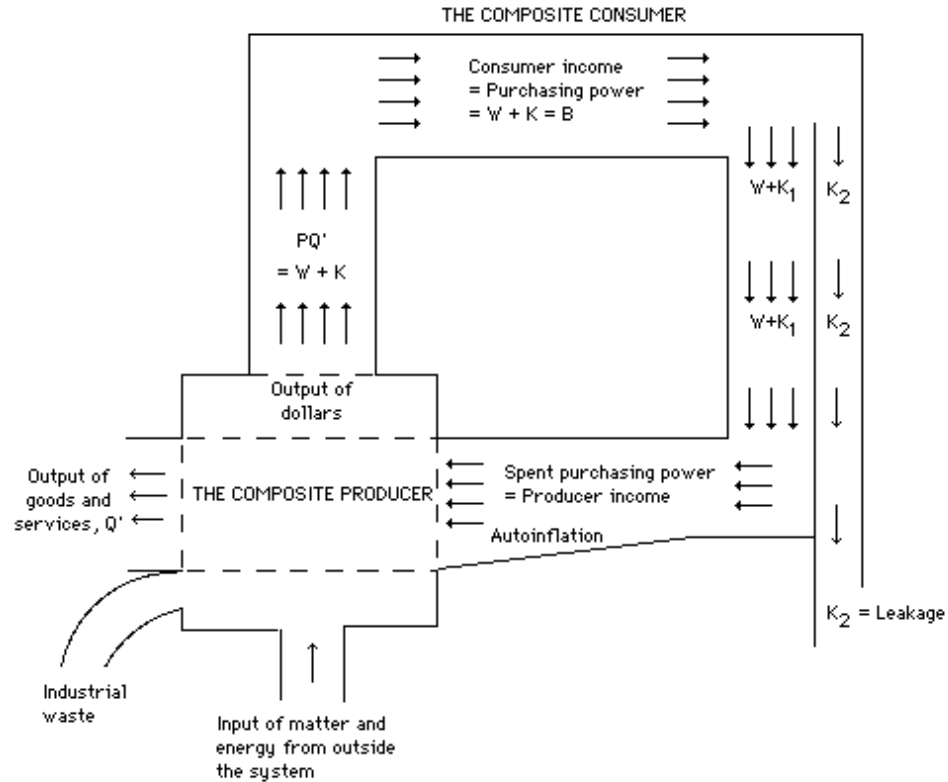
# Human Nature: Closed Loop Control

## Needs and Wants



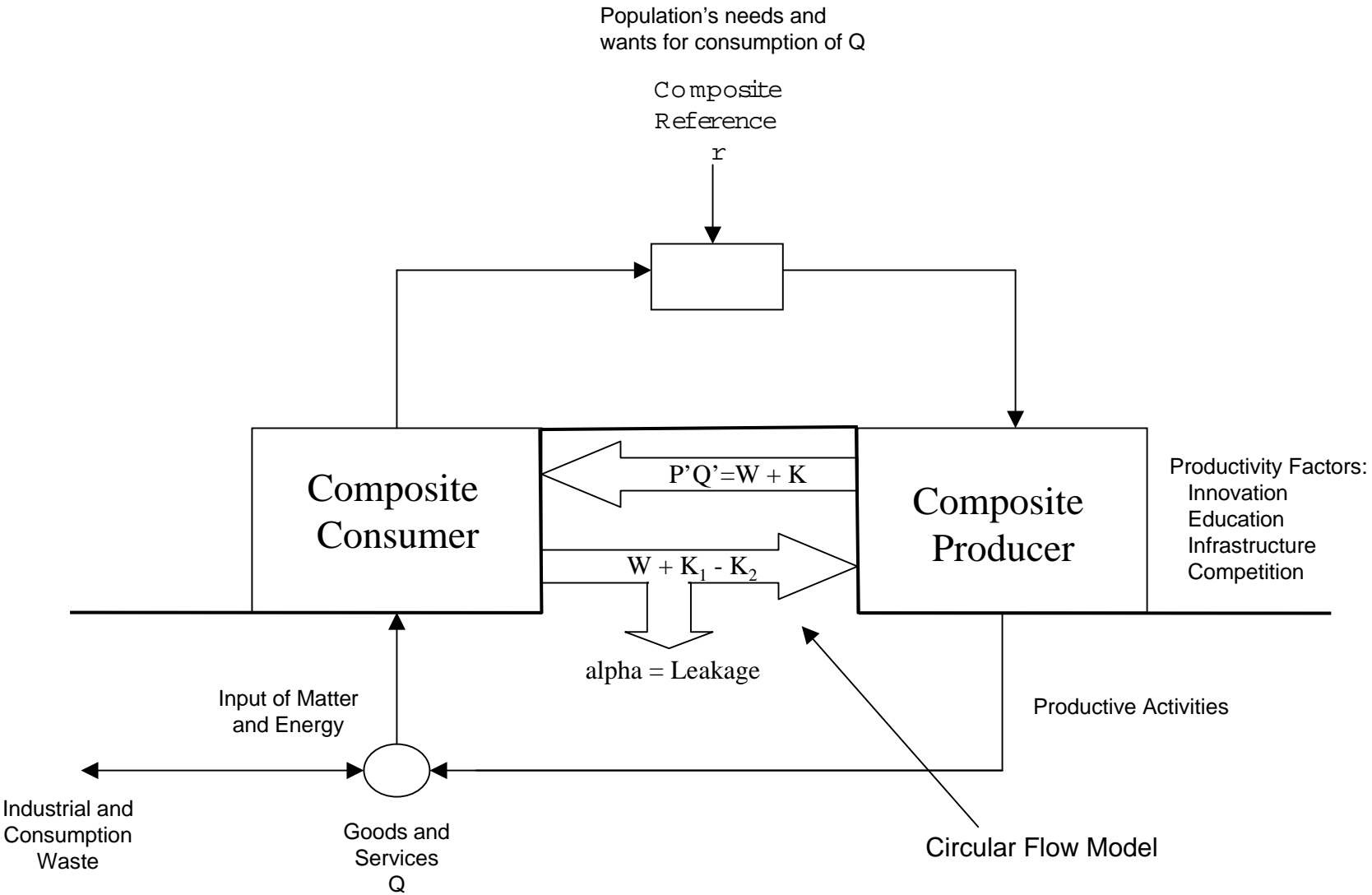
Control theory references at:  
[www.mindreadings.com](http://www.mindreadings.com)

# Circular Flow Model: Closed Loop Economics



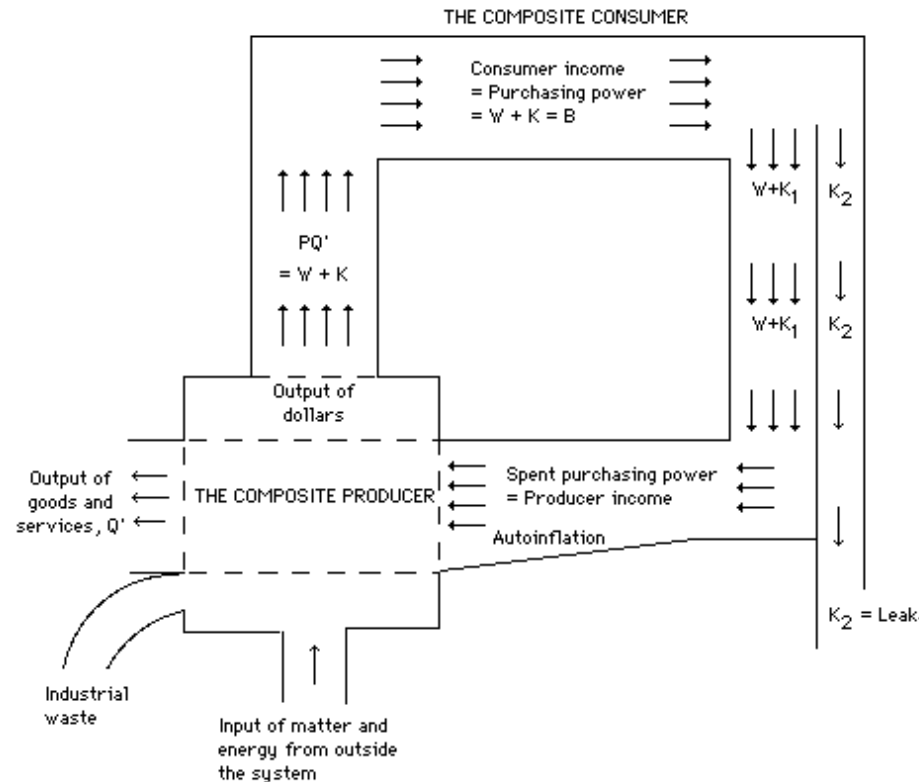
From T. C. Powers, *Leakage*, p. 98

# Composite Controller



# Derivation of Effect of Leakage on Output: Underproduction

- Ideal production
  - All of GDP paid to composite consumer is returned to composite producer as buying power
  - $PQ' = B$  (1)
- Production with leakage
  - Some GDP not returned to composite producer
  - $PQ = (1 - \alpha) B$  (2)
- Dividing (2) by (1) gives impact of leakage on output give
  - $Q/Q' = (1 - \alpha)$  (3)
  - $Q$  is actual,  $Q'$  is potential output
  - When  $Q/Q' < 1$  there is underproduction
  - Underproduction should be negatively related to leakage ( $\alpha$ )
    - $Q/Q'$  should decrease with increased in  $\alpha$



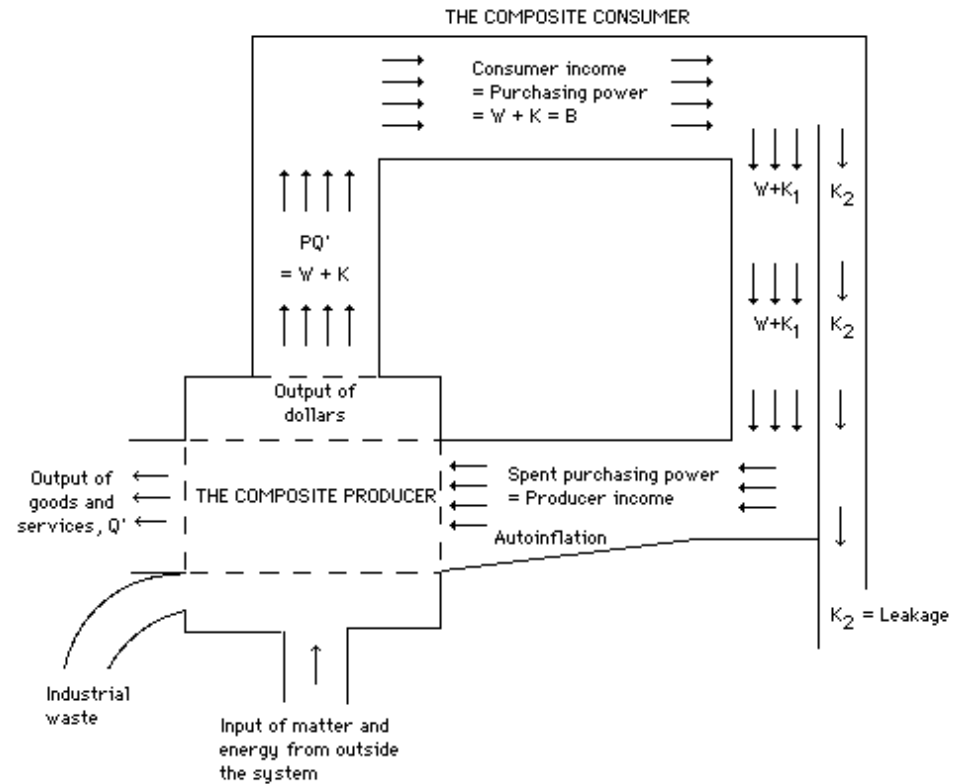
# Predicting $Q/Q'$ From Alpha

- Estimate of alpha
  - Savings (S) plus undistributed Corporate Profits (U)
  - $\text{Alpha} = (S+U)/\text{GDP} * 100$
- Estimate of  $Q'$ 
  - $\text{GDP} + k * \text{Unemployment Rate}$
  - Changes in k produce small changes in  $R^2$  and in size (but not sign) of coefficient of alpha
- Find weak but appropriately negative relationship between alpha and  $Q/Q'$



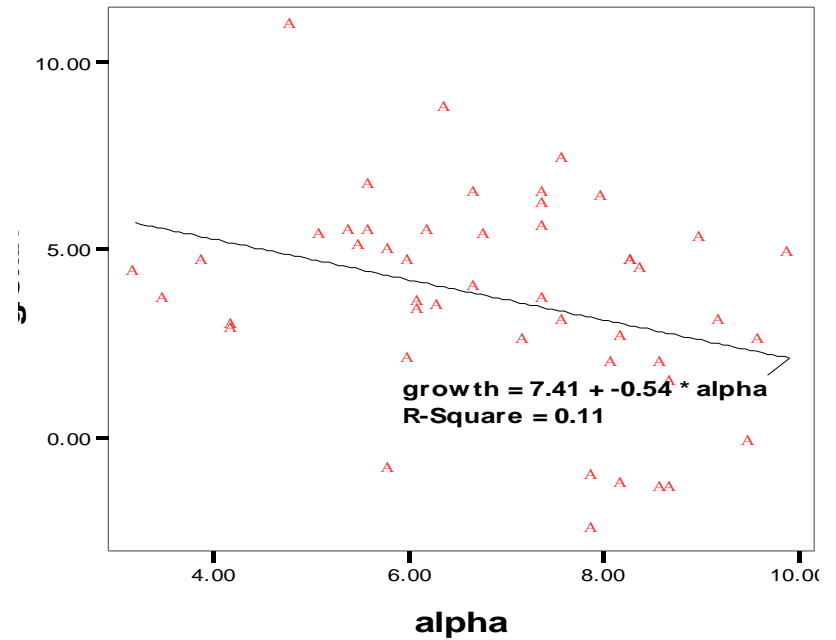
# Effect of Leakage on Growth Rate

- Effect of leakage on growth rate is assumed (*Leakage*, p. 101)
  - Rate of growth,  $r$ , depends on
    - Growth in productivity:  $z\dot{}$  (output/capita)
    - Growth in population:  $N\dot{}$
    - $dQ'/dt = (z\dot{+}N\dot{)} Q'$
  - Without leakage
    - $r = z\dot{+}N\dot{}$
  - With leakage
    - $r = z\dot{+}N\dot{} - \alpha$



# Predicting Growth From Alpha

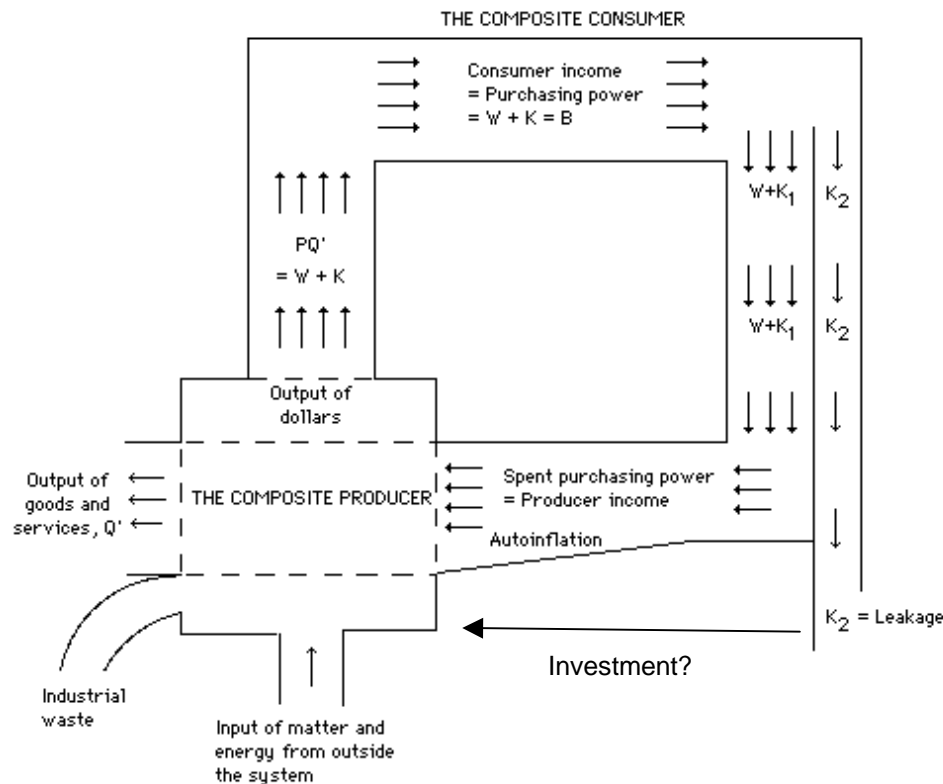
- Although no relationship is derived, negative relationship is observed



Graph produced by Dr. Demetri Kantarelis

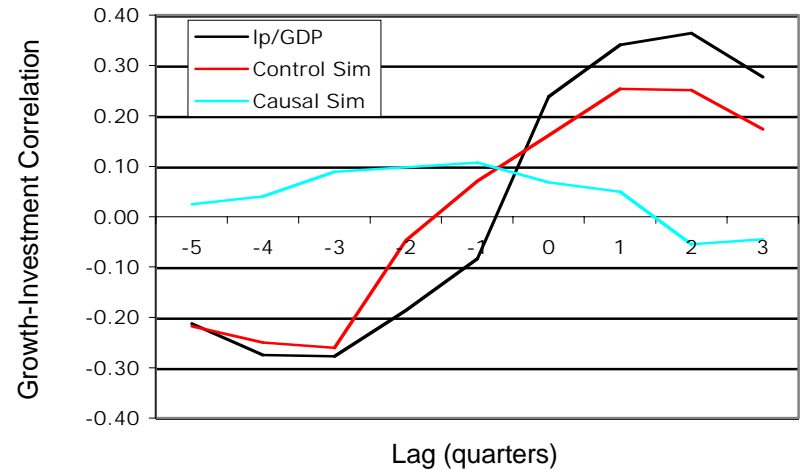
# Where Does Leakage Go?

- Savings and undistributed corporate profits are held in banks
- Banks lend against deposits
- So leakage should lead to investment and growth
- But loop is closed
  - More investment would produce more output
  - But this output can't be consumed



# Growth and Investment

- Observed negative relationship between growth and the investment the precedes it
- Control model invests to match past demand
- Causal model invests based on prior investment



# Conclusions

- Growth may not be best measure of how well economy is doing
  - Economy must grow to meet increase in population
  - An economy could be successful and not grow at all
    - Given zero population growth
    - $Q =$  Composite reference
- Better measure of how well economy is doing is difference between reference for  $Q$  and  $Q$ 
  - Poverty rates
  - Income distribution
  - Surveys of satisfaction