Graphically Characterizing the Equilibrium of the Neoclassical Model

ECON 30020: Intermediate Macroeconomics

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Readings

GLS Ch. 18

GLS Ch. 19

For now, ignore parts related to money supply and nominal variables

Neoclassical Model

The optimizing, equilibrium 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:

$$
\begin{aligned}
C_t &= C^d(Y_t - G_t, Y_{t+1} - G_{t+1}, r_t) \\
N_t &= N^s(w_t, \theta_t) \\
N_t &= N^d(w_t, A_t, K_t) \\
I_t &= I^d(r_t, A_{t+1}, f_t, K_t) \\
Y_t &= A_t F(K_t, N_t) \\
Y_t &= C_t + I_t + G_t
\end{aligned}
$$

Equilibrium Conditions (Cont.)

First four are optimal decision rules of household and firm

Fifth is a technological constraint (the production function)

Sixth is resource constraint / market-clearing condition

Exogenous variables: A_t, A_{t+1}, G_t, G_{t+1}, K_t, θ_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

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

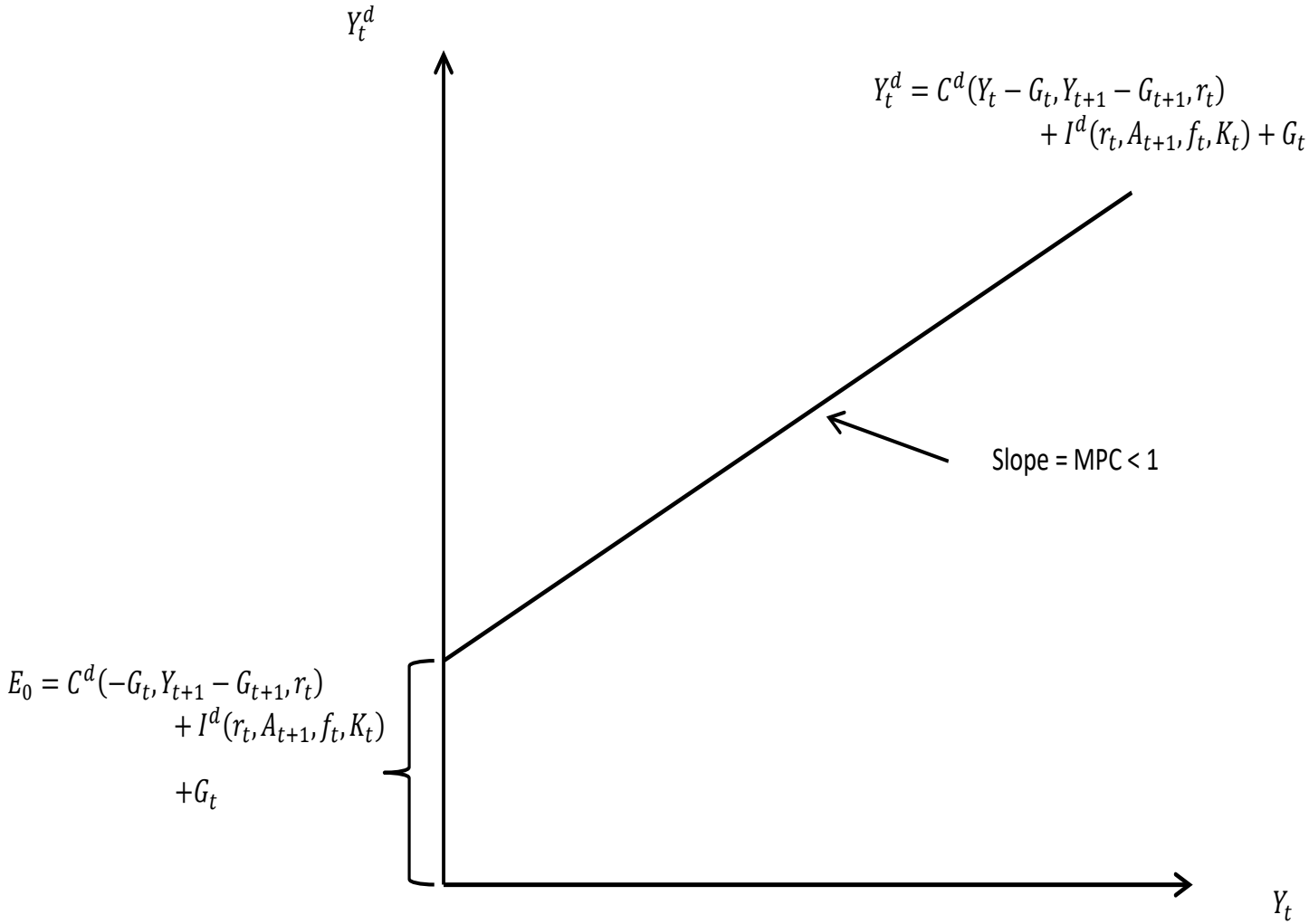
Start by writing total desired expenditure as

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

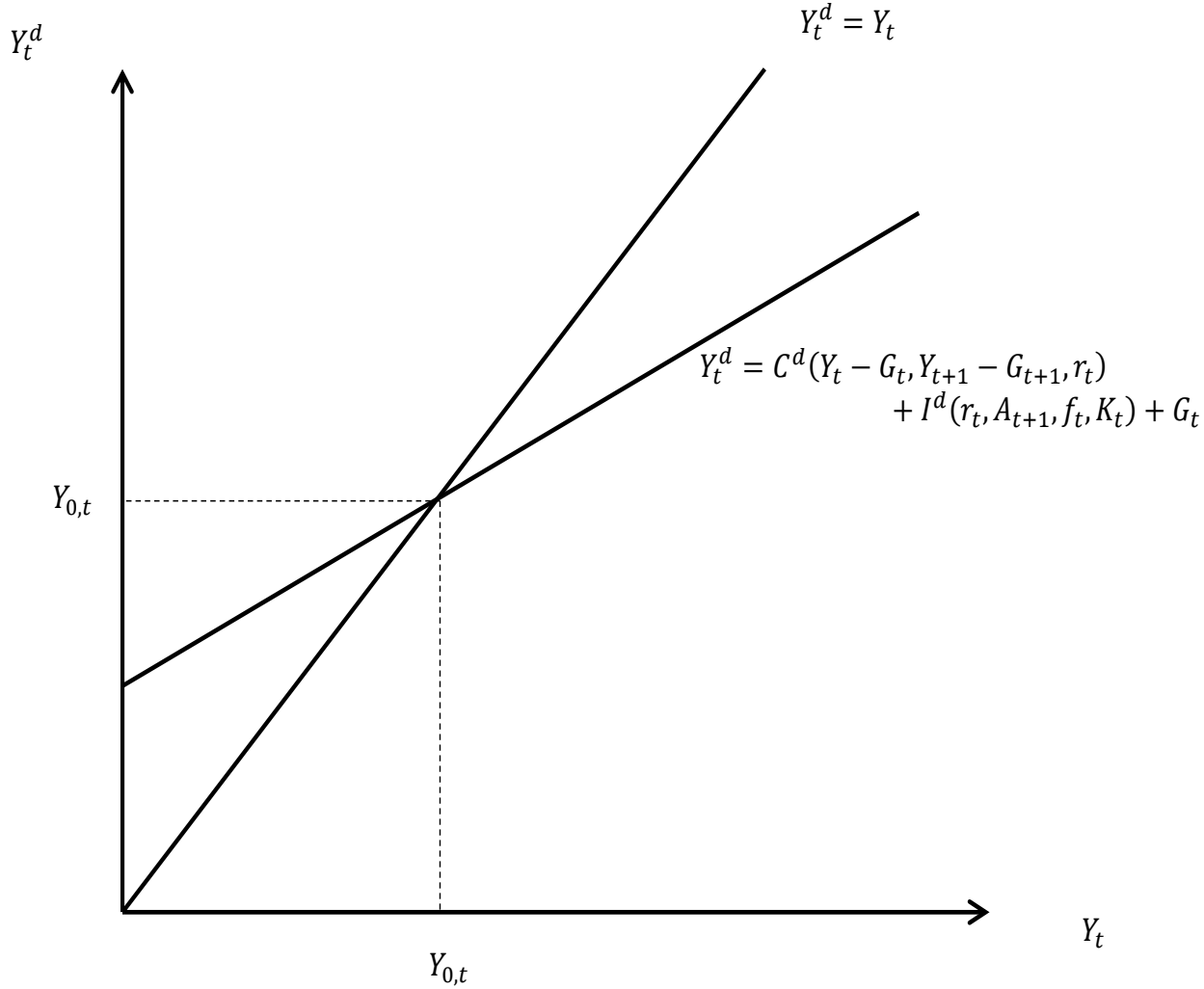
Impose that $Y_t^d = Y_t$

Graph the set of (r_t, Y_t) pairs where this holds

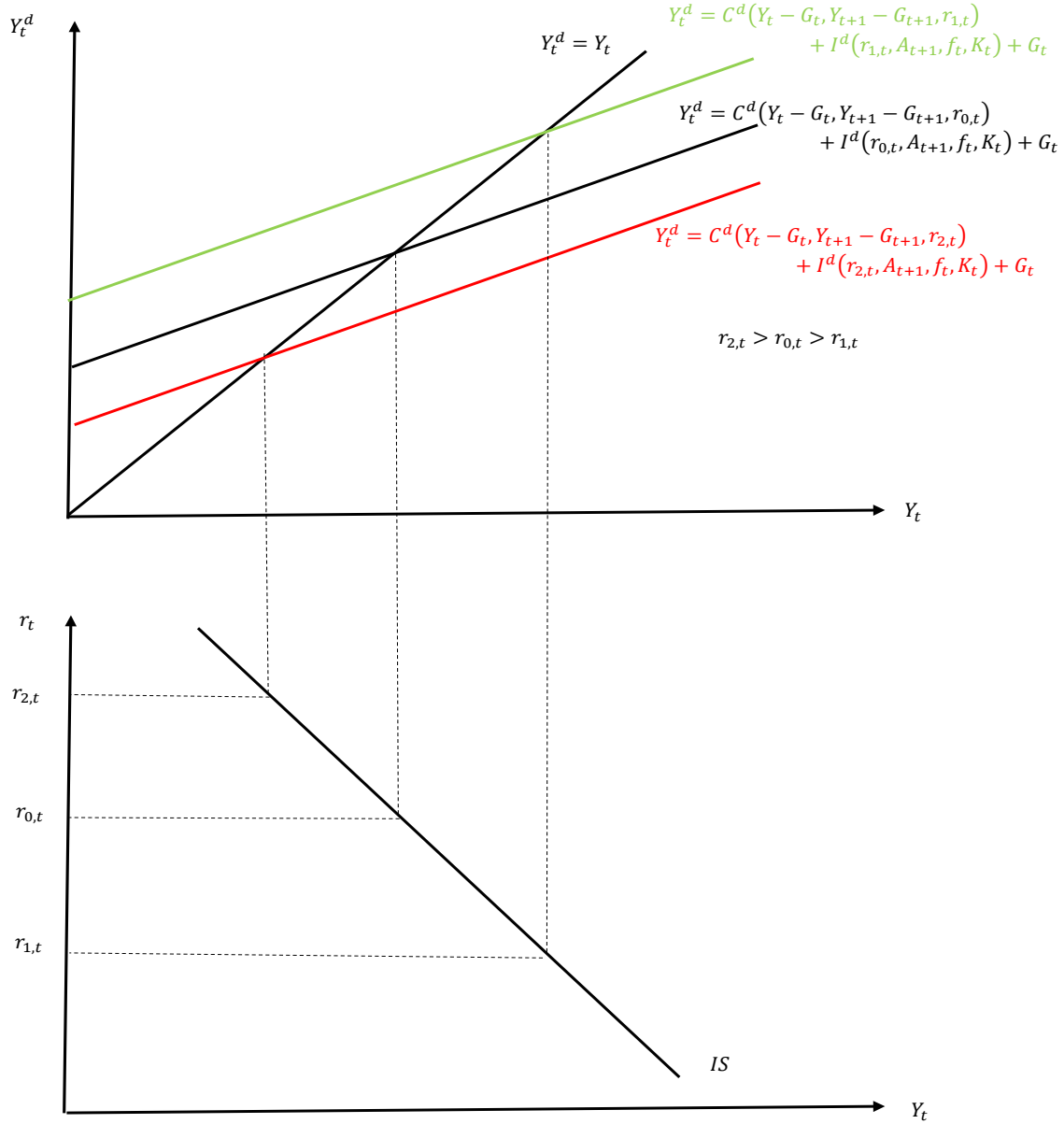
Expenditure vs. Income



Income Equals Expenditure



The *IS* Curve


Y_t^d
$Y_t^d = Y_t$
$Y_t^d = C^d(Y_t - G_t, Y_{t+1} - G_{t+1}, r_{1,t}) + I^d(r_{1,t}, A_{t+1}, f_t, K_t) + G_t$
$Y_t^d = C^d(Y_t - G_t, Y_{t+1} - G_{t+1}, r_{0,t}) + I^d(r_{0,t}, A_{t+1}, f_t, K_t) + G_t$
$Y_t^d = C^d(Y_t - G_t, Y_{t+1} - G_{t+1}, r_{2,t}) + I^d(r_{2,t}, A_{t+1}, f_t, K_t) + G_t$
$r_{2,t} > r_{0,t} > r_{1,t}$
Y_t
r_t
$r_{2,t}$
$r_{0,t}$
$r_{1,t}$
IS
Y_t

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:

- $\uparrow A_{t+1}$: *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

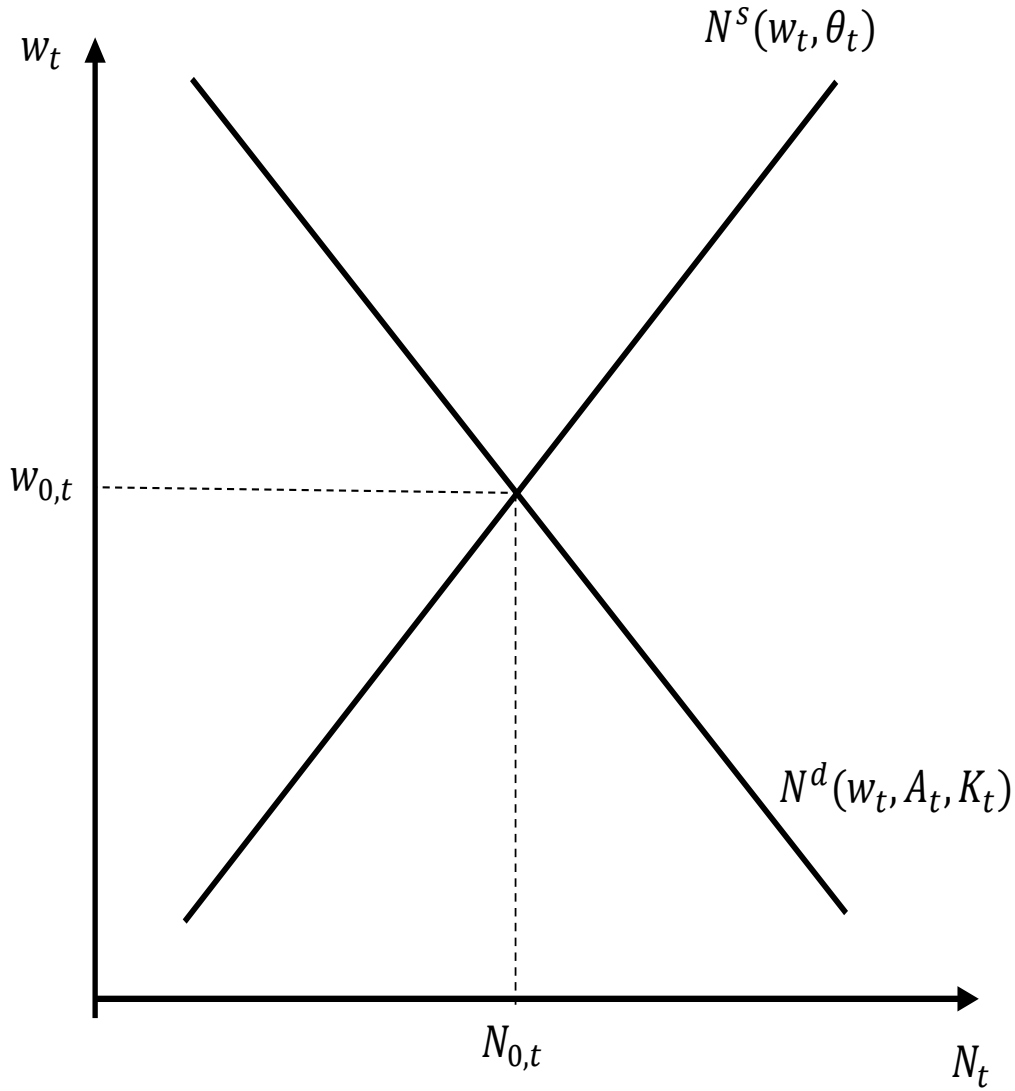
Begin by plotting labor demand and labor supply. Find the N_t where these intersect

Given this N_t, determine Y_t from the production function

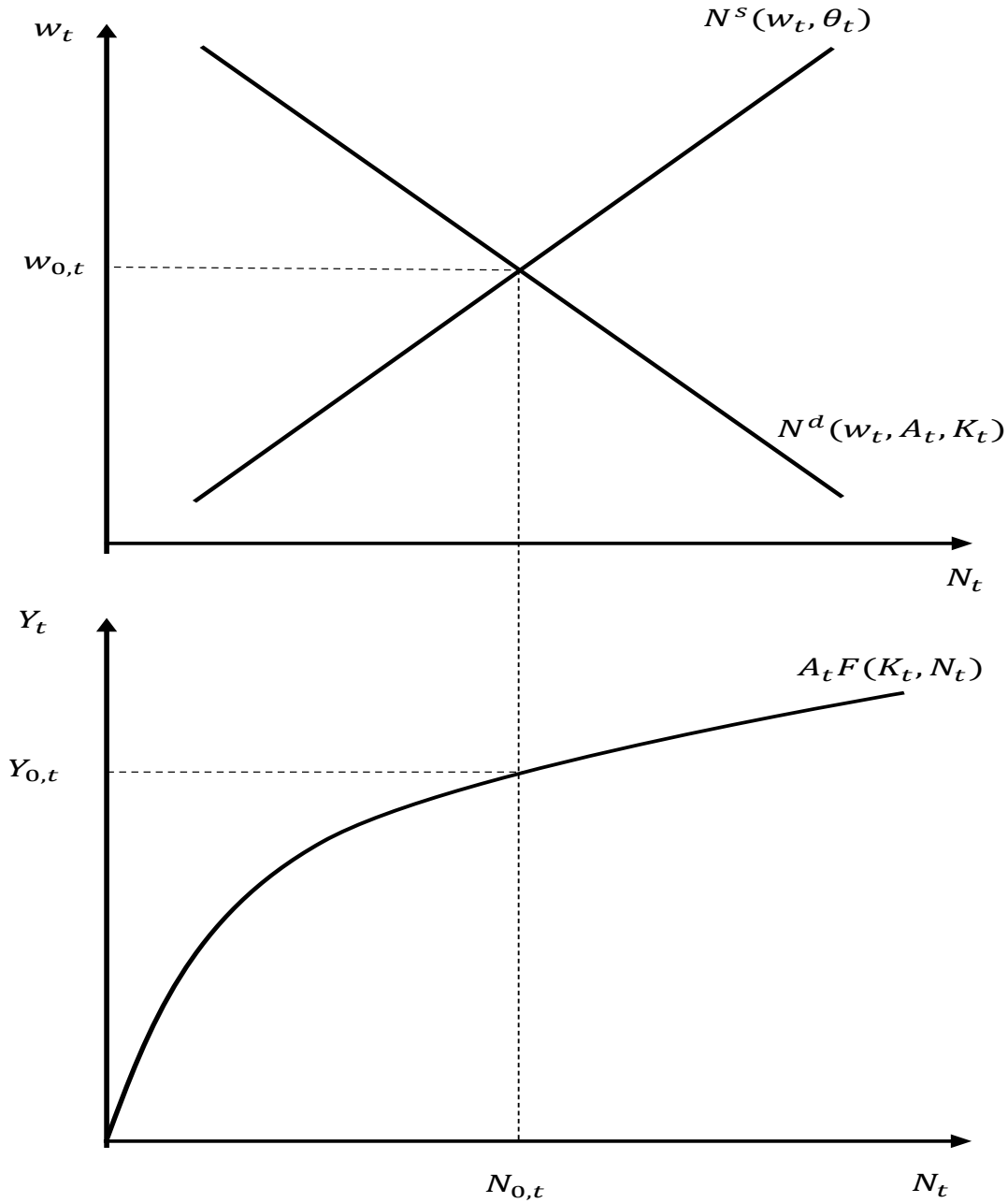
r_t irrelevant for labor demand, supply, and the production function under our assumptions (GHH preferences): Y^s curve is still vertical as in endowment economy

Could generate an upward-sloping Y^s curve, and some role for IS shocks, if we considered effect of r_t on labor supply (non-GHH preferences)

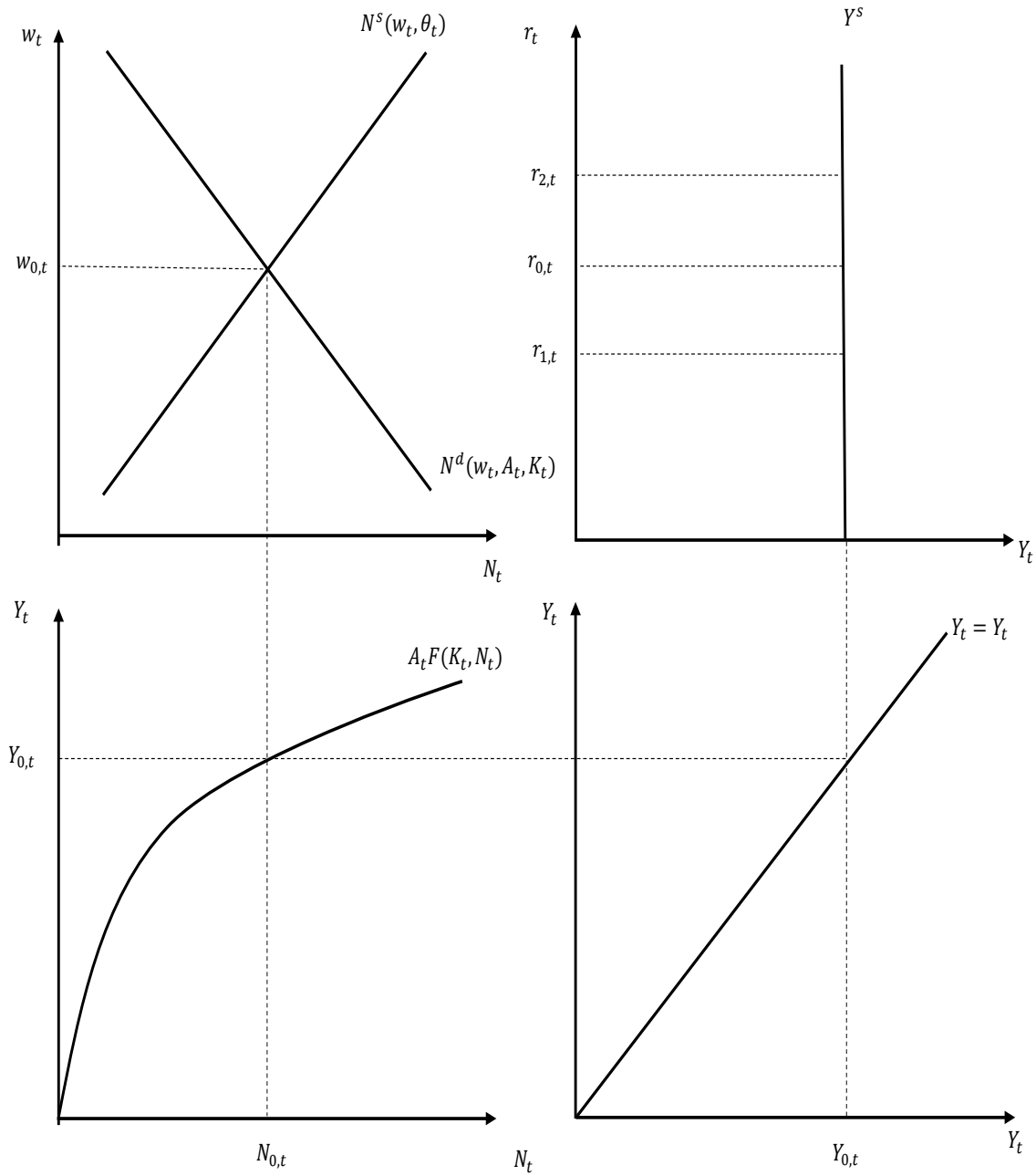
Labor Market



Production Function



The Y^s Curve


w_t
$N^s(w_t, \theta_t)$
$w_{0,t}$
$N^d(w_t, A_t, K_t)$
N_t
r_t
Y^s
$r_{2,t}$
$r_{0,t}$
$r_{1,t}$
Y_t
Y_t
$A_t F(K_t, N_t)$
$Y_{0,t}$
$N_{0,t}$
N_t
Y_t
$Y_t = Y_t$
$Y_{0,t}$
Y_t

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"

- $\uparrow A_t$: Y^s shifts right
- $\uparrow \theta_t$: Y^s shifts left
- $\downarrow K_t$: Y^s shifts left

Bringing it All Together

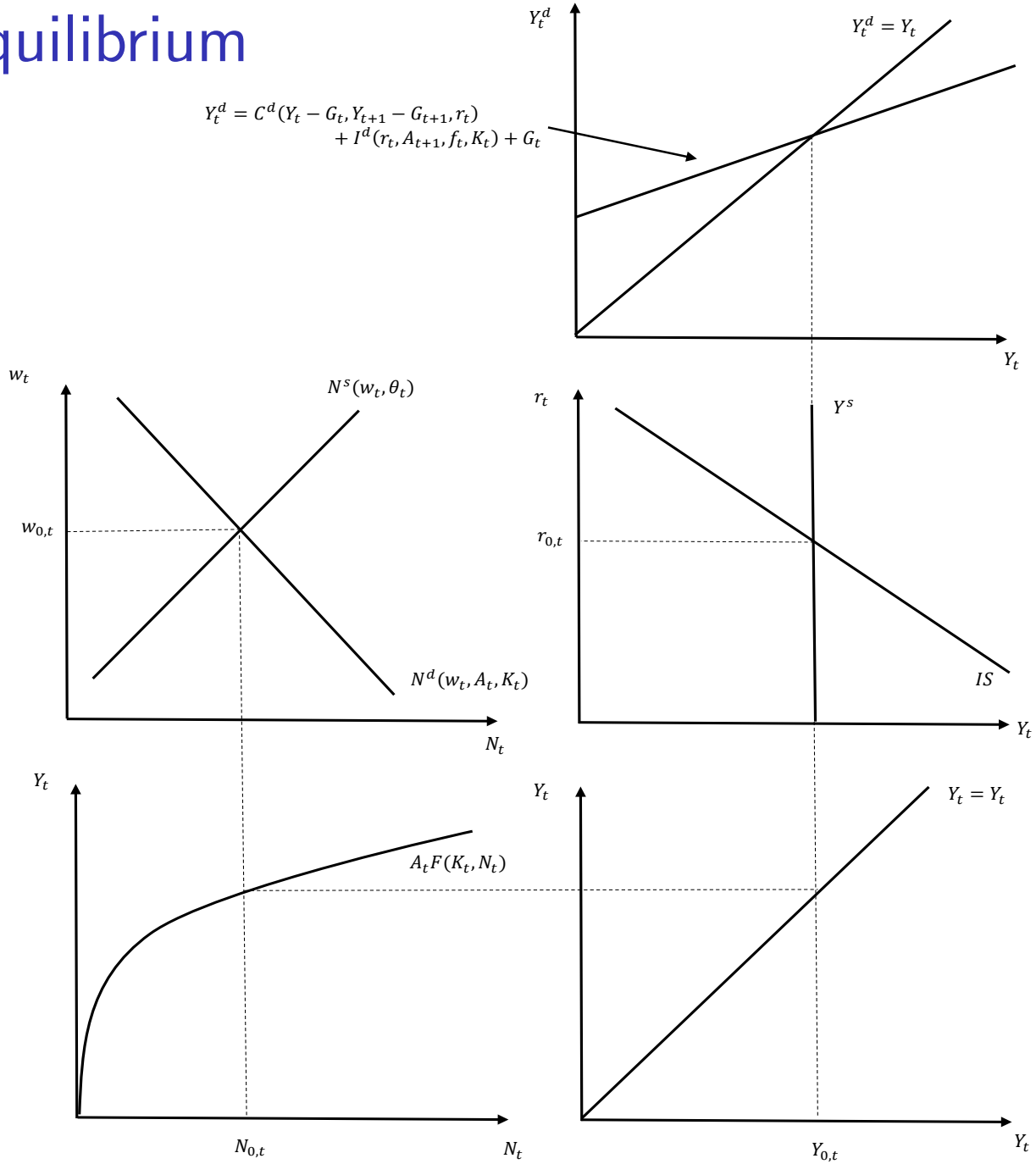
In general equilibrium, economy must be on both the IS and Y^s curves

- Labor market clearing: Y^s curve
- Goods market / financial market clearing: IS curve

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



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

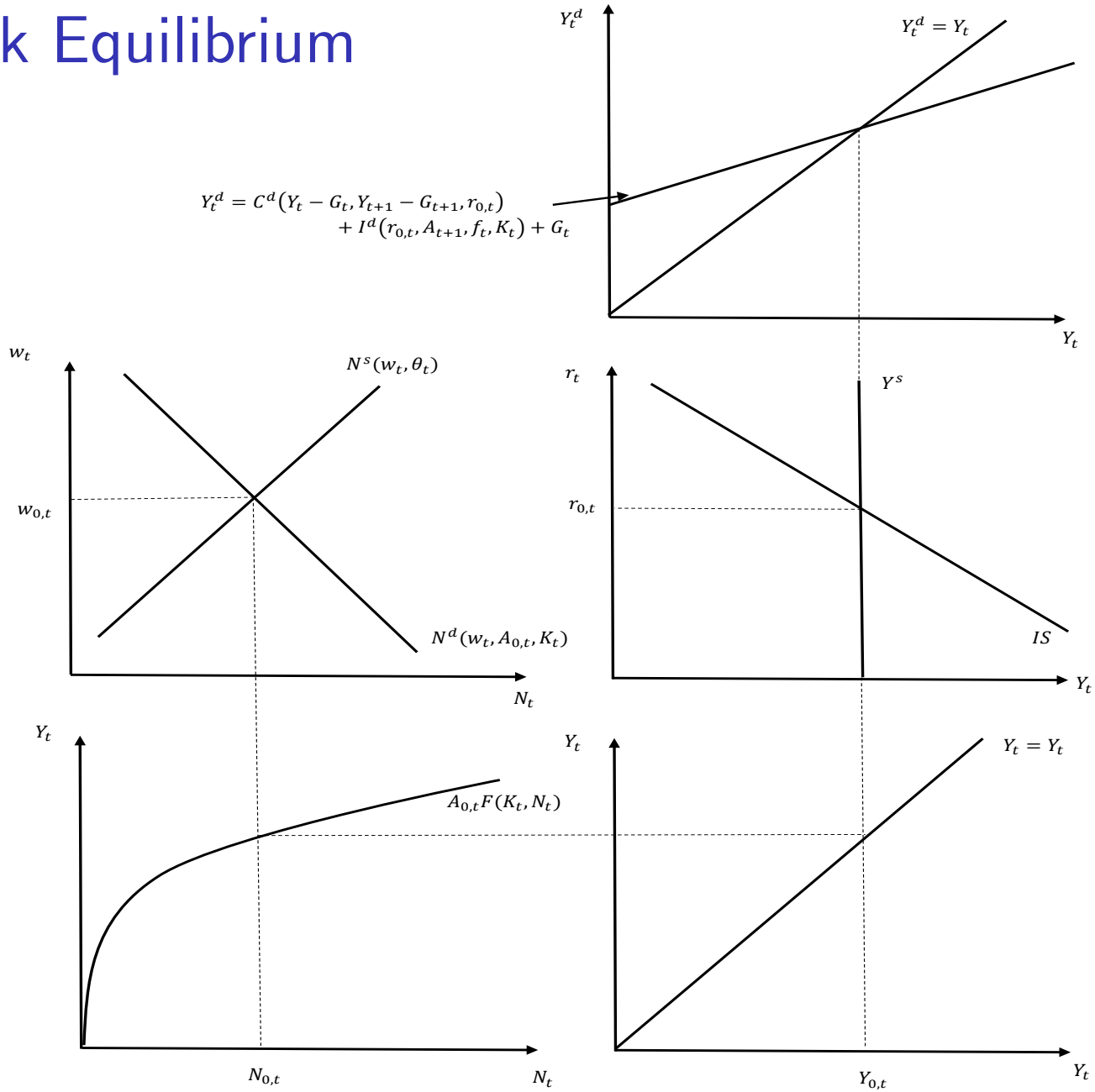
Figure out how Y^s and IS curve shift, determine new r_t. Use this to figure out how other endogenous variables react

A complication arises: changes in I_t affect K_{t+1}, which affects Y_{t+1}, and hence C_t

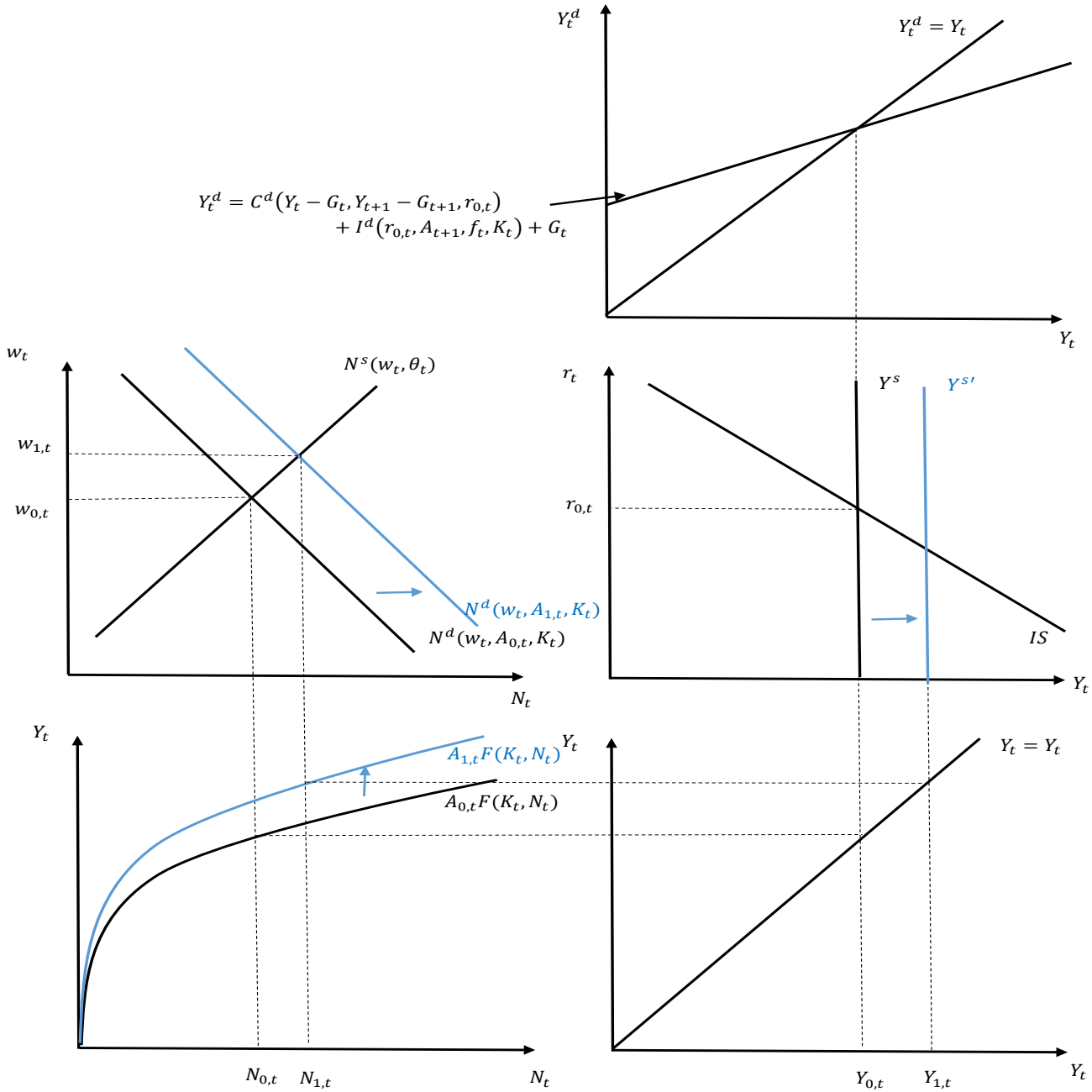
We ignore these effects – size of capital stock is large relative to investment, and in medium run can treat capital stock as approximately fixed (unlike long run where we study capital accumulation)

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

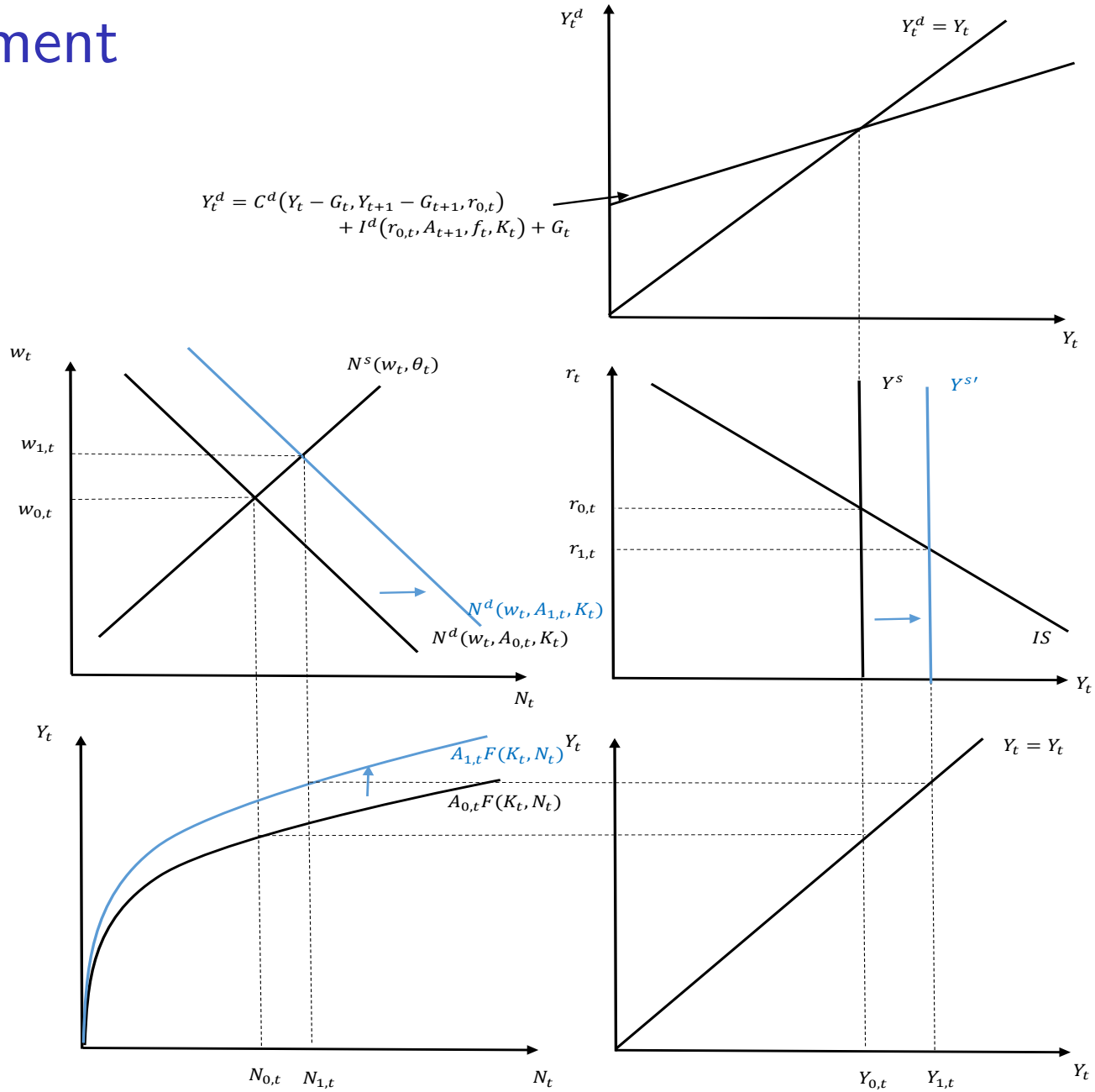
Supply Shock: $\uparrow A_t$, Pre-Shock Equilibrium



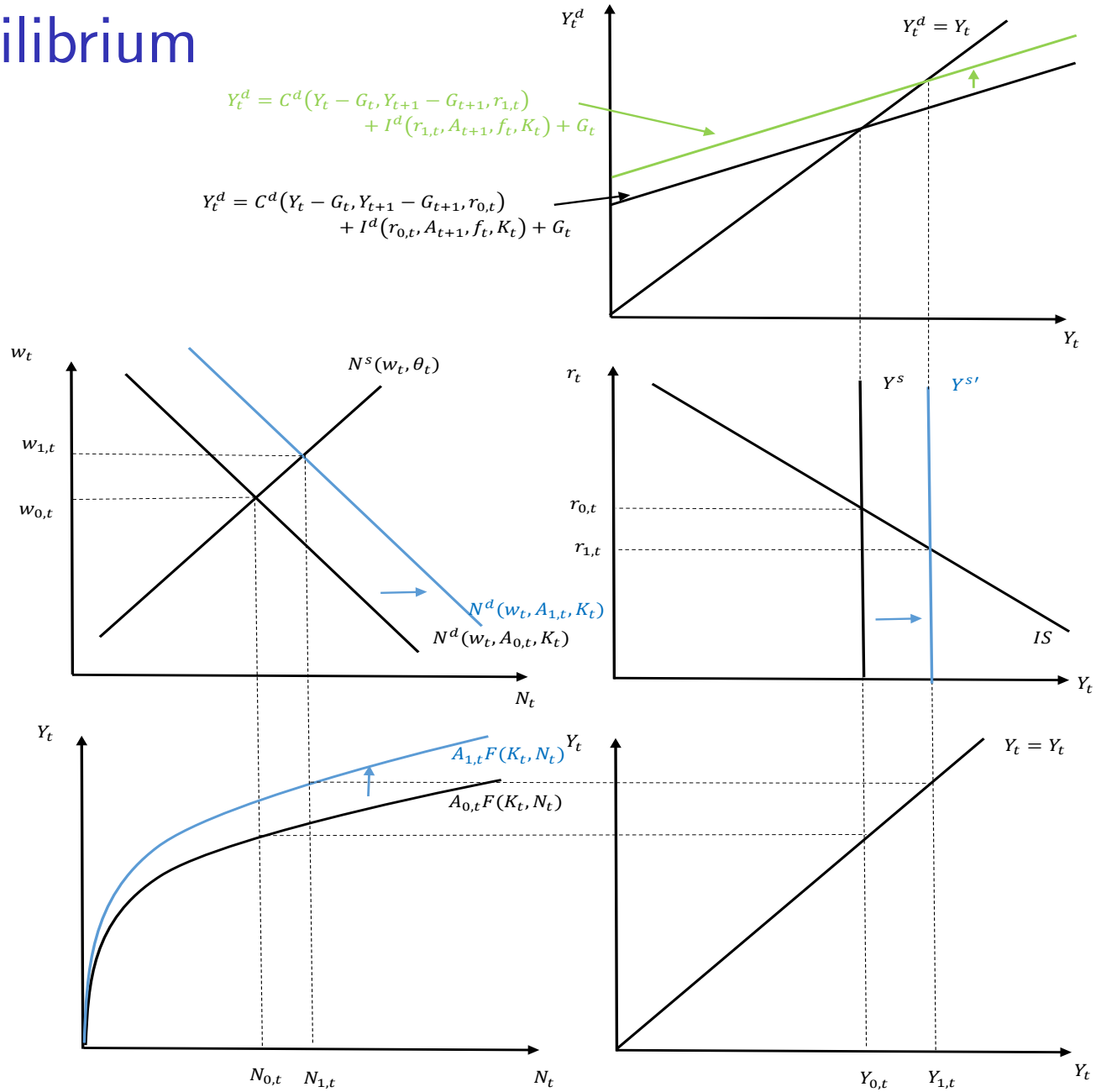
Supply Shock: $\uparrow A_t$
Y^s Shift



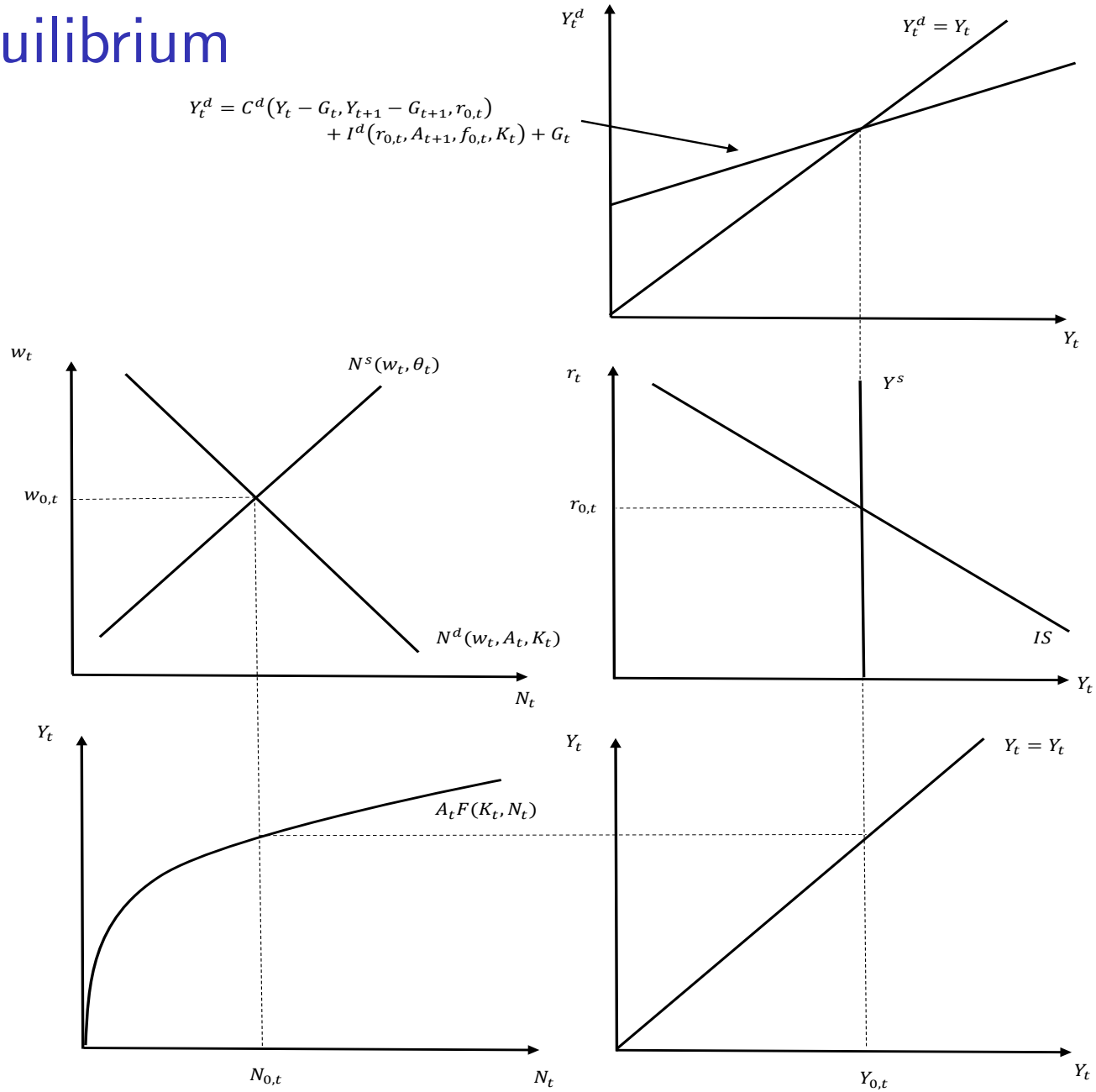
Supply Shock: $\uparrow A_t$
r_t adjustment



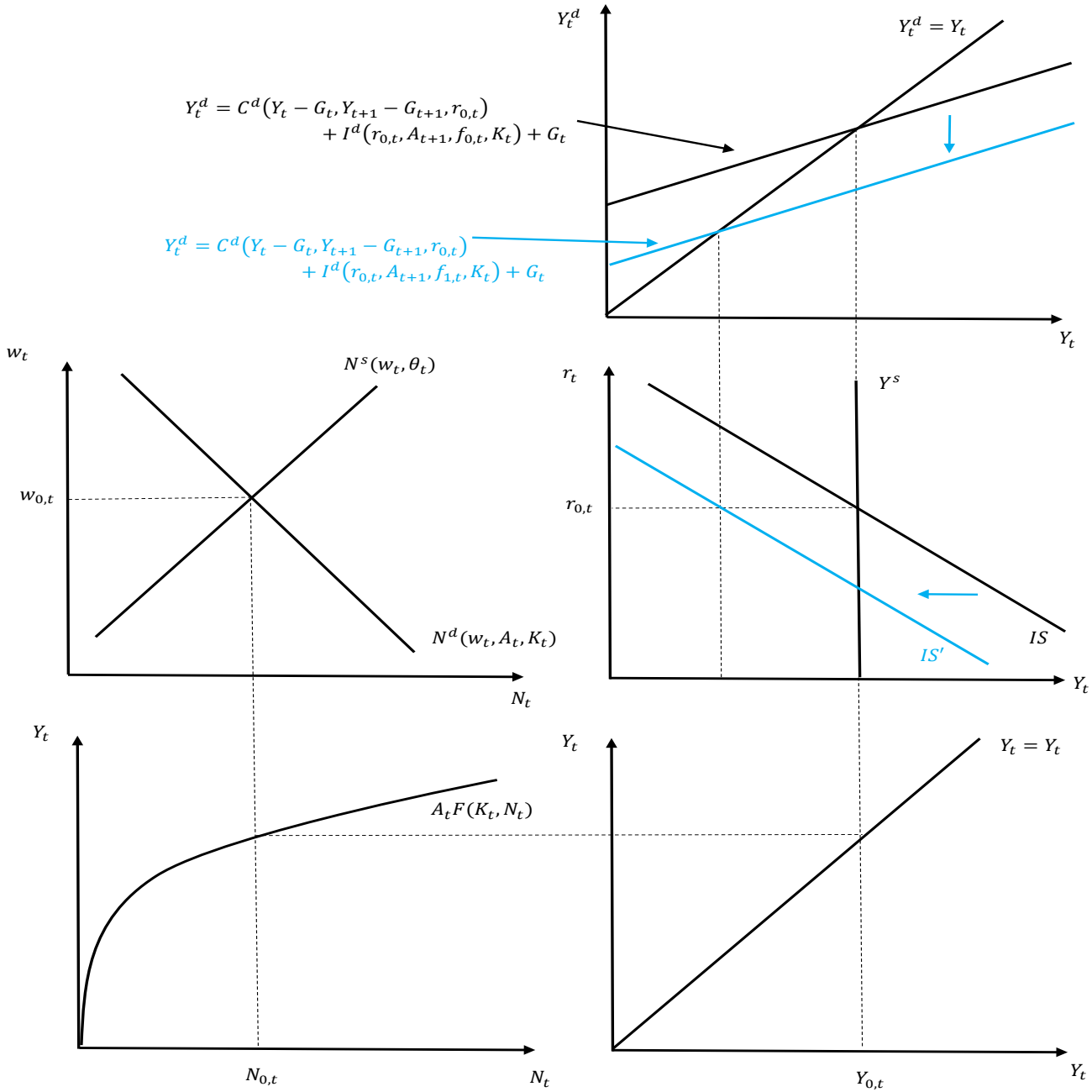
Supply Shock: $\uparrow A_t$
New Equilibrium



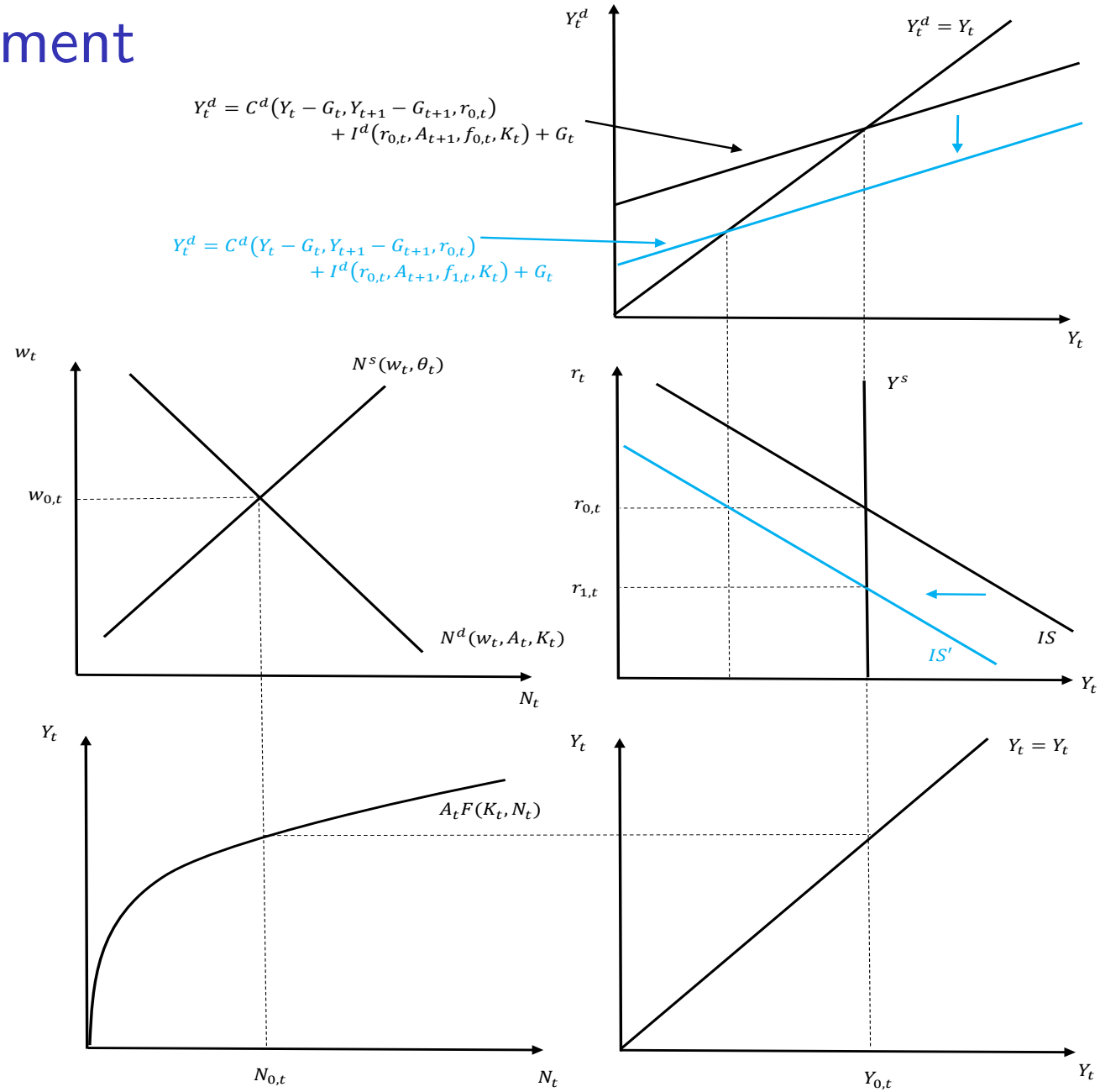
Demand Shock: $\uparrow f_t$
Initial Equilibrium



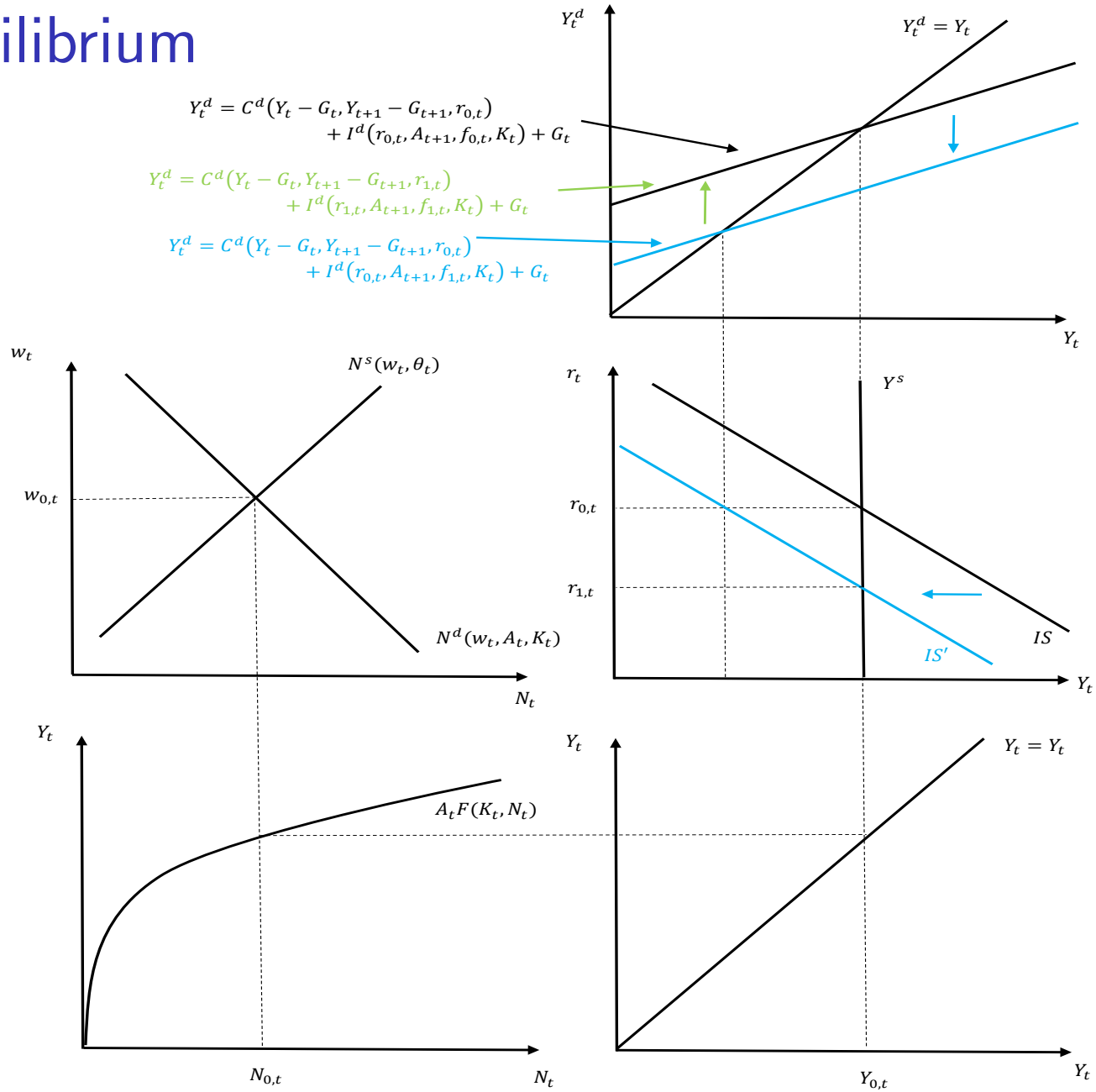
Demand Shock: $\uparrow f_t$
IS Shift



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 (i.e., ifinterest 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

	Exogenous Shock					
Variable	$\uparrow A_t$	$\uparrow \theta_t$	$\uparrow f_t$	$\uparrow A_{t+1}$	$\uparrow G_t$	$\uparrow G_{t+1}$
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)