

UWTSD MBA HKBM7009
(UWMBA-30013-2024-1-SS)

Global Business Challenges (5-1)

National Income Accounting and Determination of National Income in a Four- Sector Economy

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8 February 2025; Saturday 13:00pm to 15:30pm



How to determine the ranking of a country in terms of its economic performance?

How to measure the expected (mean) economic growth rate and the volatility of an economy you are going to invest in?

Are worldwide economies correlated?

What are the major economic factors determining a market economy's economic growth?

Lecture Agenda:

- Some Empirical Facts
- Conceptual Framework and Methods of Compiling GDP
- Two Approaches to Determine Income in a Simple Keynesian Model: A two-sector model
- Determination of National Income in a Closed Economy: A three-sector model
- Determination of National Income in an Open Economy: A four-sector model

Some Empirical Facts

World GDP Figures

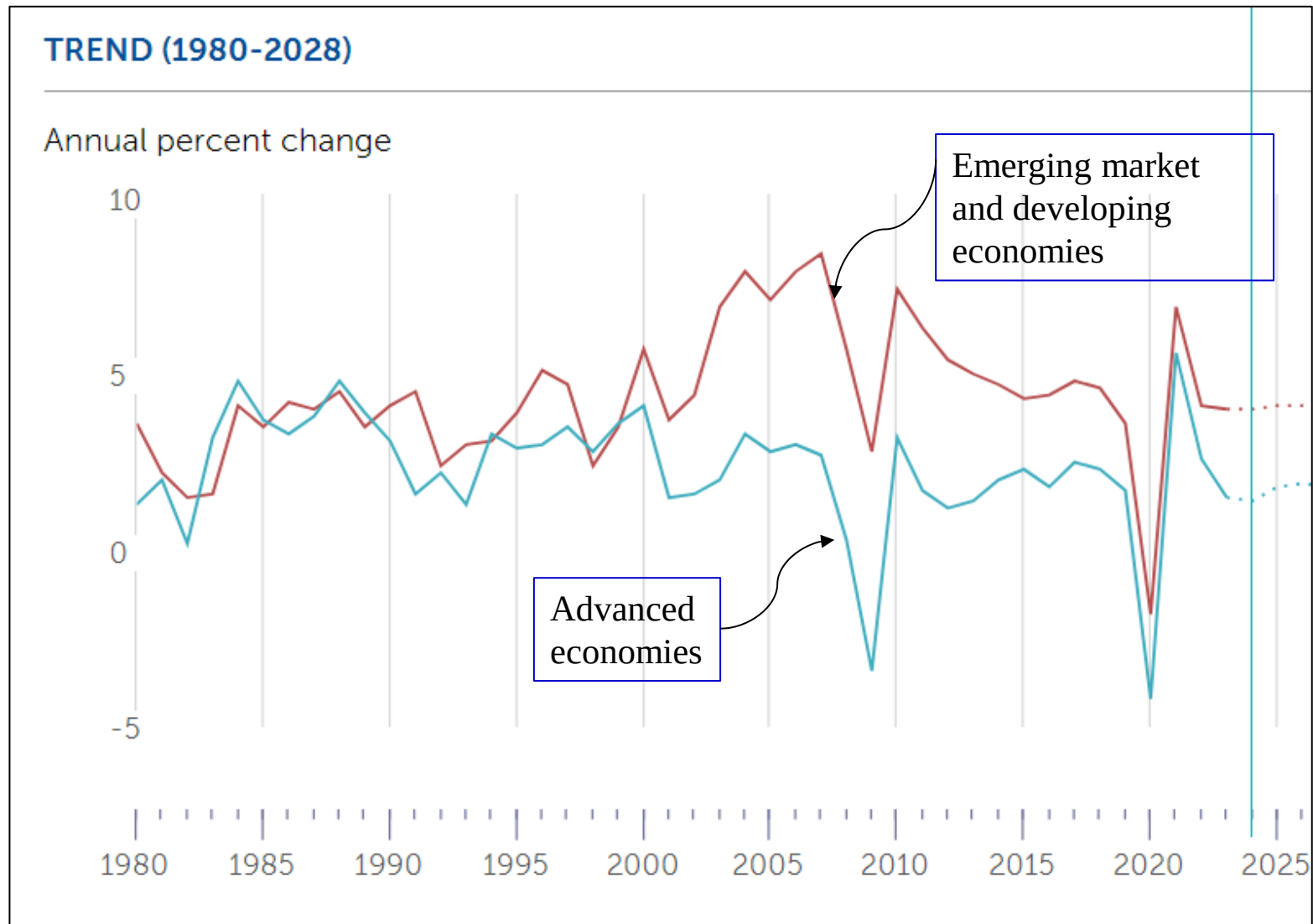
IMF DataMapper

https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD

Economic growth rate $G_t = \left(\frac{Real\ GDP_t}{Real\ GDP_{t-1}} - 1 \right) \times 100\%$

The Pearson correlation coefficient, **r**, can take a range of values from +1 to -1. A value of 0 indicates that there is no association between the two variables. A value greater than 0 indicates a positive association; that is, as the value of one variable increases, so does the value of the other variable.

Real GDP growth (Annual percent change)



Data matrix of Economic growth rate of selected countries 2008 to 2024

Real GDP growth (Annual percent change)	2008	2009	2010	2018	2019	2020	2021	2022	2023*	2024*
Australia	2.7	1.9	2.4	2.8	2	-2.1	4.9	3.9	2	1.2
Canada	1	-2.9	3.1	2.8	1.9	-5.2	4.5	3.8	1.2	1.3
China	9.7	9.4	10.6	6.8	6	2.2	8.1	3	5.2	4.8
Hong Kong SAR	2.1	-2.5	6.8	2.8	-1.7	-6.5	6.3	-3.7	3.3	3.2
India	3.9	8.5	10.3	6.5	3.7	-6.6	8.7	7	8.2	7
Japan	-1.1	-5.4	4.2	0.6	-0.4	-4.6	1.7	1.2	1.7	0.3
Korea, Republic of	3	0.8	6.8	2.9	2.2	-0.7	4.1	2.7	1.4	2.5
Macao SAR	3.4	1.3	25.3	6.5	-2.5	-54	18	-21.4	80.5	10.6
Singapore	1.9	0.1	14.5	3.7	1.1	-4.1	7.6	3.8	1.1	2.6
Taiwan	0.7	-1.6	10.6	2.8	3.1	3.4	6.6	2.6	1.3	3.7
United Kingdom	-0.3	-4.2	1.7	1.7	1.7	-9.3	7.4	4.8	0.3	1.1
United States	-0.1	-2.5	2.6	2.9	2.3	-3.4	5.7	2.5	2.9	2.8
World	3	-0.1	5.4	3.6	2.8	-3	6	3.6	3.3	3.2

* Figures estimated by the IMF

Sources: <https://www.imf.org/external/datamapper/NGDPDPC@WEO/CHN/HKG/JPN/KOR/MAC/SGP/USA>

Correlation matrix of Economic growth rate of selected countries (2008-2024)

	Australia	Canada	China	HK	India	Japan	Korea	Macao	SG	Taiwan	UK	USA	World
Australia	1.00												
Canada	0.86	1.00											
China	0.44	0.24	1.00										
HK	0.55	0.67	0.61	1.00									
India	0.77	0.69	0.57	0.70	1.00								
Japan	0.58	0.87	0.19	0.75	0.60	1.00							
Korea	0.62	0.77	0.61	0.78	0.66	0.82	1.00						
Macao	0.41	0.43	0.37	0.72	0.70	0.56	0.35	1.00					
SG	0.59	0.72	0.58	0.77	0.69	0.80	0.97	0.37	1.00				
Taiwan	0.16	0.46	0.19	0.55	0.19	0.70	0.76	0.08	0.80	1.00			
UK	0.91	0.97	0.22	0.62	0.70	0.77	0.68	0.41	0.64	0.38	1.00		
USA	0.74	0.93	0.11	0.73	0.63	0.86	0.65	0.55	0.62	0.50	0.93	1.00	
World	0.85	0.96	0.43	0.83	0.78	0.89	0.85	0.58	0.81	0.52	0.93	0.92	1.00

Mean and standard deviation of Economic growth rate of selected countries (2008-2024)

	Mean	SD
Australia	2.17	1.84
Canada	1.15	3.02
China	6.58	2.86
Hong Kong SAR	1.01	4.40
India	5.72	4.79
Japan	-0.18	2.92
Korea, Republic of	2.57	2.00
Macao SAR	6.77	34.21
Singapore	3.23	4.96
Taiwan	3.32	3.33
United Kingdom	0.49	4.59
United States	1.57	2.76
World	2.78	2.60

High and stable economic growth rates indicate a country's opportunity to expand the production of commodities and services.

Conceptual Framework and Methods of Compiling GDP



In general, is a country operating at more than, less than, or full employment?

Does supply create its own demand or demand create its own supply”

Macroeconomics or **Income Theory** is the study of aggregate economic behavior to analyze the principal determinants of an economy's level and growth of income with aggregate demand (AD) and aggregate supply (AS) as the two basic theoretical tools.

John Maynard Keynes was an early 20th-century British economist, known as the father of Macroeconomics.

Because the assumption of less than full employment, **the Keynesian Economics** relies on three derived assumptions: rigid prices (good prices and wages), demand creates its own supply, and in the short-run.

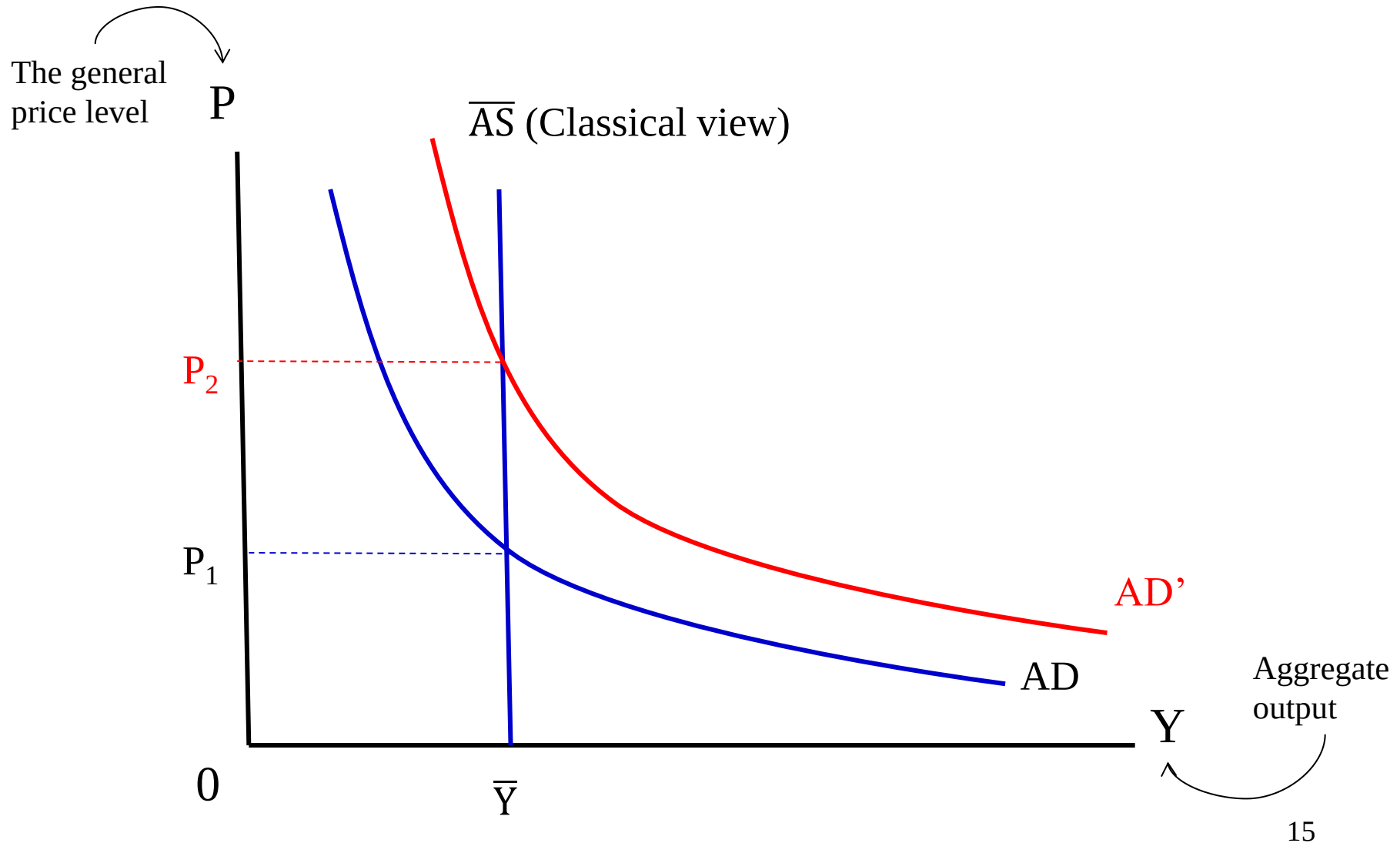
The conceptual framework of national income accounting

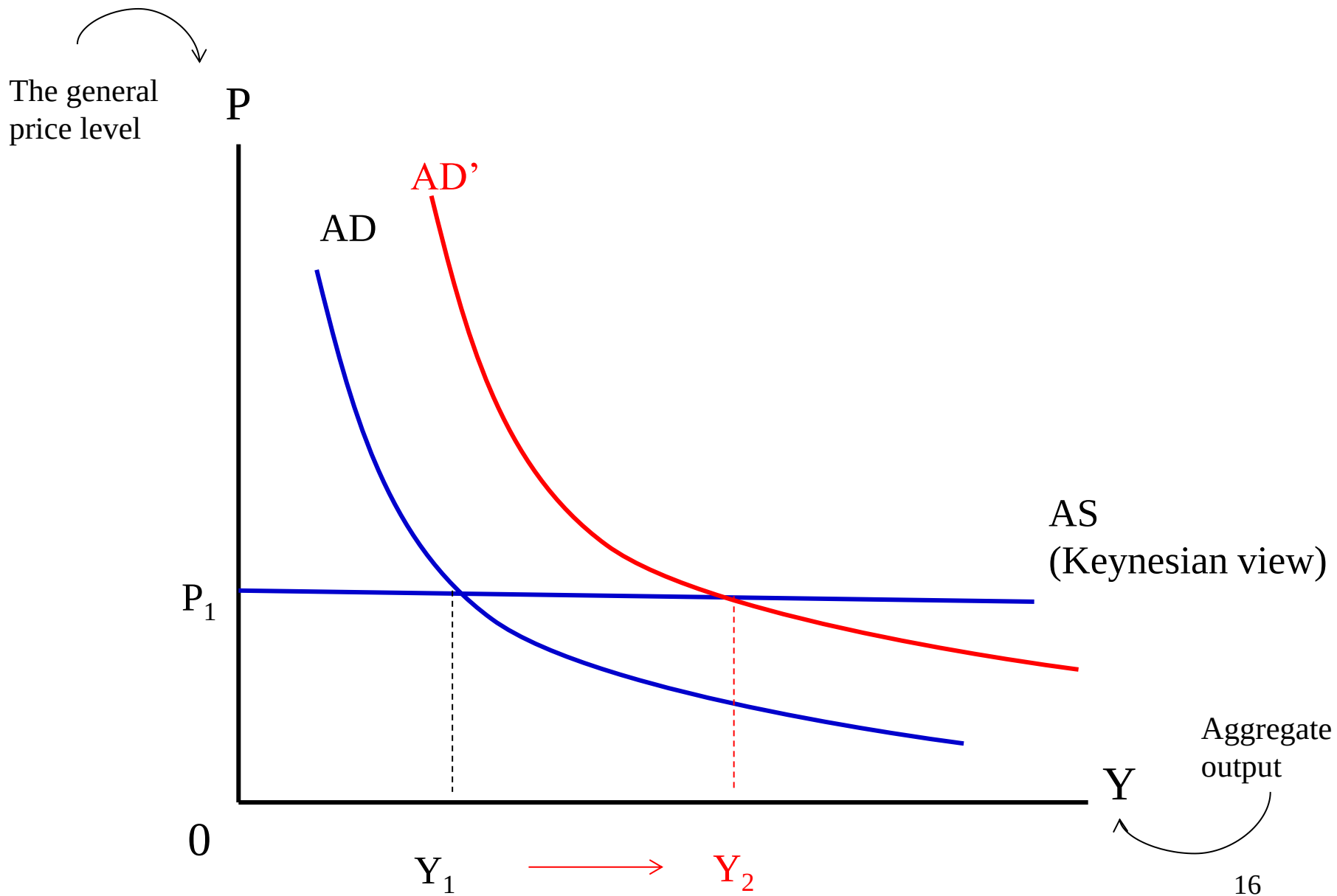
Fisher equation of exchange :

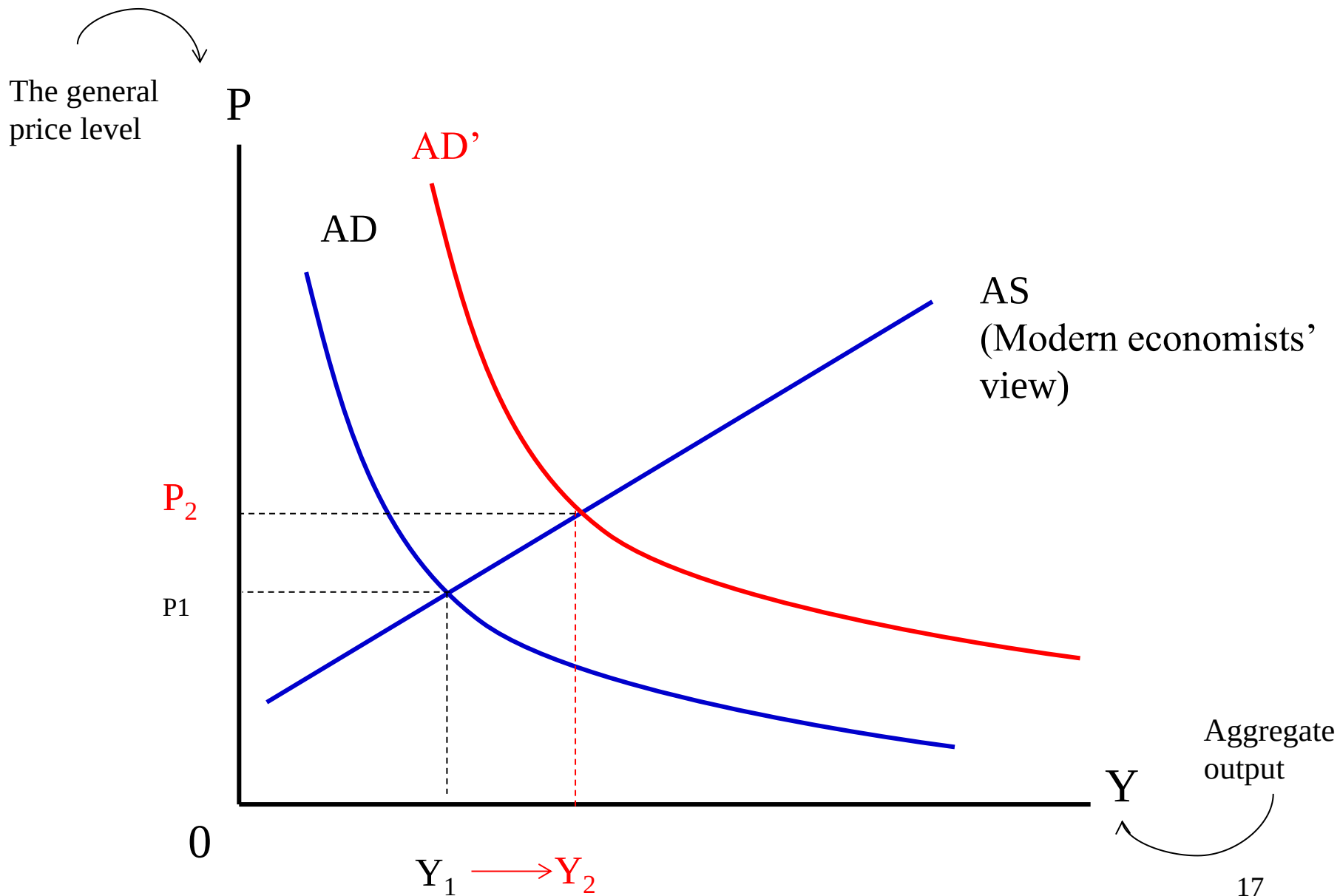
$$\underbrace{MV}_{\substack{\text{Aggregate} \\ \text{Expenditure} \\ \text{/demand}}} = \underbrace{PT}_{\substack{\text{Aggregate} \\ \text{Income/output}}}$$

Where: M = Quantity of money supply
V = Velocity of money circulation
P = The price level
T = Trade volume

Aggregate demand and supply analytical model







Approaches of GDP estimation

- Expenditure approach
 - International general practice
 - Currently used by Hong Kong
 - $GDP = C + I + G + X - M$
- Production/ value-add approach
 - Currently used by China
- Income approach
 - For complementary purpose

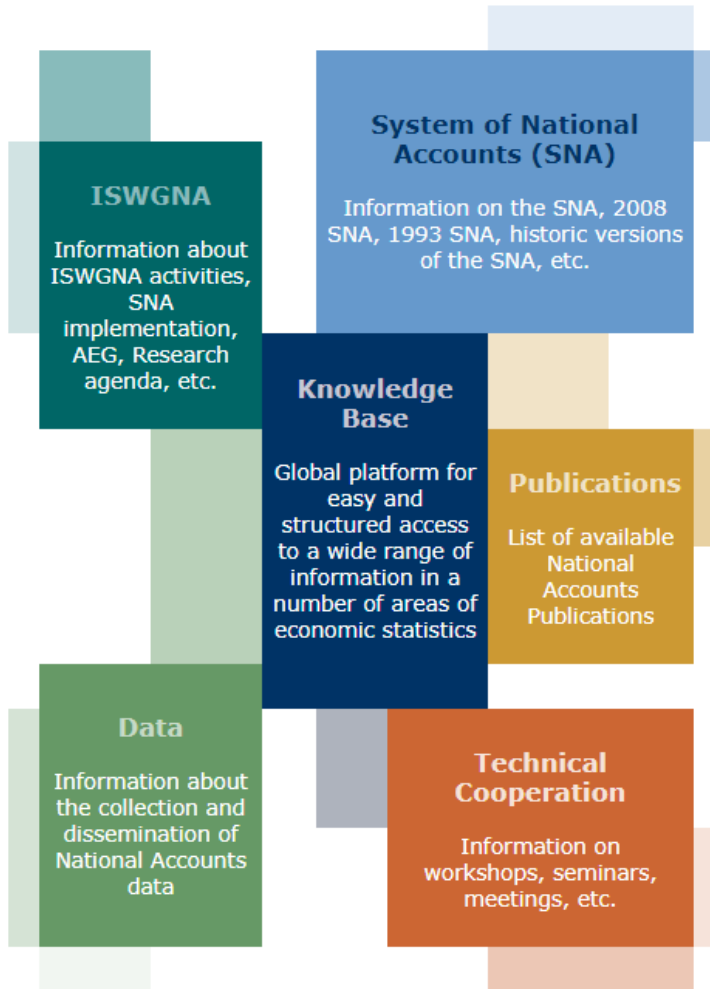
System of National Accounts

National Accounts

About the National Accounts Section

The National Accounts Section of the United Nations Statistics Division:

- ▶ Contributes to the international coordinated development and updating of the **System of National Accounts (SNA)**; and undertakes methodological research on issues on the **research agenda** of the SNA in collaboration with the **Intersecretariat Working Group on National Accounts (ISWGNA)**.
- ▶ Supports the **implementation programme of the SNA** by developing and updating supporting normative standards, training material and compilation guidance for the implementation of national accounts and supporting economic statistics and maintaining a **knowledge base on economic statistics**.
- ▶ Delivers a **statistical capacity building programme** for the implementation of the 2008 SNA and supporting statistics through a series of regional and interregional workshops and seminars in collaboration with the regional commissions and regional agencies and through a limited number of individual country technical assistance missions.
- ▶ Collects and disseminates **annual national accounts statistics** from countries and provides substantive service to the Committee on Contributions of the Fifth Committee of the United Nations on technical aspects of the elements of scale methodology for assessing the contributions to the United Nations by Member States.
- ▶ Publishes the outputs of the Section in various **publications** of UNSD.



System of National Accounts: Developments since 2008



National Accounts News

Updated 8 October 2019

The Main Aggregates and Detailed Tables, 2018 is available for download [here](#). The data included in the publication will soon be available on UNData.

The final manuscript for Satellite Account on Nonprofit and Related Institutions and Volunteer Work is available [here](#).

SNA News and Notes (Number 39/40) is now available.



Latest National Accounts Brochure

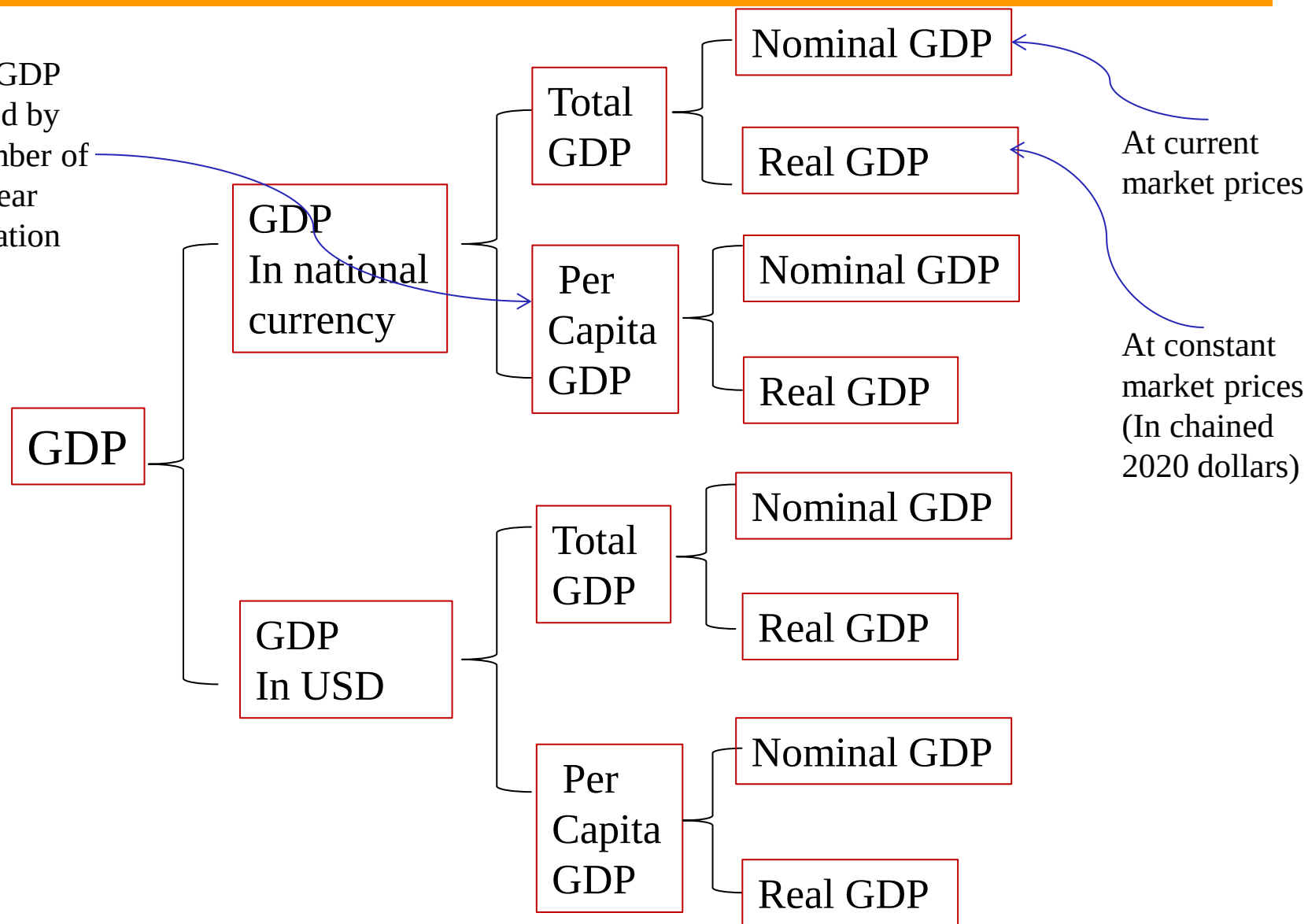
<https://unstats.un.org/unsd/nationalaccount/>

The Compilation Framework of GDP in HK

- The compilation framework of GDP accords essentially with the international statistical standards as stipulated in the System of National Accounts 2008 (2008 SNA).
- GDP is a measure of the total value of production of all resident producing units of an economy in a specified period (typically a year or a quarter), before deducting the consumption of fixed capital.
- Under the expenditure approach, GDP is compiled as the total final expenditures on goods and services (including private consumption expenditure, government consumption expenditure, gross domestic fixed capital formation, changes in inventories and exports of goods and services), less imports of goods and services.

Expression of GDP figures

Total GDP
divided by
the number of
mid-year
population



Estimation of GDP by the Expenditure Approach

- Private Consumption Expenditure
 - + Government Consumption Expenditure
 - + Gross Domestic Capital Formation
 - + Changes in Inventories
 - + Exports of Goods (f.o.b.)
 - + Exports of Services
 - Imports of Goods (f.o.b.)
 - Imports of services
-

GDP

National Income Definitions

	GDP at current market prices
-	Indirect taxes less subsidies
	GDP at current factor cost
+	Net property income from abroad
	GNP at current factor cost
-	Depreciation
	Net National Product at current market prices
-	Corporate income tax plus Undistributed corporate profit
-	Social security contributions
+	Transfer payments
	Personal Income
-	Personal income taxes plus non-tax payments
	Disposable Personal Income
-	Private consumption expenditure
	Household savings

The relation Among nominal, real value and Implicit Price Deflator

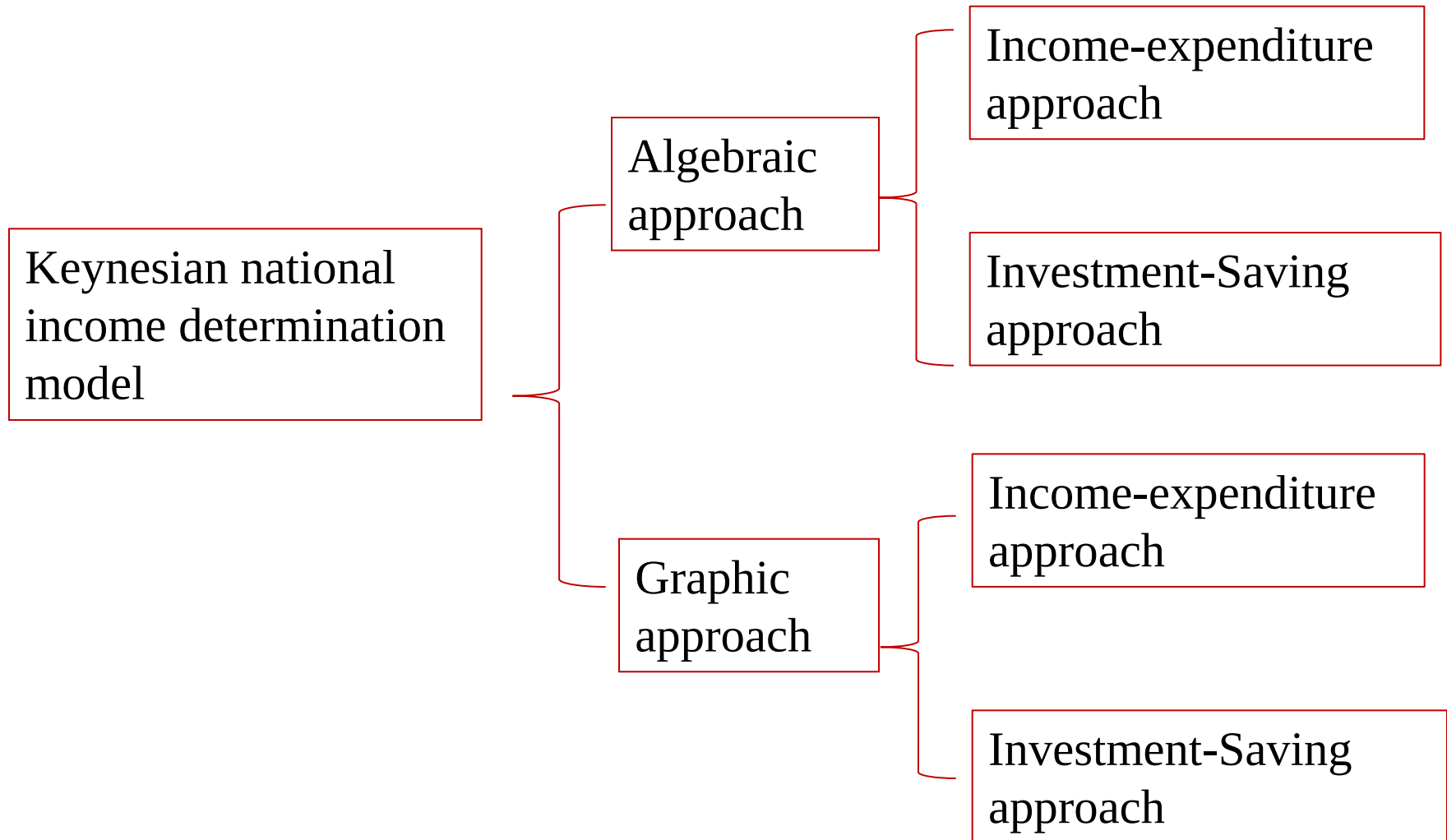
$$\text{GDP}_R = \frac{\text{GDP}_N}{\text{GDPD}} \times 100$$

$$\text{PCE}_R = \frac{\text{PCE}_N}{\text{PCED}} \times 100$$

$$\text{PCED} = \frac{\text{PCE}_N}{\text{PCE}_R} \times 100$$

Determine income in a simple Keynesian model:
A two-sector model

Assumptions: In a two-sector economy and with no income induced investment



Algebraic approach

$$Y^d = C + I \dots\dots\dots (1)$$

$$Y_d = Y \dots\dots\dots (4)$$

Definitional equation

Where Y^d , C , I , and Y_d , represents aggregate demand, consumption demand, investment demand, and disposable income, respectively.

$$C = C_0 + b Y_d$$

Since $Y=Y_d$, we have

$$C = C_0 + b Y \dots\dots\dots (2)$$

$$I = I_0 \dots\dots\dots (3)$$

Behavioral equations

Where C_0 , I_0 , b , I , Y , and b represents autonomous consumption, autonomous investment, marginal propensity to consume MPC, and aggregate income, respectively.

$$Y = Y^d \dots\dots\dots (4)$$

Equilibrium condition

It determines the equilibrium aggregate income level (Y)

Marginal propensity to consume MPC means a change in consumption resulting from one unit change in income.

$$\text{MPC} = \frac{\Delta C}{\Delta Y} = \frac{8}{10} = 0.8$$

The characteristics of MPC:

- (1) In the short run, MPC is a constant
- (2) $0 \leq \text{MPC} \leq 1$
- (3) $\text{MPC}_{\text{poor}} \geq \text{MPC}_{\text{rich}}$

By substituting equations (2) and (3) into equation (1), we have:

$$Y^d = (C_0 + b Y) + (I_0) \dots\dots\dots (5)$$

To satisfy the equilibrium condition, we substitute equation (5) into equation 4, we write the result in equation 6:

$$Y = (C_0 + b Y) + (I_0) \dots\dots\dots (6)$$

Rearrange the expression, we obtain the calculating equation for the equilibrium level of national income :

$$Y = C_0 + b Y + I_0$$

$$Y - bY = C_0 + I_0$$

$$Y(1 - b) = C_0 + I_0$$

$$Y = \frac{1}{1-b} \times (C_0 + I_0)$$

Investment - saving: Algebraic approach

To satisfy the equilibrium condition: $I = S$ (8)

By substituting equations (3) and (7) into equation (8), we get:

$$I_0 = -C_0 + (1-b)Y$$

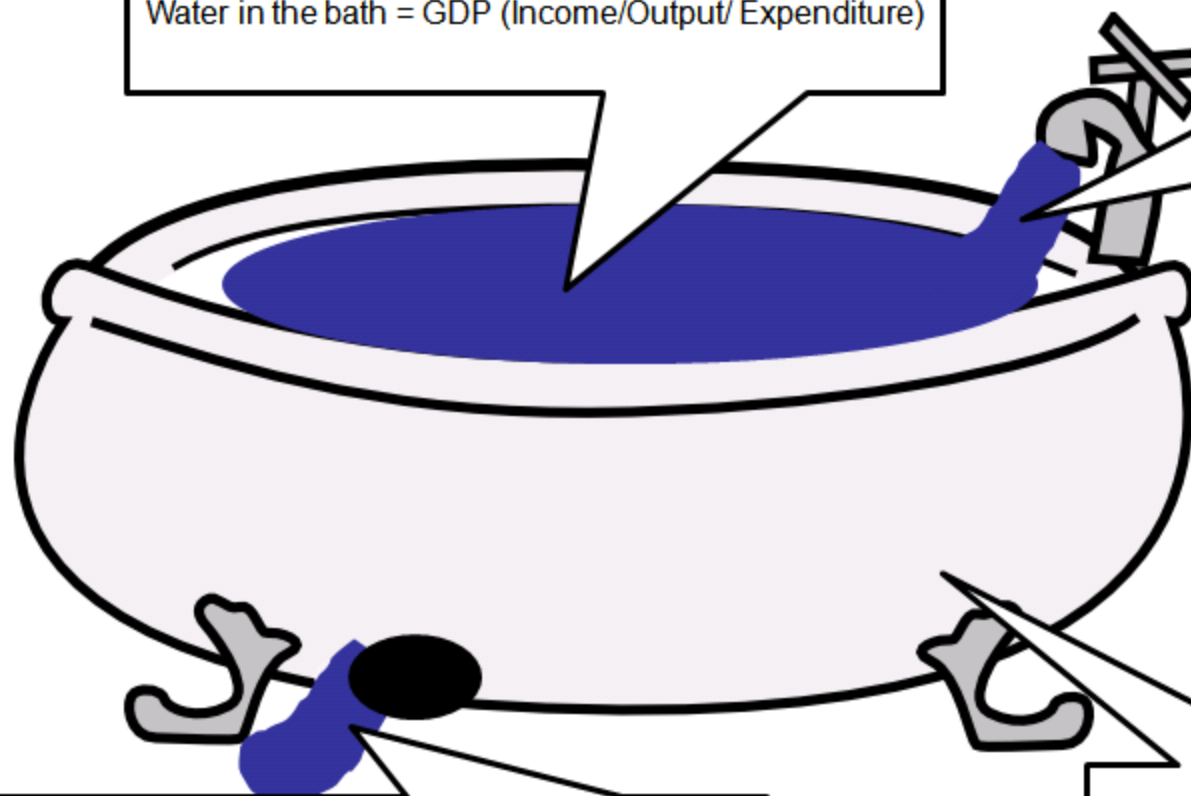
$$(1-b)Y = C_0 + I_0$$

$$Y_e = \frac{1}{1-b} (C_0 + I_0)$$

Water in the bath = GDP (Income/Output/ Expenditure)

The flow of water (income) into the bath (economy) are injections.

- Investment
- Govt. Spending
- Exports



The flow of water (income) out of the bath (economy) are withdrawals.

- Savings
- Taxes
- Imports

The bath tub is the economies potential based on the size of resources

Exercise:

$$\text{Given} \quad \left\{ \begin{array}{l} C = 100 + 0.8 Y \\ I = 400 \end{array} \right.$$

- (1) Show the savings function
- (2) Calculate the equilibrium level of income.
- (3) Calculate the investment expenditure multiplier and the new equilibrium level of income.

Solutions:

$$\text{Given} \quad \left\{ \begin{array}{l} C = 100 + 0.8 Y \\ I = 400 \end{array} \right.$$

(1) Show the savings function

Since saving is income not spent in a closed economy with no government , we can use equation (7) to show their relation

$$Y = C + S \dots\dots\dots (7)$$

By substituting equations (2) into equation (7), we have:

$$Y = C + S \dots\dots\dots (7)$$

$$Y = (C_0 + b Y) + S$$

$$S = -(C_0 + b Y) + Y$$

$$S = -C_0 - b Y + Y$$

$$MPS = \frac{\Delta S}{\Delta Y} = \frac{2}{10} = 0.2$$

The savings function:

$$S = -C_0 + (1-b)Y \quad \text{Or,} \quad S = -C_0 + (MPS)Y$$

$$S = -100 + 0.2Y$$

Where MPS is marginal propensity to save.

Solutions:

$$\text{Given} \quad \left\{ \begin{array}{l} C = 100 + 0.8 Y \\ I = 400 \end{array} \right.$$

(2) Calculate the equilibrium level of income.

$$Y = \frac{1}{1-b} \times (C_0 + I_0)$$

$$Y = \frac{1}{1-0.8} \times (100+400) = (5) \times (500) = 2500$$

Solutions:

$$\text{Given} \quad \left\{ \begin{array}{l} C = 100 + 0.8 Y \\ I + \Delta I = 400 + 100 = 500 \end{array} \right.$$

(3) Calculate the investment expenditure multiplier and the new equilibrium level of income.

$$Y = \frac{1}{1-b} \times (C_0 + I_0)$$

$$\Delta Y = \frac{1}{1-b} \times (\Delta C_0 + \Delta I_0)$$

$$\Delta Y = \frac{1}{1-b} \times \Delta I_0 = \frac{1}{1-0.8} \times 100 = 500$$

$$Y_{\text{new}} = Y_{\text{old}} + \Delta Y = 2500 + 500 = 3000$$

The investment expenditure multiplier is the ratio of the change in national income to the change in investment expenditure, it indicates that the investment will lead to changes in income several times change.

$$\Delta I \longrightarrow \Delta Y_t \longrightarrow \Delta C_t \longrightarrow \Delta Y_{t+1} \longrightarrow \Delta C_{t+1} \longrightarrow \Delta Y_{t+2} \longrightarrow \Delta C_{t+2} \longrightarrow \dots$$

A one-shot increase in investment expenditure will generate a series of perpetual but diminishing increment of income.

The investment expenditure multiplier

$$K = \frac{\Delta Y}{\Delta I} = \frac{1}{1-b} = \frac{1}{1-0.8} = 5$$

And thus:

$$\Delta Y = k\Delta I = 5(100) = 500$$

$$Y_{\text{new}} = Y_{\text{old}} + \Delta Y = 2500 + 500 = 3000$$

Determination of National Income in a closed Economy with the Government Sector : A Three-Sector Model

A set of equations

$$Y^d = C + I + G \dots\dots\dots (1)$$

$$Y_d = Y - T + TR \dots\dots\dots (2)$$

Definitional equations

Where G represents government expenditure

$$C = C_0 + b Y_d \dots\dots\dots (3)$$

$$I = I_0 \dots\dots\dots (4)$$

$$G = G_0 \dots\dots\dots (5)$$

$$T = T_0 + tY \dots\dots\dots (6)$$

$$TR = TR_0 \dots\dots\dots (7)$$

Behavioral equations

Where G_0 , T_0 , t , TR_0 represents autonomous government expenditure, autonomous lump-sum tax, rate of income tax, and transfer payments, respectively.

$$Y = Y^d \dots\dots\dots (8)$$

Equilibrium condition

It determines the equilibrium aggregate income level (Y)

Deriving the reduced form equation

By substituting Equations 6, and 7 into Equation 2, the disposable income consumption in a three-sector economy with a lump-sum tax, a proportional income tax, and transfer payments becomes the following:

$$\begin{aligned} Y_d &= Y - T + TR \\ &= Y - (T_0 + tY) + TR_0 \\ &= Y - T_0 - tY + TR_0 \dots\dots\dots (9) \end{aligned}$$

And then, by substituting Equations 9 into Equation 3, the consumption function becomes the following:

$$\begin{aligned} C &= C_0 + b Y_d \\ &= C_0 + b(Y - T_0 - tY + TR_0) \\ &= C_0 + bY - bT_0 - btY + bTR_0 \dots\dots\dots (10) \end{aligned}$$

We replace C, I, and G in Equation 1 by Equations 10, 4, and 5, the aggregate demand function becomes the following:

$$\begin{aligned} Y^d &= C + I + G \\ &= C_0 + bY - bT_0 - btY + bTR_0 + I_0 + G_0 \dots\dots\dots (11) \end{aligned}$$

To satisfy the equilibrium condition, we substitute Equation 11 into Equation 8, and get:

$$\begin{aligned} Y &= Y^d \\ &= C_0 + bY - bT_0 - btY + bTR_0 + I_0 + G_0 \\ Y - bY + btY &= C_0 - bT_0 + bTR_0 + I_0 + G_0 \\ Y(1 - b - bt) &= C_0 - bT_0 + bTR_0 + I_0 + G_0 \\ Y &= \frac{1}{1 - b - bt} (C_0 - bT_0 + bTR_0 + I_0 + G_0) \dots\dots\dots (12) \end{aligned}$$

Determination of National Income in an Open Economy: A Four Sector Model

A set of equations

$$Y^d = C + I + G + X - M \dots\dots\dots(1)$$

$$Y_d = Y - T + TR \dots\dots\dots(2)$$

$$C = C_0 + b Y_d \dots\dots\dots(3)$$

$$I = I_0 \dots\dots\dots(4)$$

$$G = G_0 \dots\dots\dots(5)$$

$$T = T_0 + tY \dots\dots\dots(6)$$

$$T R = TR_0 \dots\dots\dots(7)$$

$$X = X_0 \dots\dots\dots(8)$$

$$M = M_0 + mY \dots\dots\dots(9)$$

$$Y = Y^d \dots\dots\dots(10)$$

Definitional equations

Where X and M represents exports and imports, respectively.

Behavioral equations

Where X_0 , M_0 , and m represents autonomous exports, autonomous imports, and marginal propensity to import, respectively. Given the marginal propensity to import (m), as income increases, mY will increase.

Equilibrium condition

It determines the equilibrium aggregate income level (Y)

The reduced form equation

$$Y = Y^d$$

$$= C_0 + bY - bT_0 - btY + bTR_0 + I_0 + G_0 + X_0 - M_0 - mY$$

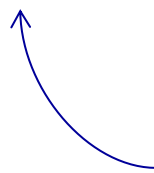
$$Y - bY + btY + mY = C_0 - bT_0 + bTR_0 + I_0 + G_0 + X_0 - M_0$$

$$Y(1 - b + bt + m) = C_0 - bT_0 + bTR_0 + I_0 + G_0 + X_0 - M_0$$

$$Y = \frac{1}{1 - b(1 - t) + m} (C_0 - bT_0 + bTR_0 + I_0 + G_0 + X_0 - M_0) \dots\dots\dots (11)$$

$$\Delta Y = \frac{1}{1 - b(1 - t) + m} \Delta(C_0 - bT_0 + bTR_0 + I_0 + G_0 + X_0 - M_0)$$

$$= \frac{1}{1 - b(1 - t) + m} (\Delta C - b\Delta T + b\Delta TR_0 + \Delta I + \Delta G + \Delta X - \Delta M) \dots\dots\dots (12)$$

 The expenditure multiplier

Exercise

(1) Given the following behavioral functions, Find the equilibrium national income of an open economy with a lump-sum tax, a proportional income tax, and transfer payments.

$$C = 200 + 0.8 Y_d$$

$$I = 100$$

$$G = 100$$

$$T = 120 + 0.2Y$$

$$T R = 10$$

$$X = 150$$

$$M = 100 + 0.14Y$$

(2) Other things remain unchanged, what will be the change in equilibrium income if both autonomous exports and autonomous imports decrease/**increase** by 10%?

$$Y = (1/[1 - 0.8(1 - 0.2) + 0.14])(100 - 96 + 8 + 100 + 100 + 150 - 100) \\ = 2(262) = 524$$

$$Y' = (1/0.5)(100 - 96 + 8 + 100 + 100 + 135 - 90) = 2(257) = 514$$

Change in equilibrium income = $514 - 524 = -10$

Or

$$2[(-15 + 10)] = -10$$

Thanks for *Attention*