Universitat Pompeu Fabra Barcelona

Macroeconomics I

(22104, Fall 2017,
Isaac Baley)

IS-LM in Open Economy

Part I: Goods market

Roadmap

1. **Overview of international trade**
   - Indicators
   - Trade Balance vs. Current Account

2. **Exchange rate**
   - Nominal vs. Real

3. **Goods Market in Open Economy**
   - IS Curve

4. **Effects of Policies**

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International trade has shaped history…

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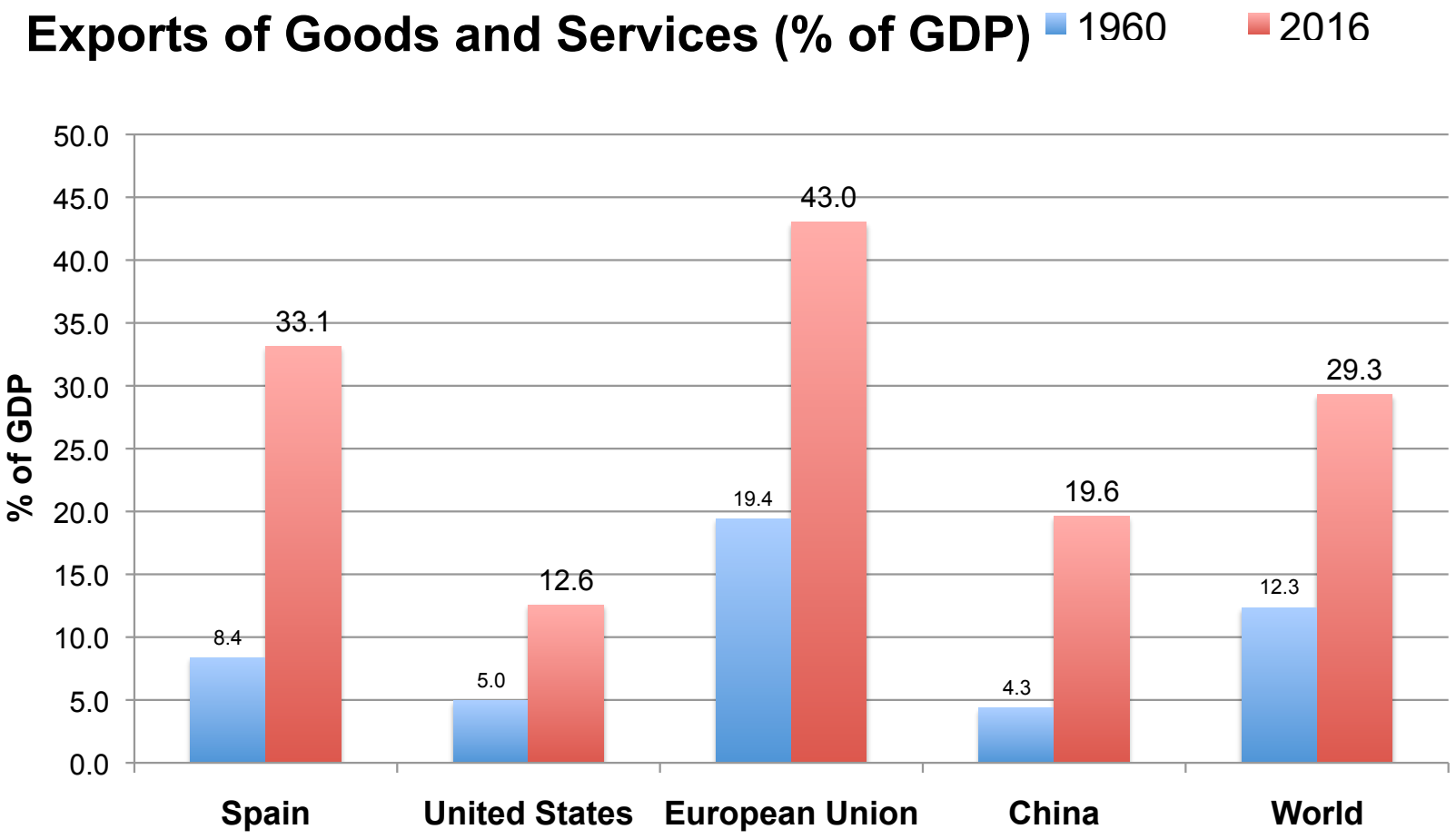
Some examples:

1. Silk road
2. America's discovery
3. British Empire
4. African's slavery
5. Creation of the European Union

The Open Economy

- Economies trade with one another …
- Trade is in goods, services and capital (financial assets).
- Trade has increased substantially over the last 30 years.

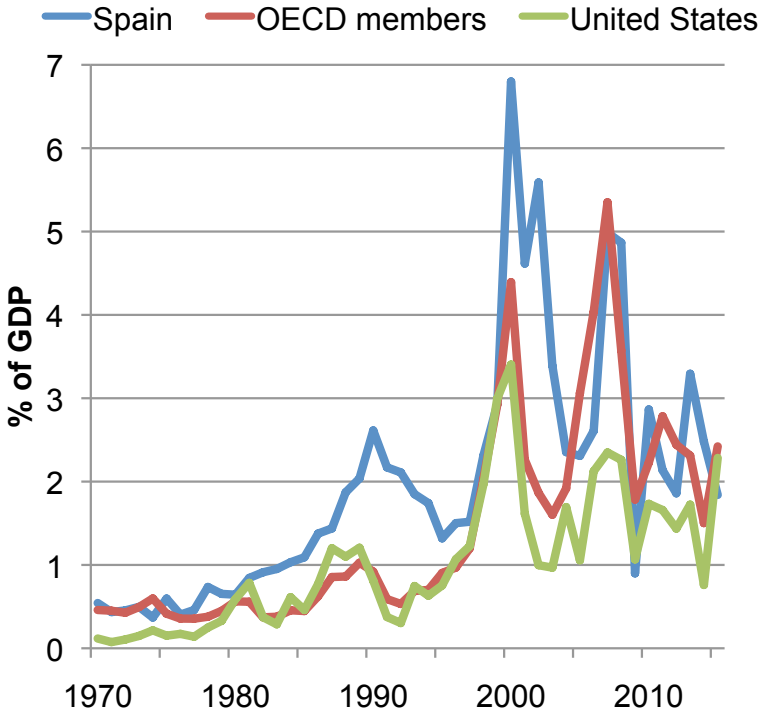
Dramatic increase in trade of goods and services



Source: The World Bank - World Development Indicators, Aug 2016

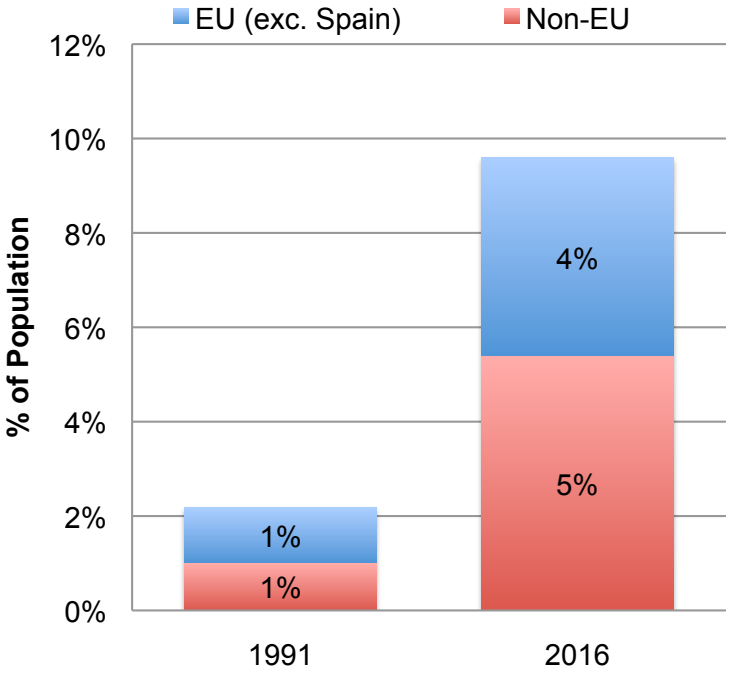
Other indicators of globalization

Foreign Direct Investment Net Inflow



Source: Eurostat.

Foreign Residents in Spain



Source: Spanish Institute of Statistics (INE)

Cross-border telephone calls:

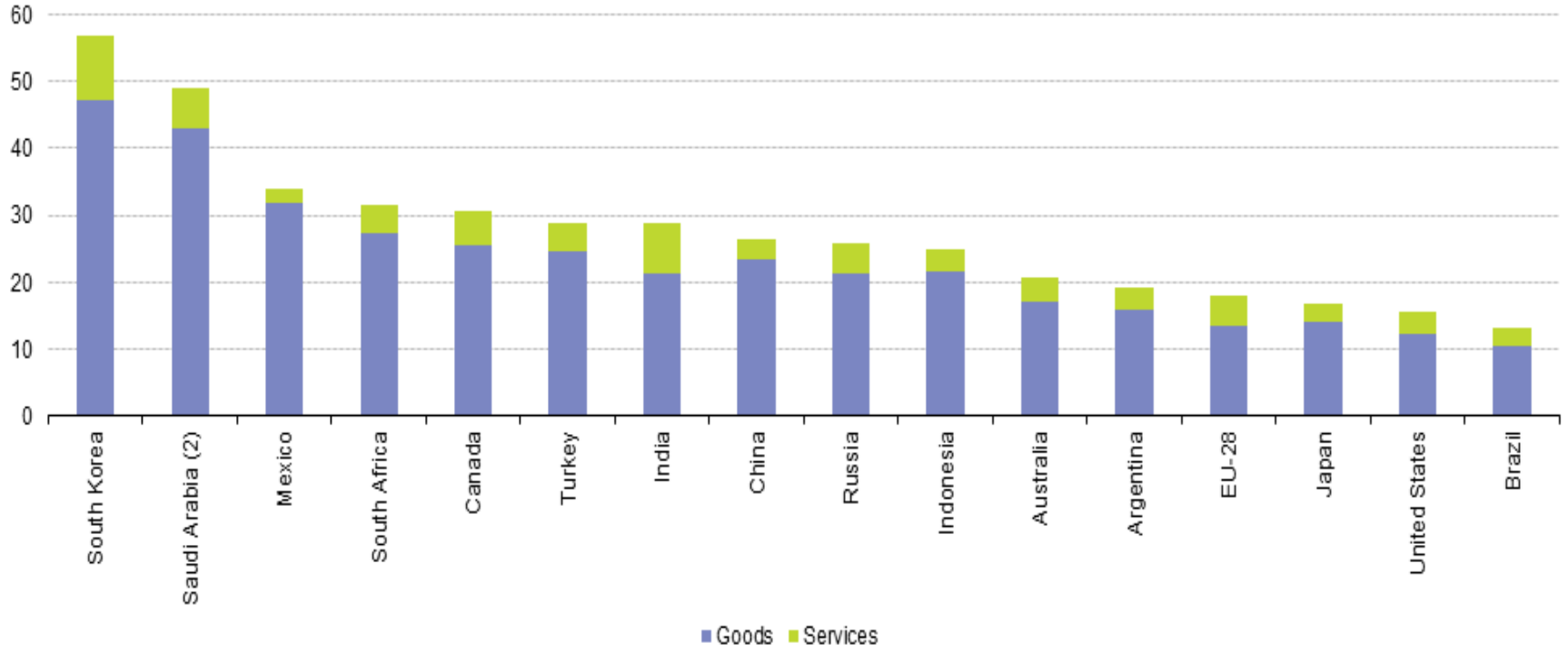
7.3 minutes per person in 1991 to **61.5 minutes per person** in 2012.

Foreign workers:

78 million (2.4% of world population) in 1965 to **213 million** (3.0% of world) in 2010.

Some countries are more open than others

$$\text{Openness} = \frac{\text{Exports + Imports}}{\text{GDP}}$$



(1) Average value of imports and exports relative to GDP. EU-28: extra-EU flows. Other countries: flows with the rest of the world.

(2) Goods: 2011.

Source: Eurostat (online data codes: bop_q_eu and nama_gdp_c), the World Bank (World Development Indicators, based on International Monetary Fund (Balance of Payments Statistics Yearbook and data files), World Bank and OECD (GDP estimates))

We will extend our IS-LM to account for:

Economic Integration: large flows of
- Goods and Services
- Capital
- Workers

What happens in one country affects other countries!

QUESTIONS we want to answer:

What are the consequences of opening the economy to imports, exports, foreign investment?

How do economic policies change in the open economy?

- Economic policies are (usually) decided at single country level
- Outcome of such policies depends on international trade

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Terminology

Current Account

1. Exports (X)	100	
2. Imports (IM)	150	
Trade Balance = (X) - (IM)		**-50**
3 Net Transfers	25	
Current Account Balance = CA (1-2+3)		**-25**

Capital Account

4. Increase in foreign holdings of domestic assets	75	
5. Increase in domestic holdings of foreign assets	50	
Capital account balance = KA (4-5)		**25**

Balance of Payments = CA + KA ≈ 0

Europe's current account balance

(with the rest of the world, 2004–2014, EUR billion)

	2008	2009	2010	2011	2012	2013	2014
EU-28 (²)	-301.3	-117.6	-108.7	-41.0	95.9	155.5	126.5
Euro area (EA-19) (²)	-151.9	-15.7	8.8	7.2	119.9	185.1	212.7
Belgium	-3.5	-3.8	6.4	-4.1	-2.8	-0.9	5.7
Bulgaria	:	:	-0.3	0.4	-0.1	0.8	0.4
Czech Republic	-3.1	-3.4	-5.7	-3.5	-2.5	-0.8	1.0
Denmark	6.4	7.6	13.8	14.1	14.1	18.2	15.9
Germany	143.3	141.1	145.1	164.6	187.3	182.0	219.7
Estonia	-1.4	0.4	0.3	0.2	-0.4	-0.2	0.0
Ireland	-10.7	-5.1	0.9	1.4	2.7	7.6	11.5
Greece	:	-25.8	-22.5	-20.6	-4.6	1.1	1.6
Spain	-103.3	-46.2	-42.4	-34.0	-3.0	15.1	8.5
France	-19.0	-16.1	-16.7	-21.2	-32.2	-30.3	-21.1
Croatia	-4.2	-2.3	-0.5	-0.4	-0.1	0.4	0.3
Italy	-46.3	-30.4	-55.7	-50.4	-8.2	15.0	31.2

Source: Eurostat

Q4

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NOMINAL Exchange Rate (currency)

Amount of **Domestic Currency** needed to buy 1 unit of **Foreign Currency**

US$1 = € 0.89 "It takes 0.89 Euros to buy 1 US Dollar"

Amount of **Foreign Currency** needed to buy 1 unit of **Domestic Currency**

€1 = US$ 1.12 "It takes 1.12 US Dollars to buy 1 Euro"

Nominal Exchange Rate: E
Price of 1 unit of Domestic Currency in terms of Foreign Currency

Examples: **€1 = $1.12** "It takes 1.12 US Dollars to buy 1 Euro"
€1 = £0.72 "It takes 0.72 British Pounds to buy 1 Euro"

E ↑ : Nominal Exchange Rate *Appreciates*
E ↓ : Nominal Exchange Rate *Depreciates*

REAL Exchange Rate (goods)

Price of **Domestic Goods** in terms of **Foreign Goods**

Aggregate Economy

P : Price Level in Domestic Economy (in Domestic Currency)

*P** : Price Level in Foreign Economy (in Foreign Currency)

E : Nominal Exchange Rate

P x E : Domestic Price Level in Foreign Currency

Real Exchange Rate: $\varepsilon = \frac{P \times E}{P^*}$

$\varepsilon \uparrow$: Real Appreciation

$\varepsilon \downarrow$: Real *Depreciation*

Example: Cheese market (ton)

Manchego = € 5000
Cheddar = US$ 1867
Nominal Exchange Rate: *E* = $1.12 / € 1

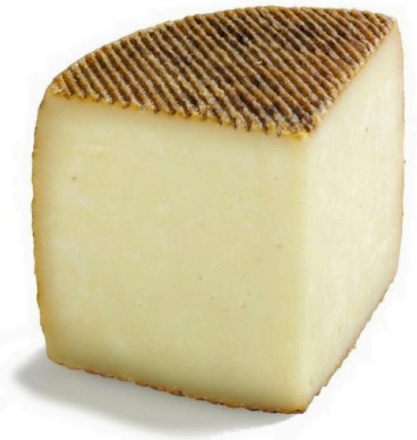
What is the price of Cheddar in terms of a Manchego?

- Step A: express price of Manchego in USD

- Step B: compare prices in the same currency

"It takes X tons of Cheddar to buy 1 ton of Manchego"

Example: Cheese market (ton)



Manchego = € 5000
Cheddar = US$ 1867
Nominal Exchange Rate: *E* = $1.12 / € 1

What is the price of Cheddar in terms of a Manchego?

- Step A: express price of Manchego in USD

$$5000 € \times E = 5000€ \times \$1.12 / € 1 = \$5600$$

- Step B: compare prices in the <u>same currency</u>

$$\varepsilon_{CHEDDAR/MANCHEGO} = \$5{,}600 / \$1{,}867 = 3$$

"It takes 3 tons of Cheddar to buy 1 ton of Manchego"

Example: Big Mac Index

Published by The Economist.

The Big Mac index

	Big Mac prices*		Implied PPP† of the dollar	Actual dollar exchange rate July 21st	Under(-)/over(+) valuation against the dollar, %
	in local currency	in dollars			
United States‡	$ 3.73	3.73			
Argentina	Peso 14.0	3.56	3.75	3.93	-5
Australia	A$ 4.35	3.84	1.17	1.13	3
Brazil	Real 8.71	4.91	2.33	1.77	31
Britain	£ 2.29	3.48	1.63 §	1.52 §	-7
Canada	C$ 4.17	4.00	1.12	1.04	7
Chile	Peso 1,750	3.34	469	524	-10
China	Yuan 13.2	1.95	3.54	6.78	-48

Q5

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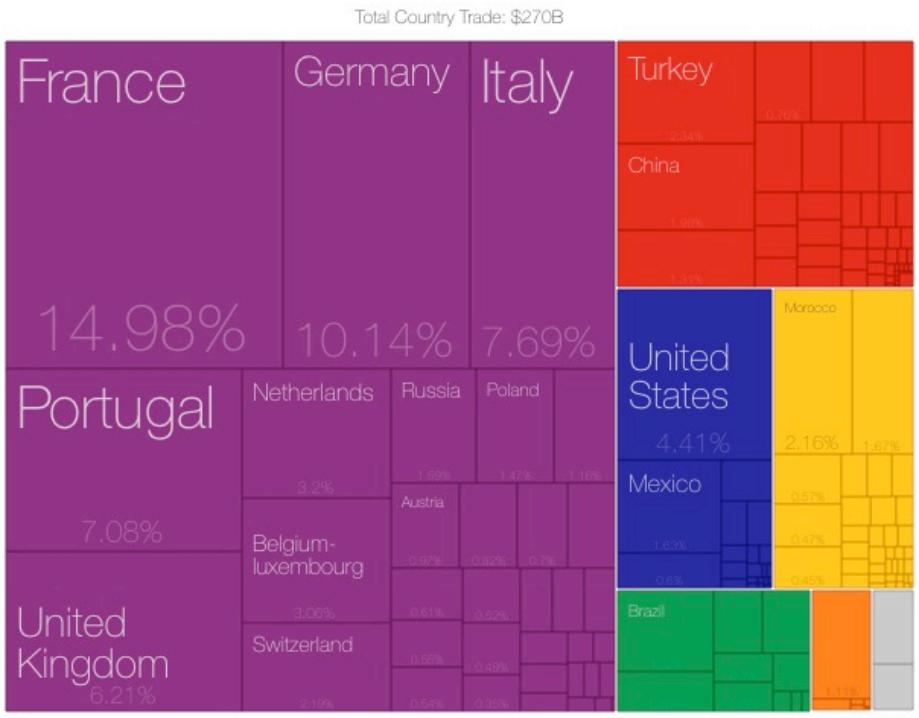
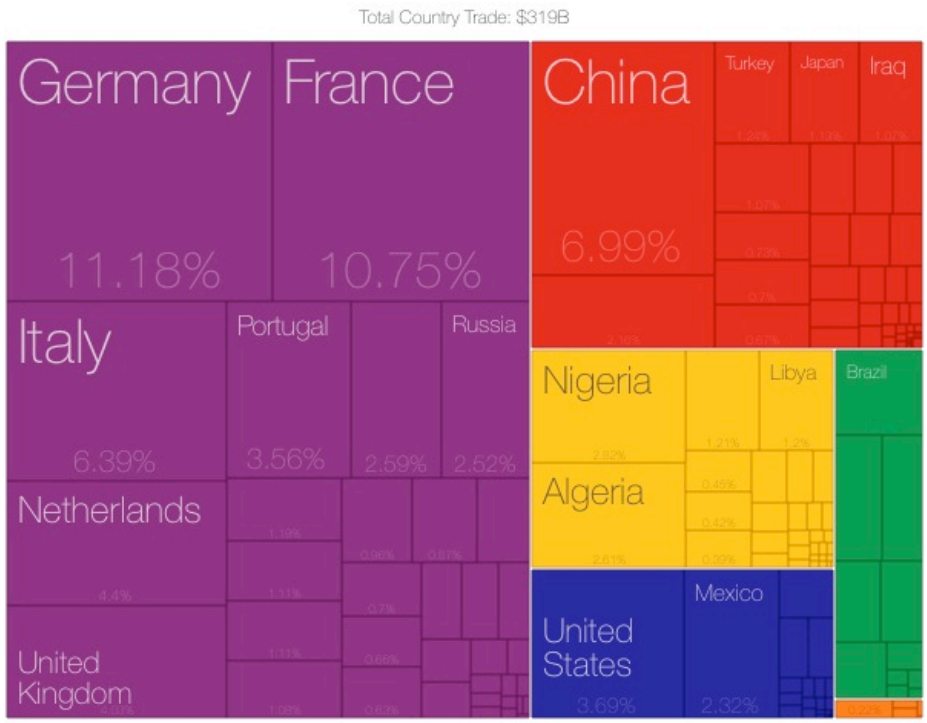
   - Domestic vs. Foreign

Spanish trade flows (by country)

Export destination



Import origins



More on exports and imports: https://atlas.media.mit.edu

Market for Goods

- Domestic Demand: demand for goods from

Domestic Consumers	Domestic Firms	Government
C	*I*	*G*

- Domestic Supply: supply of goods from

Domestic Producers *Y*

Closed Economy: Domestic Supply = Domestic Demand

$$Y = C + I + G$$

Open Economy: Domestic Supply ≠ Domestic Demand

What is the Equilibrium Equation?

Market for Goods

- Domestic Demand: satisfied by
  $D = C + I + G$
  - Domestic Goods
  - Foreign Goods — **Imports (IM)**

- Domestic Supply: sold to
  Y
  - Domestic Buyers
  - Foreign Buyers — **Exports (X)**

Equilibrium in the Market for Goods in Open Economy:

Total Supply of Domestic Goods = Total Demand for Domestic Goods

Y Z

Market for Goods

How to get *Z (Total demand of domestic goods)*?

Step 1: Find *A* domestic demand satisfied by domestic goods

Domestic Demand	-	Domestic Demand Satisfied by Foreign Goods	=	Domestic Demand Satisfied by Domestic Goods
$D = C + I + G$		IM		A

Step 2: Add *X* exports

Domestic Demand Satisfied by Domestic Goods	+	Foreign Demand for Domestic Goods	=	Total Demand for Domestic Goods
A		X		Z

$$Z = A + X = C + I + G + X - IM$$

Equilibrium in the Market for Goods in Open Economy

Total Supply of Domestic Goods = Total Demand for Domestic Goods

$$Y = C + I + G + (X - IM)$$

Equilibrium in the Market for Goods in Open Economy

Total Supply of Domestic Goods = Total Demand for Domestic Goods

$$Y = C + I + G + (X - IM)$$

- We need to correct small imprecision

C + *I* + *G*: measured in domestic goods

X : measured in domestic goods

IM : measured in foreign goods

IM x *1/ε* : measured in domestic goods

$$Y = C + I + G + (X - IM / \varepsilon)$$

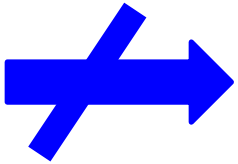
Properties of Equilibrium in Open Economy

- Remember: Focus on Short Run (Prices fixed)
- Output is determined by **demand**
- Effects of policy depend on how domestic demand affects domestic supply

➢ **Closed Economy:**

Domestic Demand  Domestic Supply

➢ **Open Economy**

Domestic Demand  Domestic Supply

Determinants of *Z (Total demand for domestic goods)*

- **Domestic Demand**

$$D = C\,(Y\text{-}T) + I(Y,r) + G$$

$$\qquad\quad\;\; {\scriptstyle +} \qquad\quad\;\; {\scriptstyle +\ -}$$

Determinants of *Z (Total demand for domestic goods)*

- **Domestic Demand**

$$D = \underset{+}{C}(Y\text{-}T) + \underset{+\ -}{I}(Y,r) + G$$

- **Demand for Imports**

$$IM = IM\left(\underset{+}{Y}, \underset{+}{\varepsilon}\right)$$

Higher domestic income *Y* means higher demand for goods, including foreign goods.

Higher real exchange rate means higher demand for foreign goods.

Determinants of *Z (Total demand for domestic goods)*

- **Domestic Demand**

$$D = \underset{+}{C}(Y\text{-}T) + \underset{+\ -}{I}(Y,r) + G$$

- **Demand for Imports**

$$IM = IM\left(\underset{+}{Y}, \underset{+}{\varepsilon}\right)$$

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- **Demand for Exports**

$$X = X\left(\underset{+}{Y^*}, \underset{-}{\varepsilon}\right)$$

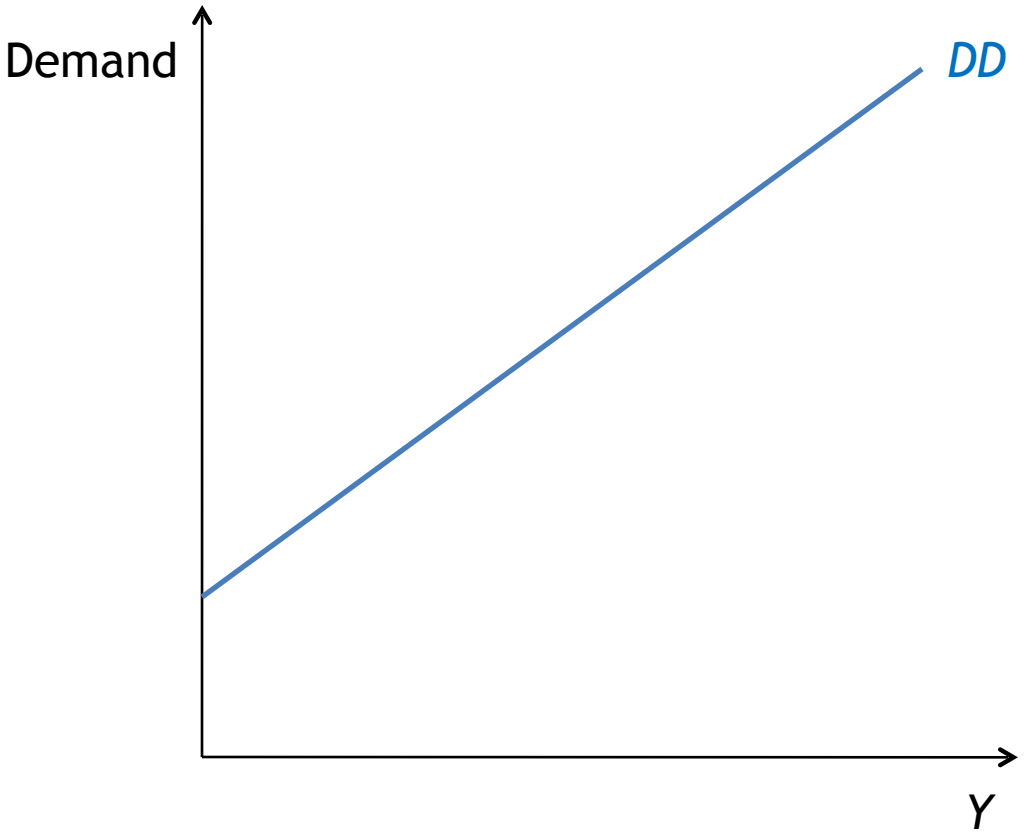
Higher foreign income Y^* means higher demand for goods, including domestic goods.

Higher real exchange rate means lower demand for domestic goods.

Market for Goods

DD : *C* (*Y*-*T*) + *I* (*Y* ,*r*) + *G*

- Increasing in *Y*



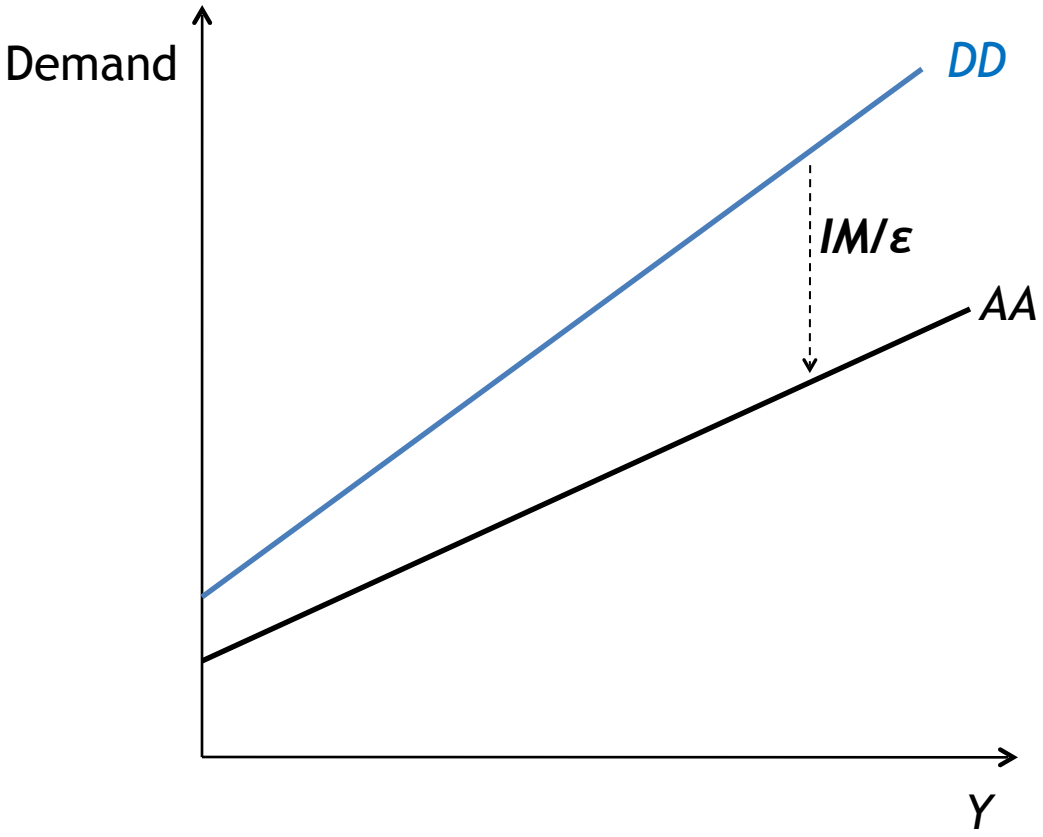
Market for Goods

DD : *C* (*Y*-*T*) + *I* (*Y* ,*r*) + *G*

- Increasing in *Y*

AA : *DD* - *IM* (*Y* , *ε*)

- Flatter than *DD*



Market for Goods

DD : $C(Y-T) + I(Y, r) + G$

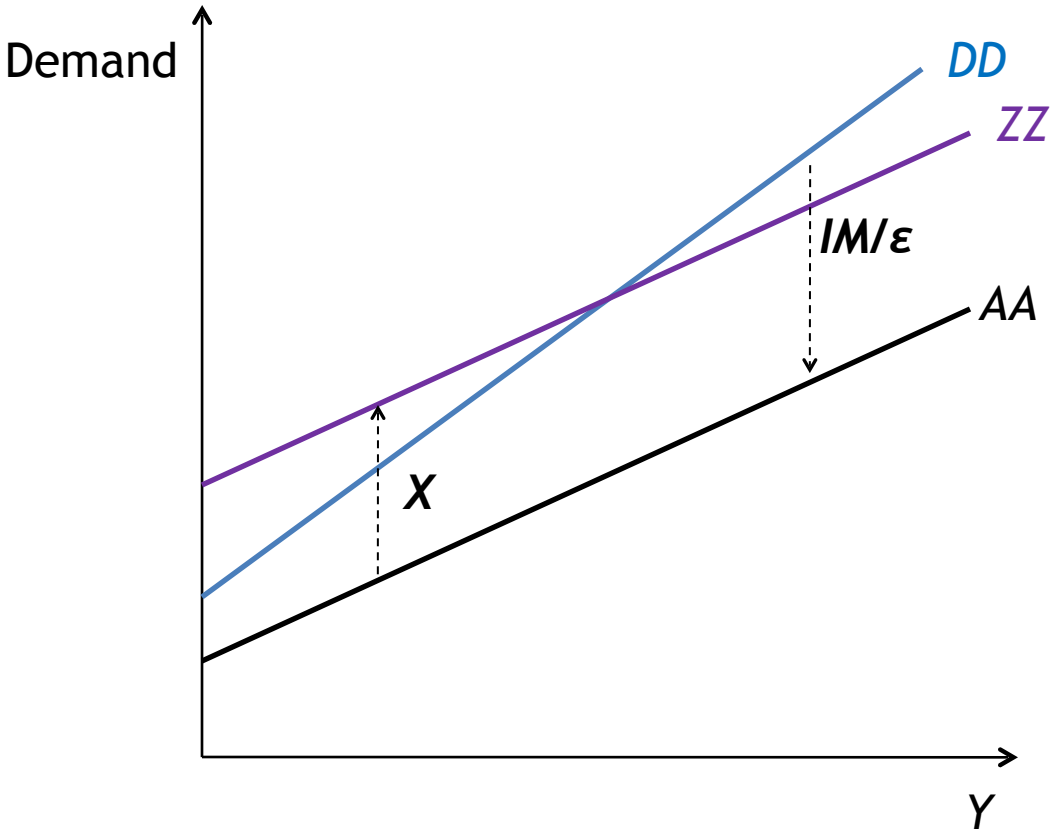
- Increasing in *Y*

AA : $DD - IM(Y, \varepsilon)$

- Flatter than *DD*

ZZ : $AA + X(Y^*, \varepsilon)$

- Parallel to *AA*



Market for Goods

$DD : C(Y-T) + I(Y, r) + G$

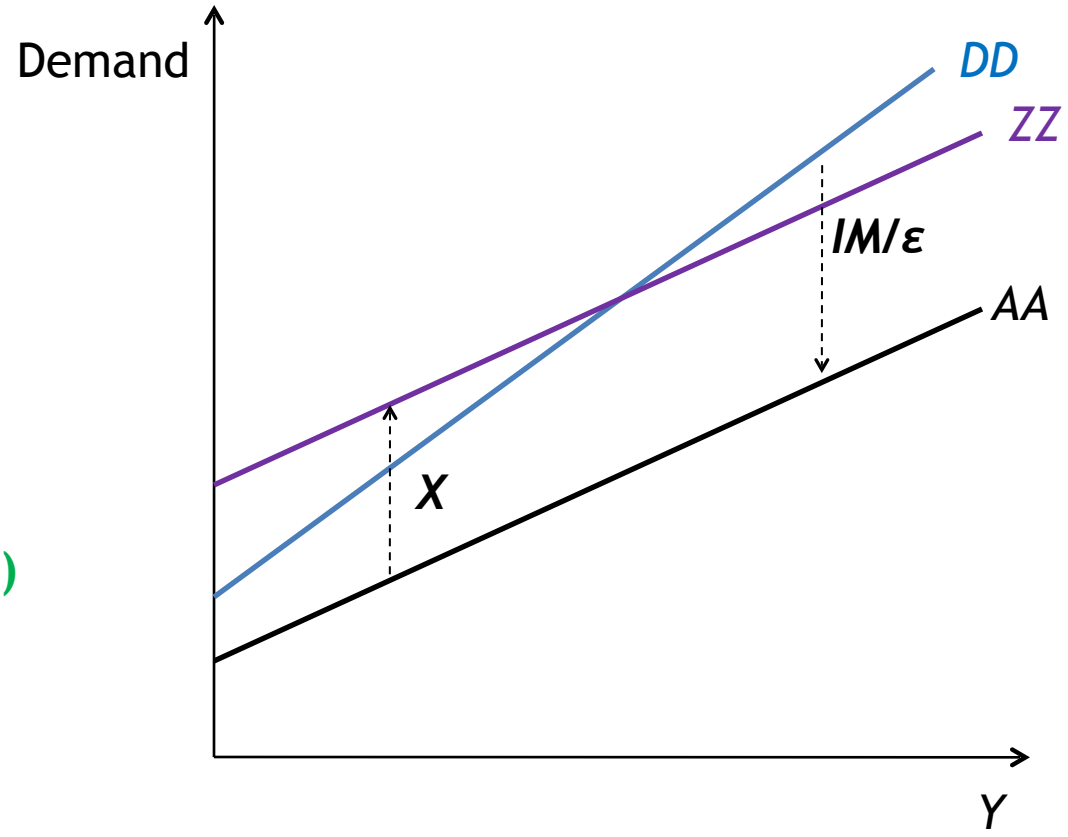
$AA : DD - IM(Y, \varepsilon)$

$ZZ : AA + X(Y^*, \varepsilon)$

Trade Balance (Net Exports)

$NX = X - IM/\varepsilon$

- If $ZZ > DD$ then $NX > 0$
- If $ZZ < DD$ then $NX < 0$
- If $ZZ = DD$ then $NX = 0$



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Trade Balance (Net Exports)

$NX = X - IM/\varepsilon$

- If $ZZ > DD$ then $NX = X - IM/\varepsilon > 0$
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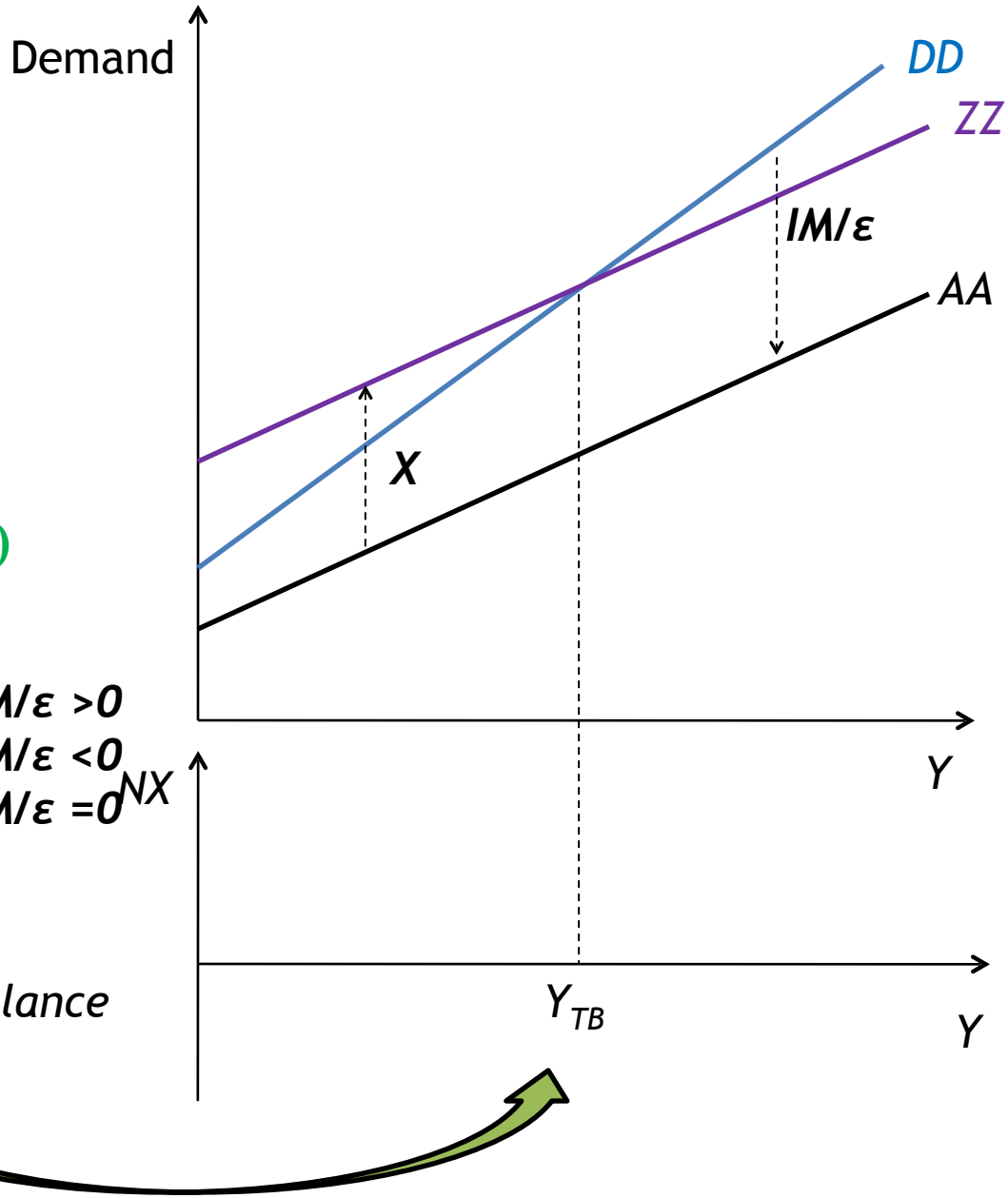

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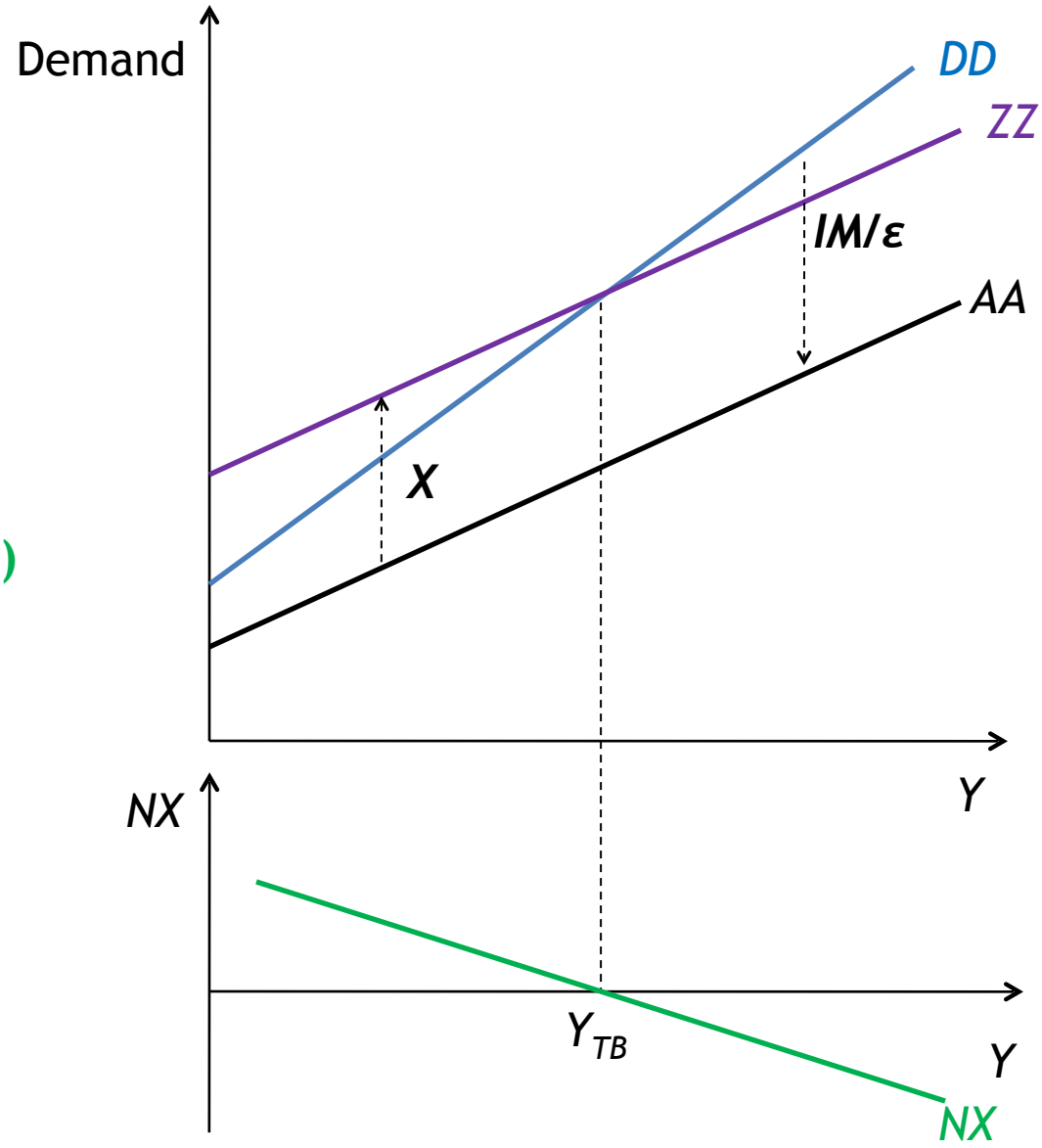

Market for Goods

$DD : C(Y-T) + I(Y, r) + G$

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Trade Balance (Net Exports)

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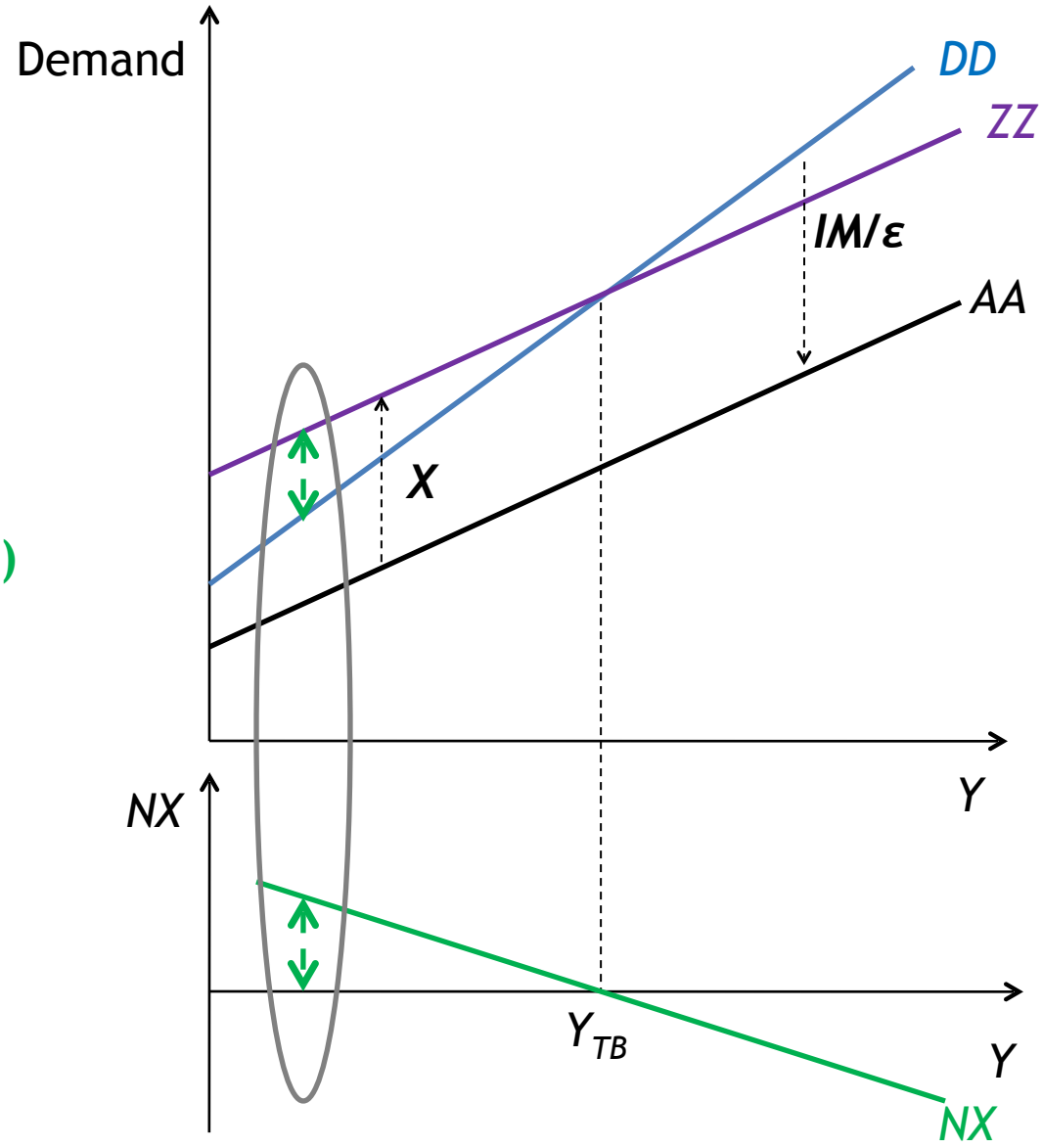

Trade Surplus

Market for Goods

$DD : C(Y-T) + I(Y, r) + G$

$AA : DD - IM(Y, \varepsilon)$

$ZZ : AA + X(Y^*, \varepsilon)$

Trade Balance (Net Exports)

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- If $ZZ > DD$ then $NX > 0$
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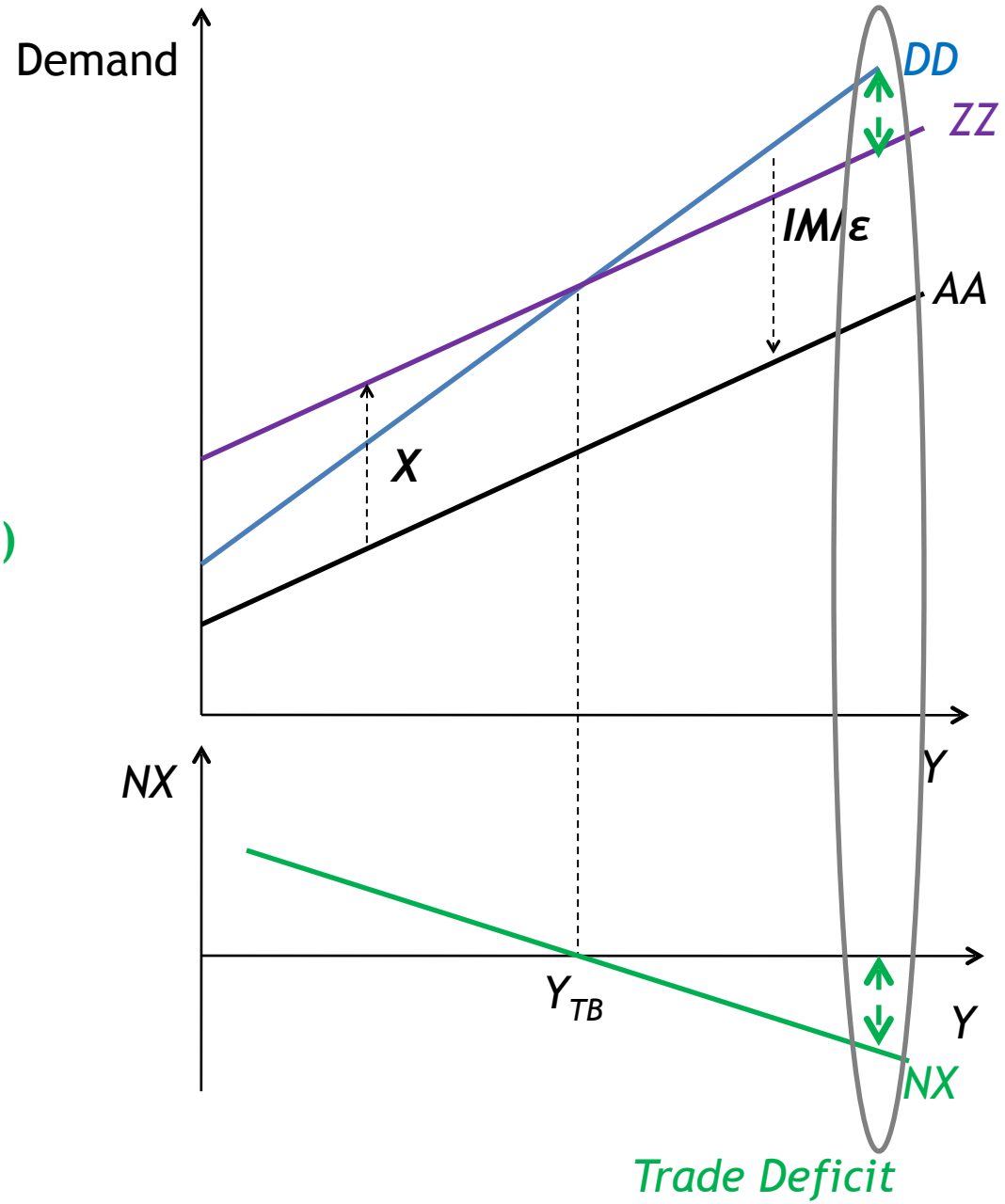

Market for Goods

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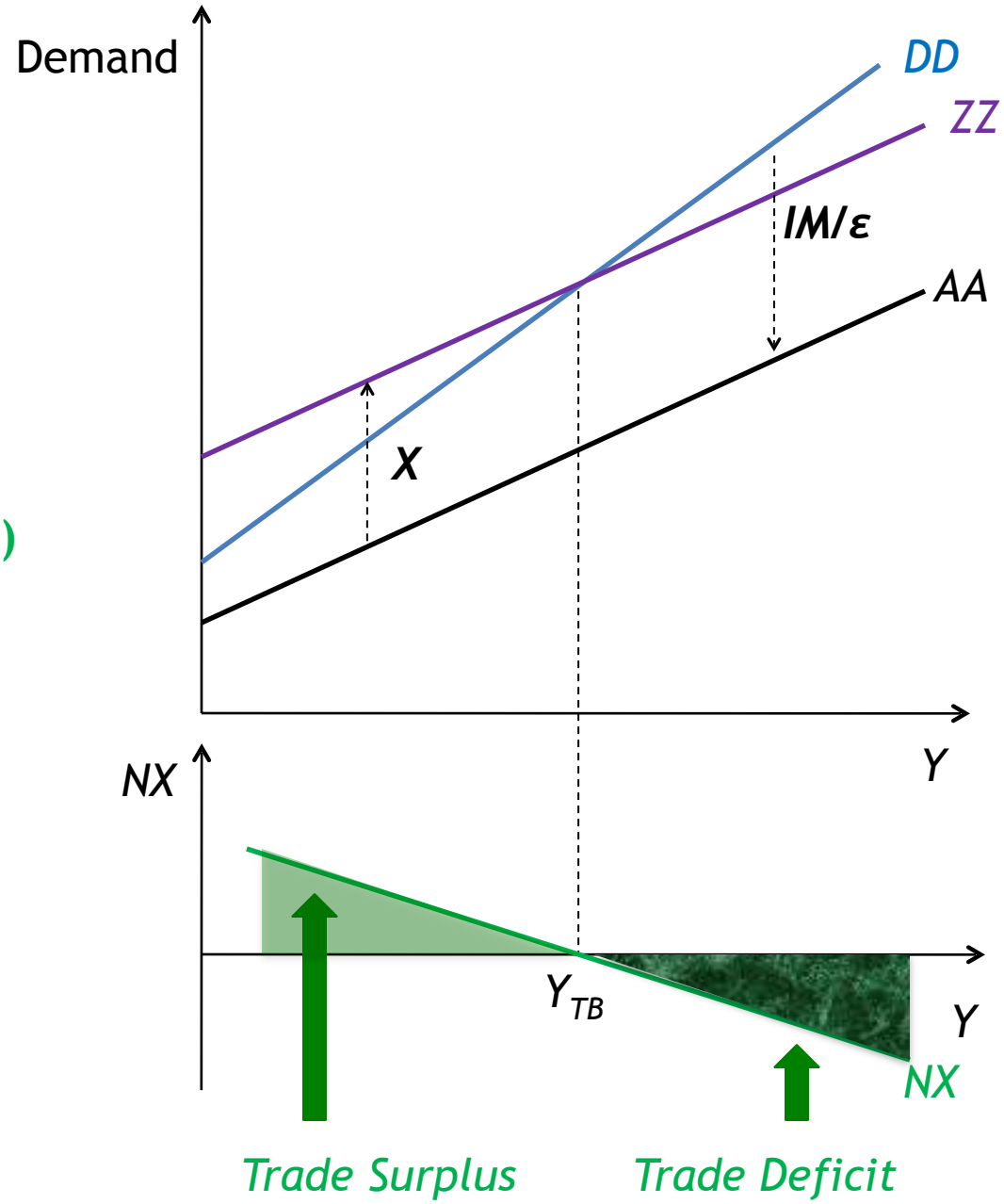

Market for Goods

$DD : C\,(Y-T) + I\,(Y, r) + G$

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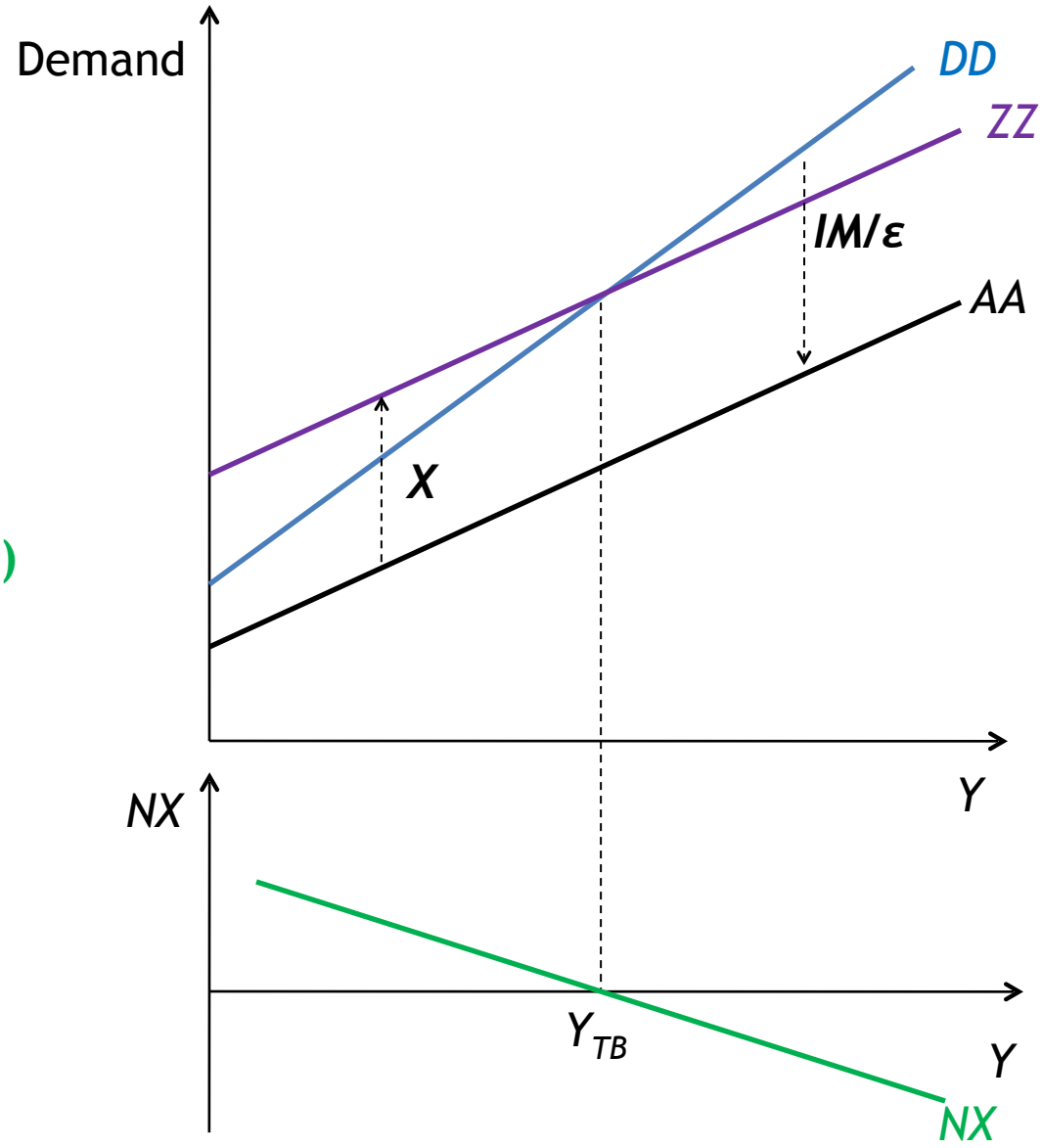


NET EXPORTS

- **Net Exports (Trade Balance)**

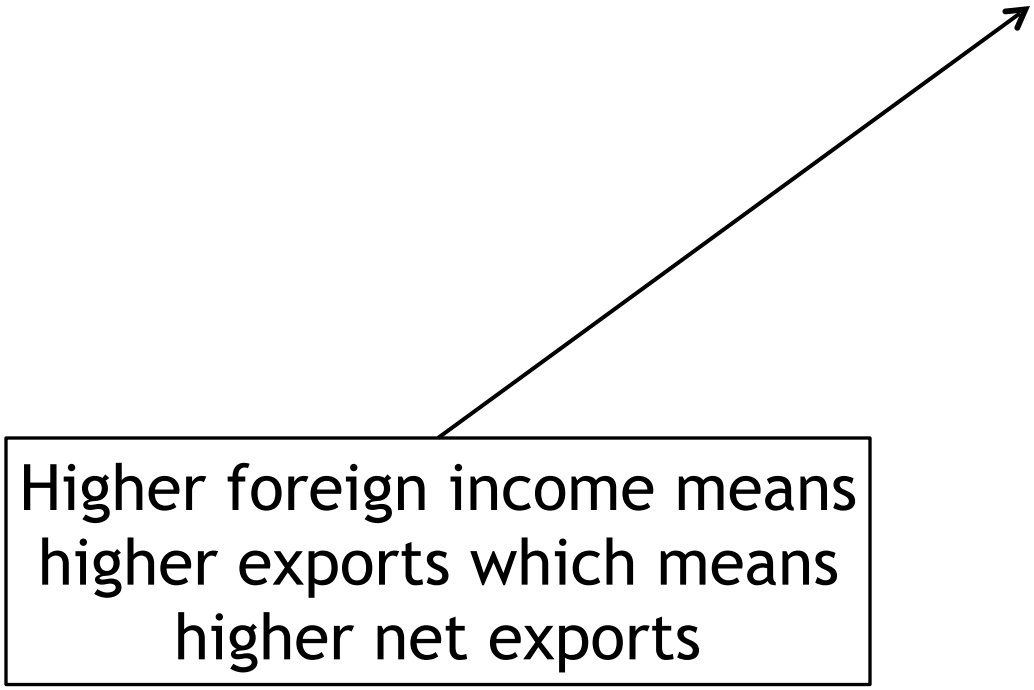
$$NX = X\left(\underset{+}{Y^*}, \underset{-}{\varepsilon}\right) - IM\left(\underset{+}{Y}, \underset{+}{\varepsilon}\right) \quad \varepsilon = NX\left(\underset{-}{Y}, \underset{+}{Y^*}, \underset{?}{\varepsilon}\right)$$

Higher domestic income means higher imports which means lower net exports

NET EXPORTS

- **Net Exports (Trade Balance)**

$$NX = X\left(\underset{+}{Y^*}, \underset{-}{\varepsilon}\right) - IM\left(\underset{+}{Y}, \underset{+}{\varepsilon}\right) \quad \varepsilon = NX\left(\underset{-}{Y}, \underset{+}{Y^*}, \underset{?}{\varepsilon}\right)$$



NET EXPORTS

- **Net Exports (Trade Balance)**

$$NX = X\left(\underset{+}{Y^*}, \underset{-}{\varepsilon}\right) - IM\left(\underset{+}{Y}, \underset{+}{\varepsilon}\right) / \varepsilon = NX\left(\underset{-}{Y}, \underset{+}{Y^*}, \underset{?}{\varepsilon}\right)$$

Multiple effects of a change in the real exchange rate.

Suppose $\varepsilon \downarrow$ (real depreciation)

A. Domestic goods are cheaper, so $X \uparrow$ and $NX \uparrow$
B. Foreign goods are more expensive, so $IM \downarrow$ and $NX \uparrow$
C. Foreign goods are worth more in terms of domestic goods, $1/\varepsilon \uparrow$, so $NX \downarrow$

Overall effect of a real depreciation (or real appreciation) is **ambiguous.**

NET EXPORTS

- **Net Exports (Trade Balance)**

$$NX = X\underset{+}{\left(Y^{*}, \underset{-}{\varepsilon}\right)} - IM\left(\underset{+}{Y}, \underset{+}{\varepsilon}\right) \quad \varepsilon = NX\left(\underset{-}{Y}, \underset{+}{Y^{*}}, \underset{-}{\varepsilon}\right)$$

Ambiguity resolved by assuming:

Marshall-Lerner Conditions (MLC)

Elasticities of Demand for Imports and Exports with respect to ε are such that

- When $\varepsilon \downarrow$ then $NX \uparrow$
- When $\varepsilon \uparrow$ then $NX \downarrow$

If MLC holds, then NX depend negatively on ε .

How do we find the equilibrium of goods market?

Use 45^0 line to find:

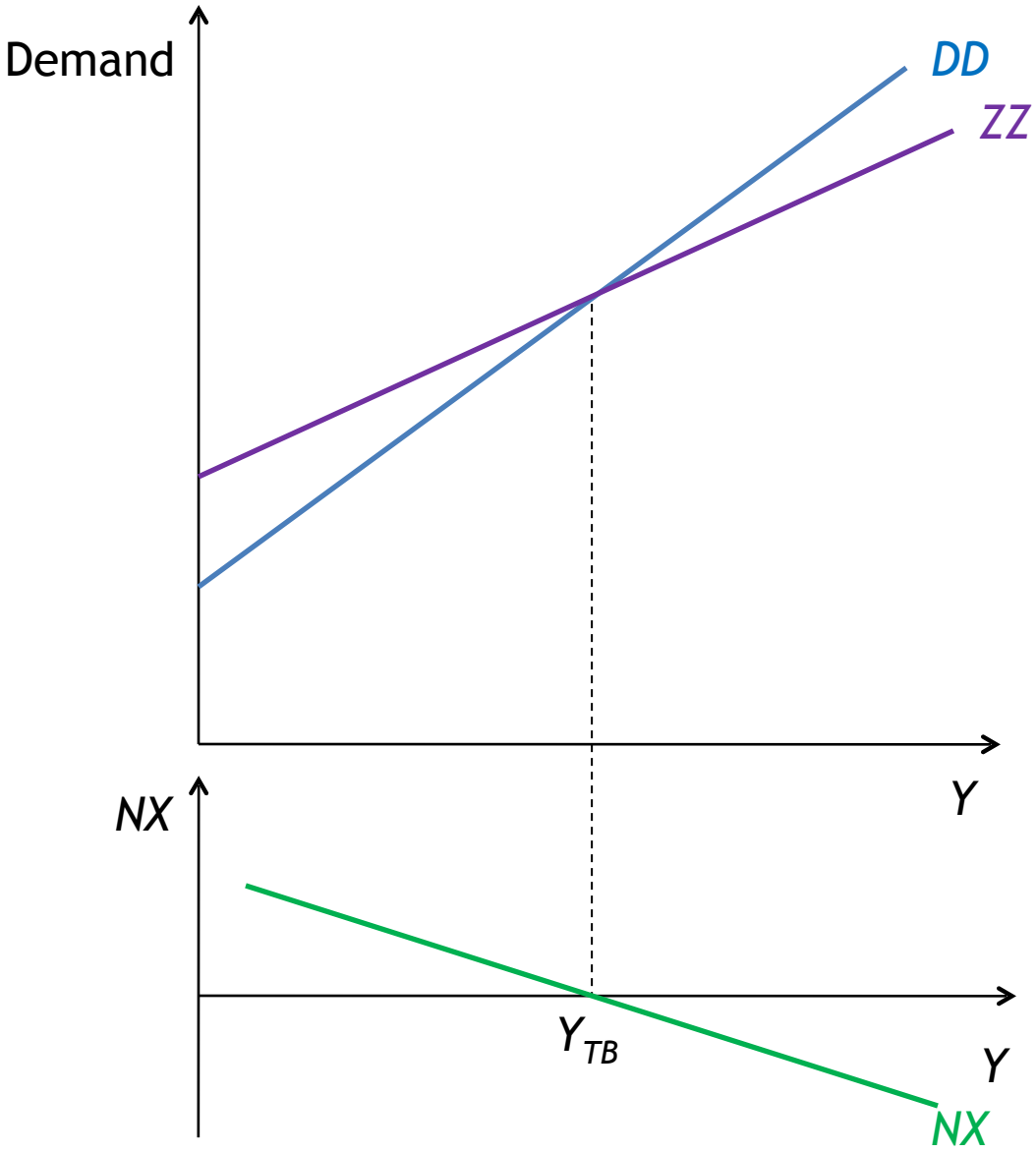
$$Y = Z$$

Total Supply of **Domestic** Goods = Total Demand for **Domestic** Goods

IMPORTANT: FOR NOW WE ASSUME INTEREST RATE IS FIXED….

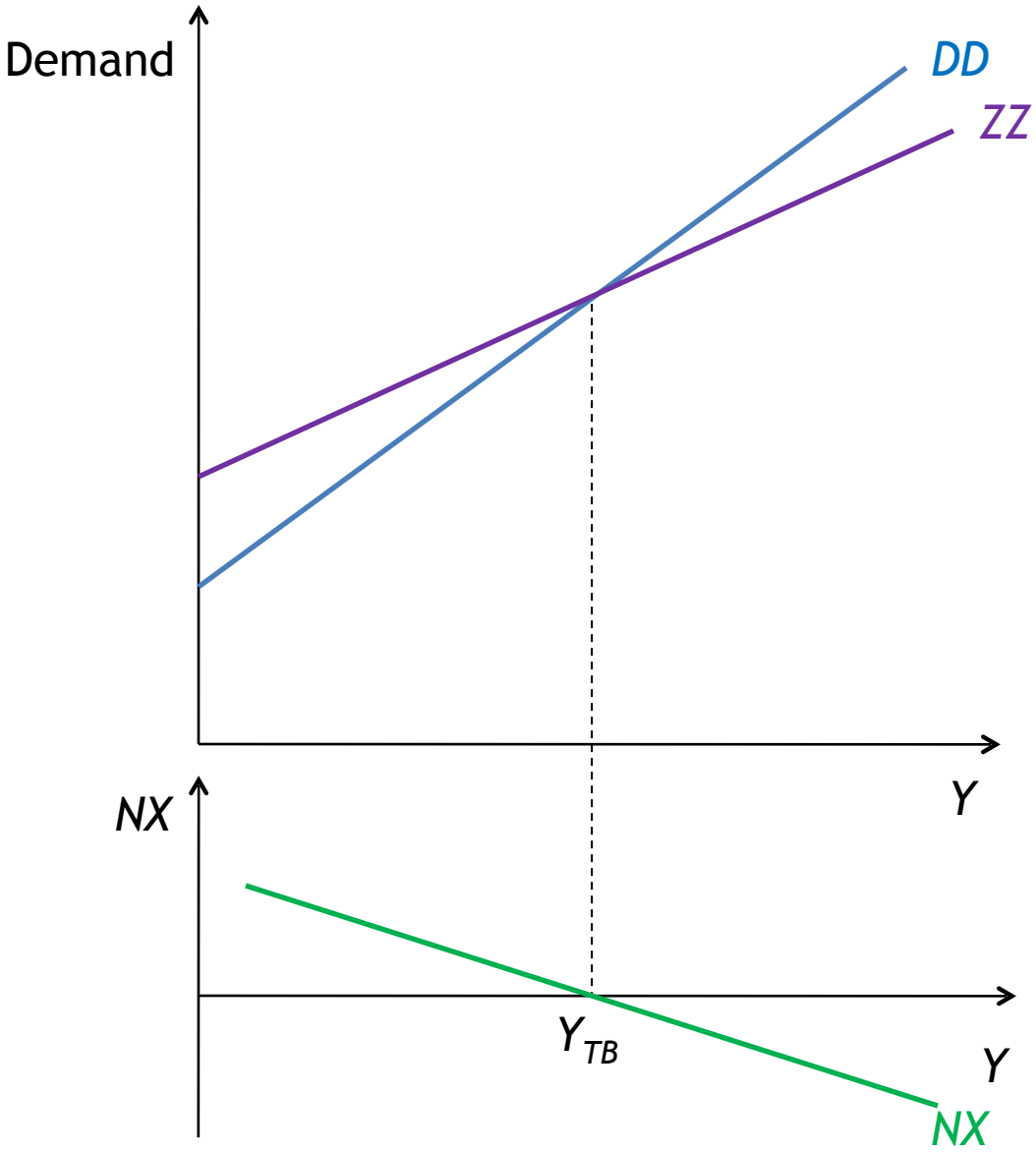
Equilibrium in the Open Economy: Market for Goods

Equilibrium?



Equilibrium in the Open Economy: Market for Goods

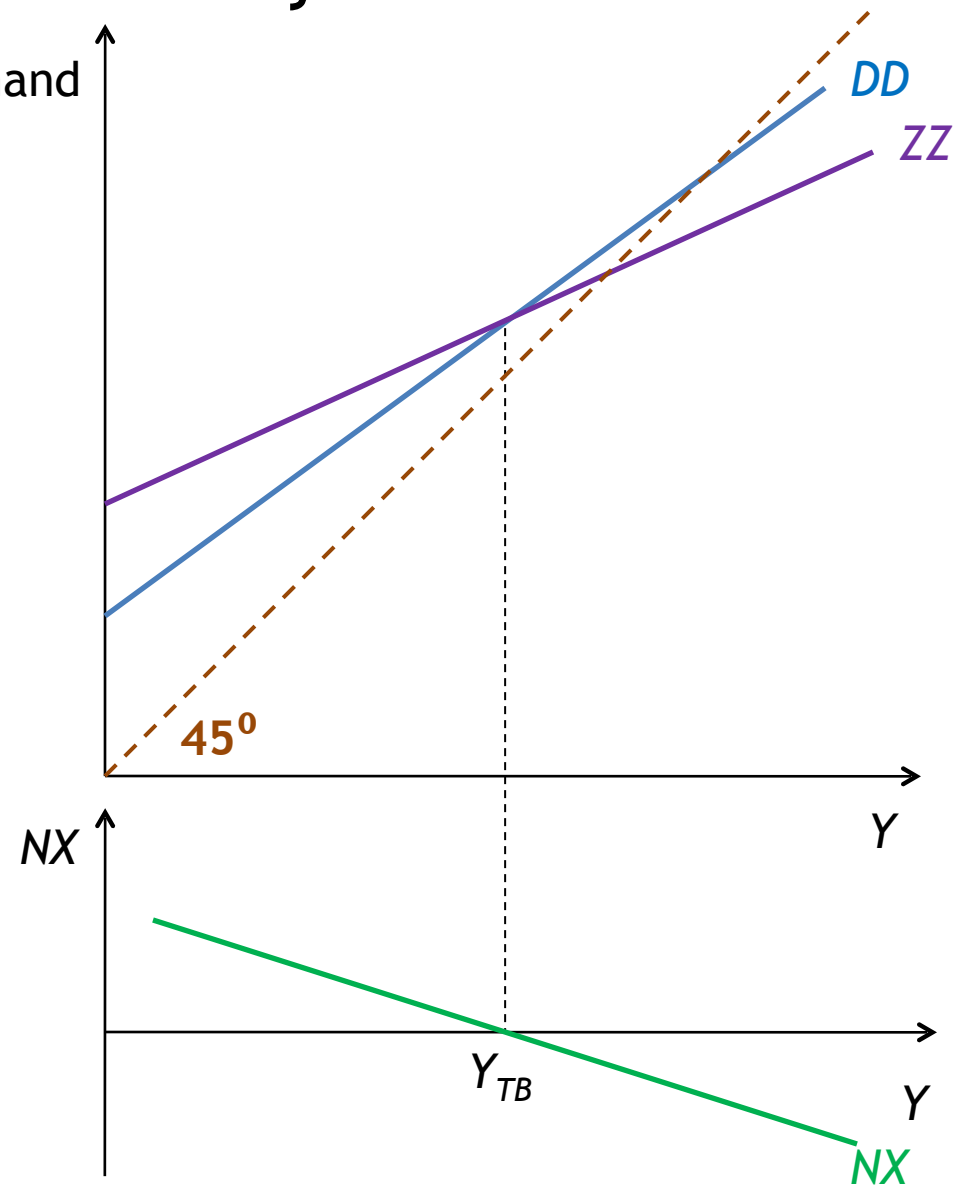
Equilibrium: $Y = Z$



Equilibrium in the Open Economy: Market for Goods

Equilibrium: $Y = Z$

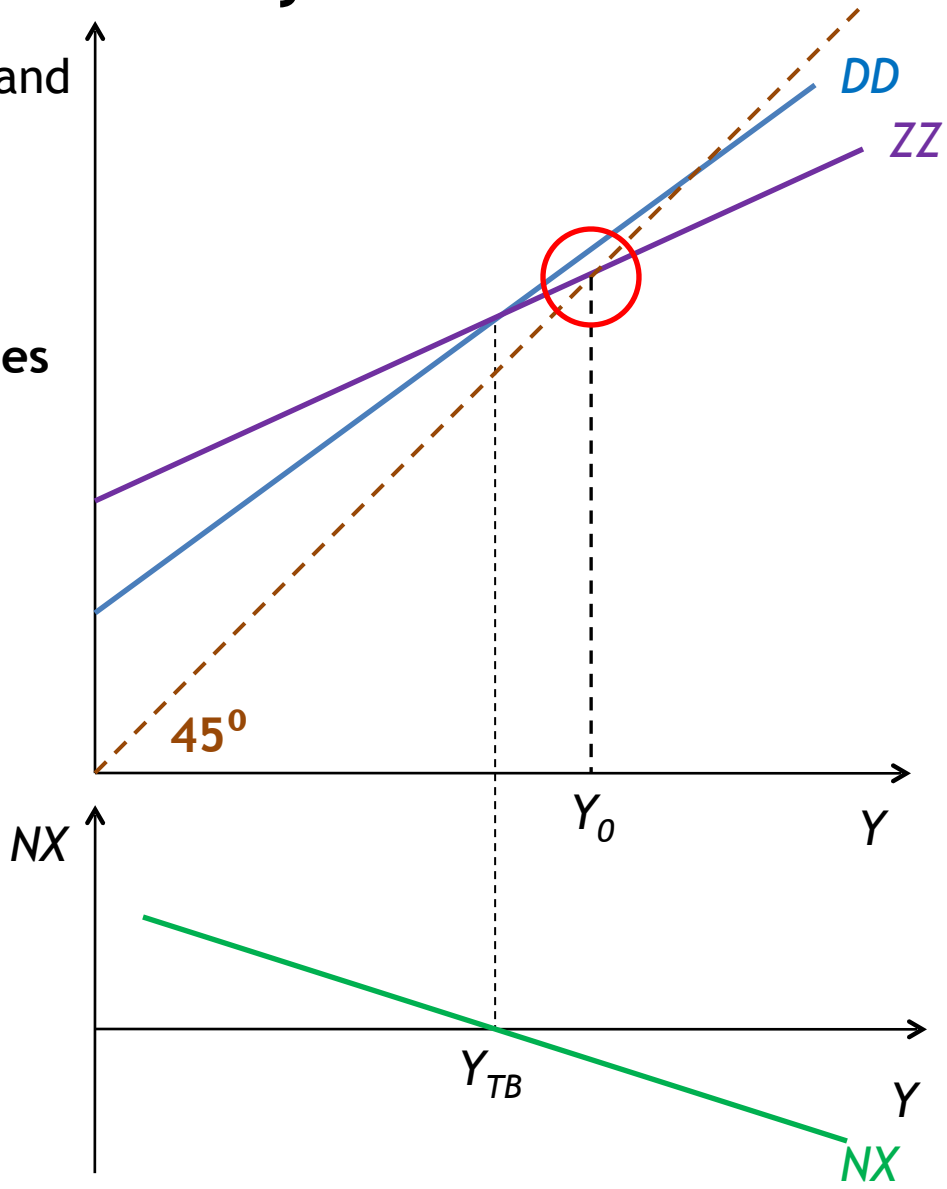
1. **Draw the 45^0 line**



Equilibrium in the Open Economy: Market for Goods

Equilibrium: $Y = Z$

1. Draw the 45^0 line
2. Determine Y_0 where ZZ crosses the 45^0 line.



Equilibrium in the Open Economy: Market for Goods

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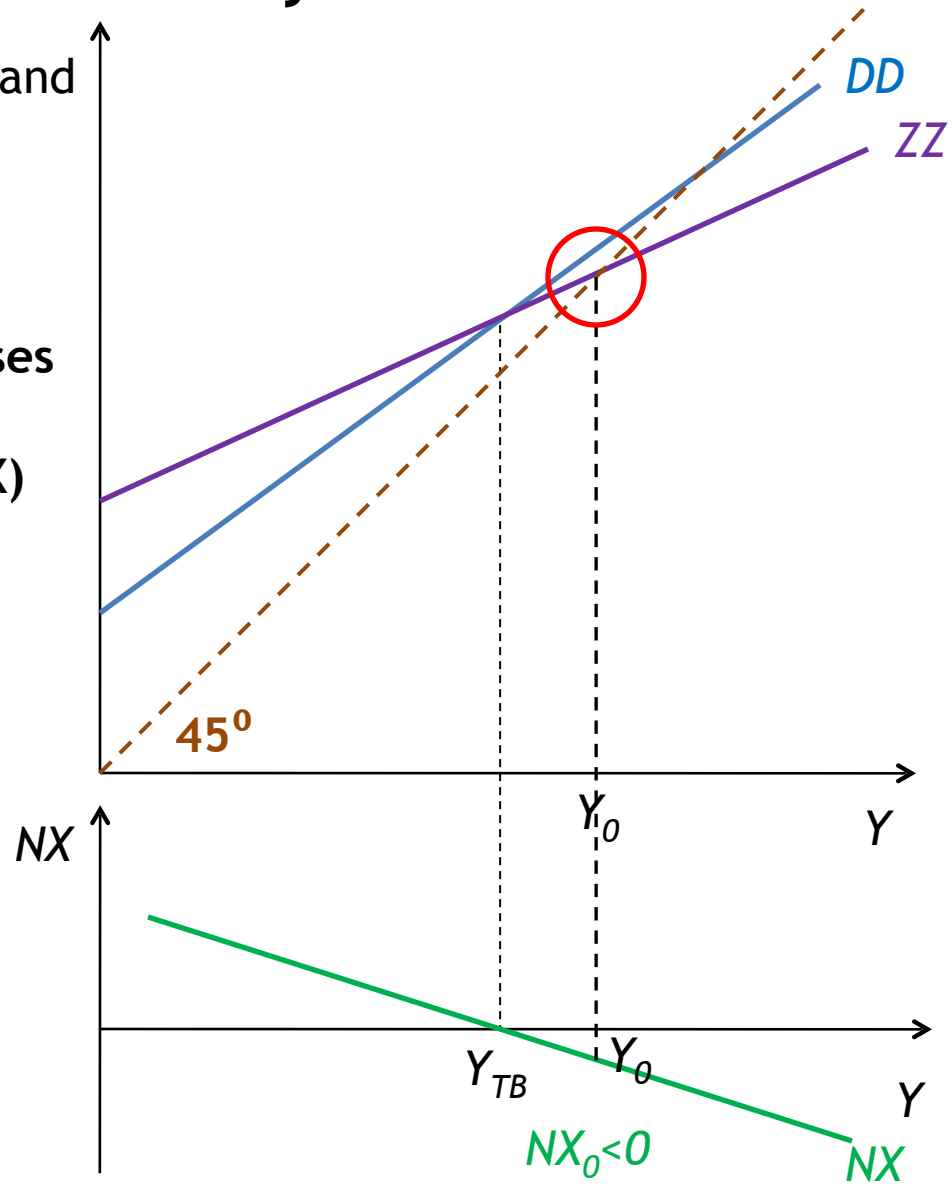

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1. Draw the 45^0 line
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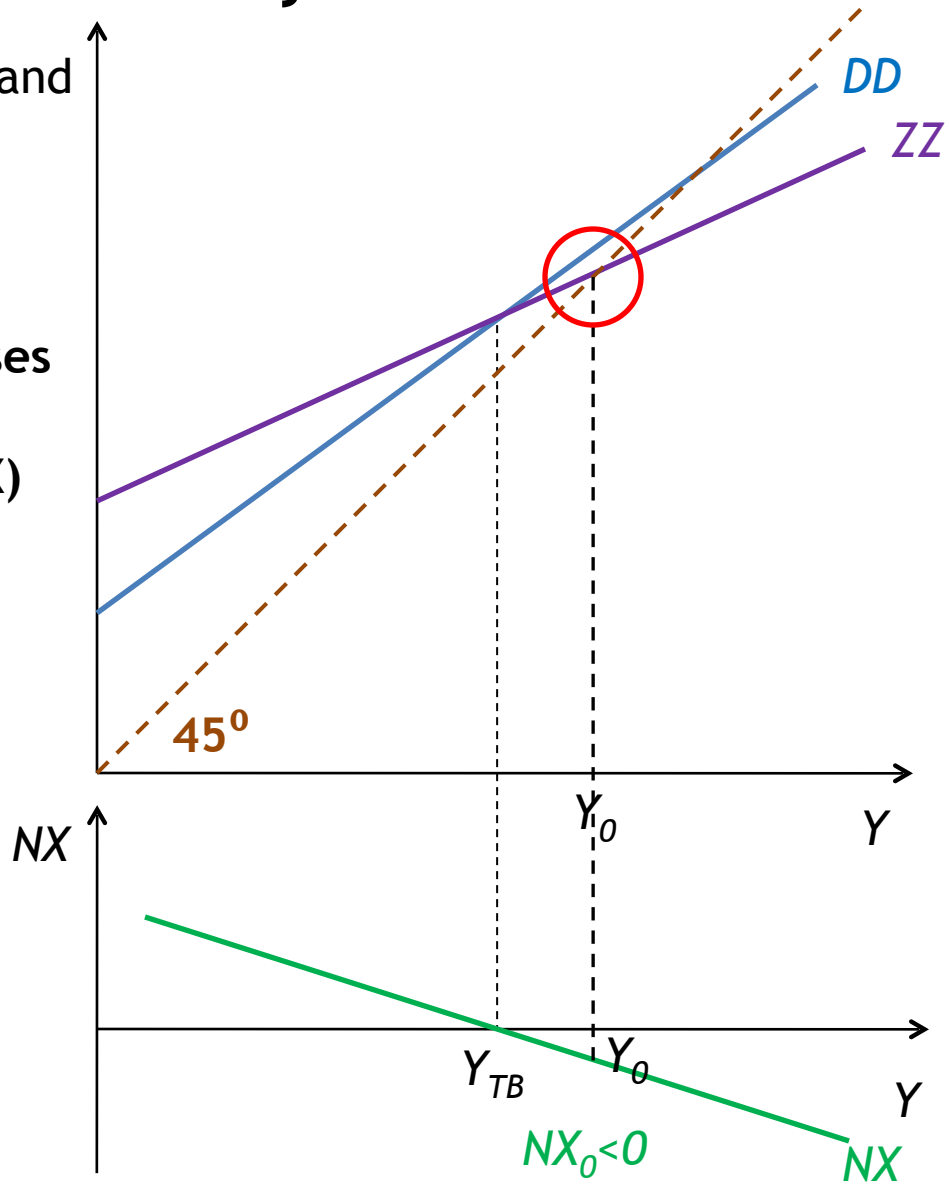
Equilibrium can feature:
NX = 0
NX > 0
NX < 0



Roadmap

1. **Overview of international trade**
   - Indicators
   - Trade Balance vs. Current Account

2. **Exchange rate**
   - Nominal vs. Real

3. **Goods Market in Open Economy**
   - IS Curve

4. **Effects of Policies**

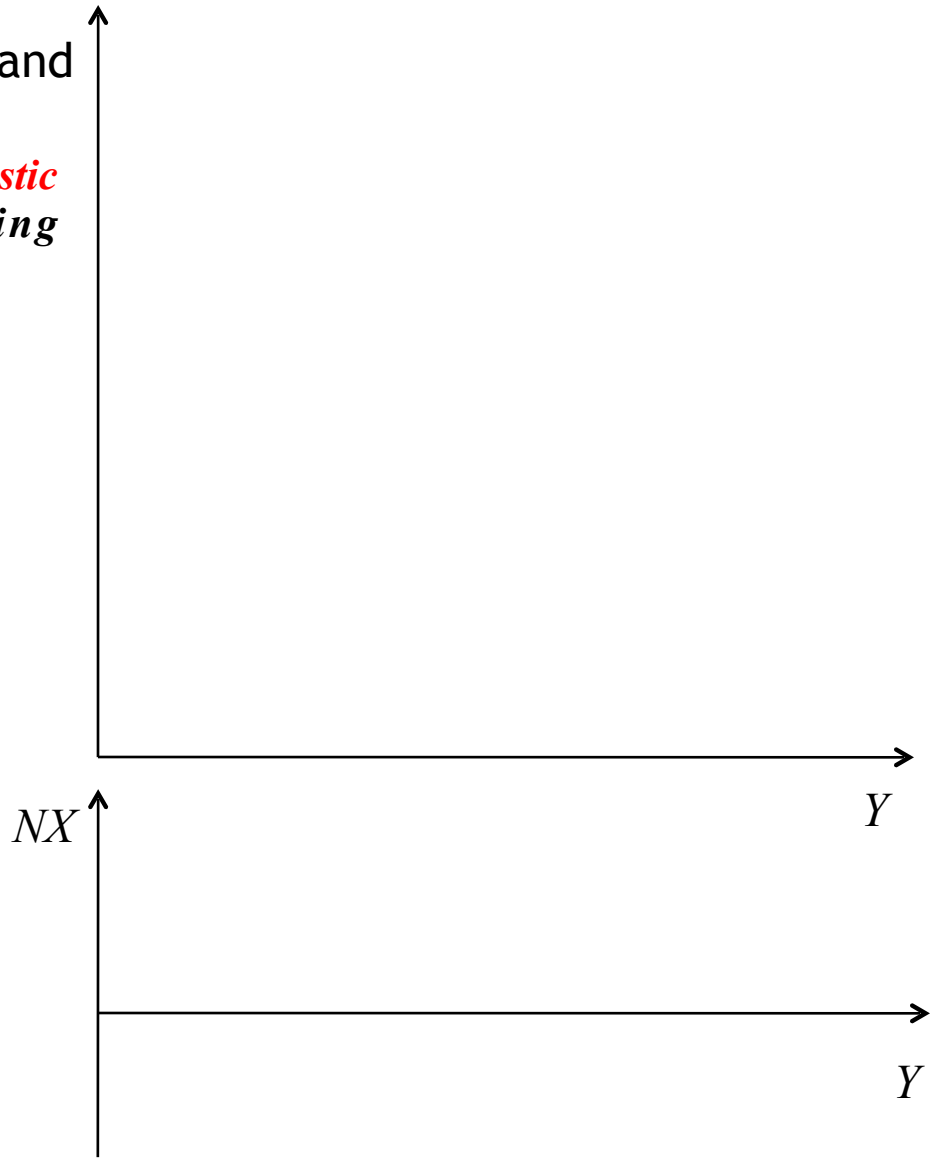
Effects of different shocks and policies

- Changes in Domestic Demand
- Changes in Foreign Demand
- Changes in Real Exchange Rate
- Government and Exchange Rate Policies Combined

Changes in domestic demand

Government implements an increase in Domestic Demand by reducing taxes (or increasing Government spending).

What is the effect on equilibrium output?
What is the effect on the trade balance?



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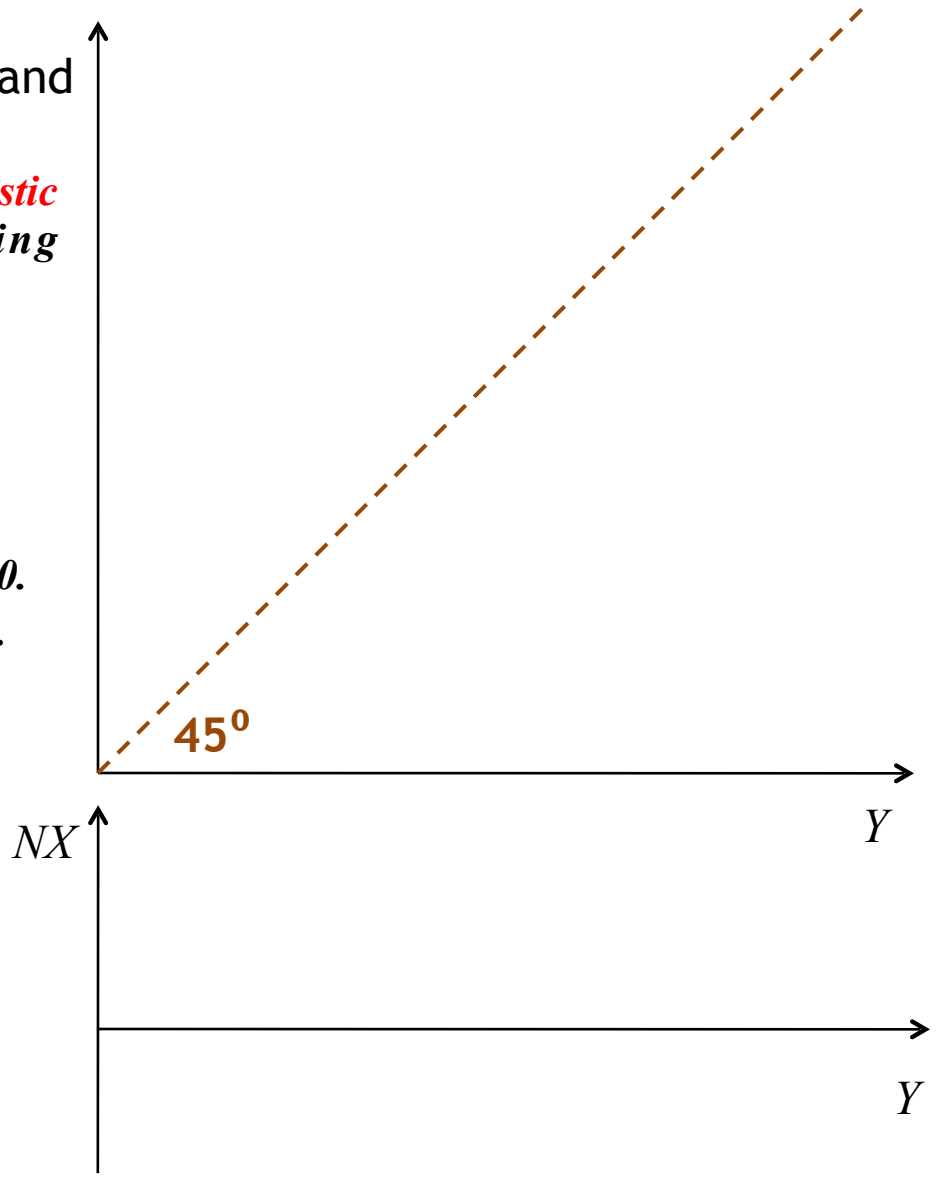

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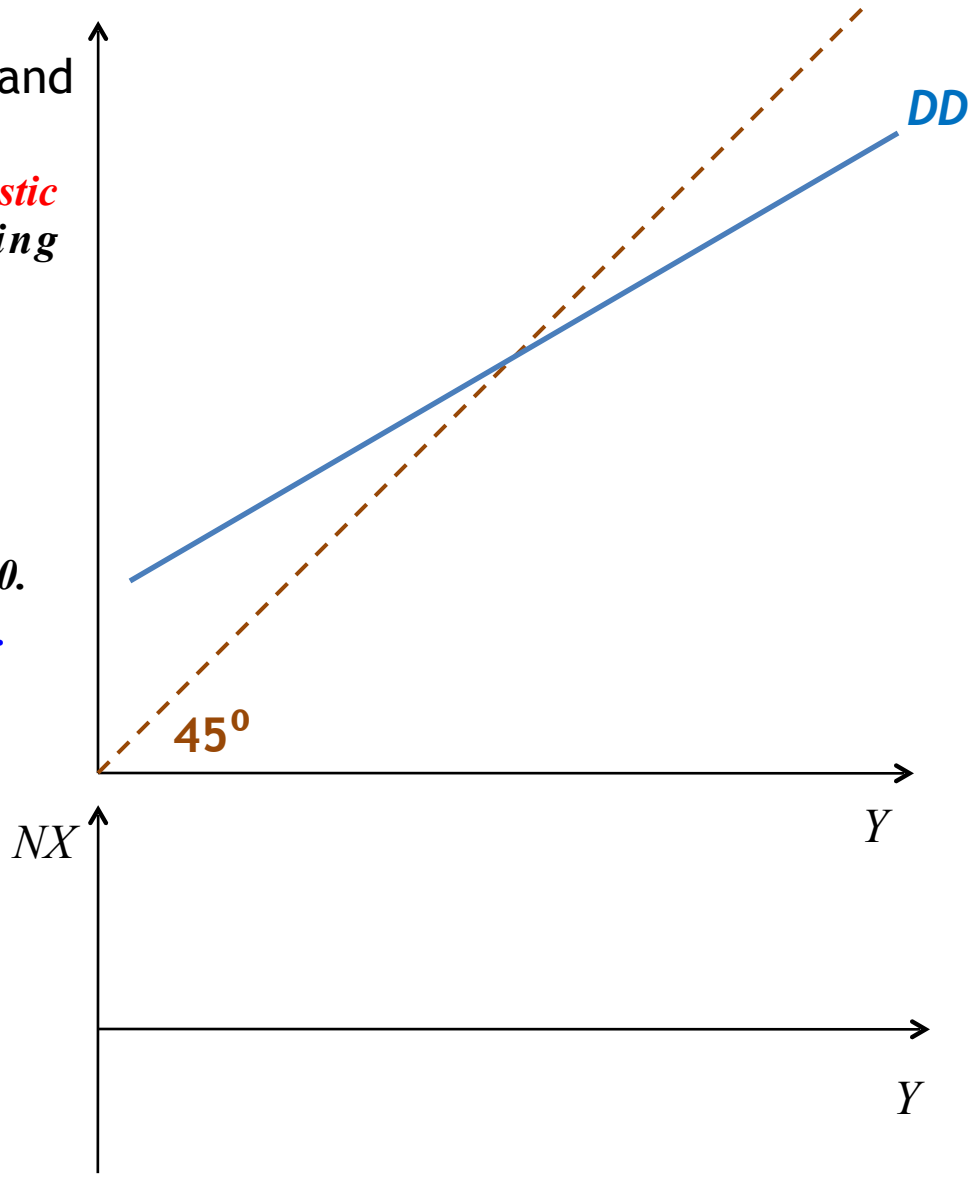

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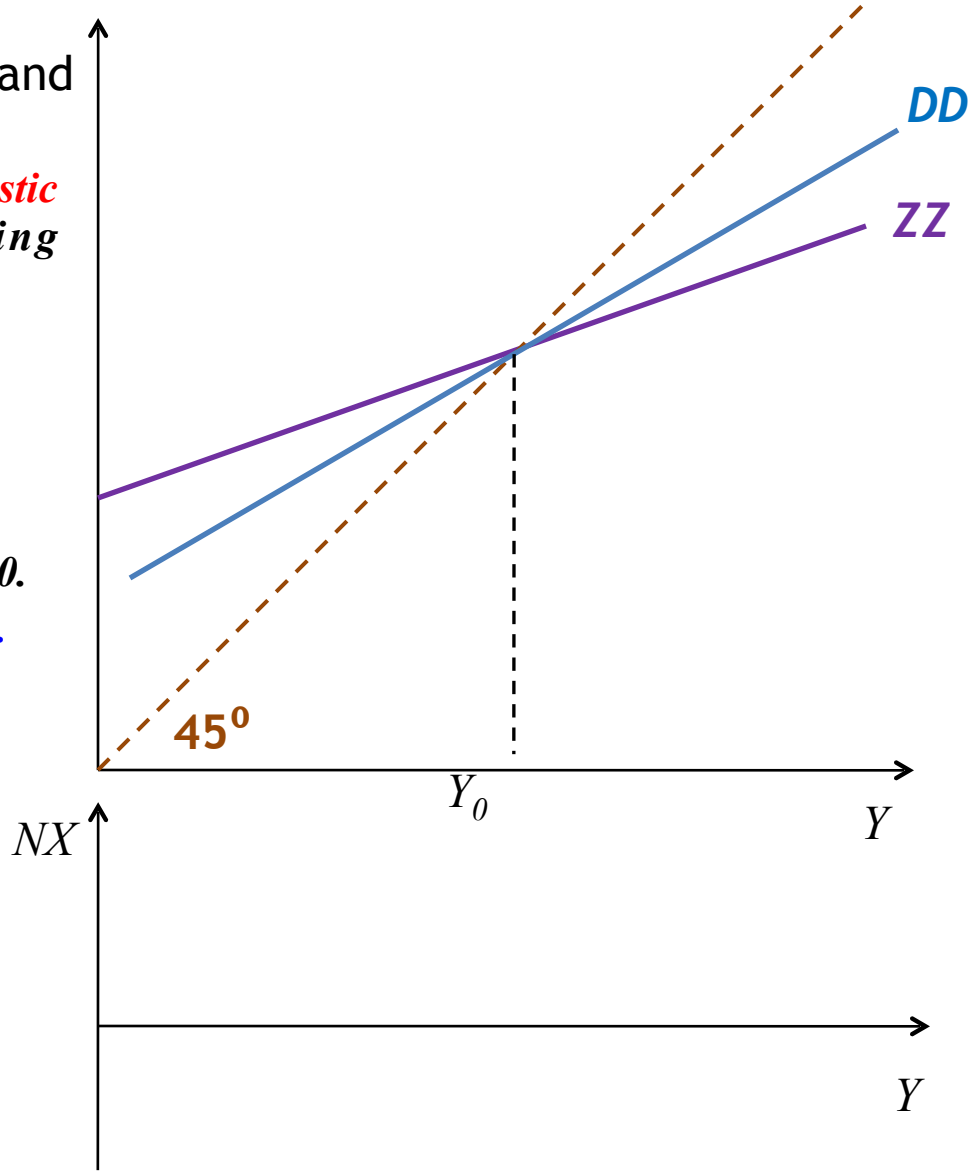

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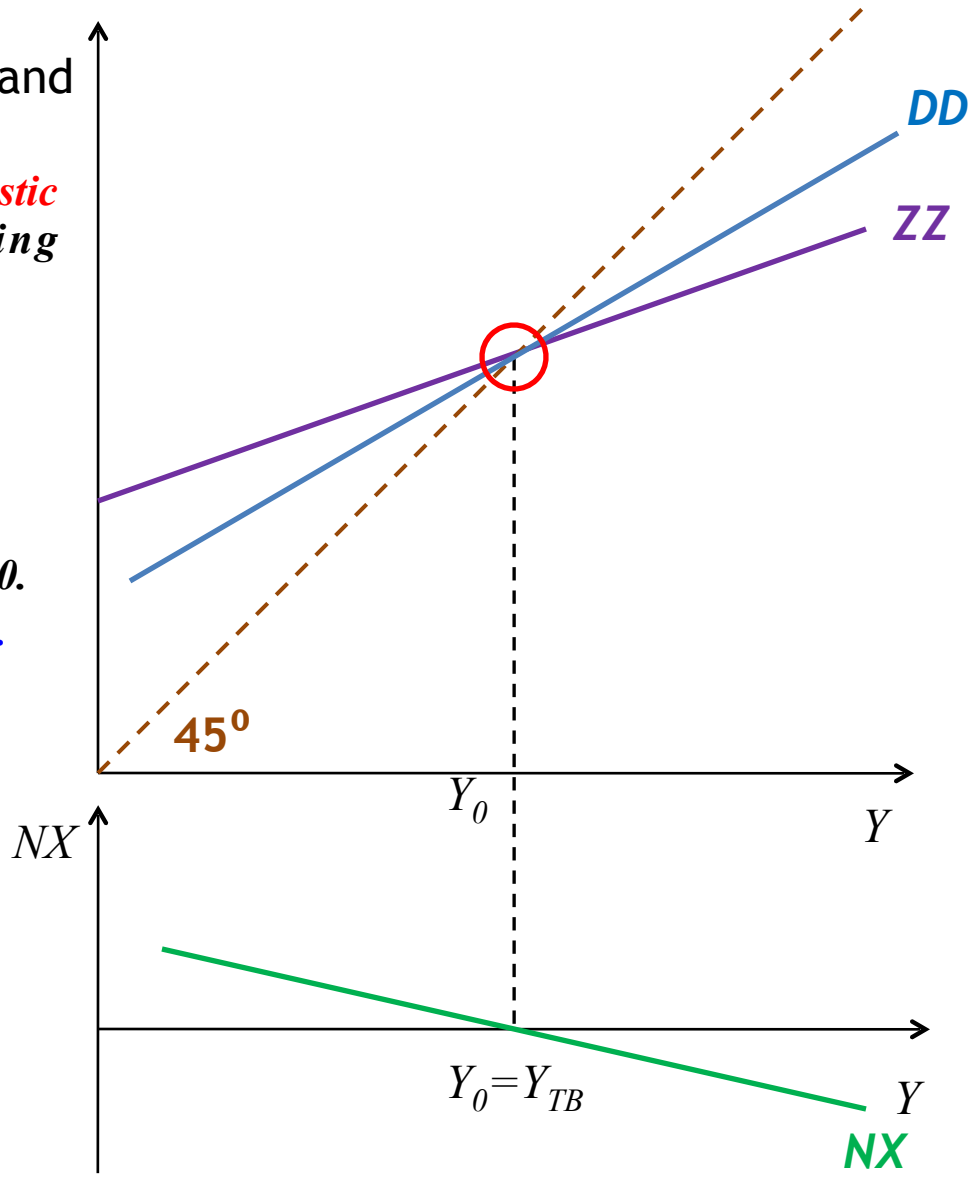

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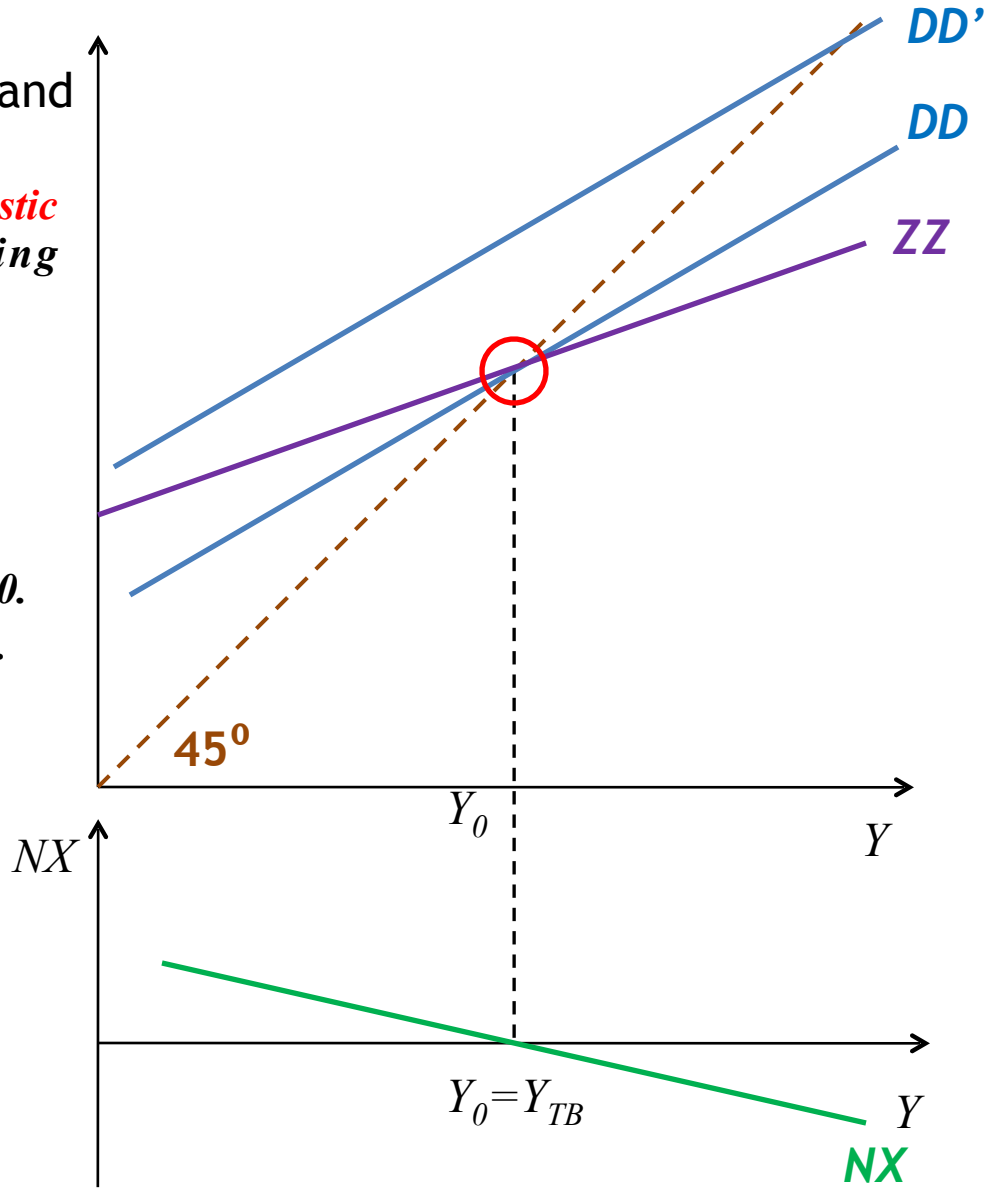
$D = C + I + G$

$D' = C + I + G'$



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$Z = D + NX$

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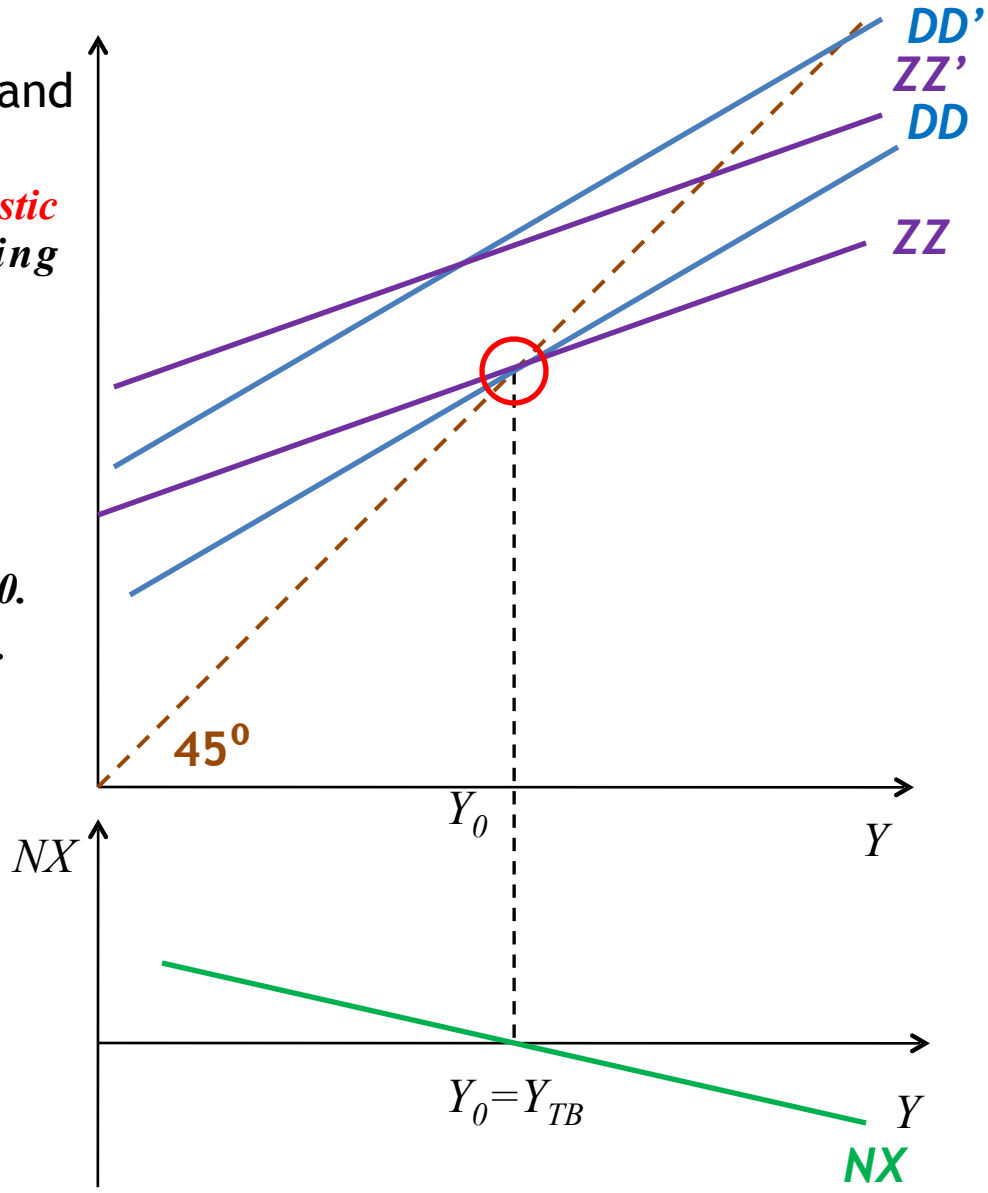

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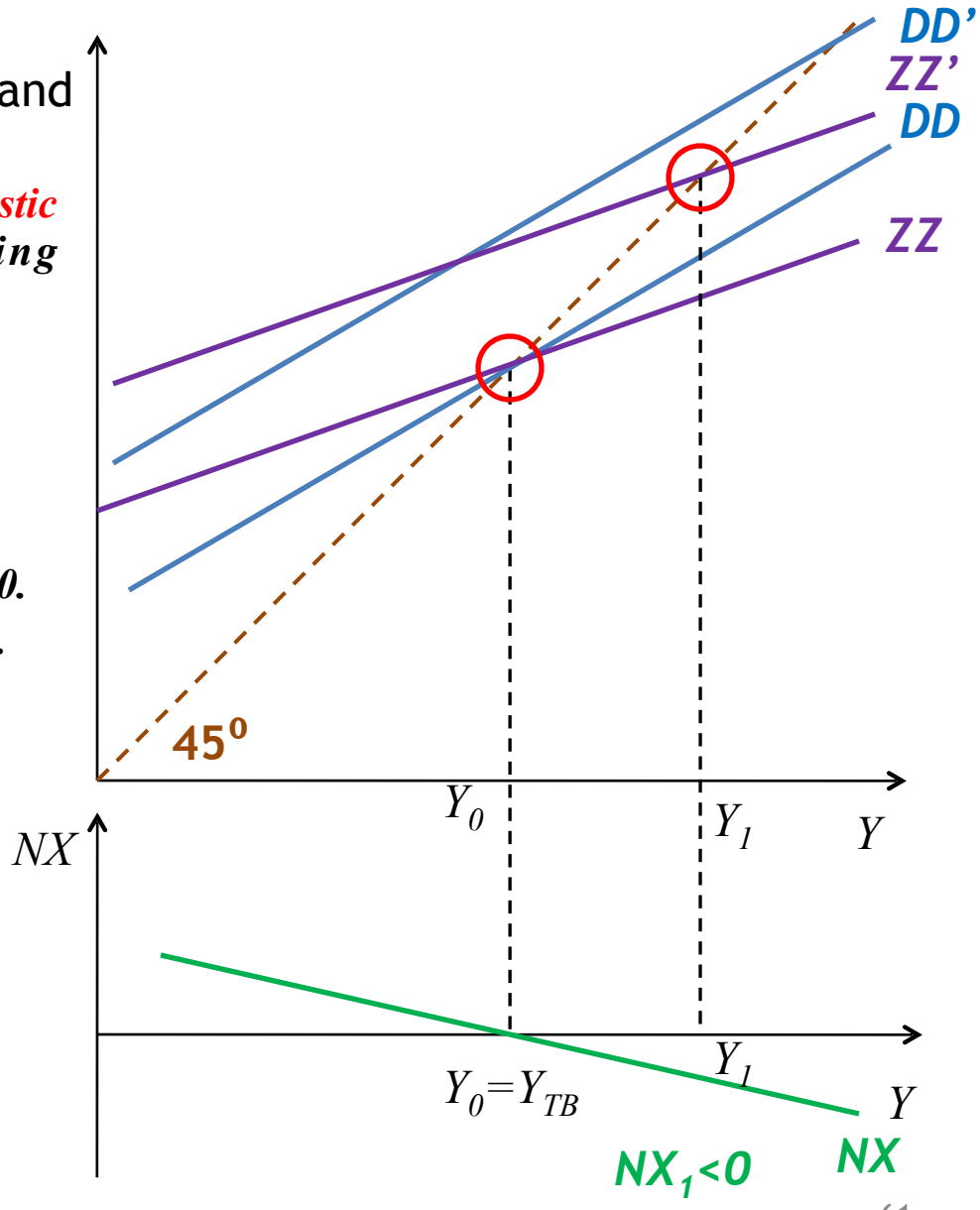

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Equilibrium Output increases
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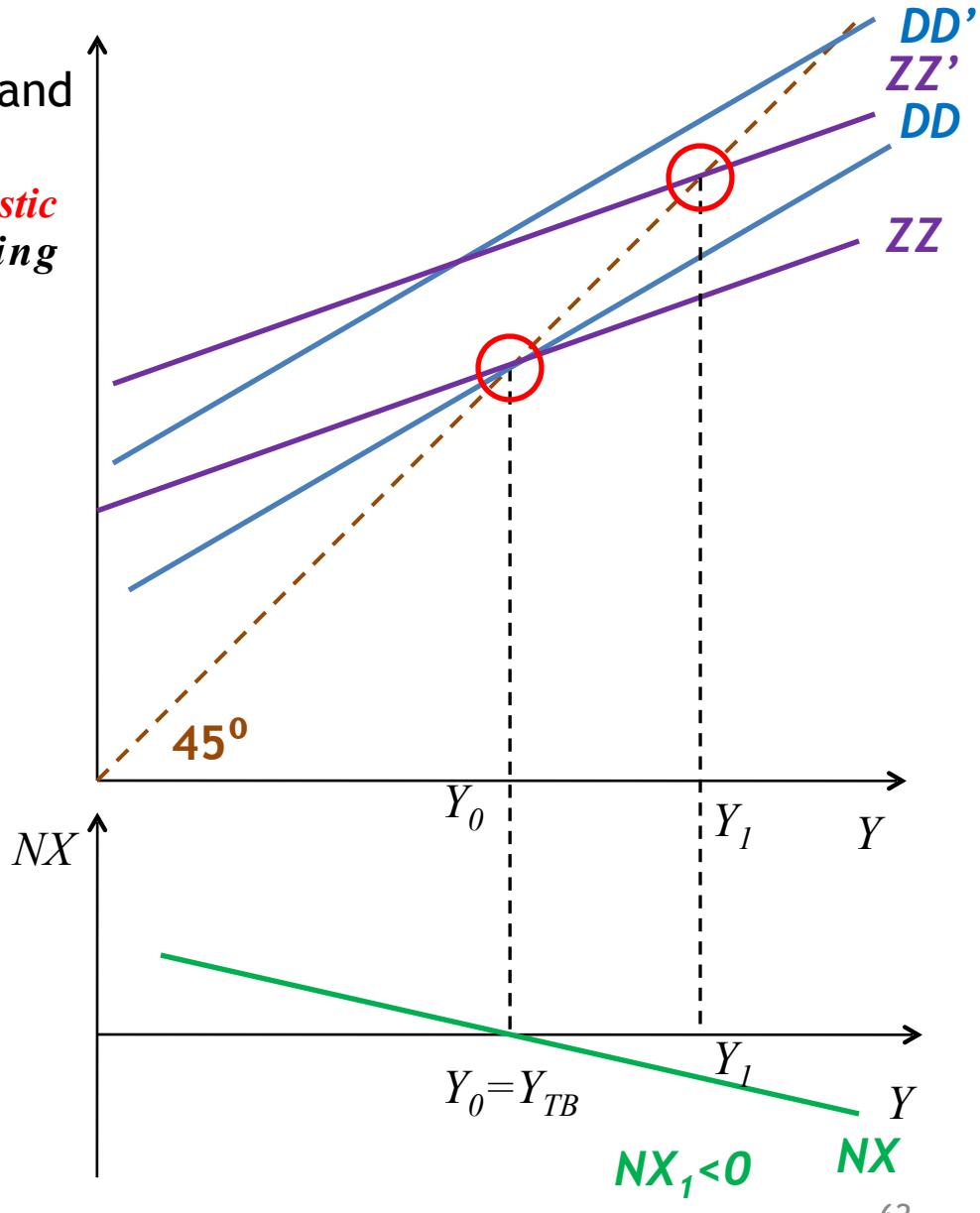
Trade Balance deteriorates



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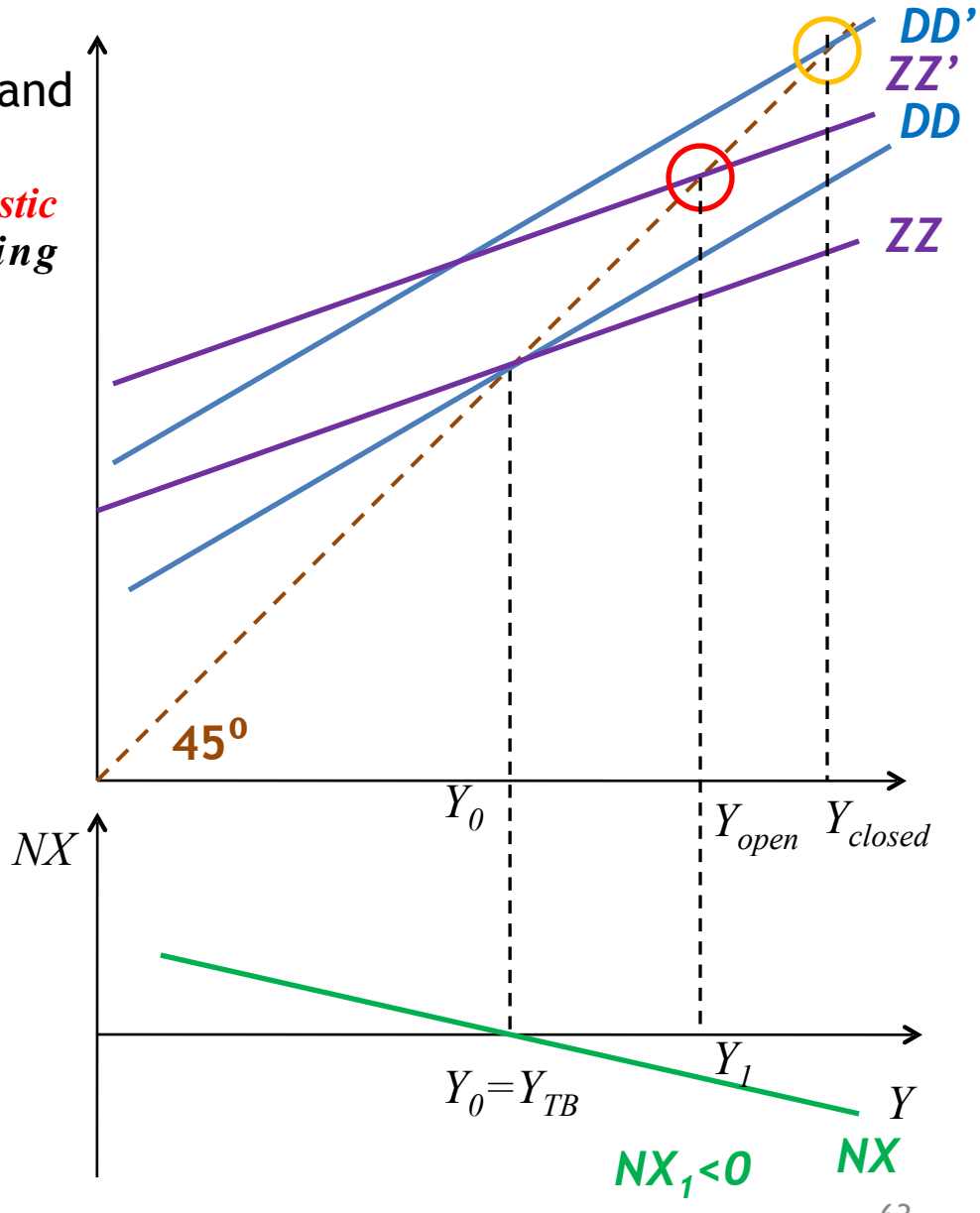
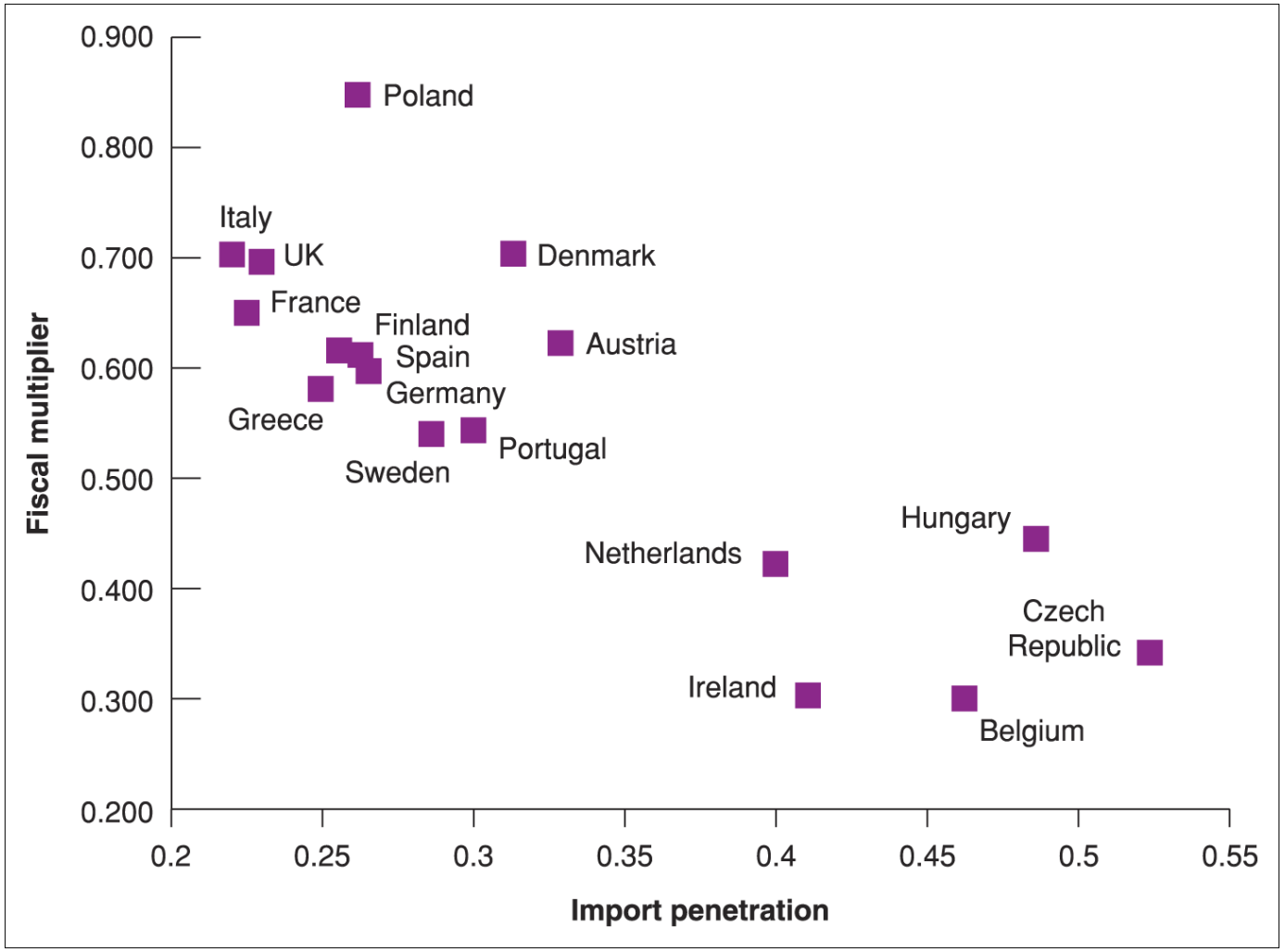
Effect is smaller than in closed economy!



From Model to the Data: Fiscal Multiplier (ΔY/ΔG) and Openness in Europe



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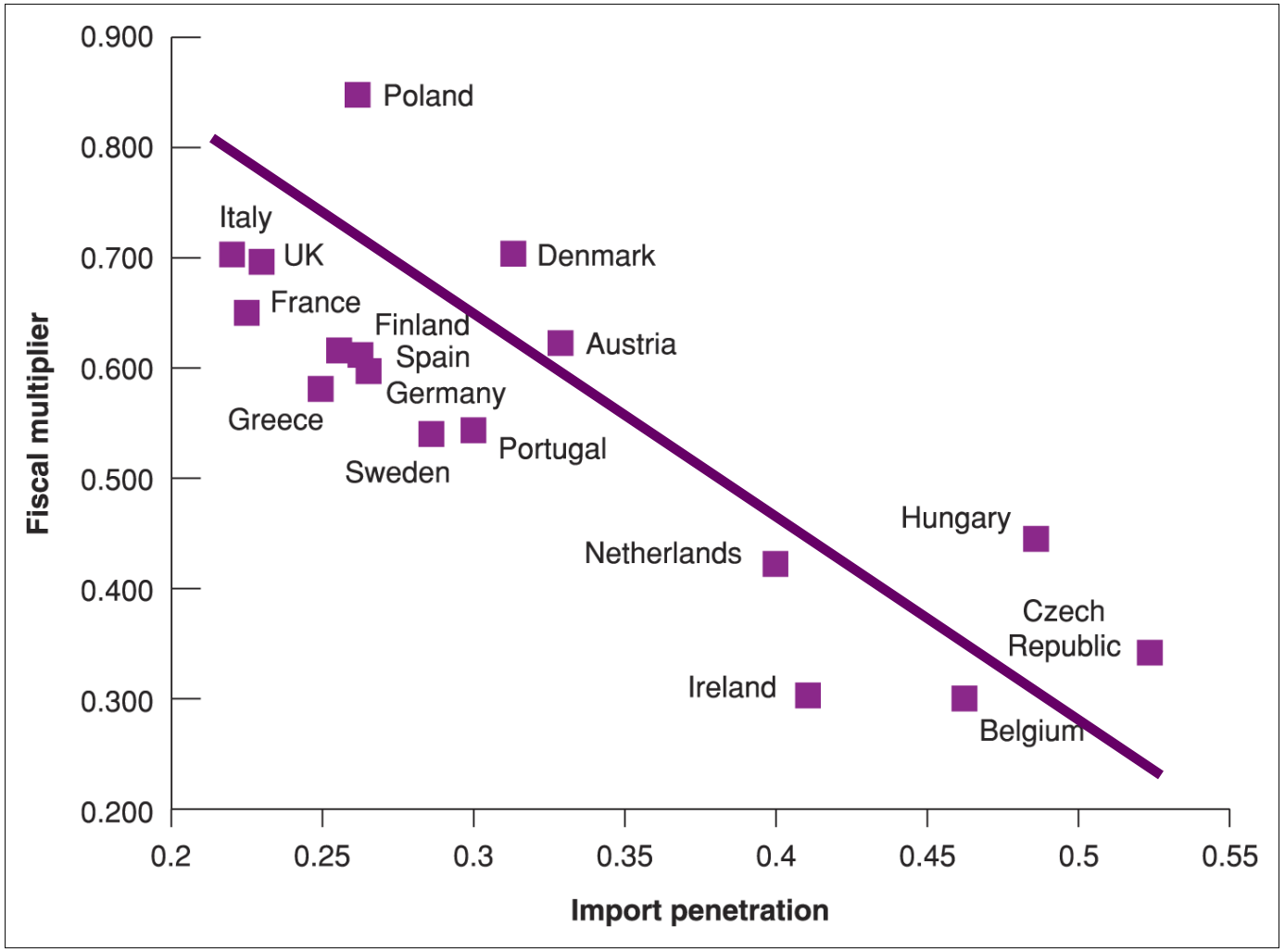

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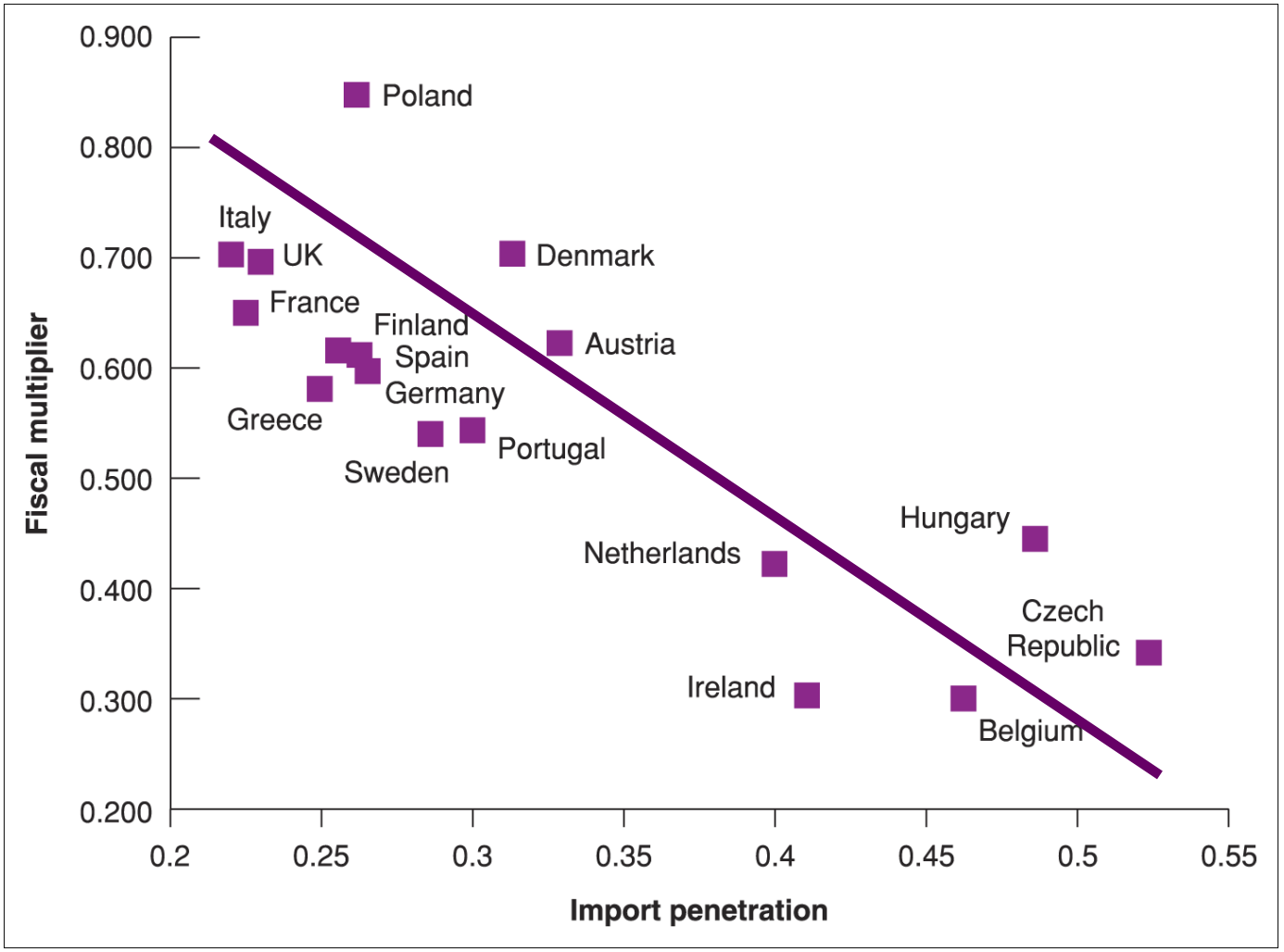
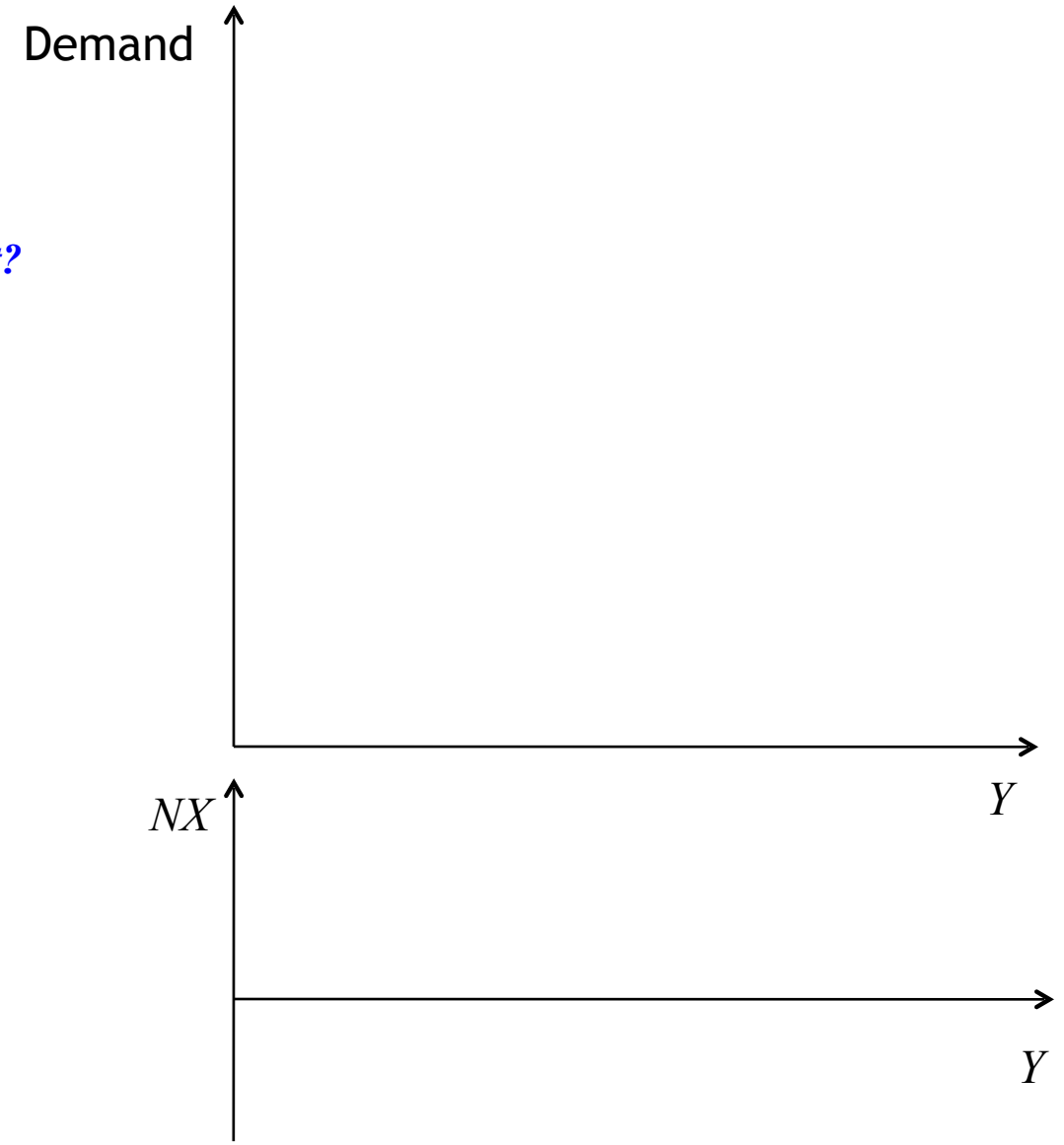


More openness less effects of fiscal policy

Changes in foreign demand

Foreign output increases Y*↑

What is the effect on equilibrium output?
What is the effect on the trade balance?



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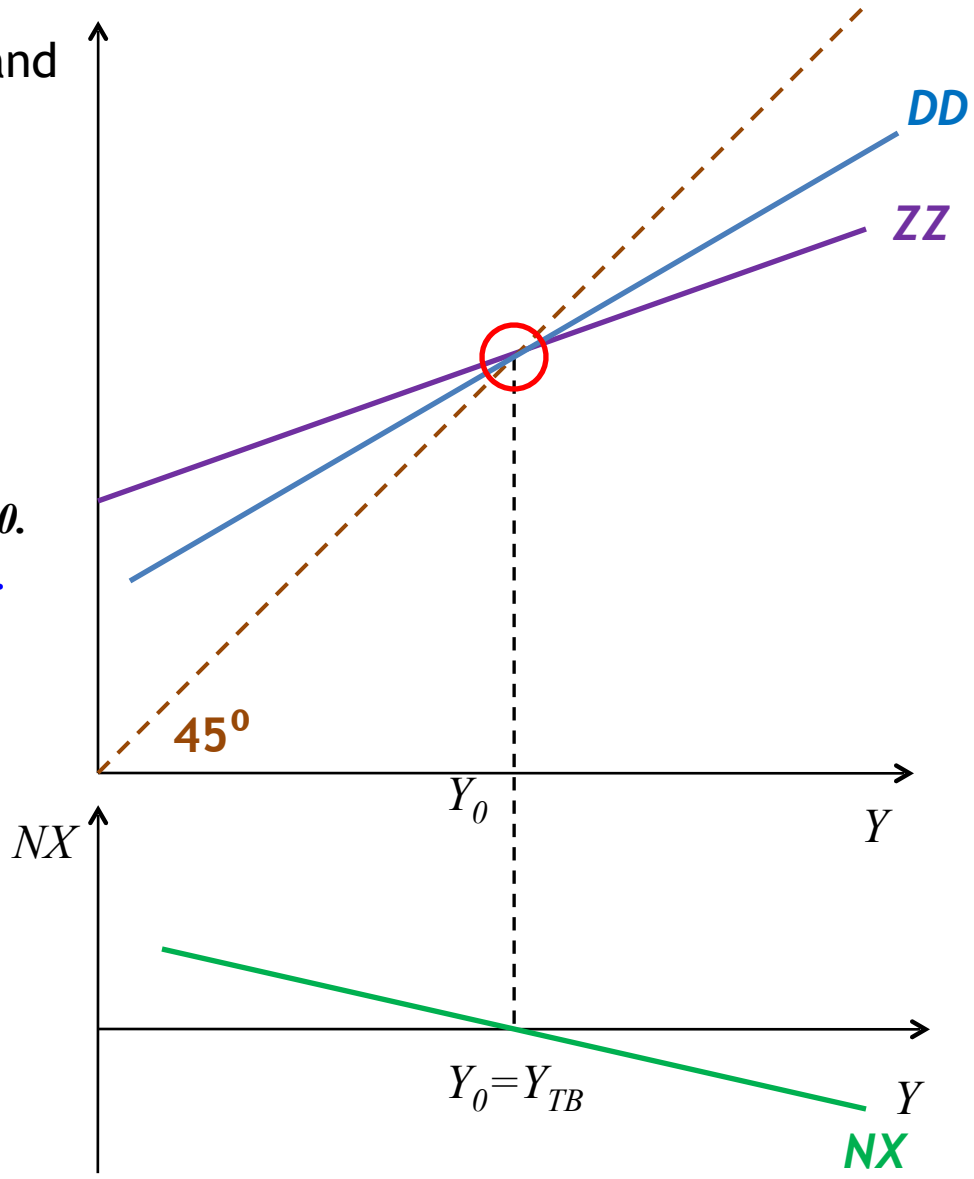

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$NX = X - IM/\varepsilon$

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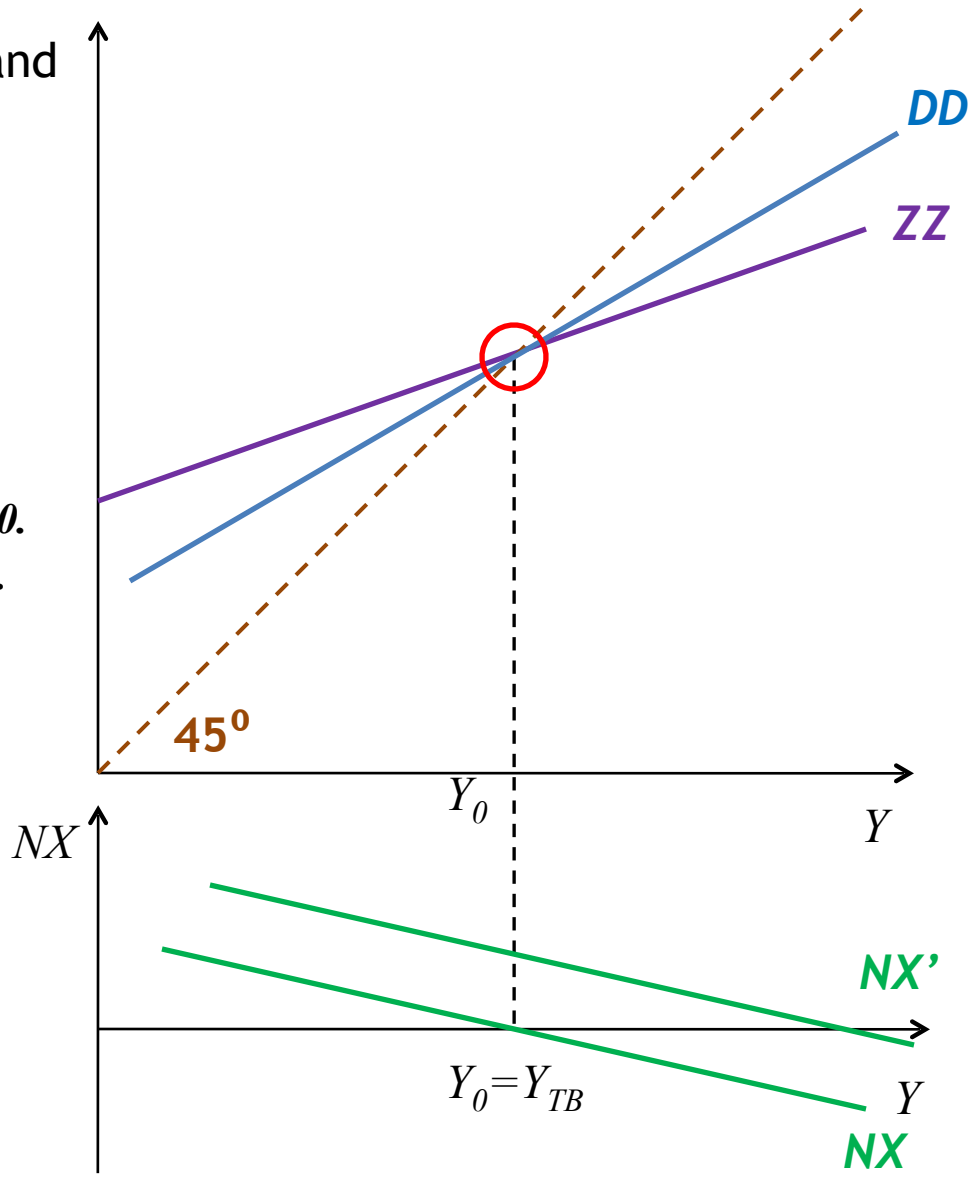

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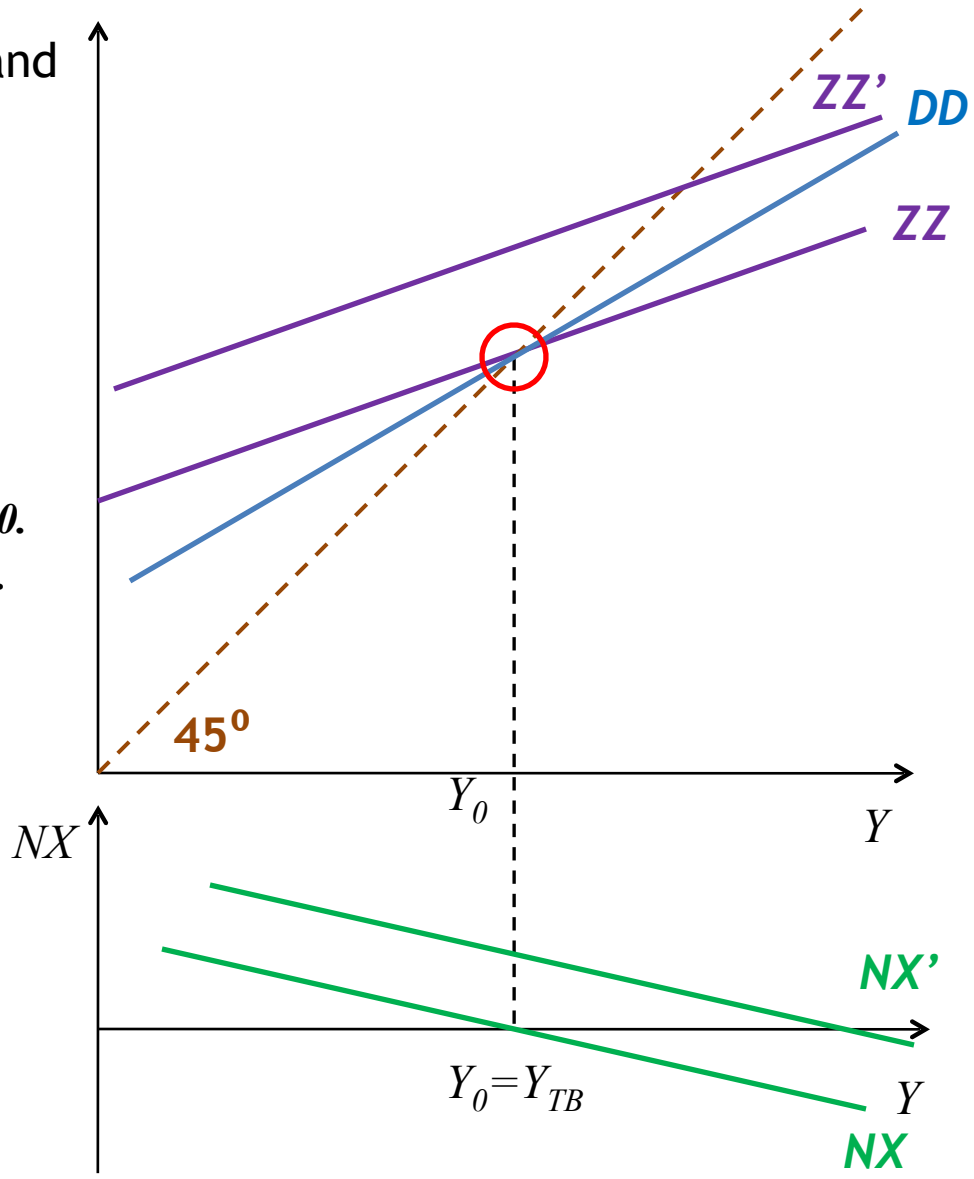

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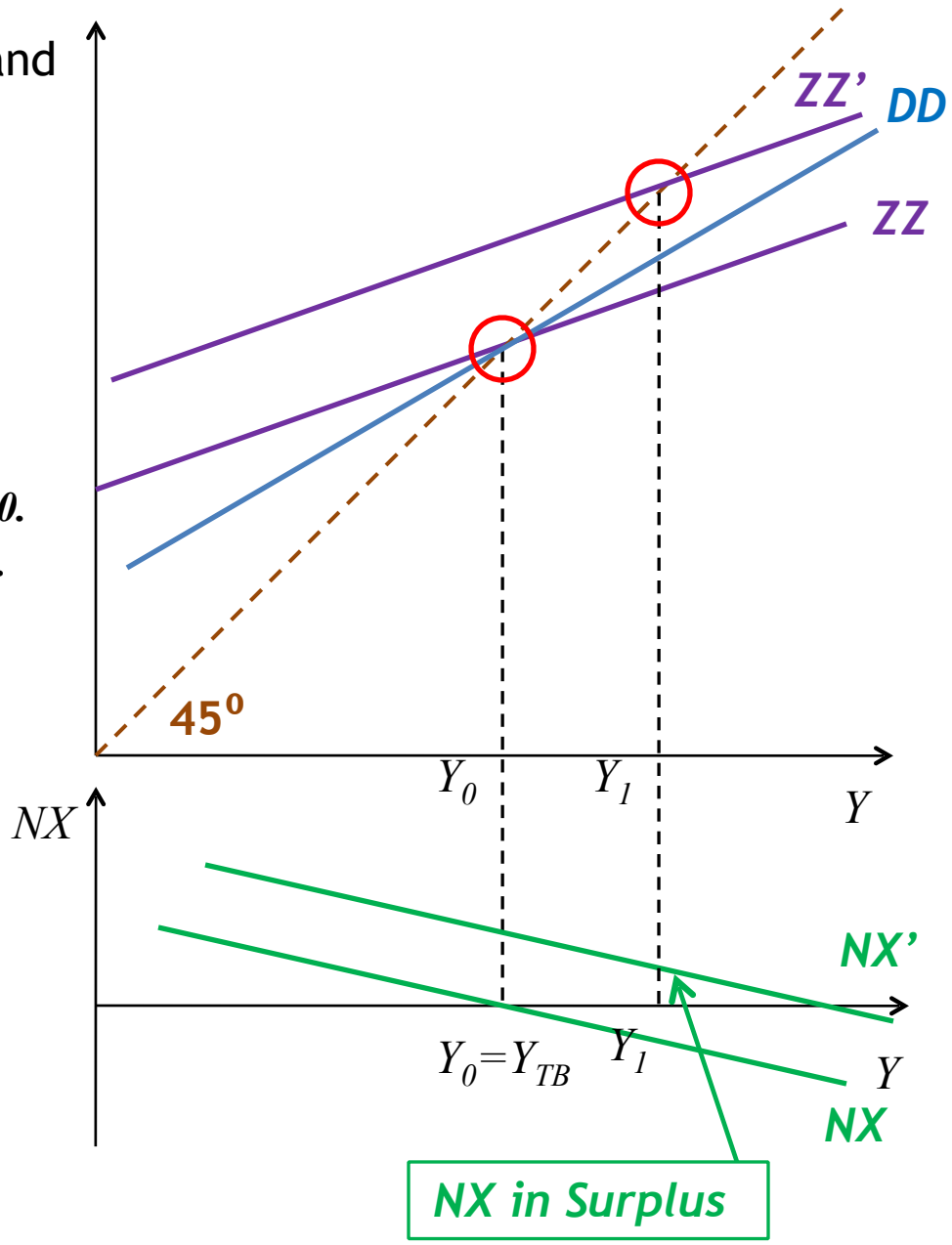

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Foreign output increases Y↑*

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Equilibrium Output increases
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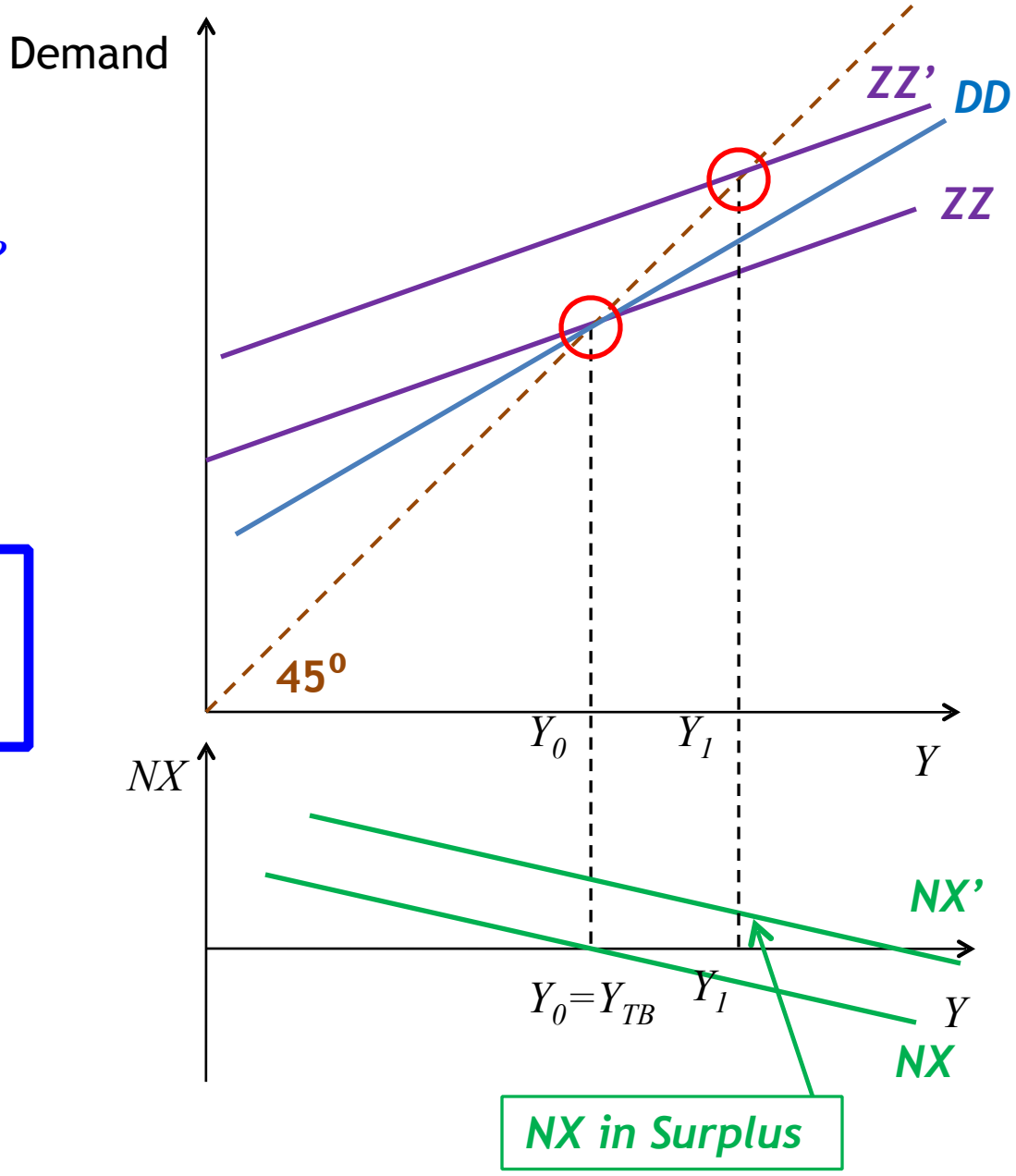
Trade Balance improves



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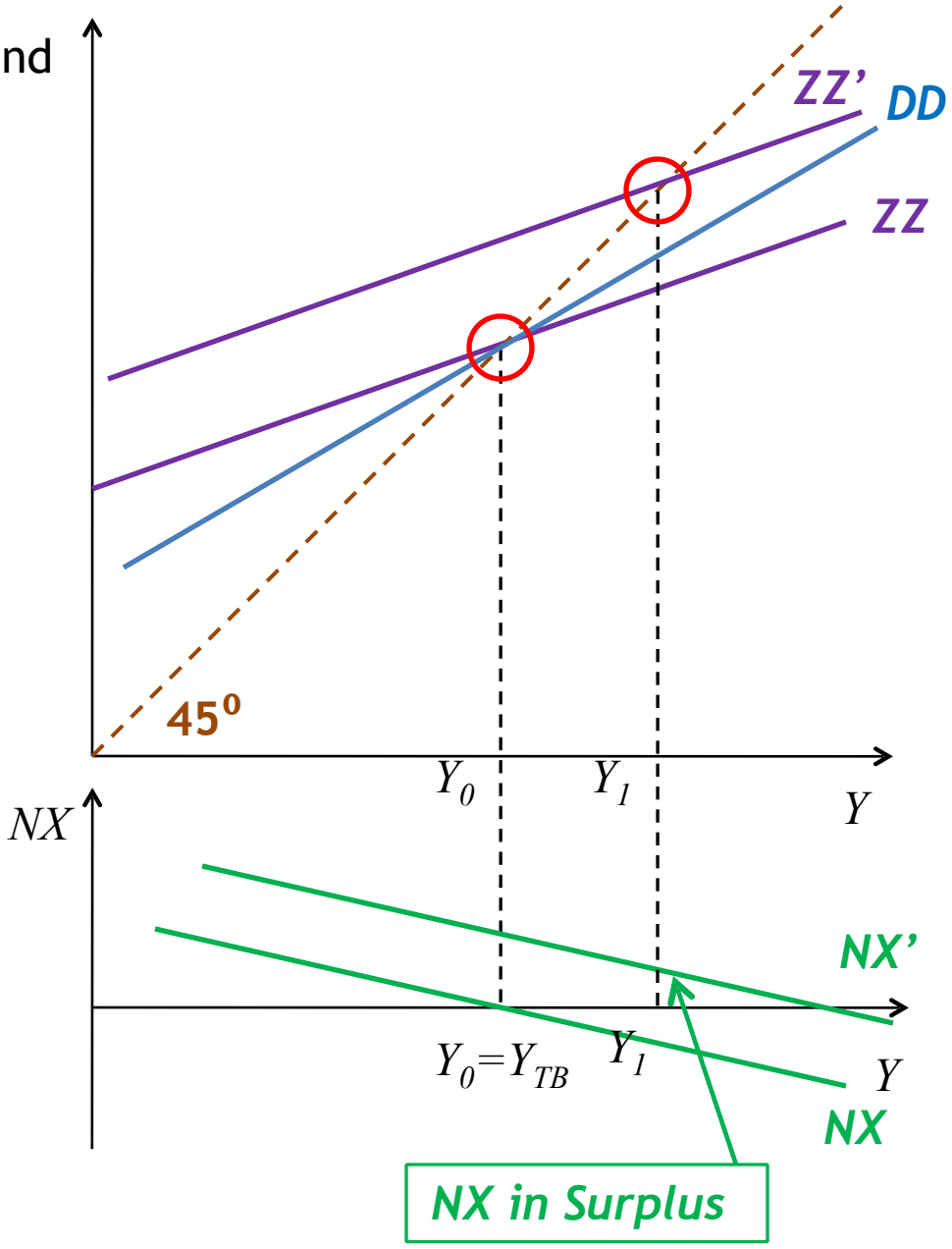
Very different effects
from domestic policy!



From Model to the Data: Coordination among countries

1. **Increase in Domestic Demand**
   (Government Spending and Taxes Policies)

   - Increase in Domestic Output (Y↑)
   - Deterioration of Trade Balance (NX↓)

2. **Increase in Foreign Demand**

   - Increase in Domestic Output (Y↑)
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Domestic prefers Foreign to Stimulate Demand

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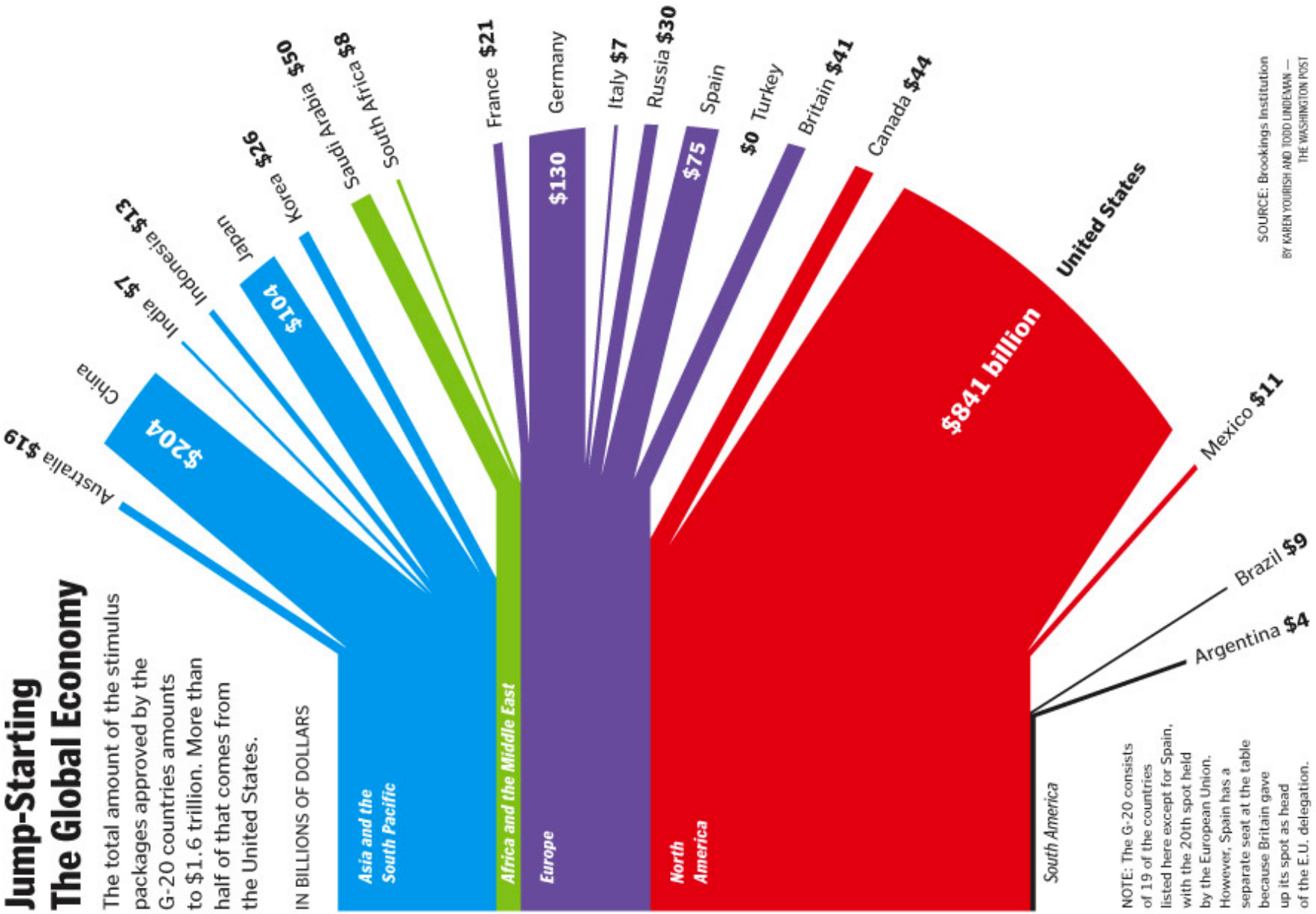
➡ **BIG ROLE FOR COORDINATION (G8, G20, etc)**

G-20 Fiscal Plan For 2007 Crisis

- Financial crisis turned into a broader macro crisis by fall 2008.
- Monetary policy acted first but...
  - Nominal interest rate reached **zero lower bound**.
  - Conventional monetary policy lost its power.
- In 2009, G-20 countries agreed to a **joint fiscal stimulus** plan.
  - Combined amount of stimulus: **1.6 trillion dollars**
  - Country differences in:
    - ✓ Amount (size of economy)
    - ✓ Composition (tax cut vs. spending)
    - ✓ Speed (budget processing)

G-20 Fiscal Plan For 2007 Crisis



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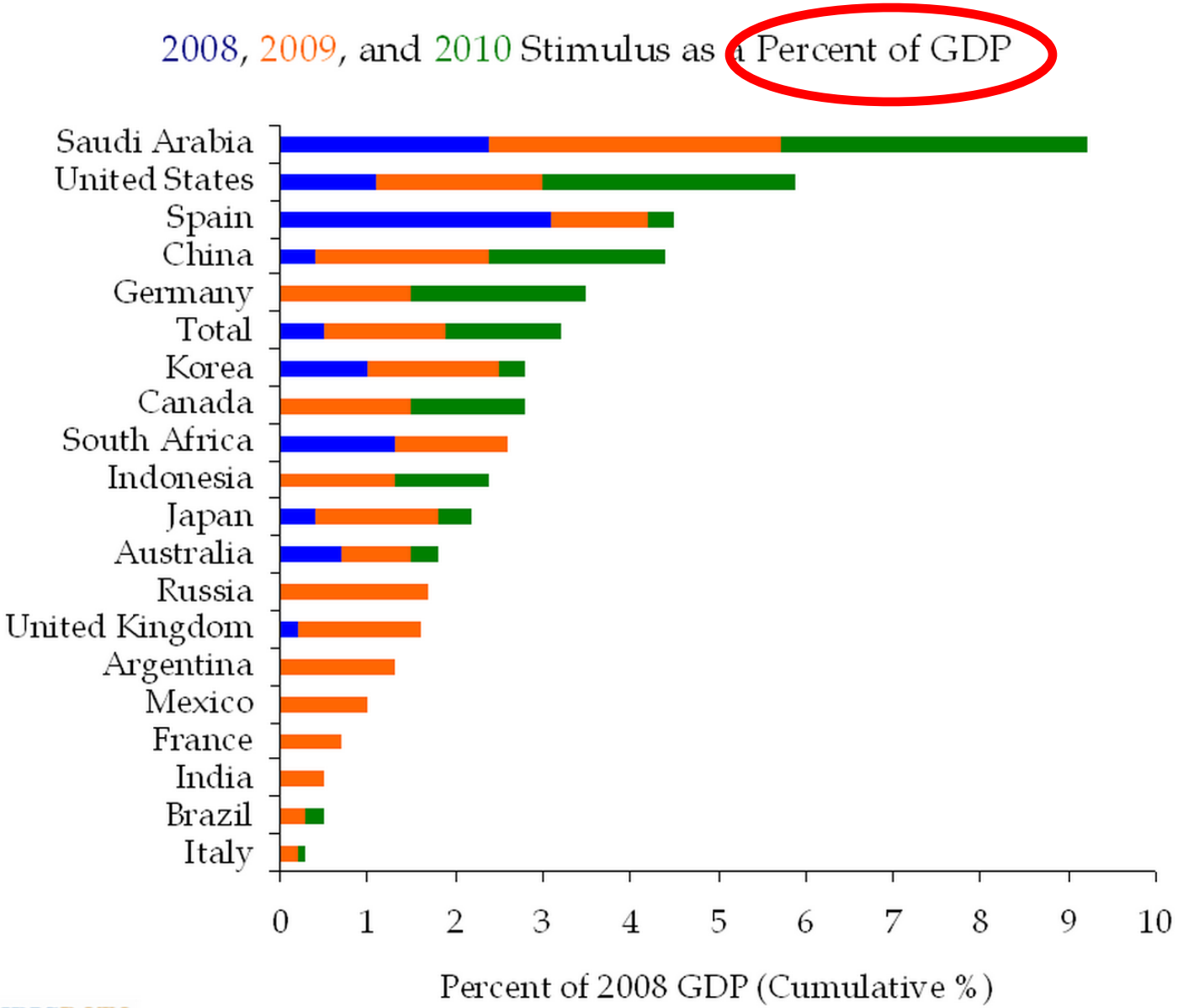

Changes in real exchange rate

Government engineers a real depreciation, so that $\varepsilon\downarrow$.

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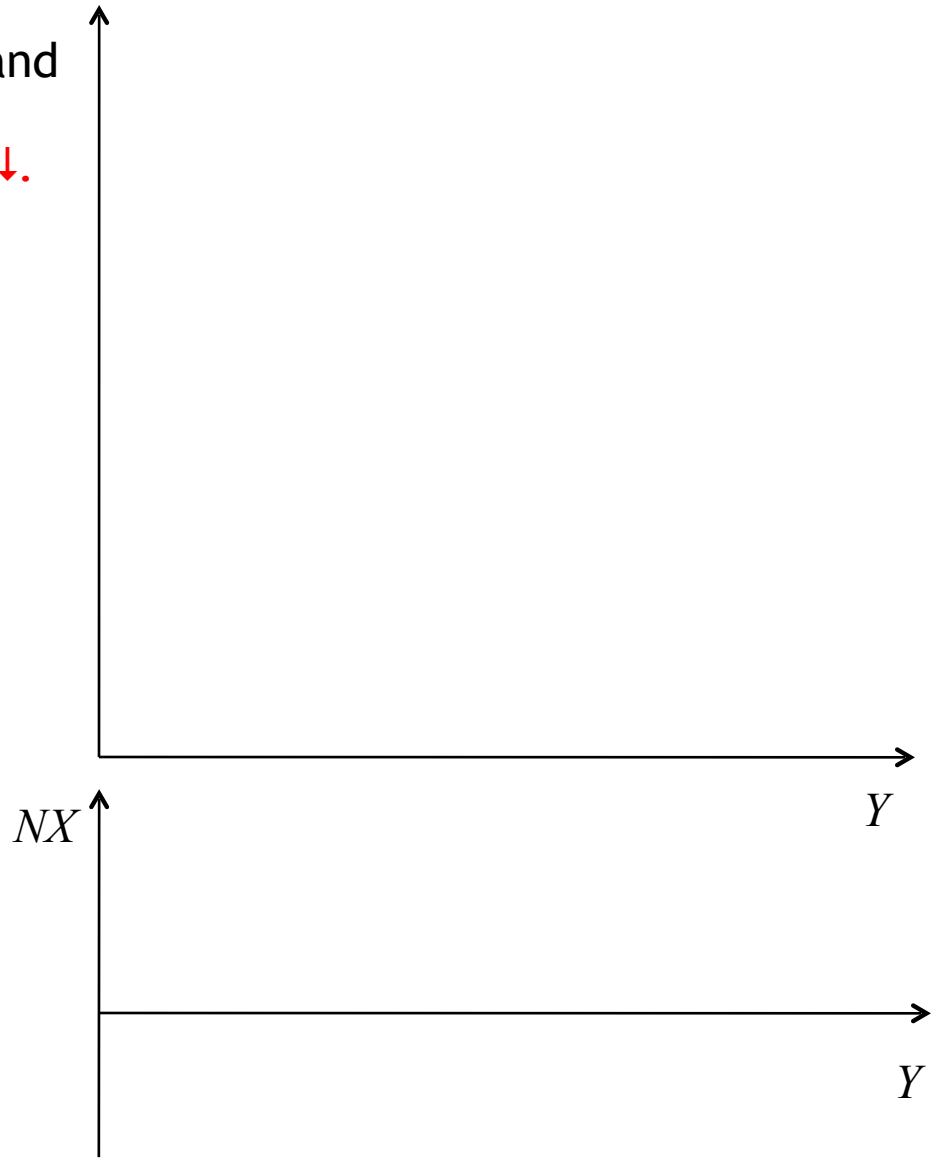

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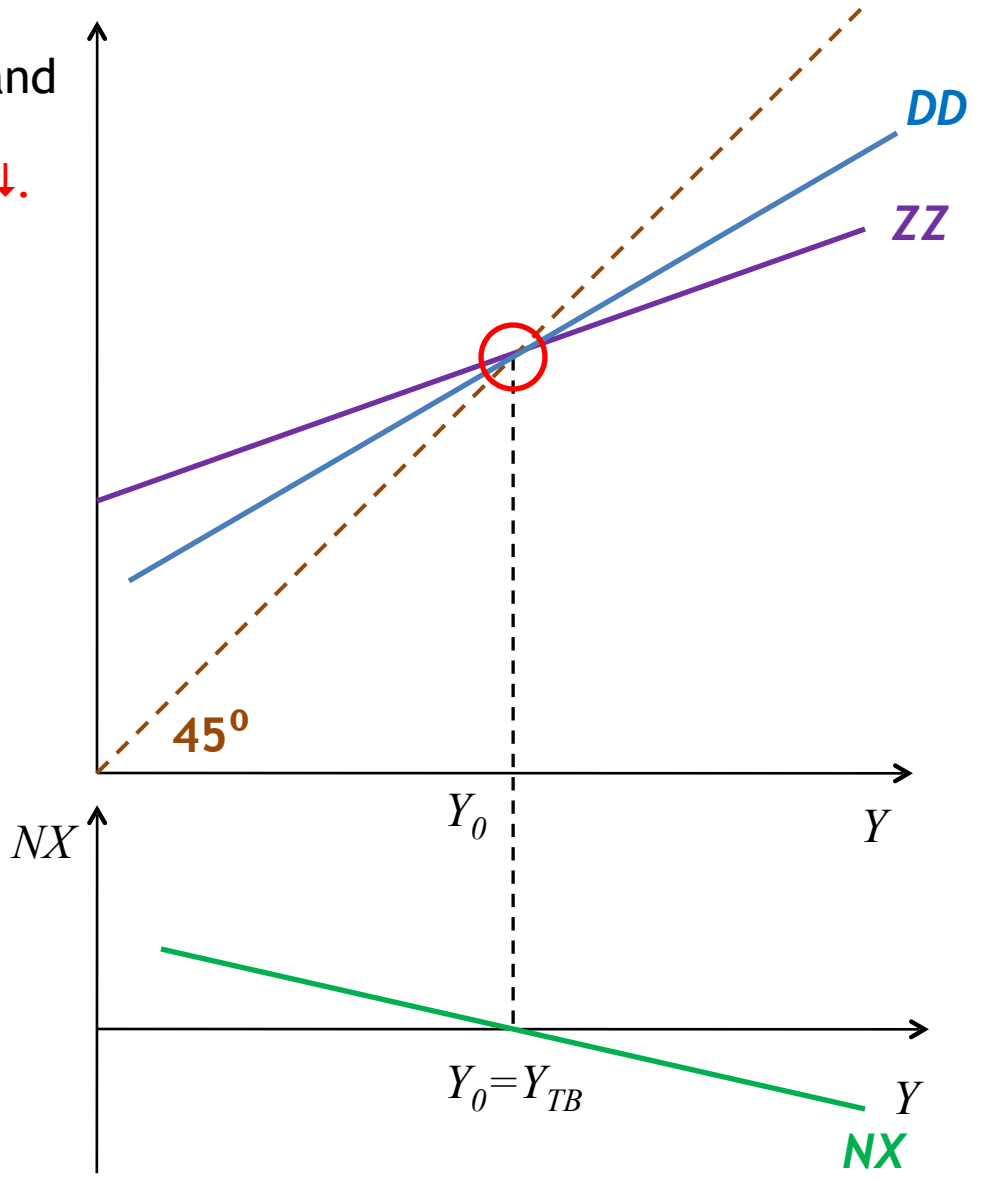

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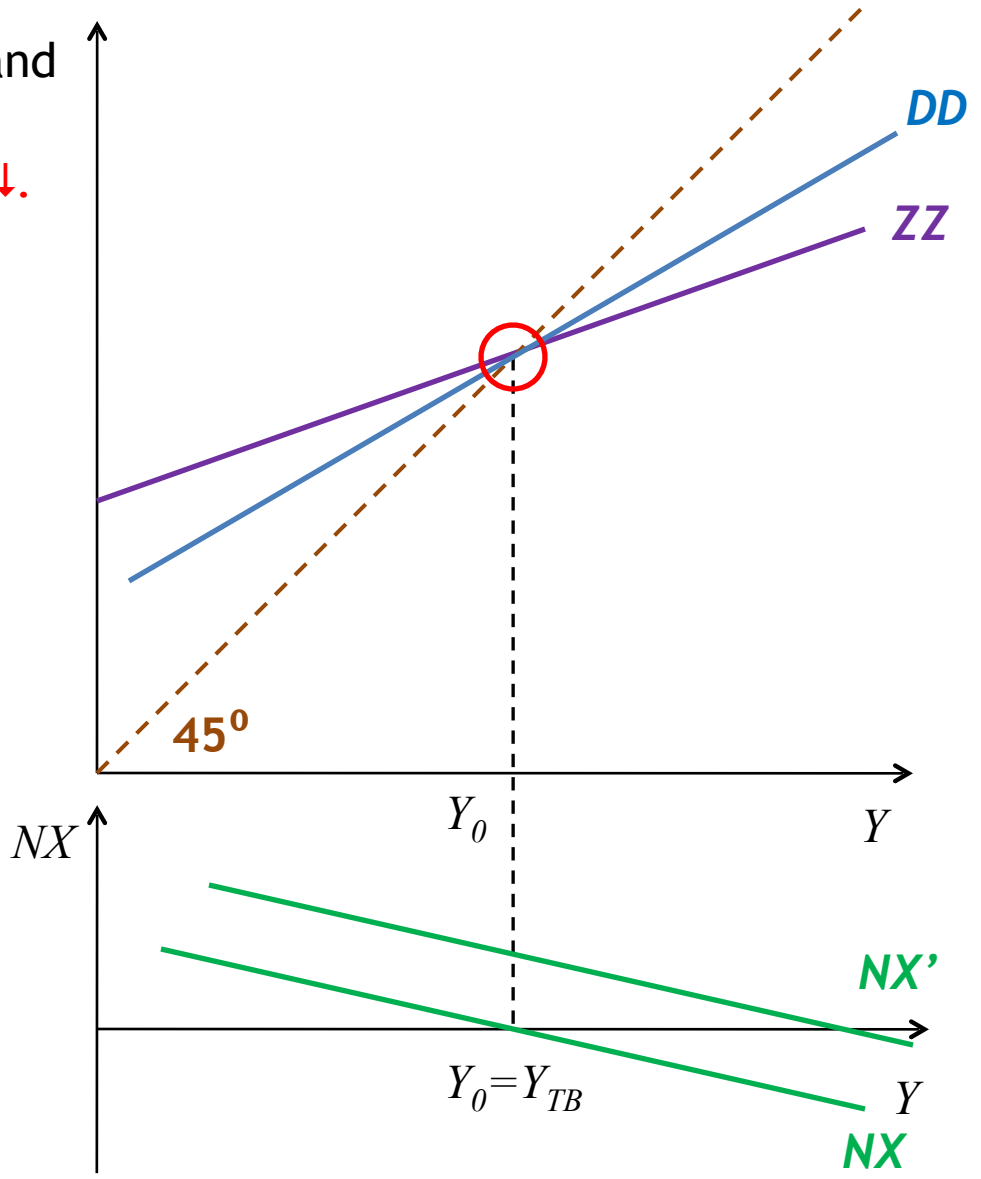
$NX = X - IM/\varepsilon$

$NX' = X' - IM'/\varepsilon'$ (MLC implies) $NX' > NX$



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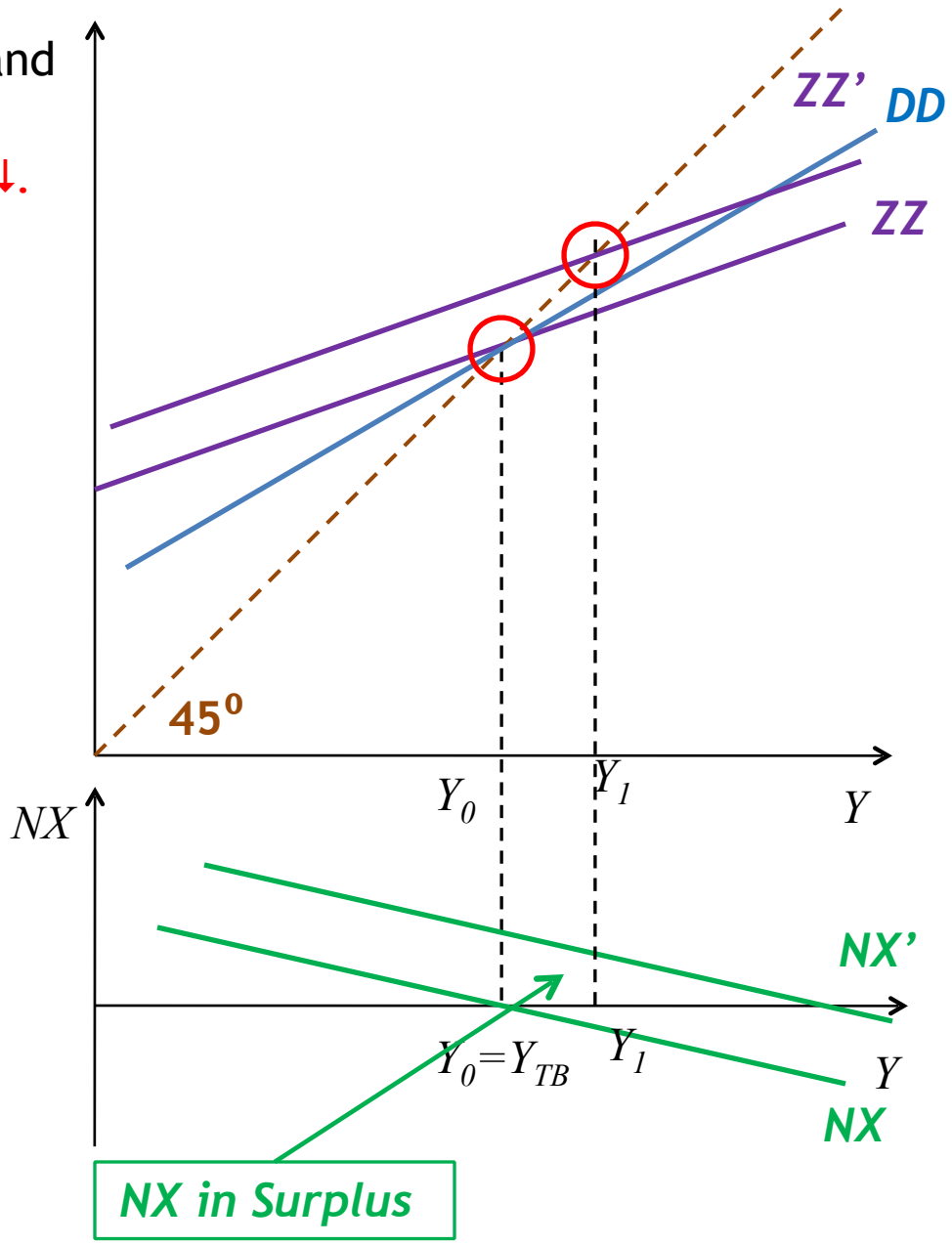

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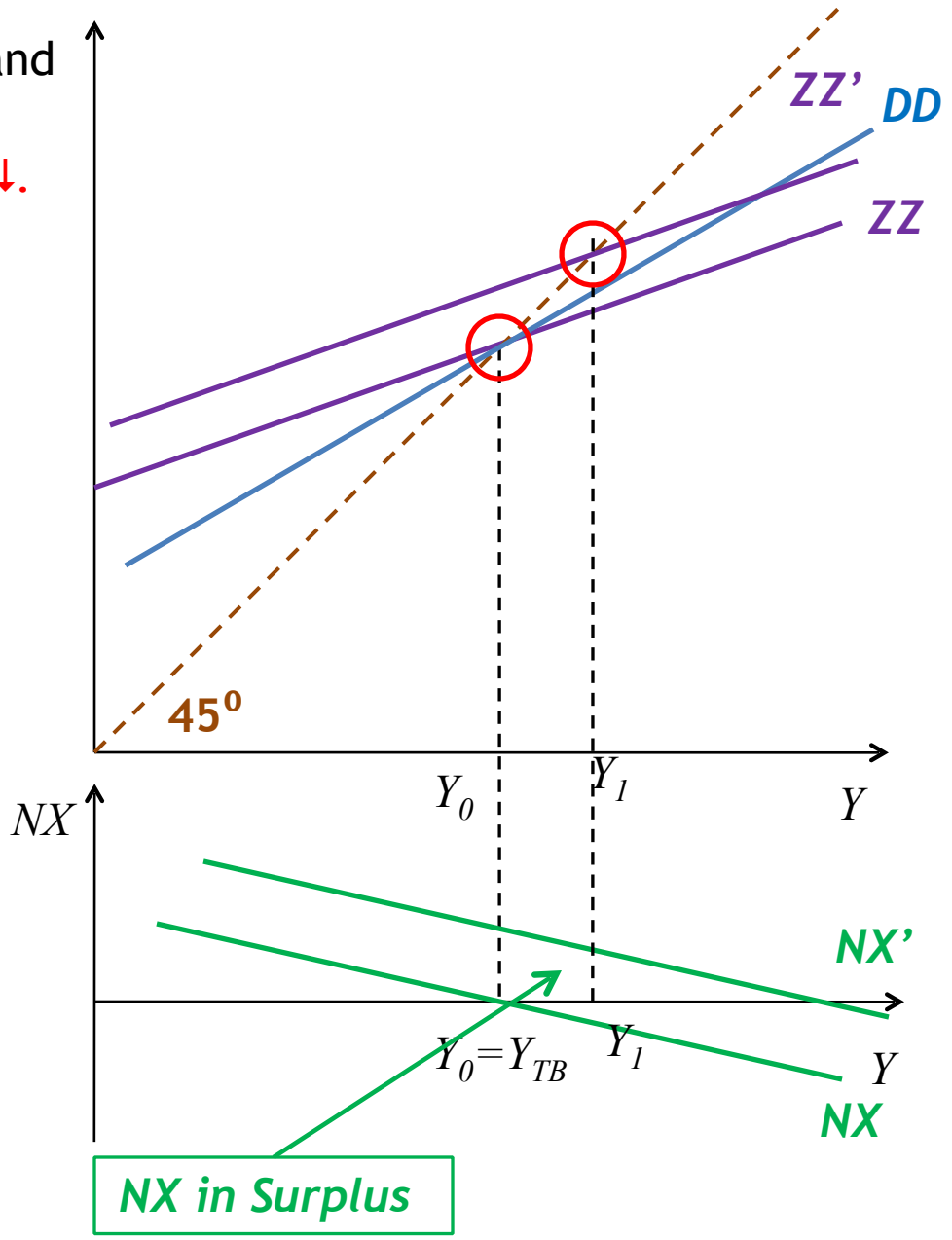

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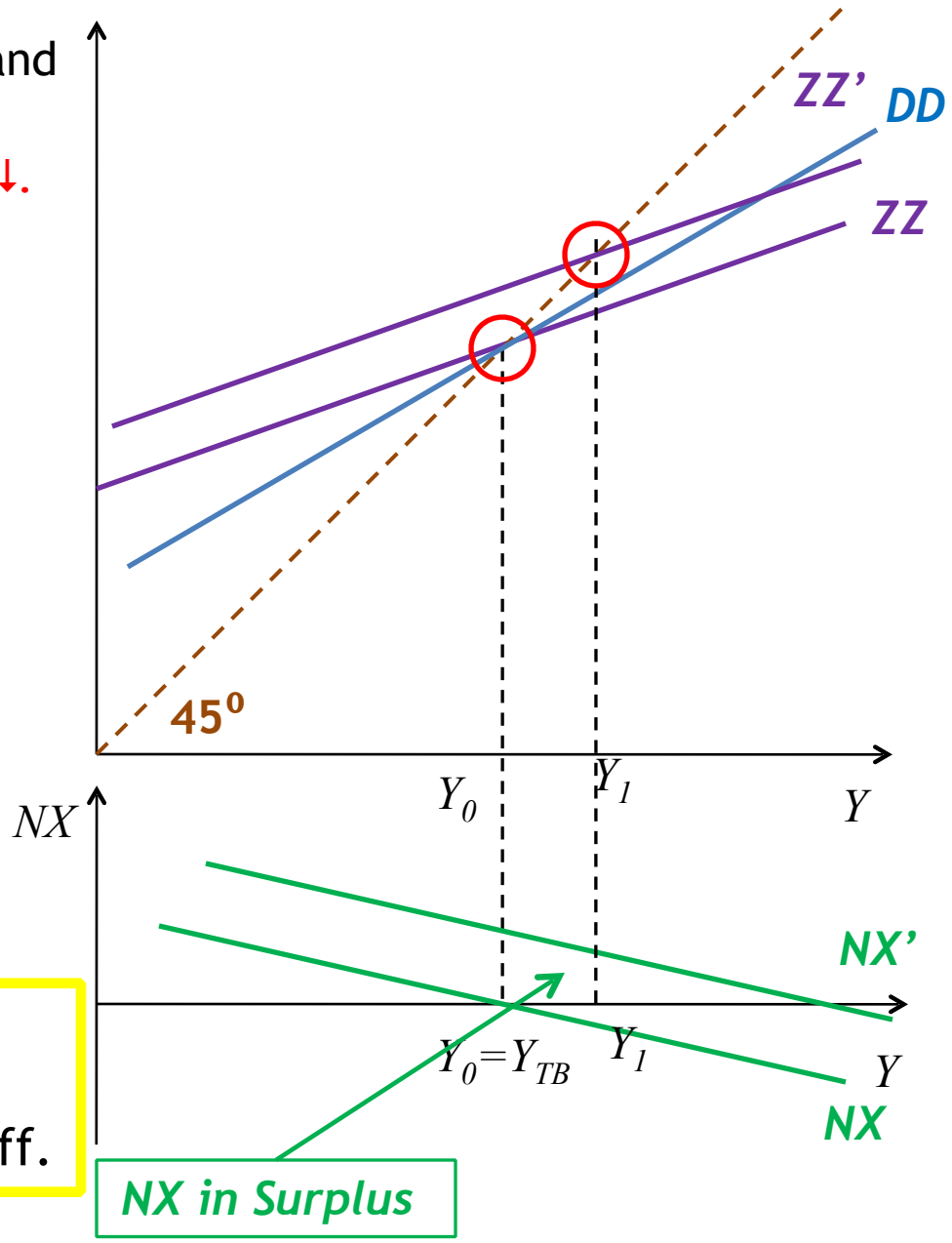
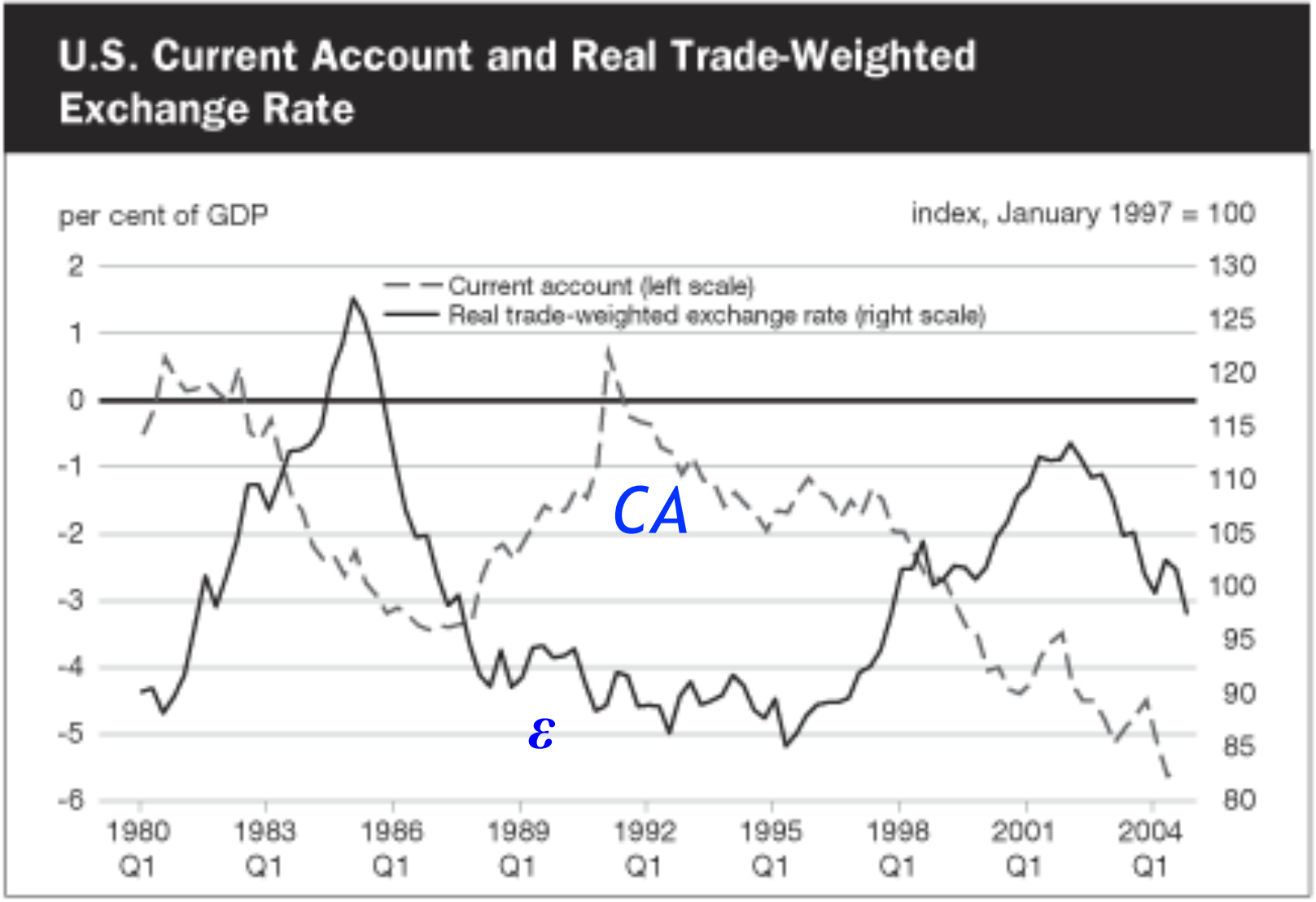
Trade Balance improves

Same as with increase in Y* but…now foreign goods are more expensive. Given income consumers are worse-off.



From Model to the Data:
US Trade deficit and Value of the dollar



Sources: Bureau of Economic Analysis and Federal Reserve (Real Broad Dollar Index).

The J-Curve

Multiple effects of a change in the real exchange rate in net exports.

$$NX = X\left(\underset{+}{Y^*}, \underset{-}{\varepsilon}\right) - IM\left(\underset{+}{Y}, \underset{+}{\varepsilon}\right)/\varepsilon = NX\left(\underset{-}{Y}, \underset{+}{Y^*}, \underset{-}{\varepsilon}\right)$$

Suppose $\varepsilon \downarrow$ (real depreciation)

A. Domestic goods are cheaper, so $X \uparrow$ and $NX \uparrow$
B. Foreign goods are more expensive, so $IM \downarrow$ and $NX \uparrow$
C. Foreign goods are worth more in terms of domestic goods, $1/\varepsilon \uparrow$, so $NX \downarrow$

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Effects A and B take time to realize. Effect C happens immediately.

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Timing of Adjustment:
The **J-Curve**

The J-Curve

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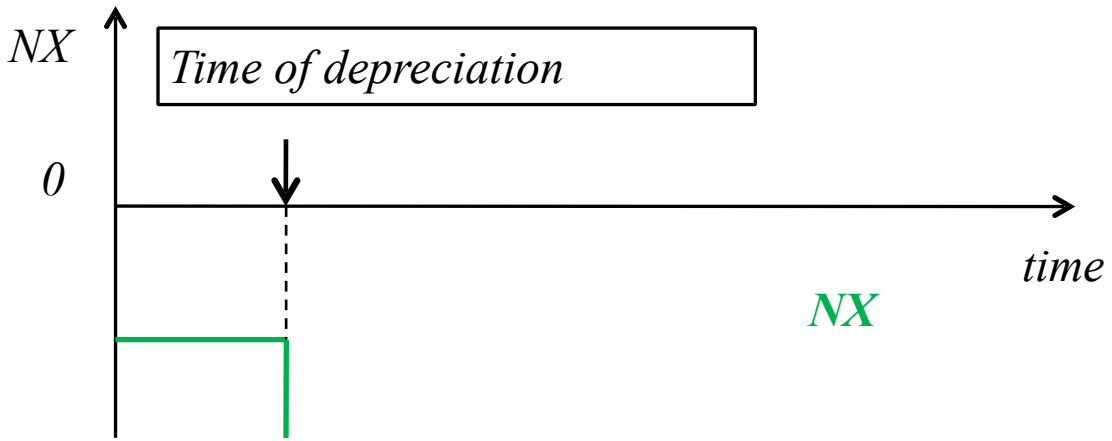
B. Foreign goods are more expensive, so $IM \downarrow$ and $NX \uparrow$
C. Foreign goods are worth more in terms of domestic goods, $1/\varepsilon \uparrow$, so $NX \downarrow$

Effects A and B take time to realize. Effect C happens immediately.

Timing of Adjustment:
The **J-Curve**



The J-Curve

Multiple effects of a change in the real exchange rate in net exports.

$$NX = X\left(\underset{+}{Y^*}, \underset{-}{\varepsilon}\right) - IM\left(\underset{+}{Y}, \underset{+}{\varepsilon}\right)/\varepsilon = NX\left(\underset{-}{Y}, \underset{+}{Y^*}, \underset{-}{\varepsilon}\right)$$

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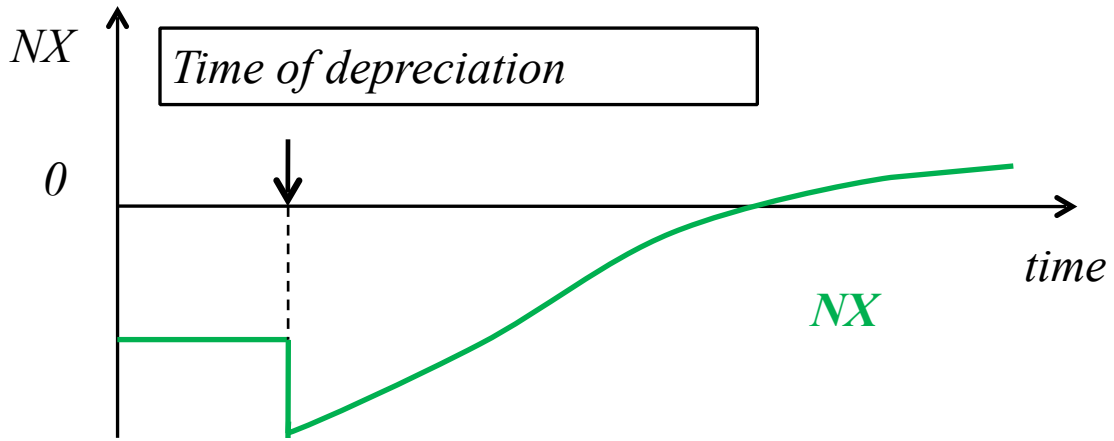


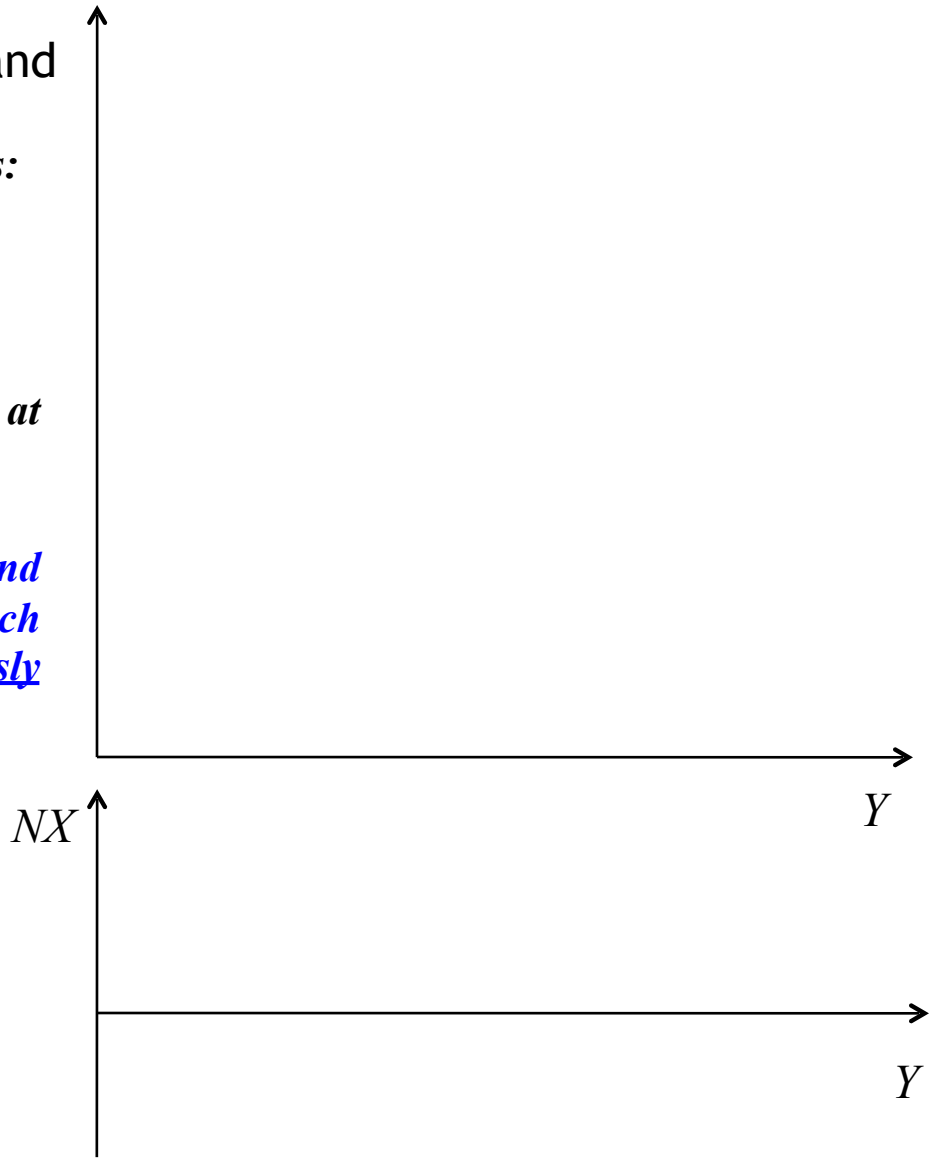
Government and Exchange Rate Policies Combined

Suppose that the Government has 2 policy objectives:

A) Output equal to a target level $\hat{Y}$
B) Trade Balance equal to zero (NX=0).

Suppose that the open economy is in equilibrium at output $\hat{Y}$ but their is trade deficit ($NX_0<0$).

What is the appropriate combination of demand (G↑↓) and exchange rate (ε↑↓) policies such that the two policy objectives are <u>simultaneously</u> reached?



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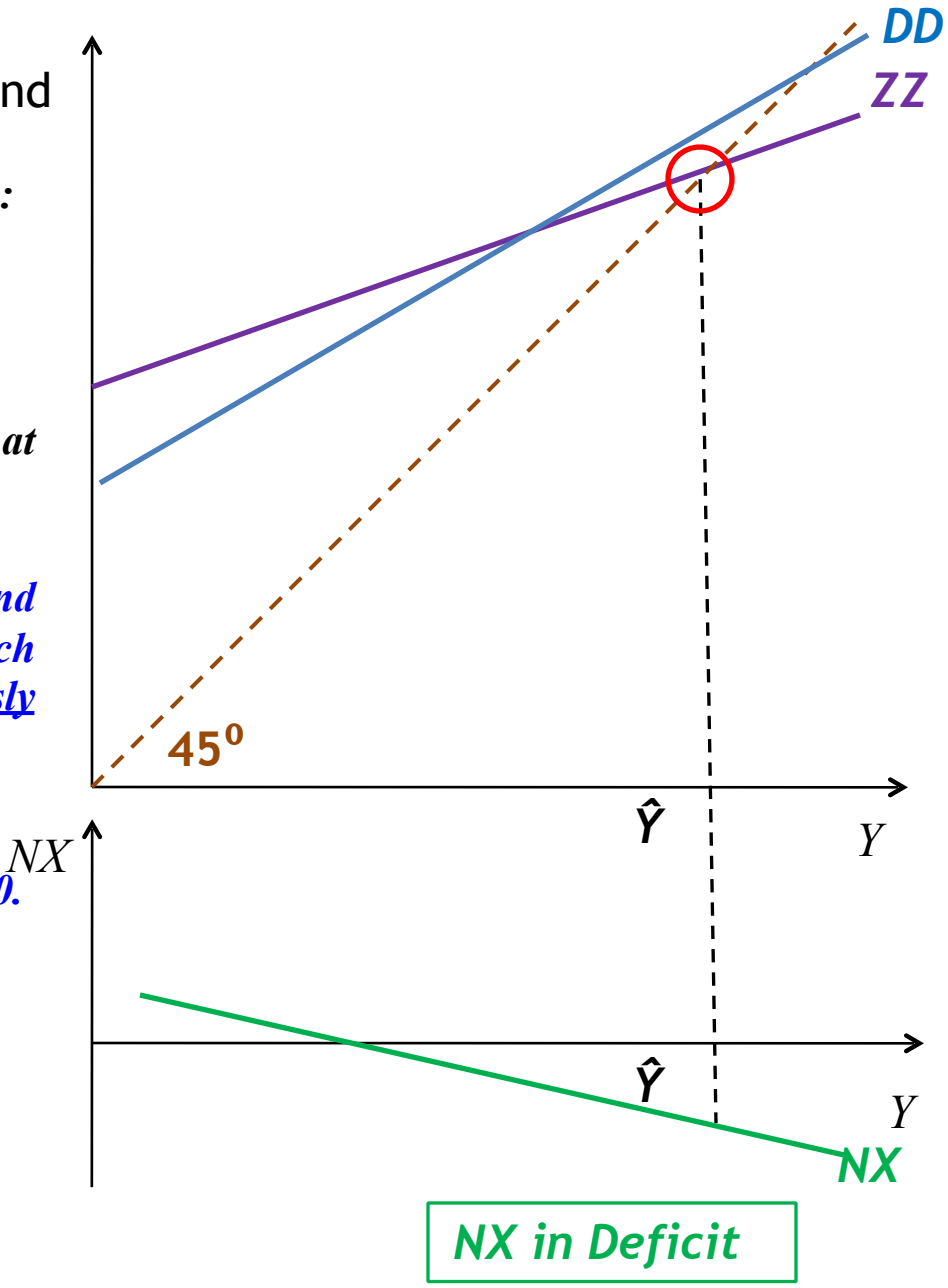
<u>STEPS</u>

1. ***Start from equilibrium output $\hat{Y}$ such that NX <0.***
2. ***Represent equilibrium in DD-ZZ-NX diagram.***

Note: Any policy combination should leave ZZ unchanged (why?)



NX in Deficit

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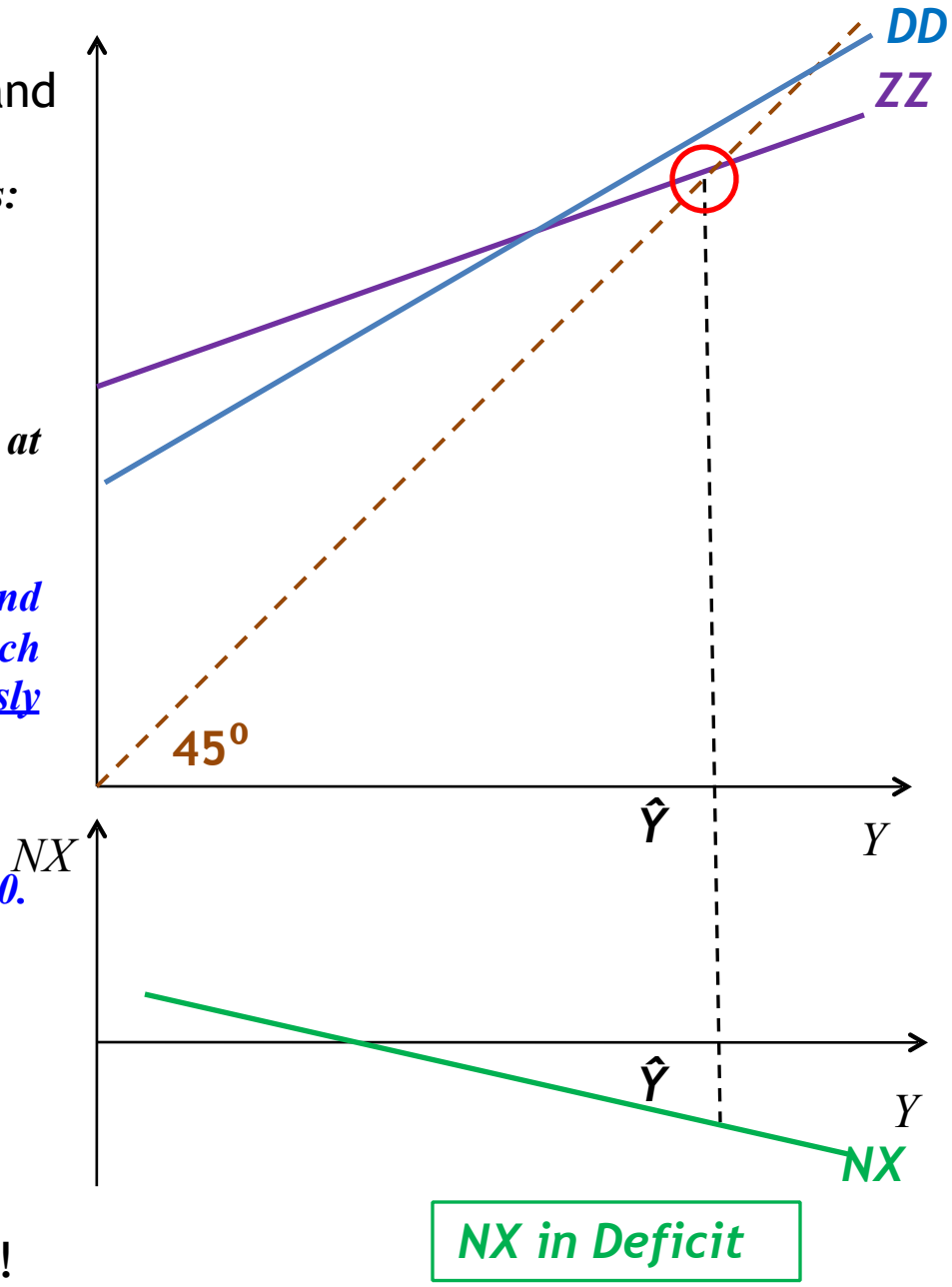
To do: SHIFT NX TO THE RIGHT!!



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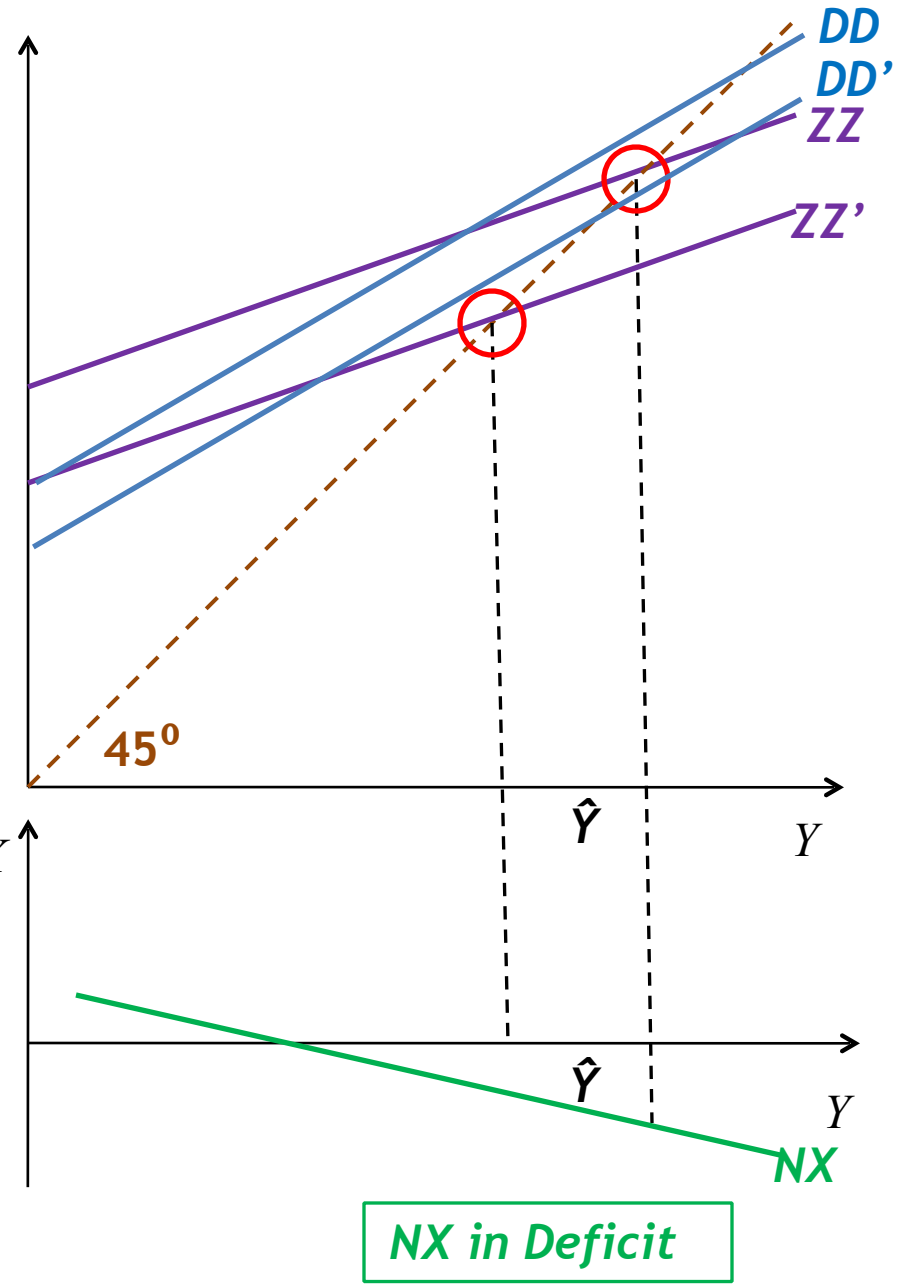
3. ***Decrease domestic demand (G↓)***
   - ***DD shifts down, ZZ shifts down***



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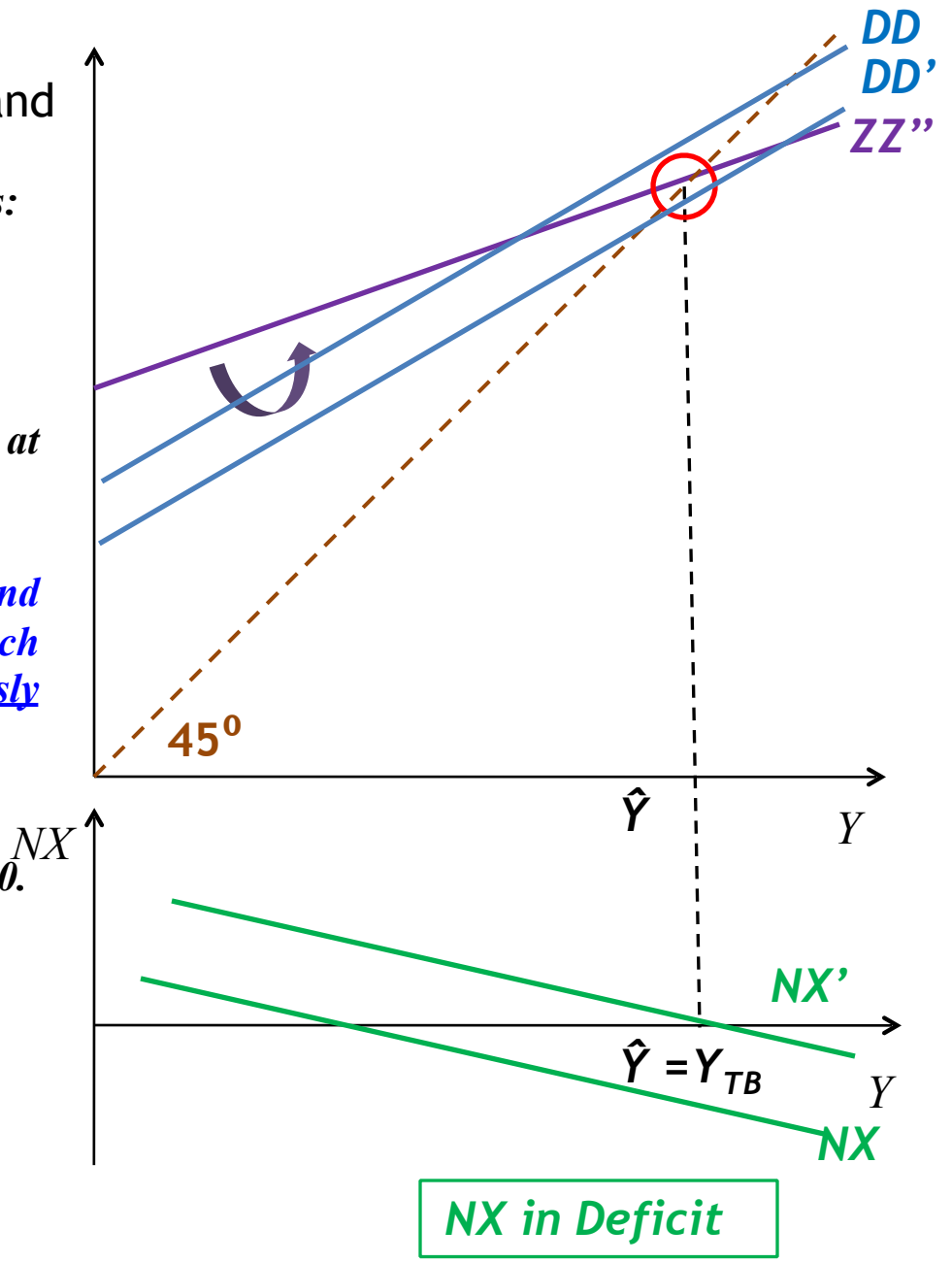
<u>STEPS</u>

1. ***Start from equilibrium output $\hat{Y}$ such that NX <0.***
2. ***Represent equilibrium in DD-ZZ-NX diagram.***
3. ***Decrease domestic demand (G↓)***
   - ***DD shifts down, ZZ shifts down***
4. ***Depreciate exchange rate (ε↓)***
   - ***NX shifts up, ZZ shifts up***



NX in Deficit

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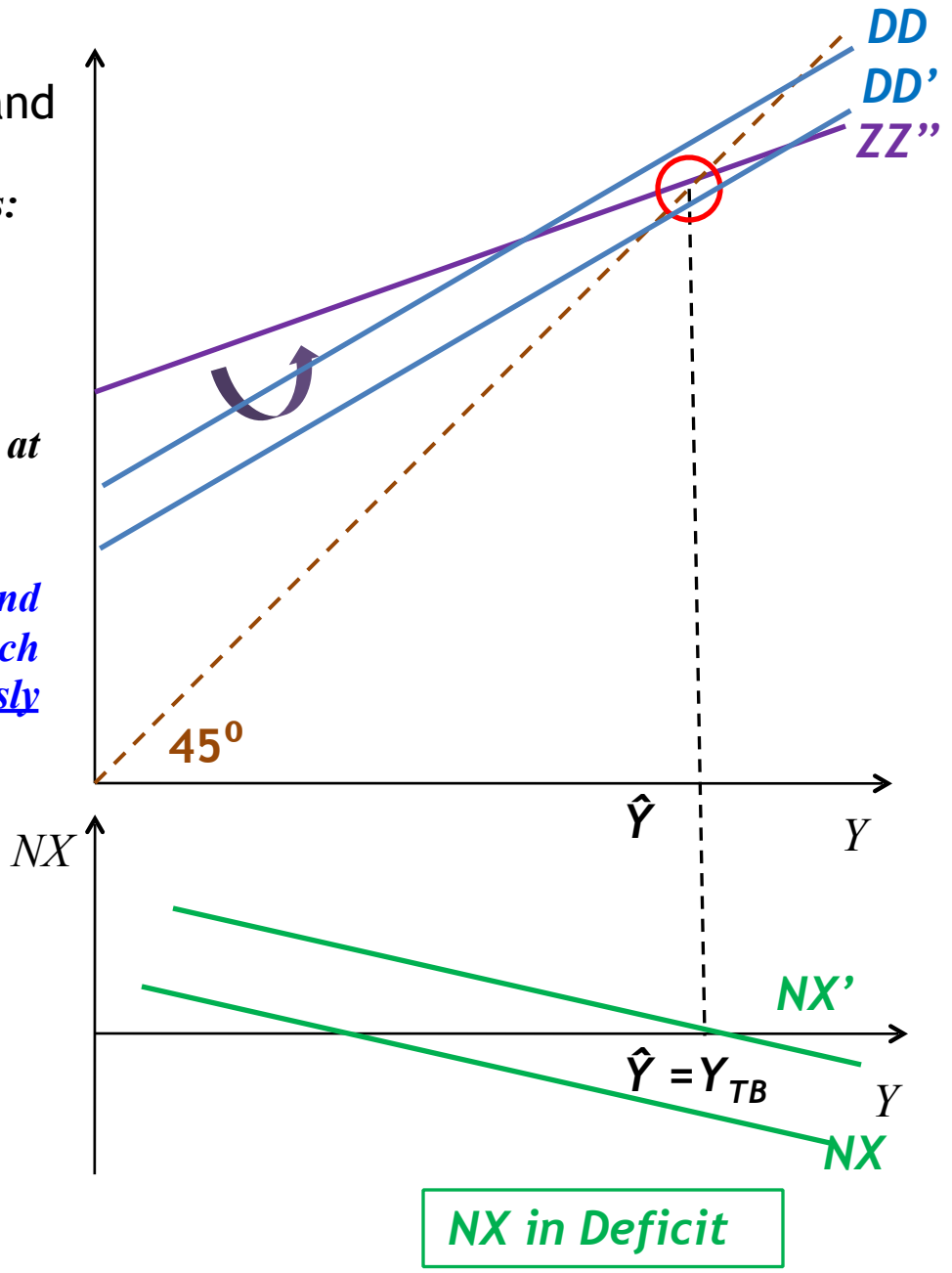
What is the appropriate combination of demand (G↑↓) and exchange rate (ε↑↓) policies such that the two policy objectives are simultaneously reached?

G↓: DD shifts down, ZZ shifts down
ε↓: NX shifts up, ZZ shifts up



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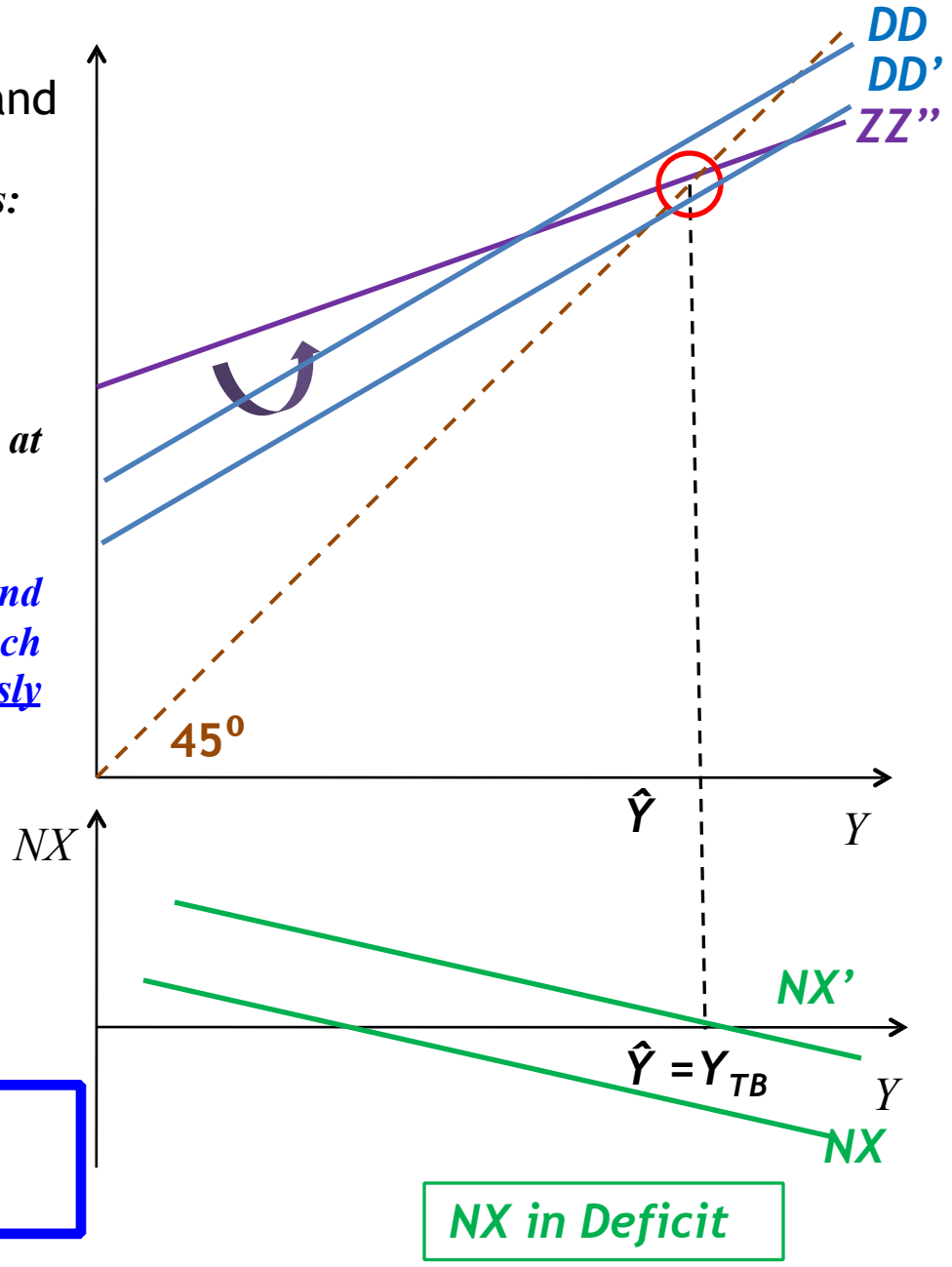

2 policies for 2 objectives:
Contractionary fiscal policy +
Real exchange rate depreciation

Equilibrium Output unchanged &
Trade Balance improves to NX=0