

Graphically Characterizing the Equilibrium of the Neoclassical Model

ECON 30020: Intermediate Macroeconomics

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Readings

- ▶ GLS Ch. 15
- ▶ GLS Ch. 16
- ▶ For now, ignore parts related to money supply and nominal variables

Neoclassical Model

- ▶ The optimizing model of the economy with which we have been working is sometimes called the “neoclassical model” or “real business cycle” model
- ▶ The model features optimizing agents and frictionless markets
- ▶ It emphasizes supply shocks (changes in A_t or θ_t) as the principal drivers of fluctuations in endogenous variables
- ▶ As written, it abstracts from money and nominal variables. In this model, the “classical dichotomy” holds, so this is okay
- ▶ We take the model to be a relevant description of the real world in the “medium run” – frequencies of time between a couple of years and a decade

Equilibrium Conditions

- ▶ In equilibrium, the following conditions must hold:

$$C_t = C^d(Y_t - G_t, Y_{t+1} - G_{t+1}, r_t)$$

$$N_t = N^s(w_t, \theta_t)$$

$$N_t = N^d(w_t, A_t, K_t)$$

$$I_t = I^d(r_t, A_{t+1}, f_t, K_t)$$

$$Y_t = A_t F(K_t, N_t)$$

$$Y_t = C_t + I_t + G_t$$

- ▶ First four are optimal decision rules of household and firm; fifth is a technological constraint (production function), and sixth is resource constraint / market-clearing condition
- ▶ Exogenous variables: $A_t, A_{t+1}, G_t, G_{t+1}, K_t, \theta_t, f_t$.
Endogenous: C_t, N_t, I_t, Y_t, w_t , and r_t
- ▶ Treat Y_{t+1} as “pseudo-exogenous”: not affected by I_t , which impacts K_{t+1} . Medium run assumption: treat capital stock as roughly constant

Graphical Analysis

- ▶ Want to graphically summarize these equations
- ▶ IS curve: set of (r_t, Y_t) pairs where household and firm behave optimally with respect to consumption and investment demand and income equals expenditure
 - ▶ Summarizes consumption function, investment demand function, and resource constraint
- ▶ Y^s curve: set of (r_t, Y_t) pairs where household and firm behave optimally, labor market clears, and production function holds
 - ▶ Summarizes labor supply, demand, and production function
- ▶ General equilibrium: on both IS and Y^s curves simultaneously

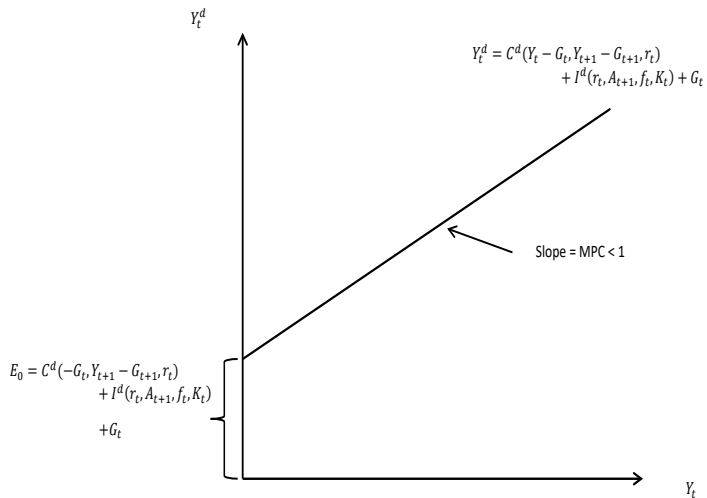
IS Curve

- ▶ Same as before, just another expenditure category
- ▶ Start by writing total desired expenditure as:

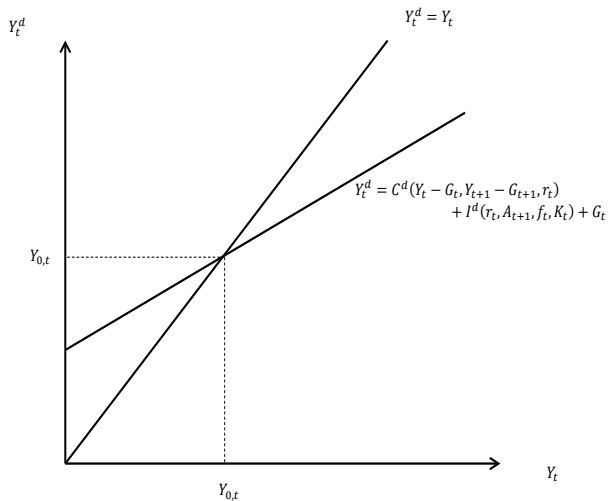
$$Y_t^d = C^d(Y_t - G_t, Y_{t+1} - G_{t+1}, r_t) + I^d(r_t, A_{t+1}, f_t, K_t) + G_t$$

- ▶ Impose that $Y_t^d = Y_t$
- ▶ Graph the set of (r_t, Y_t) pairs where this holds

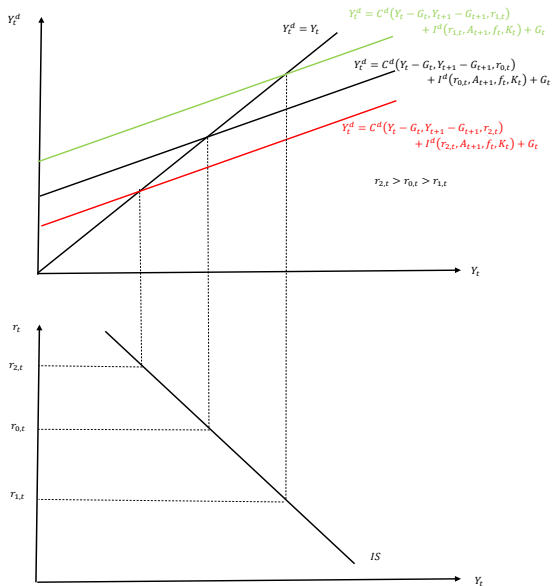
Expenditure vs. Income



Income Equals Expenditure



The IS Curve



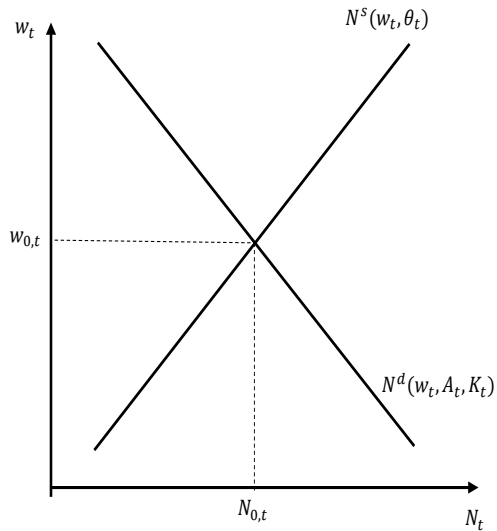
IS Curve Shifts

- ▶ The *IS* curve will shift if any exogenous variable relevant for desired consumption or investment change, as well as changes in government spending
- ▶ Shifts:
 - ▶ $\uparrow A_{t+1}$: *IS* shifts right
 - ▶ $\uparrow f_t$: *IS* shifts left
 - ▶ $\uparrow G_t$: *IS* shifts right (via earlier arguments)
 - ▶ $\uparrow G_{t+1}$: *IS* shifts left
 - ▶ $\downarrow K_t$: *IS* shifts right

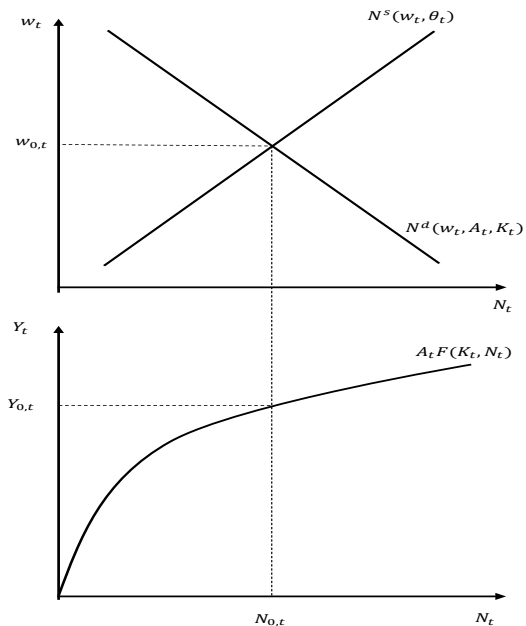
The Y^s Curve

- ▶ Begin by plotting labor demand and labor supply. Find the N_t where these intersect
- ▶ Given this N_t , determine Y_t from the production function
- ▶ r_t irrelevant for labor demand, supply, and the production function under our assumptions: Y^s curve is still vertical as in endowment economy
- ▶ Could generate an upward-sloping Y^s curve, and some role for IS shocks, if we considered effect of r_t on labor supply

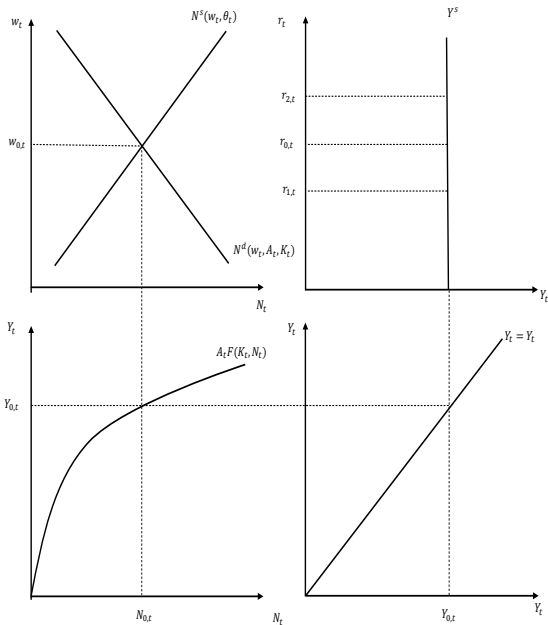
Labor Market



Production Function



The Y^s Curve



Shifts of the Y^s Curve

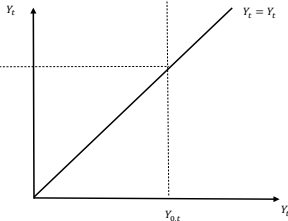
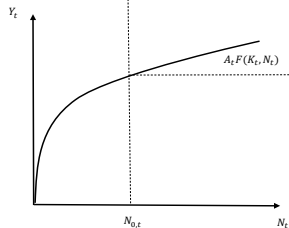
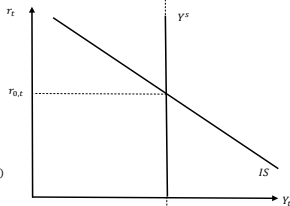
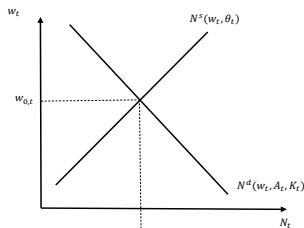
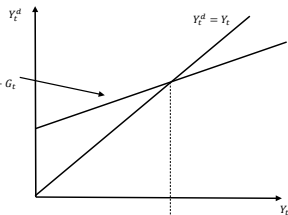
- ▶ The Y^s curve will shift if any exogenous variable relevant for the positions of the labor demand, labor supply, or production functions changes
- ▶ Shifts:
 - ▶ $\uparrow A_t$: Y^s shifts right
 - ▶ $\uparrow \theta_t$: Y^s shifts left
 - ▶ $\downarrow K_t$: Y^s shifts left

Bringing it All Together

- ▶ In equilibrium, economy must be on both the IS and Y^s curves
- ▶ Intersection jointly determines Y_t , r_t , N_t , and w_t
- ▶ Figure out split between C_t and I_t , given Y_t and r_t , by looking at consumption and investment demand functions

General Equilibrium

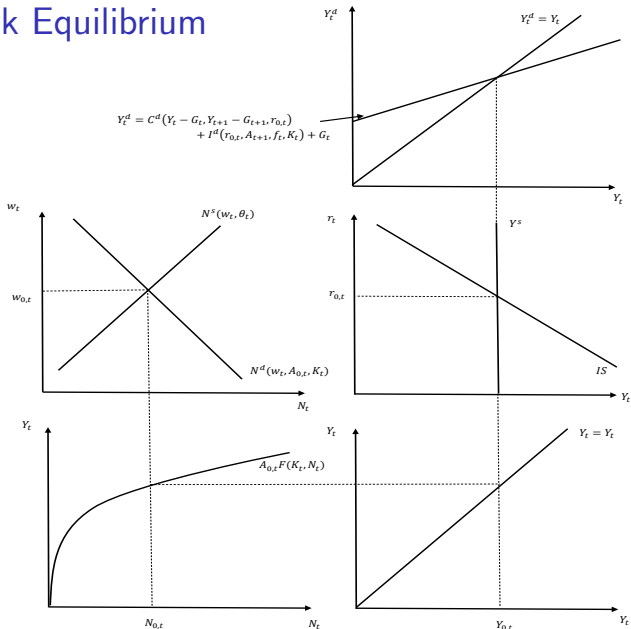
$$Y_t^d = C^d(Y_t - G_t, Y_{t+1} - G_{t+1}, r_t) + I^d(r_t, A_{t+1}, f_t, K_t) + G_t$$



Working Through Effects of Changes in Exogenous Variables

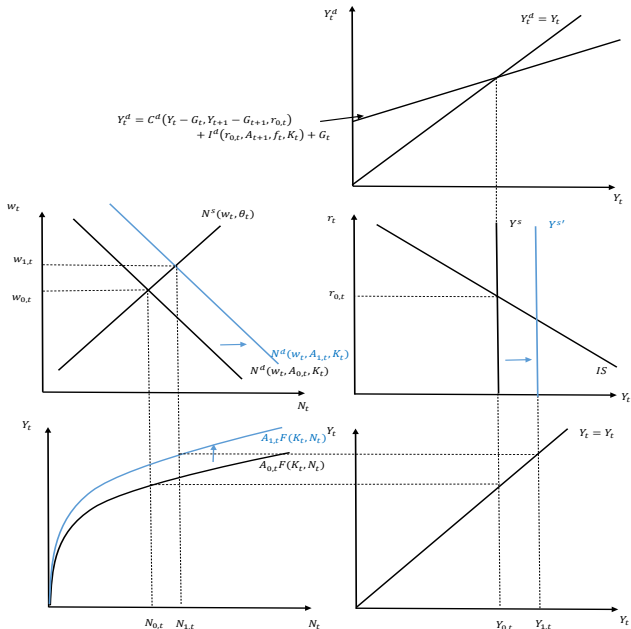
- ▶ A_t , θ_t , and K_t affect the position of the Y^s curve
- ▶ A_{t+1} , f_t , G_t , G_{t+1} , and K_t affect the IS curve
- ▶ Figure out how Y^s and IS curve shift, determine new r_t . Use this to figure out how other endogenous variables react
- ▶ A complication arises: changes in I_t affect K_{t+1} , which affects Y_{t+1} , and hence C_t
- ▶ We ignore these effects – size of capital stock is large relative to investment, and in medium run can treat capital stock as approximately fixed (unlike long run where we study capital accumulation)
- ▶ Y_{t+1} will therefore only be affected by changes in exogenous variables dated $t + 1$: A_{t+1} and G_{t+1} . “Pseudo-exogenous” in sense we will treat it as unaffected by time t exogenous shocks

Supply Shock: $\uparrow A_t$, Pre-Shock Equilibrium



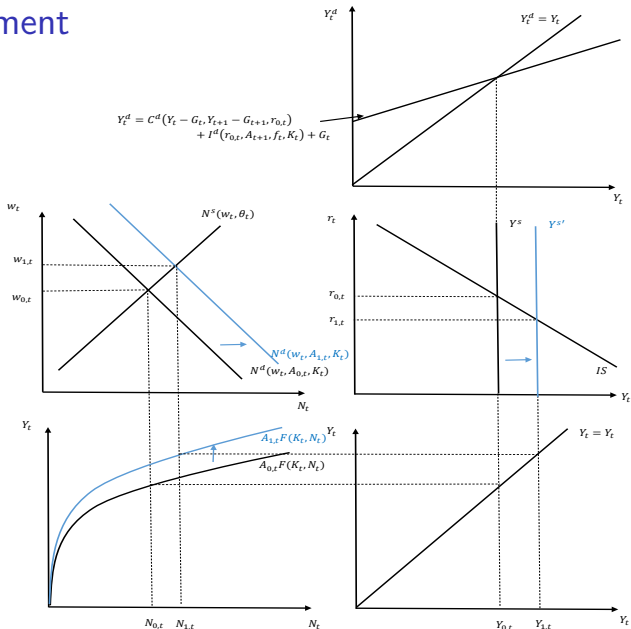
Supply Shock: $\uparrow A_t$

Y^s Shift



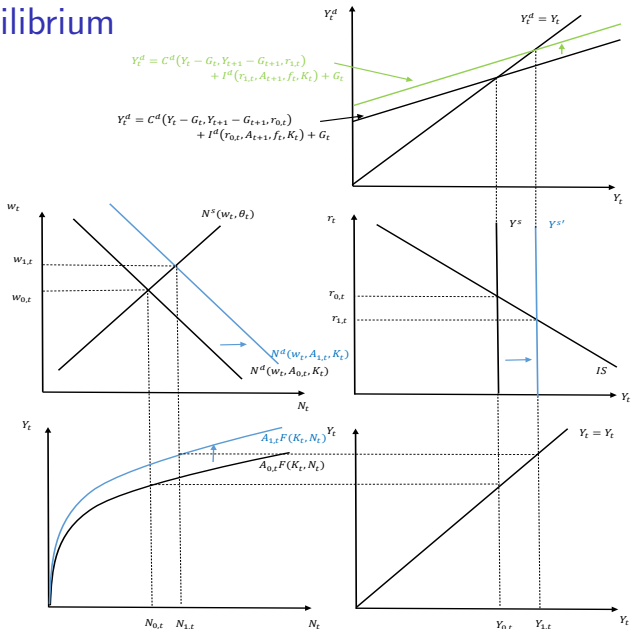
Supply Shock: $\uparrow A_t$

r_t adjustment



Supply Shock: $\uparrow A_t$

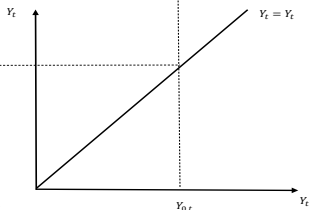
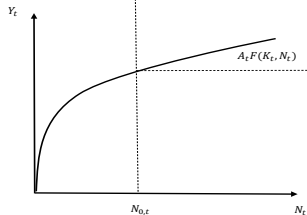
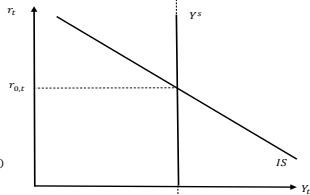
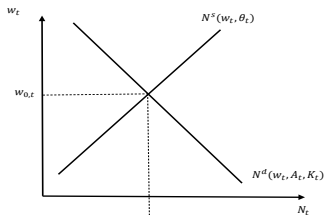
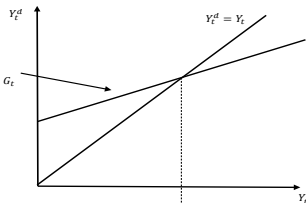
New Equilibrium



Demand Shock: $\uparrow f_t$

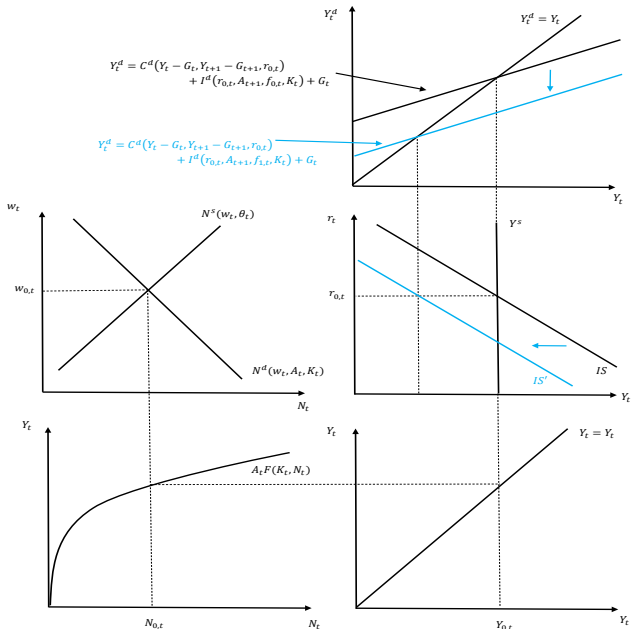
Initial Equilibrium

$$Y_t^d = C^d(Y_t - G_t, Y_{t+1} - G_{t+1}, r_{0,t}) + I^d(r_{0,t}, A_{t+1}, f_{0,t}, K_t) + G_t$$



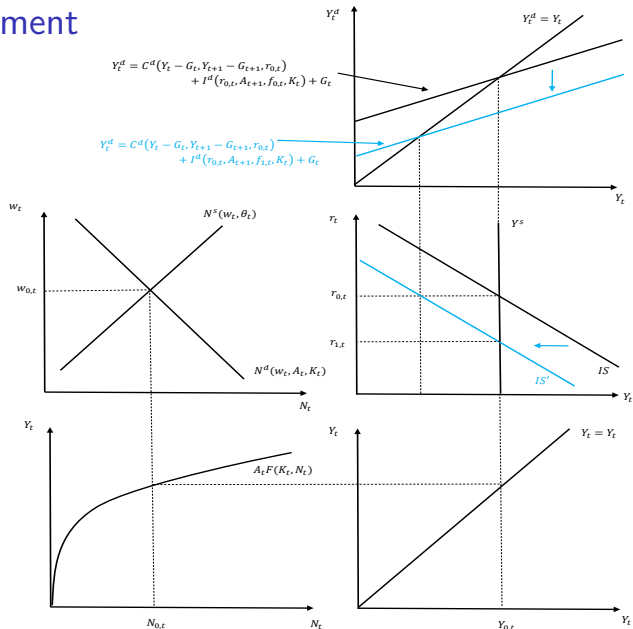
Demand Shock: $\uparrow f_t$

IS Shift



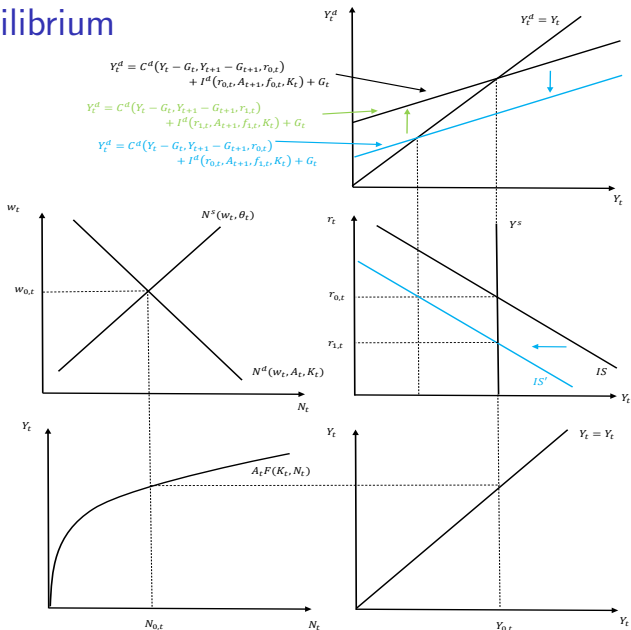
Demand Shock: $\uparrow f_t$

r_t Adjustment



Demand Shock: $\uparrow f_t$

New Equilibrium



Supply versus Demand

- ▶ With a vertical Y^s curve, output is completely supply-determined
- ▶ “Demand shocks” (shocks which shift the IS curve) affect composition of output and r_t , but not the level of output
- ▶ Neoclassical model thus emphasizes supply shocks (productivity and labor preference) as chief source of fluctuations
- ▶ Can get demand shocks to impact output if Y^s is upward-sloping (because interest rate affects labor supply), but doesn't change fact that model still needs to be predominantly driven by supply-shocks to make predictions which are more or less consistent with data

Qualitative Effects of Changes in Exogenous Variables

Variable	Exogenous Shock					
	$\uparrow A_t$	$\uparrow \theta_t$	$\uparrow f_t$	$\uparrow A_{t+1}$	$\uparrow G_t$	$\uparrow G_{t+1}$
Y_t	+	-	0	0	0	0
C_t	+	-	+	?	-	-
I_t	+	-	-	?	-	+
N_t	+	-	0	0	0	0
w_t	+	+	0	0	0	0
r_t	-	+	-	+	+	-

- ▶ Do not consider changes in K_t – shifts both Y^s and IS curves, and can only consider reductions in K_t (e.g. natural disasters, wars)