МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ
РОССИЙСКОЙ ФЕДЕРАЦИИ

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by M.Yu. Malkina

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Настоящее пособие предназначено для проведения занятий с англоязычными студентами, обучающимися в ННГУ им. Н.И. Лобачевского по программе «Erasmus Mundus», изучающими курс «Макроэкономика (продвинутый уровень)». Пособие включает 4 базовых единицы курса, для каждой из которых приведены основные понятия, принципы и модели, задания для самостоятельной работы, включающие типовые задачи, симуляционные ситуации с применением программы Exel и кейс-стади. Пособие завершает список рекомендуемой литературы и глоссарий.

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Contents

Unit 1. The basic propositions of macroeconomics

1.1. Main notions, concepts, effects and equilibrium models

Aggregate sectors of the national economy:

Householders, Firms, Government, and Foreign Sector (the Rest of the World)

Main aggregate variables:

1. *Gross domestic product* (Y):

- nominal GDP ($Y_n = \sum_{i=1}^{m} p_{i1} \times q_{i1}$) and real GDP ($Y_r = \sum_{i=1}^{m} p_{i0} \times q_{i1}$); deflator of GDP: ($Def_{GDP} = \frac{Y_n}{Y_r}$); economic growth rate: $g_t = \left(\frac{Y_{Rt}}{Y_{Rt-1}} - 1 \right) \times 100\%$.
- actual GDP (Y) and potential GDP (Y_f); output gap ($\frac{Y - Y_f}{Y_f}$).

2. *Price level* and *inflation rate*.

- deflator: $Def_{GDP} = \frac{\sum p_1 \times q_1}{\sum p_0 \times q_1}$; $\pi_t = \left(\frac{def_t}{def_{t-1}} - 1 \right) \times 100\%$.
- consumer price index: $CPI = \frac{\sum p_1 \times q_0}{\sum p_0 \times q_0} = \sum \frac{p_1}{p_0} \times \eta_0$, $\eta_0 = \frac{p_0 \times q_0}{\sum p_0 \times q_0}$; $\pi_t = \left(\frac{CPI_t}{CPI_{t-1}} - 1 \right) \times 100\%$.

3. *Employment and unemployment.* Actual level of unemployment (u) and natural level of unemployment (u_n). Okun's law: $\frac{Y - Y_f}{Y_f} = \gamma \times (u - u_n)$.

4. *Consumption, Saving, Investment.*

Main regulative policies:

Fiscal, Monetary, Exchange Rate, and Foreign Trade Policy.

Purposes of the policies: 1) economic growth; 2) full employment; 3) prices stability; 4) stability of the balance of payments («the magic quadrangle» after Jan Tinbergen).

Short-run and long-run periods of economic performance

Short-run is the period of time when:

- price level rigidity (non-elasticity) takes place;

- money supply affects the real economic variables;
- the economy does not adapt to the shocks completely;
- the actual GDP may deviate from its potential level, and the actual unemployment does not coincide with its natural level.

Long-run is the period of time when:

- price level is perfectly flexible;
- neutrality of the money takes place, that is, changes in money supply do not affect the real economic variables;
- the economy adapts to the shocks completely;
- the actual GDP is equal to the potential GDP, and the actual level of unemployment is equal to its natural level.

Main macroeconomic identities:

1. Formation and distribution of gross national income: $\boxed{Y = C + I_p + G + NX}$, where C – consumption; I_p – gross private internal investment; G – government purchases of final goods and services; NX – net export (export (X) – import (Z));

2. Formation and distribution of disposable income: $Y_d = Y - T + TR + N$ – formation of gross income at the disposal of the home private sector, where T – taxes; TR – transfers from government to private sector; N – paid interests for public bonds held by private sector. $Y_d = C + S_p$ – distribution of disposable income, where S_p – private savings.

3. Interaction between aggregate sectors: $S_p + (T - TR - N) + Z = I_p + G + X$ (withdrawals (leakages) = injections).

4. Distribution of private savings: $\boxed{S_p = I_p + BD + NX}$, where BD – public budget deficit ($BD = G + TR + N - T$).

5. Balance of payments: $NX = I_r + \Delta R$, where NX – trade account, I_r – capital outflows abroad, i.e. domestic country's foreign investment (capital account of the balance of payments with an opposite sign), $\Delta R = \Delta R_P + \Delta R_g$ – changes in the country's international reserves, both private (ΔR_P) and official ones (ΔR_g).

6. State budget balance: $BD = \Delta M_{bd} + \Delta B$. Budget deficit is financed by credits to government from the Central Bank and thus by money emission (ΔM_{bd}) and by government offering of

public bonds ($\Delta B = \Delta B_p + \Delta B_g$), that are finally purchased by the private sector (ΔB_p) and by the Central Bank (ΔB_g).

7. Three channels of money supply: $\Delta M = \Delta M_1 + \Delta M_2 + \Delta M_3$, ΔM_1 – Central Bank gets credits to the national economy: commercial banks and government («credit channel»): $\Delta M_1 = \Delta M_{cb} + \Delta M_{bd}$ (in stationary economy $\Delta M_{cb} = 0$); ΔM_2 – central bank purchases the public bonds («stock channel») to finance the part of budget deficit ($\Delta M_2 = \Delta B_g$); ΔM_3 – central bank purchases foreign currency («exchange channel») and replenishes the official reserves ($\Delta M_3 = \Delta R_g$).

8. Finally, private savings are distributed in the forms: $\boxed{S_p = I_p + I_r + \Delta M + \Delta B_p + \Delta R_p}$.

9. General rule for savings and investment: $\boxed{S_p + S_g + S_r = I_p + I_g + I_r}$. Summary savings from all the sectors of economy are equal to their summary investment.

Macroeconomic models differ:

1. Exogenous and endogenous variables (inputs and outputs).
2. Some models are based on perfect mobility of the resources (mainly the capital), and other assume non-perfect mobility.
3. Statics, Comparative Statics and Dynamics.
4. Short-run and long-run performance.

Multiplier effects of macroeconomic policies:

Table 1

Multipliers in an open economy with induced investment

Multiplier of…	Formula for calculation	Total expenditures influence
- autonomous expenditures	$m_a = \dfrac{1}{1-[MPC \times (1-t) - \mu + \eta]}$	$\Delta Y^D = m_a \times \Delta A_a$
- investment	$m_I = \dfrac{1}{1-[MPC \times (1-t) - \mu + \eta]}$	$\Delta Y^D = m_I \times \Delta I_a$
- government purchases	$m_G = \dfrac{1}{1-[MPC \times (1-t) - \mu + \eta]}$	$\Delta Y^D = m_G \times \Delta G_a$
- transfers	$m_{TR} = \dfrac{MPC}{1-[MPC \times (1-t) - \mu + \eta]}$	$\Delta Y^D = m_{TR} \times \Delta TR_a$
- autonomous taxes	$m_T = \dfrac{-MPC}{1-[MPC \times (1-t) - \mu + \eta]}$	$\Delta Y^D = m_T \times \Delta T_a$
- balanced budget	$m_{BD} = \dfrac{1-MPC}{1-[MPC \times (1-t) - \mu + \eta]}$ (when extra government purchases are financed	$\Delta Y^D = m_{BD} \times \Delta G_a$ (on conditions that:

	by additional autonomous tax) $m_{BD}=\frac{1-MPC}{1-[MPC-\mu+\eta]}$ (when extra government purchases are financed by additional income tax)	$\Delta G_a=\Delta T_a$)

Note: MPC – marginal propensity to consume as to disposable income; t – income tax rate; $MPC\times(1-t)$ – marginal propensity to consume as to gross income; μ – marginal propensity to consume import goods and services; η – marginal propensity to induced investment.

The Haavelmo theorem affirms that an increase in the public expenditures, which is financed fully over additional income taxes, primarily results in the same product increase, thus $\Delta G=\Delta T=\Delta Y$.

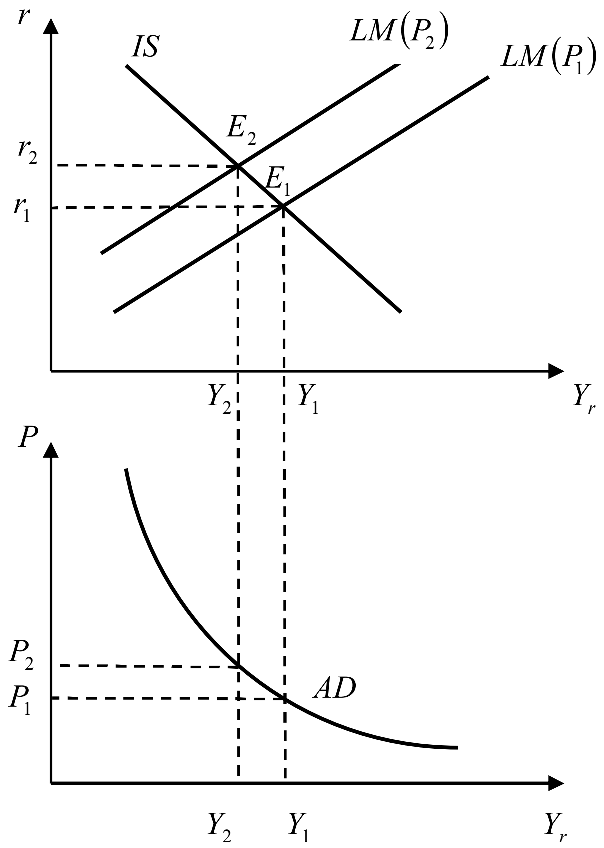


Figure 1. Aggregate demand formation

Arithmetic of the IS-LM model.

IS function:

$$\boxed{Y=A+m_G\times G_a+m_T\times T_a-\beta\times m_I\times r},$$

where $A=\frac{C_a+MPC\times TR_a+I_a}{1-MPC\times(1-t)}=m_a\times A_a$ – multiplied autonomous expenditures, which is a constant value; $I=I_a-\beta\times r$ – function of investment.

LM function:

$$\boxed{Y=-L+\frac{h}{k}\times r+\frac{1}{k}\times\left(\frac{M_S}{P}\right)},$$

where M_S/P is real money supply; $L(Y,r)=L_a+k\times Y-h\times r$ - real money demand; $M_S/P=L(Y,r)$ – equilibrium in money market; $L=\frac{L_a}{k}$, $\frac{h}{k}$ and $\frac{1}{k}$ – coefficients, which are constant.

Crowding-out effect – the offset in aggregate demand that results when expansionary fiscal policy rises the interest rate and thereby reduces investment spending[1].

Aggregate demand – different quantities of goods and services that aggregate sectors of households, firms, and the government can and want to buy at each price level.

[1] Mankiw G. (2010). Macroeconomics.

AD function negative slopes are attributable to three effects:

- Pigou's Wealth Effect;
- Keynes's Interest-Rate Effect;
- Mundell-Fleming's Exchange-Rate Effect.

Aggregate supply – different quantities of goods and services that aggregate sectors of firms can and wish to produce and sell at each price level.

1.2. Problems

Problem 1. Examine the following case. Before the economic crisis of 2008-2009, Russia was an economy with two surpluses: the trade account surplus ($NX > 0$) and the state budget surplus ($BS = -BD$). Favorable conjuncture for petroleum and other energy resources in world markets resulted in inflows of sustainable export revenues into Russian economy. Russian banks and non-financial corporations borrowed actively abroad. They expected ruble exchange rate would further increase. Foreign currency inflows to national economy have enlarged considerably. The Central Bank of Russia purchased exchange currency to restrain ruble revaluation and avoid worsening of national competitiveness, actually accomplishing a massive ruble intervention. The Russian government formed Stabilization funds in foreign currency deposits and advanced countries' public bonds to sterilize excessive money supply.

Describe Russian economics conditions in terms of main economic identities presented above. What were the conditions in advanced countries at that time?

Problem 2. Suppose some economy has shown the following annual results: gross income Y=2800; consumption: C=2000; government purchases G=600; transfers from government to public TR=300; interests paid for public bonds at the disposal of private holders N=100; taxes T=800; net export NX=–300.

Determine the value of: a) gross internal private investment; b) deficit/surplus of state budget; c) income at the disposal of private sector; d) private savings.

Answer: a) $I_g = 500$; b) $BD = 200$; c) $Y_d = 2400$; d) $S_p = 400$.

Problem 3. Suppose some economy has shown the following annual results: C=2000; G=300; TR=240; T=450; trade balance surplus is equal to 180. Gross income is equal to 3100.

Evaluate the share of gross private savings aimed at financing gross internal private investment.

Answer. 0,7 (or 70%).

Problem 4. Suppose some economy has shown the following annual results: consumption C=2400; gross internal investment I=700; government purchases G=800; social transfers TR=100; paid interest for public debt bonds at the disposal of private sector N=200; autonomous taxes T=800. Budget deficit is planned to be covered for 80% by bonds offering, and for 20% by money emission.

What share of new private savings should be presented in the form of public bonds purchases?

Answer. 24%.

Problem 5. What economic conditions are not taken into account at the Haavelmo theorem?

Problem 6. Suppose the economy of some country is characterized by the following data: $Y = C + I + G + NX$, $C = 200 + 0{,}6 \times Y_d$, $I = 400 - 2000 \times r$, $NX = 100 - 0{,}1 \times Y$, $M_d / P = 0{,}5 \times Y - 3000 \times r$.

Tasks:

a) Derive the equations for IS and LM functions;

b) Let $T = 400$, $G = 300$, $M_S = 600$, and $P = 1$. Evaluate the equilibrium income and the equilibrium interest rate for these conditions;

c) Develop the equation for AD curve as the relation between the real expenditures and the real money supply, autonomous taxes and government purchases;

d) Suppose the Government has decided to increase aggregate demand in short-run by 180 units. How much should it change the autonomous taxes or the public purchases of goods and services to achieve this aim? Estimate the crowding-out effect in this case. Determine equilibrium interest rate change.

e) Suppose not the Government but the Central Bank has set the goal to increase the income by 180 units by means of monetary policy. How much it has to change money supply in the short-run period? Estimate the changes in equilibrium level of the interest rate and investment in this case.

Answer. a) IS: $Y_{IS} = 1400 - 1{,}2 \times T + 2 \times G - 4000 \times r$; LM: $Y_{LM} = 2 \times \dfrac{M_S}{P} + 6000 \times r$; b) $Y_E = 1392$ units; $r_E = 0{,}032$ (or 3,2%); c) AD: $Y_{AD} = 840 - 0{,}72 \times T + 1{,}2 \times G + 0{,}8 \times {M_S}/{P}$; d) $\Delta T = -250$ units, or $\Delta G = +150$ units. The crowding-out effect is equal to 120 units in both cases. $r_E = 0{,}062$ (or 6,2%); e) $\Delta M_S = +225$ units, $\Delta r = -4{,}5\%$; $\Delta I = +90$ units.

Problem 7. Imagine some closed economy with the following characteristics: consumption function is $C = 600 + 0{,}6 \times (Y - T)$; investment function is $I = 500 - 1600 \times r$ (r is expressed as a fraction); tax function is $T = 100 + 0{,}25 \times Y$; government purchases function is $G = 400 + 0{,}15 \times Y$. Demand for real money is $(M/P)_d = 0{,}5 \times Y - 3000 \times r$; money supply is $M_S = 1600$; price level is $P = 2$.

Suppose the government has increased autonomous government expenditures by 200 units. Estimate the crowding-out effect. What should the Central Bank undertake to neutralize this effect entirely?

Answer. The crowding-out effect is equal to 200 units. The Central Bank should increase money supply by $\Delta M_S = 500$ units.

UNIT 2. Economics Growth

2.1. Solow Growth Model

This model was developed by Robert Solow and T.W. Swan in 1956.

1. It is based on following *production function* (PF):

$$Y(t) = F(K(t), A(t) \times L(t)) \qquad (1),$$

where Y – output, K – capital, L – labor, A – knowledge or the «effectiveness of labor», t – time. $A(t) \times L(t)$ is so called «effective labor», and the technical progress here is «labor augmenting» or Harrod-neutral.

2. There are some *assumptions* concerning production function:

- *homogeneous character*;
- *constant returns to scale*:

$$\forall c \geq 0, \; F(cK, cAL) = cF(K, AL). \qquad (2)$$

It means that: a) the advantages of specialization are exhausted, and the economy is sufficiently big; b) other factors, such as natural resources and land, have no impact on output.

By dividing both parts of the equation (1) by AL, we get he expression:

$$\frac{Y}{AL} = \frac{1}{AL} F(K, AL) = F\left(\frac{K}{AL}, 1\right), \qquad (3)$$

that can be interpreted as follows: output per unit of effective labor ($y = \frac{Y}{AL}$) is a function of capital per unit of effective labor ($k = \frac{K}{AL}$). And the equation (3) takes the intensive form:

$$y = f(k). \qquad (4)$$

- *declining but positive returns to capital* (and to «capital per unit of effective labor») as capital rises:

$$f(0)=0,\ MP_k = f'(k)>0,\ f''(k)<0, \tag{5}$$

where $MP_k = \frac{\partial Y}{\partial K} = \frac{\partial y \cdot AL}{\partial k \cdot AL} = \frac{\partial y}{\partial k}$ is the marginal product of capital.

- *production function satisfies the Inada conditions:* $\lim_{k\to 0} f'(k)=\infty$, $\lim_{k\to\infty} f'(k)=0$.

3. Cobb-Douglas function might be considered as an appropriate case of PF:

$$F(K, AL) = K^{\alpha}(AL)^{1-\alpha}, \qquad 0<\alpha<1. \tag{6}$$

In intensive form: $f(k)=k^{\alpha}$. (7)

Marginal product of capital: $MP_k = f'(k) = \alpha k^{\alpha-1} = \alpha \times f(k)^{\frac{\alpha-1}{\alpha}}$. (8)

All the above-listed requirements are satisfied.

4. *Dynamics of the model with constant inputs*: $\dot{k}(t) = s\times f(k(t)) - \delta \times k(t)$, (9)

where $\dot{k}(t)$ – time rate change of the capital stock per unit of effective labor; s – saving rate, i.e. average part of output that householders and firms intend to propose as a source for investment; δ – depreciation rate, the part of capital that wears out; both parameters are exogenous and constant.

Equilibrium in the model: $s\times f(k^*) = \delta \times k^*$, (10)

k^* *is steady level of* k, under which *actual investment is equal to break-even investment.*

Parameters of equilibrium for Cobb-Douglas function: $k^* = \left(\frac{s}{\delta}\right)^{\frac{1}{1-\alpha}}$; $y^* = \left(\frac{s}{\delta}\right)^{\frac{\alpha}{1-\alpha}}$.

5. *Factors of economic growth*:

- growth in labor: $\dot{L} = n\times L(t)$, $n = \dot{L}(t)/L = d\ln L(t)/dt$;
- growth in knowledge: $\dot{A} = g\times A(t)$, $g = \dot{A}(t)/A = d\ln A(t)/dt$.

Parameters n and g are considered exogenous.

Dynamics of the model with growing inputs: $\boxed{\dot{k}(t) = s\times f(k(t)) - (n+g+\delta)\times k(t)}$. (11)

Equilibrium in the model:

$\boxed{s\times f(k^*) = (n+g+\delta)\times k^*}$.

Parameters of equilibrium for Cobb-Douglas function: $k^* = \left(\frac{s}{n+g+\delta}\right)^{\frac{1}{1-\alpha}}$; $y^* = \left(\frac{s}{n+g+\delta}\right)^{\frac{\alpha}{1-\alpha}}$.

6. *Balanced growth path* – a situation of constant rate growth of each variable in the model (Table 2).

Table 2

Rates of growth of main variables on «balanced growth path»

Variables	Rate of Growth
Capital per unit of effective labor ($k = K/AL$)	0
Capital per worker ($k = K/L$)	g
Stock of capital ($K = k \times (AL)$)	$n+g$
Output per unit of effective labor ($y = f(k) = Y/AL$)	0
Output per worker ($Y/L = y \times A$)	g
Stock of effective labor (AL)	$n+g$
Output ($Y = y \times (AL)$)	$n+g$

7. *Shifts in equilibrium under the impact of s and δ changes* are presented in Figure 2.

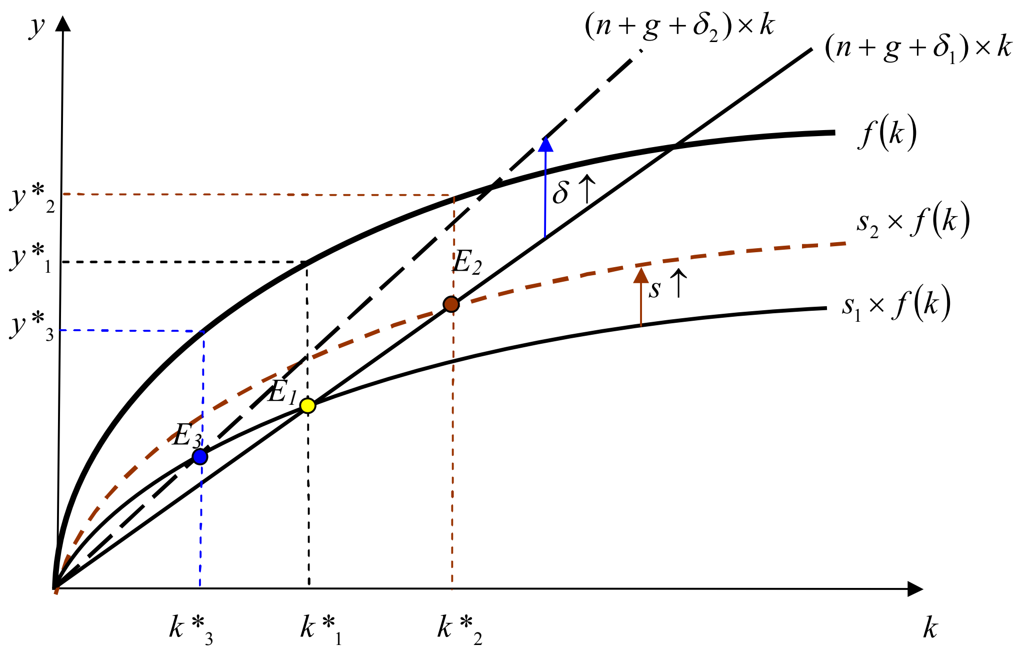


Figure 2. The Solow growth model: equilibrium and its change

8. *Golden rule level of capital stock by E. Phelps* affirms that a steady level of capital per unit for effective labor should ensure maximum consumption.

Consumption per unit of effective labor: $c(k) = (1-s)\times f(k) = f(k) - (n+g+\delta)\times k \rightarrow$max. $c'(k) = 0$, $c''(k) < 0$.

$$f'(k^{**}) = n+g+\delta \ , \qquad (11)$$

or the same: $\boxed{MP_K = n+g+\delta}$. (12)

It is represented on the figure 3:

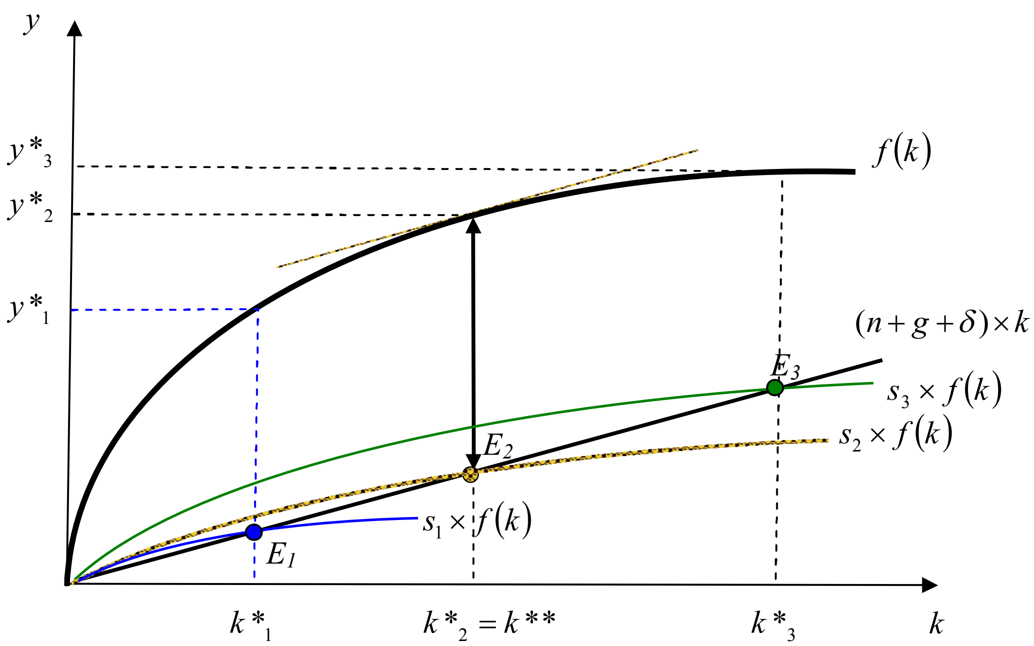


Figure 3. The Steady and the Golden levels of capital per unit for effective labor

For: $k^* = k^{**}$:

$$\begin{cases} s\times f(k) = (n+g+\delta)\times k; \\ f'(k) = n+g+\delta \ . \end{cases} \quad \Rightarrow \quad s = \frac{f'(k)\times k}{f(k)}.$$

Golden rule: *optimal saving rate is equal to elasticity of output with respect to capital*. For Cobb-Douglas function: $s = \alpha$.

When $k^* < k^{**}$ (the steady level is less that the golden level), the state should conduct an economic policy aimed at increasing the saving rate ($s\uparrow$).

When $k^* > k^{**}$ (the steady level is more that the golden level), the state should conduct an economic policy aimed at decreasing the saving rate ($s\downarrow$).

9. *Convergence* («catch-up effect») – tendency of a more rapid economic growth in developing (poor) countries than in developed (rich) countries because of the smaller initial rate of return on

capital in the former ones and their tendency to get a balanced growth path. Moreover, poor countries can replicate available technologies from rich countries thus gaining time. As a result, all economies will eventually converge in terms of per capita income.

10. Speed of convergence to the steady level: $\lambda \equiv [1-\alpha_K(k^*)](n+g+\delta)$, (13)

where λ is an annual rate of approaching k to k^*. For reducing the distance by half, the time $t^* = \ln(0{,}5)/\lambda \cong 0{,}69/\lambda$ years is required.

11. *Empirical evidence of the model.*

The expression for output growth rate:

$$\frac{\dot{Y}(t)}{Y(t)} = \alpha_K(t)\frac{\dot{K}(t)}{K(t)} + \alpha_L(t)\frac{\dot{L}(t)}{L(t)} + R(t), \tag{14}$$

The expression for output growth rate per worker:

$$\frac{\dot{Y}(t)}{Y(t)} - \frac{\dot{L}(t)}{L(t)} = \alpha_K(t)\left[\frac{\dot{K}(t)}{K(t)} - \frac{\dot{L}(t)}{L(t)}\right] + R(t), \tag{15}$$

where $\alpha_L(t)$ – the elasticity of output with respect to labor at initial moment t; $\alpha_K(t)$ – the elasticity of output with respect to capital at initial moment t ($\alpha_L(t)+\alpha_K(t)=1$), they might be interpreted as shares of the labor and of the capital respectively in gross revenue. $R(t)$ – «Solow residual» that explains the influence of knowledge (technological progress). In empirical works, $R(t)$ explains 60-70% of growth!

11. *Shortcomings of the model*: a) an exogenous character of many inputs, such as saving and depreciation rates; b) the key factor of growth, i.e. technological progress, remains «a thing in itself» and unaccountable; c) the model does not take into account significant output factors such as land, natural resources, pollution, social institutions and so on.

2.2. Alternative Growth Models

1. *The Lucas Model* (*AK model*) – endogenous-growth model with two types of capital (physical and human). It is based on the Cobb-Douglas production function and presented as: $Y_t = \bar{A} \times K_t^{\alpha} \times (LH_t)^{1-\alpha}$, where $\bar{A}$ - technological parameter (total factors of productivity), H - level of the human capital per unit of representative economic agent. I_t^k is investment of physical capital at the moment t; I_t^h is investment of human capital at the moment t. And δ is the rate of depreciation for both capitals. Changes in the capital: $\dot{K} = I^k - \delta \times K$ and $\dot{K} = I^k - \delta K$. It is assumed that

physical and human capital are perfect complementary goods. The equilibrium condition is: $MP_k = MP_h$. After mathematical transformations, we receive: $\frac{H_t}{K_t} = \frac{1-\alpha}{\alpha}$. So the production function takes the form: $Y = AK$, where $A = \bar{A} \times \left(\frac{1-\alpha}{\alpha}\right)^{1-\alpha} \times L^{(1-\alpha)}$ is the marginal as well as average productivity of capital.

Properties of the Lucas model: a) constant marginal productivity of the capital; b) equal rates of changes of the main variables: $\frac{\dot{y}}{y} = \frac{\dot{c}}{c} = \frac{\dot{k}}{k} = sA - \delta$; c) convergence effect is absent (it is considered as a shortcoming of the model).

2. Ramsey-Kass-Koopmans model.

3. Model with overlapping generations.

4. Models of endogenous growth.

2.3. Problems

Problem 1. Which parameters of the Solow growth model (s, δ, n, g) affect the level of output per worker and which have a growth effect?

Problem 2. Why rates of economic growth in developing countries are often higher than it in developed countries? How can you explain this phenomenon on the basis of the Solow Growth model? Under what conditions growth of output per capita in some poor country will be higher than it in a rich country?

Problem 3. (*Solow growth model*). Suppose some country with the production function $Y = K^{1/2} \times (AL)^{1/2}$, and other parameters of the economy are: $n = 2\%$, $g = 6\%$, $\delta = 7\%$, $s = 0{,}45$.

Determine: a) the steady and the golden levels of capital per unit of effective labor ($k^* = ?$ $k^{**} = ?$); b) speed of convergence and half-life of it.

Answer: a) $k^* = 9$, $k^{**} = 11{,}(1)$; b) $\lambda = 7{,}5\%$, $t^* \approx 9{,}2$.

Problem 4. Suppose some country with production function like $Y = K^{2/3} \times (AL)^{1/3}$, and other parameters of economy are: $n = 1\%$, $g_1 = 4\%$, $g_2 = 6\%$, $\delta = 5\%$, $s = 0{,}30$.

Determine: a) the steady and the golden level of capital per unit of effective labor ($k^* = ?$ $k^{**} = ?$); b) speed of convergence and half-life of it.

Answer: a) $k^* = 27$, $k^{**} = 15{,}625$; b) $\lambda = 4\%$, $t^* \approx 17{,}3$.

Problem 5. Look at the figures 4 and 5 and answer the following questions:

1). Why does an average rate of economic growth differ steadily for groups of countries presented in Figure 4?

2). What do you think about economic fluctuations in the globalized world?

3). How did the economic crisis of 2008-2009 influence economic performances in different countries? Why was the fall of growth rates in the Commonwealth of Independent Countries more sizable than the world average? Why did the decrease of growth rates in the Developing Asia prove to be less than the world average?

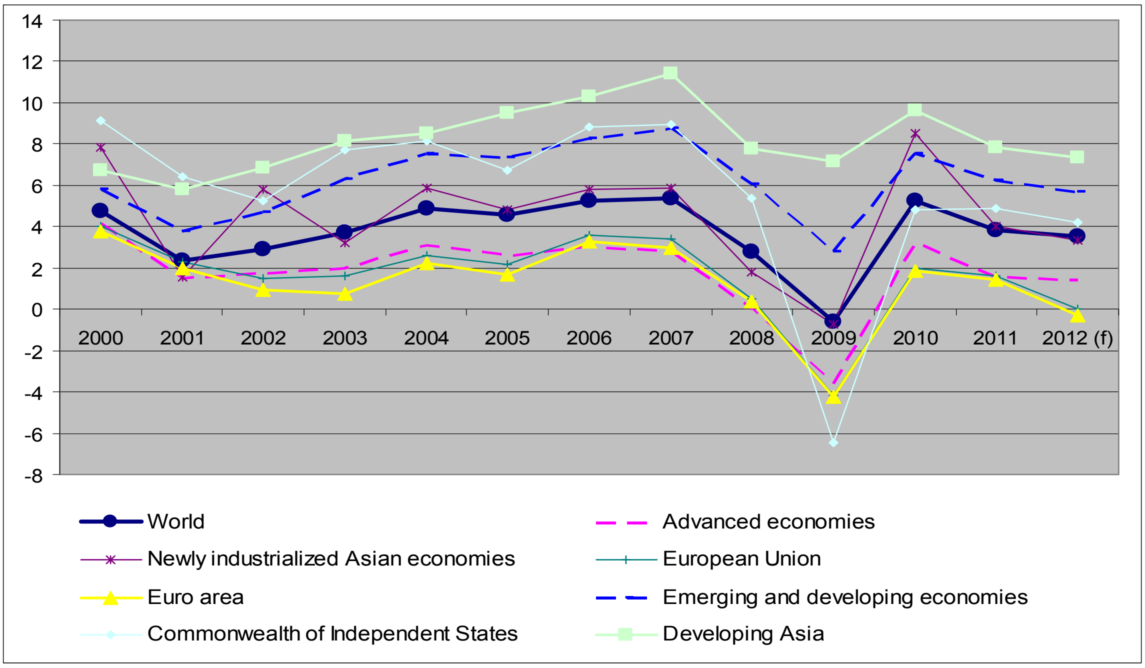


Figure 4. Gross Domestic Product in constant prices, groups of countries, percent changes

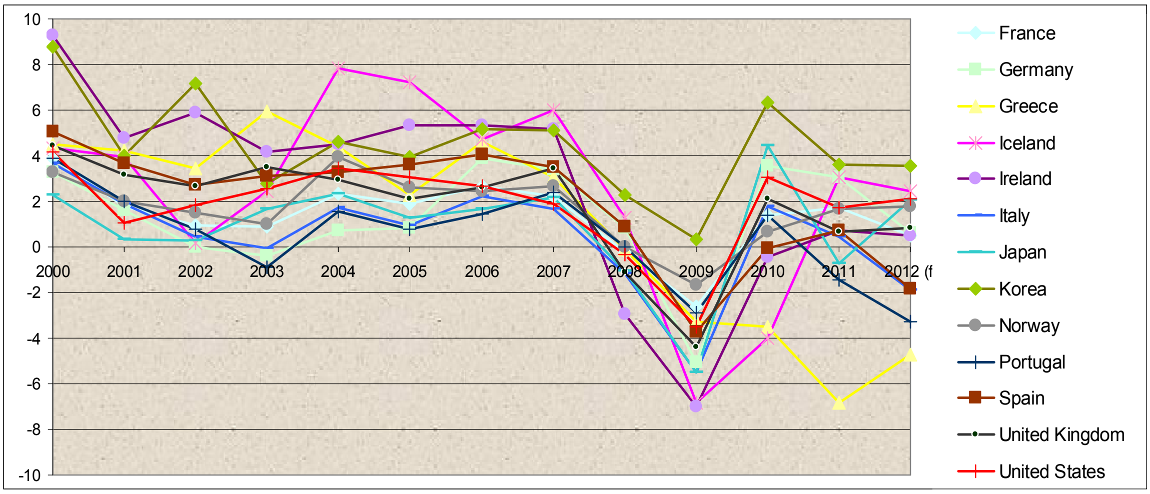


Figure 5. Gross Domestic Product in constant prices, some advanced countries, percent changes

6. Analyze information provided by the International Monetary Fund (URL: http://www.imf.org/external/pubs/ft/weo/2011/01/weodata/weoselgr.aspx) and examine economic

processes in your country. Build a time series and relevant graphs for such economic variables as GDP at constant prices percentage change, output gap in percentage of potential GDP, investment percentage change, import and export volumes percentage change, unemployment rate, etc. Define their correlations and explain the results. Examine the dynamics of the above-mentioned parameters in your country.

UNIT 3. Economic Fluctuations

3.1. Main propositions of the economic fluctuations theory

1. *Business* (*economic*) *cycle* consists of economy-wide fluctuations of the real GDP and economic activity around a long-term growth trend that last over several months or years. Its increasing wave includes: recovery (below the trend), expansion (above the trend) and boom, or peak (the highest point of the cycle). Its diminishing wave includes: recession (above the trend), depression (below the trend) and bottom (the lowest point of the cycle).

2. The variables (parameters) in the business cycle may be: procyclical, countercyclical, and acyclical; leading, lagging, and coincident.

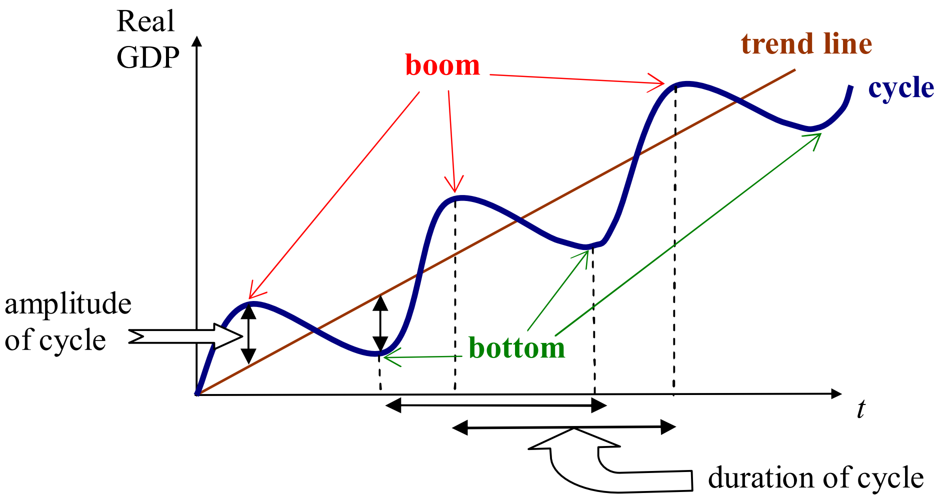


Figure 6. Business cycle

3. Main types of cycles according to their periodicity (the first four are from the classification by Joseph Alois Schumpeter)[2]:

- the Kitchin inventory cycle of 3–5 years (after Joseph Kitchin);

[2] http://en.wikipedia.org/wiki/Business_cycle.

- the Juglar fixed investment cycle of 7–11 years (often identified as 'the' business cycle);
- the Kuznets infrastructural investment cycle of 15–25 years (after Simon Kuznets also called building cycle);
- the Kondratiev wave or long technological cycle of 45–60 years (after Nikolai Kondratiev);
- the Forrester energy supply and used materials cycles of 200 years (after Jay Wright Forrester);
- the Toffler civilization cycles of 1000-2000 years (after Alvin Toffler).

4. Main theories of economic cyclicality: endogenous vs. exogenous.
- Overinvestment theory (Thomas Robert Malthus);
- Underconsumption theory (Jean Charles Léonard Simonde de Sismondi);
- Outside factors theory, or sunspot theory (William Stanley Jevons, Henry Ludwell Moore);
- Psychological theories (William Stanley Jevons, John Maynard Keynes);
- The Marxist theory and the Goodwin model (after Richard M. Goodwin) ;
- Innovative theory of economic development (Joseph Alois Schumpeter);
- New Keynesian theories (John R. Hicks and Paul A. Samuelson);
- Monetarist theory of business cycle (Milton Friedman and Edmund Phelps);
- Real business cycle theory (Finn E. Kydland and Edward C. Prescott);
- Politically-based business cycle theories (William Nordhaus).

3.2. Models of Economic Fluctuations

1. ***The Samuelson-Hicks multiplier-accelerator model***

Main model. Investment multiplier: $k = \frac{1}{1 - c_Y}$, where c_Y – marginal propensity to consume. Accelerator of investment: $v = \frac{I_t}{(Y_{t-1} - Y_{t-2})}$.

Earned income (Y) in closed economy is spent to:

- consumption: $C_t = C_a + c_Y \times Y_{t-1}$, where C_a - autonomous consumption, that does not depend on income, because it depends on other factors;
- investment: $I_t = I_a + v \times (Y_{t-1} - Y_{t-2})$, where I_a - autonomous investment;
- autonomous government purchases: $G_t = G_a$.

Put $C_a + I_a + G_a = A_a$ - the sum of autonomous expenditures. So we get the income function in dynamic form: $Y_t = C_t + I_t + G_t = A_a + (c_Y + v) \times Y_{t-1} - v \times Y_{t-2}$

When A_a is constant, income will attain some invariable level: $\bar{Y} = \frac{A_a}{1 - c_Y}$. So an income function takes the form: $Y_t = (1 - c_Y) \times \bar{Y} + (c_Y + v) \times Y_{t-1} - v \times Y_{t-2}$.

When A_a changes, Y_t will also change gradually approaching its new steady level $\bar{Y}$. We can express deviation from it for each period of time: $\Delta Y_t = Y_t - \bar{Y}$; $\Delta Y_{t-1} = Y_{t-1} - \bar{Y}$; $\Delta Y_{t-2} = Y_{t-2} - \bar{Y}$.

After substitution of Y_t, Y_{t-1} and Y_{t-2} we receive *main equation of the model*:

$$\boxed{\Delta Y_t = (c_Y + v) \times \Delta Y_{t-1} - v \times \Delta Y_{t-2}}.$$

By using the finite difference method for solving the differential equation, we can determine the value of the Discriminant: $d = b^2 - 4ac \rightarrow$

$$\boxed{d = (c_Y + v)^2 - 4 \times v}.$$

Figure 7 represents the function for $d = 0$: $c_Y = -v + 2\sqrt{v}$.

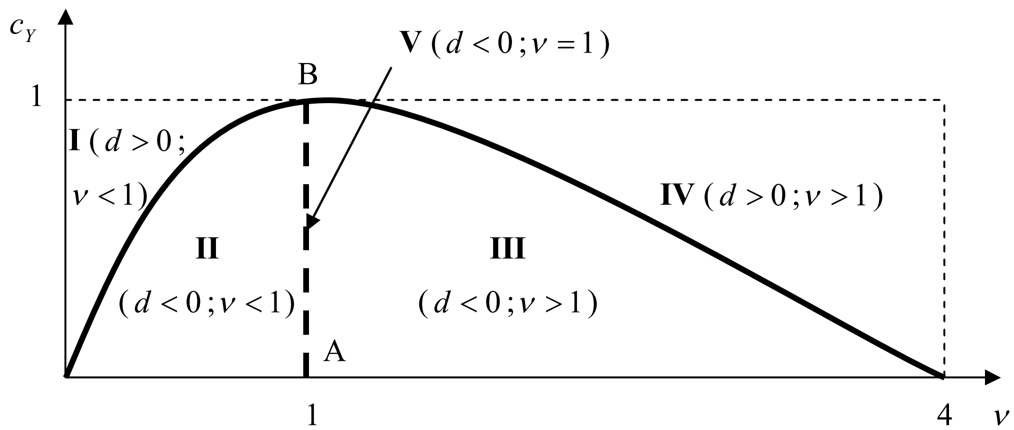


Figure 7. Function d=0 and the areas of monotonic and oscillatory changes

When $d \geq 0$, alteration of Y_t will be monotonic.

When $d < 0$, alteration of Y_t will be oscillatory.

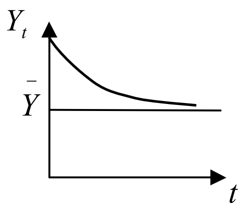
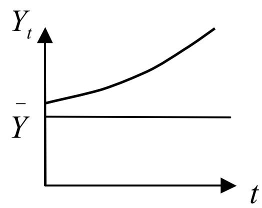
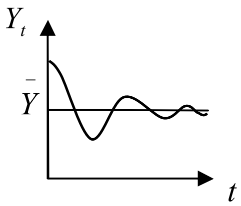
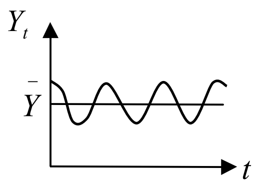
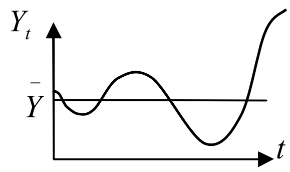
When $v < 1$, Y_t approaches the new stable level.

When $\nu > 1$, Y_t deviates from the new stable level all the more.

When $\nu = 1$, Y_t oscillates around $\bar{Y}$ with a constant amplitude.

Table 3

Types of Y_t alteration relative to $\bar{Y}$

	$\nu < 1$	$\nu = 1$	$\nu > 1$
$d \geq 0$	Monotonic convergence 	*Impossible situation* *($d = 0 \rightarrow c_Y = 1 \rightarrow$* *$\bar{Y} = \infty$)*	Monotonic divergence  Unreal situation!
$d < 0$	Convergent occilations 	Oscillations of a constant amplitude 	Divergent occilations  Fluctuations would be bounded above and below!

Model with additional constraints. To bring the Samuelson-Hicks model closer to reality, it is necessary to constrain the upper and lower boundaries for Y_t, when it changes in the zone III or IV (see Figure 7).

The upper boundary of output fluctuations coincides with the level of potential income (Y_f). Therefore we have the first constraint: Y_t=Min{$(C_t + I_t + G_t + NX_t)$; Y_f}.

The lower boundary of output fluctuations is determined with the lowest negative level of induced investment equal to the yearly depreciation (D). So we receive the second constraint: I_{ind}=Max{$(\nu \times (Y_{t-1} - Y_{t-2}))$; D}.

As a result of these built-in constraints, the economy with $\nu > 1$ will always turn into constant amplitude oscillations, independently of positive or negative value of the Discriminant (III or IV zone).

Model with exogenous growth of autonomous expenditures. Let the population grow annually at the rate n, and therefore autonomous expenditures grow at the same rate.

So we receive:

– income function in the dynamic form: $Y_t = A_{a0} \times (1+n)^t + (c_Y + v) \times Y_{t-1} - v \times Y_{t-2}$;

– dynamics of the steady level income: $\bar{Y}_t = (1+n) \times \bar{Y}_{t-1}$, after alteration it takes the form: $\boxed{\bar{Y}_t = \frac{1}{1 - \frac{c_Y + v}{1+v} + \frac{v}{(1+v)^2}} \times A_a (1+n)^t}$, where $\frac{1}{1 - \frac{c_Y + v}{1+v} + \frac{v}{(1+v)^2}}$ - the "supermultiplier" after Hicks;

– the upper boundary of the model is presented in the dynamic form: $Y_{Ft} = Y_{Ft-1}(1+n) = Y_{F0}(1+n)^t$;

– the lower boundary of the model is also presented in the dynamic form: $D_t = D_{t-1}(1+n) = D_0(1+n)^t = -I_{ind0}$ $\rightarrow$ $Y_{t\min} = (A_{a0} - D_0) \times (1+n)^t + c_Y \times Y_{t-1}$ $\rightarrow$

$$Y_{t\min} = \frac{(A_{a0} - D_0)(1+n)^t}{1 - c_y/(1+n)};$$

As a result, income fluctuations get an inclined corridor (Figure 8).

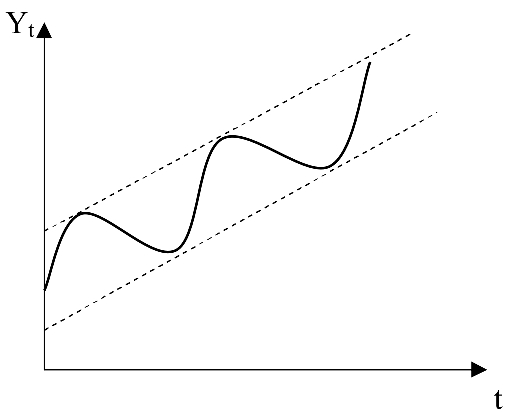


Figure 8. Dynamics of gross national income under exogenous growth of autonomous expenditures

2. ***Tewes model*** supplements Samuelson-Hicks model with money market equilibrium and demonstrates the influence of monetary policy on cyclical fluctuations.

Money demand: $L_t = l_Y \times Y_{t-1} + l_i \times (i_{\max} - i_t)$, where i_t – interest rate at the period t; parameters of the model: l_Y – money demand sensitivity of income change, and l_i - money demand sensitivity of interest rate.

Money market equilibrium with stable money supply (M) and constant price level ($P = 1$):

$$M = l_Y \times Y_{t-1} + l_i \times (i_{\max} - i_t) \rightarrow i_t = \frac{l_Y}{l_i} \times Y_{t-1} - \frac{M - l_i \times i_{\max}}{l_i}, \text{ and } \boxed{i_{t-1} = \frac{l_Y}{l_i} \times Y_{t-2} - \frac{M - l_i \times i_{\max}}{l_i}} \text{ etc.}$$

One of new prerequisites of the model is that current investment is sensitive to the previous period interest rate, so the investment function takes the form: $I_t = I_a + v \times (Y_{t-1} - Y_{t-2}) - \gamma \times i_{t-1}$.

Assuming the total income is equal to total expenditures in closed economy, we obtain: $Y_t = [C_a + c_Y \times Y_{t-1}] + [I_a + v \times (Y_{t-1} - Y_{t-2}) - \gamma \times i_{t-1}] + G_a$.

After i_{t-1} substitution in this expression, we receive the *main equation of the model,* that reflects *alteration of actual income in dynamics*: $\boxed{Y_t = B + (c_Y + v) \times Y_{t-1} - (v + \lambda) \times Y_{t-2}}$, where $B = A_a - \frac{M - l_i \times i_{\max}}{l_i}$ is absolute term of equation, and $\lambda = \gamma \times \frac{l_Y}{l_i}$ - is sensitivity ratio.

The stable level of Y_t can de defined as: $\bar{Y} = \frac{B}{1 - c_Y + \lambda}$.

Discriminant of this equation: $\boxed{d = (c_Y + v)^2 - 4 \times (v + \lambda)}$ means:

- when $d \geq 0$, alteration of Y_t will be monotonic;
- when $d < 0$, alteration of Y_t will be oscillatory.

When $v + \lambda < 1$, the new equilibrium is stable.

When $v + \lambda > 1$, the new equilibrium is unstable.

When $v + \lambda = 1$, Y_t oscillates around $\bar{Y}$ with a constant amplitude.

For $d = 0$ we receive: $c_Y = -v + 2\sqrt{v + \lambda}$ (Figure 9), which is higher than $c_Y = -v + 2\sqrt{v}$ – which is the $d = 0$ function for Samuelson-Hicks sample model.

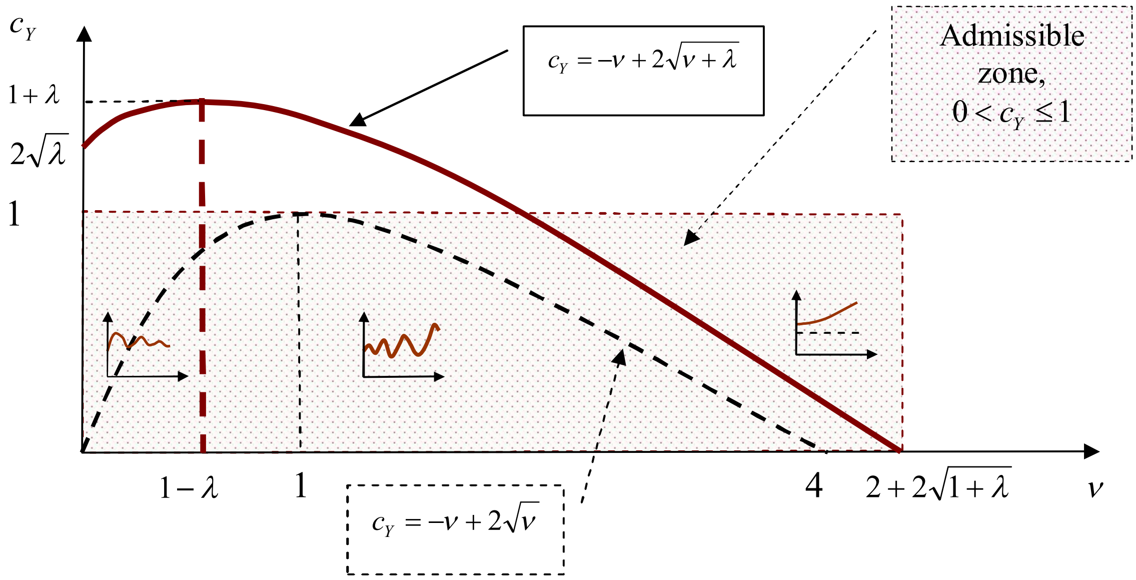


Figure 9. The function d=0 for Tewes model in comparison with Samuelson-Hicks model, and the zones of different type of output changes

As a result, the zone of monotonous changes diminishes, and the zone of oscillatory changes extends. Because of the shift the top of the graph to the left, the zone of stable equilibrium is reduced and the zone of unstable equilibrium is increased. The zone of monotonous convergence becomes unachievable at all.

When the Central Bank conducts an *active anti-cyclical monetary policy*, money supply is presented in the form: $M = l_i \times i_{\max} + \alpha \times Y_{t-1} + \beta \times i_t$.

Money market equilibrium in this case is: $l_Y \times Y_{t-1} + l_i \times (i_{\max} - i_t) = l_i \times i_{\max} + \alpha \times Y_{t-1} + \beta \times i_t$

$\rightarrow (l_Y - \alpha) \times Y_{t-1} = (l_i + \beta) \times i_t \rightarrow i_{t-1} = \dfrac{l_Y - \alpha}{l_i + \beta} \times Y_{t-2}$.

Put $\gamma \times \dfrac{\alpha - l_Y}{\beta + l_i} = h$. Obtain income in dynamics: $\boxed{Y_t = A_a + (c_Y + v) \times Y_{t-1} - (v - h) \times Y_{t-2}}$.

For this case the stable level of income: $\bar{Y} = \dfrac{1}{1 - c_Y - h} \times A_a$. Discriminant: $\boxed{d = (c_Y + v)^2 - 4 \times (v - h)}$. For the function $d = 0$ we receive: $c_Y = -v + 2\sqrt{v - h}$. When $\alpha > l_Y$, the $d = 0$ curve will be located lower along the scale of c_Y, relatively to the Samuelson-Hicks sample model, and the top of it will shift to the right. This means that the monotonic convergence admissible space will be enlarged and will become more probable. So by managing money supply function coefficients, the Central Bank can diminish the cyclicality and eliminate it altogether.

3.3. Problems

Problem 1. (*Samuelson-Hicks main model*). Suppose some economy in which the level of autonomous expenditures has increased from 100 to 200 units.

For different cases presented in Table 4, calculate the old and the new equilibrium level of income. Define the character of income alteration for each case.

Use the Excel program for calculating time series of income ($Y_t = (1 - c_Y) \times \bar{Y} + (c_Y + v) \times Y_{t-1} - v \times Y_{t-2}$) for 30 periods and draw the graphs for the function $Y(t)$ to check the type of its alteration.

Draw the graph for function $c_Y = -v + 2\sqrt{v}$ (when $d = 0$) and point the cases being examined on it.

Table 4

Definition of the type of income alteration for different cases

	Marginal propensity to consume c_Y	Accelerator v	Discriminant $d=(c_Y+v)^2-4\times v$	Type of Y changes
Case 1	0,9	0,3		
Case 2	0,7	0,8		
Case 3	0,7	1,0		
Case 4	0,7	1,05		
Case 5	0,8	2,4		

Problem 2. (*Samuelson-Hicks model with additional constraints*). Suppose some economy, in which $C_t=100+0{,}75\times Y_{t-1}$; $I_t=150+1{,}2\times(Y_{t-1}-Y_{t-2})$; $G_{a0}=50$ units. The potential level of income is equal to 2500 units. Yearly depreciation of capital is 300 units.

Assume the government decided to support national economy and has increased internal purchases of goods and services by 100 units. Determine old and new equilibrium levels of output.

Using the algorithm presented in Table 5 and Excel calculation and graph drawing, define the character of real output changes in time. Calculate minimum and maximum boundary of output changes.

Table 5

Calculation of Y_t time series

t	Y_{t-1}	$C_t = C_a + c_Y\times Y_{t-1}$	I_a	$I_{ind} = v\times(Y_{t-1}-Y_{t-2})$	$I_{ind}^* =$ Max $\{I_{ind};-300\}$	G_a	$Y_t = C_t+I_a+I_{ind}^*+G_a$	$Y_t^* =$ Min$\{Y_t;2500\}$
0			150			50		
1						150		
2								
3								
4								
5								
…								
50								

Answer. $\bar{Y}_1 = 1200$ units; $\bar{Y}_1 = 1600$ units. Initially economy will demonstrate divergent oscillations, than it will come to a constant amplitude oscillations $(\approx 297{,}9; \approx 2259{,}6)$.

Problem 3. Solve the problem 2, when in the economy being considered the value of accelerator (v) has increased up to 2,26.

Problem 4. (*Samuelson-Hicks model with growth of population at a stable rate*). Suppose some economy, where $c_Y = 0{,}6$ and $v = 1{,}25$. At initial period of time: $C_a = 200$, $I_a = 250$, and $G_a = 350$ units. The potential level of income at $t = 0$ is equal 2500 units. Depreciation of capital at $t = 0$ is equal to 300 units. The rate of population growth is 0,02 (i.e. $n = 2\%$) annually.

Using the algorithm of Table 6 and the Excel program, calculate time series of the autonomous expenditures, the depreciation level and the potential income for $t = \overrightarrow{1{,}100}$. Determine the minimum and maximum boundaries of output changes. Calculate time series of equilibrium and actual income for $t = \overrightarrow{1{,}100}$ and draw them on the graph as well as the upper and lower boundaries. Estimate the value of supermultiplicator.

Table 6

Calculation of Y_t and $\bar{Y}_t$ time series

t	0	1	2	3	4	…	100
Previous income Y_{t-1}	2000						
Autonomous expenditures $A_{at} = A_{a0} \times (1+n)^t$	800						
Consumption from income $C_{Yt} = c_Y \times Y_{t-1}$	1200						
Induced investment $I_{ind\,t} = v \times (Y_{t-1} - Y_{t-2})$	0						
Depreciation $D_t = D_0 (1+n)^t$	300						
Induced investment - adjusted for depreciation $I_{ind\,t}{*} = Max\,\{ I_{ind\,t}; -D_t \}$	0						
Lower boundary of Y_t							

$Y_{t\min} = \dfrac{(A_{a0} - D_0)(1+n)^t}{1 - c_y/(1+n)}$							
Actual income - calculated $Y_t = A_{a\,t} + C_{Yt} + I_{ind\,t}$*	2000						
Potential income $Y_{Ft} = Y_{F0}(1+n)^t$ **- upper boundary of** Y_t	2500						
Actual income - corrected $Y_t{*} = Min\,\{Y_t; Y_{Ft}\}$	2000						
Equilibrium (steady level) income $\bar{Y}_t = \dfrac{1}{1 - \dfrac{c_Y + v}{1+v} + \dfrac{v}{(1+v)^2}} \times A_{a\,t}$							

Answer. Supermultiplicator is equal to 2,58.

Problem 5. Suppose in the economy described in the problem 4, one of the following changes has taken place: a) the marginal propensity to consume out of income has decreased to $c_Y = 0{,}4$; b) the rate of population growth has increased up to 4% ($n = 0{,}04$); c) the accelerator increased up to $v = 2{,}5$. Find a new solution for each case separately.

Problem 6. (*Tewes model*). Suppose some economy, in which $C_t = 200 + 0{,}75 \times Y_{t-1}$; $I_t = 100 + 0{,}6 \times (Y_{t-1} - Y_{t-2}) - 0{,}7 \times i_{t-1}$; $G_a = 100$ units. Demand for money is presented as follows: $L_t = 0{,}8 \times Y_{t-1} + 1{,}6 \times (20 - i_t)$. Money supply is constant and equals 150 units.

Describe the algorithm of finding the $Y(t)$ function. Using the Excel program, calculate the income time series and draw the $Y(t)$ graph. Define the character of Y_t changes. Determine the stable level of income and the value of Discriminant.

Answer. Convergent oscillatory fluctuations. $\bar{Y} = 543{,}75$; $d = -1{,}9775$.

Problem 7. (*Tewes model*). Let's imagine that in the economy described in the problem 6, the Central bank has begun to conduct an active policy from some period of time. Now the money supply function is determined as follows: $M = 32 + 0 = 1{,}2 \times Y_{t-1} + 0{,}6 \times i_t$. Evaluate the multiplier and the Discriminant for dynamic income function. Calculate $Y(t)$ time series and the stable level of Y_t and display them graphically. Define the character of income changes. Determine under which α, β ratio the monotonic/oscillatory changes boundary appears to be crossed. What will be the value of h parameter and the level of multiplier in this case?

UNIT 4. Inflation

4.1. Main propositions of the inflation theory

1. *Opened inflation* is a rise in the general level of goods and commodities prices in an economy over a period of time.

Repressed (suppressed) inflation – inflation that is disguised by the government policy of prices, wages or exchange rate control or other interferences in the economy such as subsidies.

2. *Types of inflation*:

Creeping ($0 < \pi_t \leq 10\%$). Galloping ($20 < \pi_t \leq 200\%$). Hyperinflation ($50 \leq \pi_{monthly}$).

Balanced vs. unbalanced. Expected vs. unexpected. Anticipated vs. non-anticipated.

3. *Mechanisms of inflation*: a) demand-push inflation; b) cost-push inflation; c) inflationary spiral (the earliest model is «price-wage spiral»).

4. *Social costs of inflation*: a) shoe leather cost; b) menu cost; c) relative-price variability and the misallocation of resources; d) inflation-induced tax distortions; e) «confusions and inconvenience».

5. *Distributive effects* of unpredicted raise in inflation: a) distribution of incomes between capital and labor as factors of production; b) distribution of incomes between persons with flexible (or indexed) and rigid (non-indexed) salaries; c) distribution of incomes between creditors and debtors.

6. Positive effects of inflation: a) labor market adjustment; b) Central Bank maneuver with liquidity; c) Mundell-Tobin effect.

7. Inflation impacts on the state budget condition: a) Olivera-Tanzi effect – deterioration of real taxes proceeds (negative effect); b) Patinkin effect – diminishing a real value of the part of budget expenditures that is nominally expressed (positive effect); c) economic growth suppression (negative effect); d) decrease in real cost of the public debt service (positive effect).

4.2. Models of Inflation

1. ***The simple monetarist model.*** Equilibrium of money market: $\frac{M}{P} = L(Y,i)$, where M is the money stock, P - the price level, Y - the real income, i - the nominal interest rate. Real money supply is equal to real money demand. In the situation of excessive money supply, $\frac{M}{P} > L(Y,i)$, when $Y = const$, and $i = const$, prices will rise.

Neoclassical view: 1) economy is always in the conditions of full employment: $Y = Y_f$; 2) Fisher identity takes place: $i \equiv r + \pi^e$, so as π^e and i grow at the same rate, and $r = \bar{r} = const$. Hereby: $P = \frac{M}{L(Y_f, \bar{r} + \pi^e)}$, and M and P change to equal percentage.

Limitations of the model: a) in the situation of strengthening inflation expectation, $\pi^e \uparrow$, so $L \downarrow$, thereby P will grow more rapidly than M; b) excessive money supply for the first time will engender the «liquidity effect», therefore the short-term nominal and real rates may be temporarily decreased. It will cause the money demand increase, so prices will not grow completely in the short-run period.

2. ***Models of inflation based on the market equilibria.*** In these models, inflation is considered as a result of dynamic interaction of aggregate demand and aggregate supply under the monetary or fiscal policy impact.

1. *Aggregate supply dynamic function* is based on:

- Phillips curve: $W_t = W_{t-1} \times \left[1 + \alpha \times \frac{N_t - N^*}{N^*}\right]$, where W_t – wage rate at the period t, N_t - employment at the period t, N^* – full employment, and α – coefficient reflecting the sensitivity of wage rate in the current period to unemployment level in the previous period;
- A. Okun's interaction between output production and unemployment level: $\frac{Y_t - Y_F}{Y_F} = -\gamma \times (u_t - u_n)$, where Y_t - actual output; Y_F - potential output; u_t - actual level of unemployment, u_n - natural level of unemployment, γ - coefficient of relating changes in unemployment to changes in output;

- Cost-plus pricing: $P_t = (1+\lambda)\times\frac{N_t \times W_t}{Y_t} = (1+\lambda)\times\tau\times W_t$, where λ - coefficient of markup to wage-cost, and $\tau \equiv \frac{N}{Y}$ - labor-output ratio of national income.

After alteration of them, taking into account that $\frac{N^* - N_t}{N^*} = u_t - u_n$, we receive *aggregate supply function in dynamic form*: $P_t = P_{t-1}\times[1+\omega\times(Y_t - Y_F)]$, where $\omega = \frac{\alpha}{\gamma\times Y_F}$ – coefficient reflecting reaction of the wage rate to output gap. The graph of this function represents the family of curves built up for different P_{t-1} level.

As the rate of inflation is defined as $\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}$, so aggregate supply function would be presented in the form: $\pi_t = \omega\times(Y_t - Y_F)$, or $\boxed{Y_t = Y_F + \frac{1}{\omega}\times\pi_t}$.

Aggregate supply dynamic function with inflationary expectation in short-run: $\pi_t = \omega\times(Y_t - Y_F) + \pi_t^e$, $\boxed{Y_t = Y_F + \frac{1}{\omega}\times(\pi_t - \pi_t^e)}$. The graph of this function represents the family of curves built up for a different π_t^e level.

2. *Aggregate demand dynamic function* is deduced from $IS - LM$ model, which establishes a joint equilibrium for goods and money markets:

- IS function would be presented in the form: $Y = \frac{A_a - \beta\times(i - \pi^e)}{\varsigma}$, where $\varsigma = 1 - c_Y = s_Y + t$, and $1/\varsigma$ is the multiplier of autonomous expenditures, $A_a = C_a + G_a + I_a$ is the sum of autonomous expenditures. Here the function of investment is $I = I_a - \beta\times(i - \pi^e)$, where $r \approx i - \pi^e$ is the real interest rate, and π^e is the expected level of inflation;
- LM function would be presented in the form: $M/P = l_Y \times Y + l_i \times (i_{\max} - i)$.

After expressing i from both IS and LM curve and equalization of them to each other, we receive the formula for equilibrium output: $\boxed{Y = a\times A_a + b\times(M/P) + c\times\pi^e - c\times i_{\max}}$, where the coefficients of equation are determined as: $a = \frac{l_i}{\varsigma\times l_i + \beta\times l_Y}$, $b = \frac{\beta}{\varsigma\times l_i + \beta\times l_Y}$, $c = \frac{\beta\times l_i}{\varsigma\times l_i + \beta\times l_Y}$.

So we obtain the output in the dynamic form: $Y_t = a\times A_{at} + b\times(M_t/P_t) + c\times\pi_t^e - c\times i_{\max}$.

Alteration of output under the impact of monetary or fiscal impulse: $\Delta Y_t = a\times\Delta A_{at} + b\times(M_t/P_t - M_{t-1}/P_{t-1}) + c\times(\pi_t^e - \pi_{t-1}^e)$ $\rightarrow$

$\boxed{Y_t = Y_{t-1} + a\times\Delta A_{a\,t} + h\times(m_t - \pi_t) + c\times\Delta\pi_t^e}$, where $m_t = \dfrac{M_t - M_{t-1}}{M_{t-1}}$ – rate of money supply change,

$h \equiv b\times\dfrac{M_{t-1}}{P_t}$ – coefficient of the model made under the assumption that $\dfrac{M_{t-1}}{P_t} \approx const$.

3. $AS - AD$ equilibrium model:

$$\begin{cases} Y_t = Y_F + \dfrac{1}{\omega}(\pi_t - \pi_t^e); \\ Y_t = Y_{t-1} + a\times\Delta A_{a\,t} + h\times(m_t - \pi_t) + c\times\Delta\pi_t^e. \end{cases}$$

4. Model of *inflation in economics with static expectations* (i.e. $\pi_t^e = \pi_{t-1}$):

$$\begin{cases} Y_t = Y_F + \dfrac{\Delta\pi_t}{\omega}; \\ Y_t = Y_{t-1} + a\times\Delta A_{a\,t} + h\times(m_t - \pi_t) + c\times\Delta\pi_{t-1}. \end{cases}$$

Suppose some economy at initial period of time is in the condition of full employment, i.e. $Y_{t-1} = Y_{t-2} = ... = Y_F$, $\pi_{t-1} = \pi_{t-2} = ... = 0$, $m_{t-1} = 0$, $\Delta A_{a\,t} = 0$. Let from some period it experienced a monetary or fiscal shock. Examine the consequences of them separately.

Consequences of an active monetary policy

- *single monetary impulse*, $m_1 > 0$; $m_t = 0$ for $t = \overrightarrow{2,\infty}$ ($\Delta A_{a\,t} = 0$):

the 1st period:

$$\begin{cases} Y_1 = Y_F + \dfrac{\pi_1}{\omega}; \\ Y_1 = Y_F + h\times(m_1 - \pi_1). \end{cases} \Rightarrow \pi_1 = \frac{h\times\omega\times m_1}{1 + h\times\omega};\ Y_1 = Y_F + \frac{h\times m_1}{1 + h\times\omega};$$

the 2nd period:

$$\begin{cases} Y_2 = Y_F + \dfrac{\pi_2 - \pi_1}{\omega}; \\ Y_2 = Y_1 - h\times\pi_2 + c\times\pi_1. \end{cases} \Rightarrow \pi_2 = \frac{2 + c\times\omega}{1 + h\times\omega}\times\pi_1;\ Y_2 = Y_F + \frac{2/\omega + c - h\times m_1}{1 + h\times\omega};$$

each other period:

$$\begin{cases} Y_t = Y_F + \dfrac{\pi_t - \pi_{t-1}}{\omega}; \\ Y_t = Y_{t-1} - h\times\pi_t + c\times(\pi_{t-1} - \pi_{t-2}). \end{cases} \Rightarrow \pi_t = \frac{2 + c\times\omega}{1 + h\times\omega}\times\pi_{t-1} - \frac{1 + c\times\omega}{1 + h\times\omega}\times\pi_{t-2}.$$

In this case in the long-run $\pi_t \to 0$, $Y_t \to Y_F$, and convergent oscillations take place. Initial impact of monetary policy in the long-run will result in price level increase at the rate equal to money supply growth, but won't influence the output, so AS curve during this period becomes vertical;

- *permanent expansive monetary policy*, $m_t = const > 0$ ($\Delta A_{a\,t} = 0$):

$$\begin{cases} Y_t = Y_F + \dfrac{\Delta\pi_t}{\omega}; \\ Y_t = Y_{t-1} + h \times (m_t - \pi_t) + c \times \Delta\pi_{t-1}. \end{cases} \Rightarrow \pi_t = \frac{2 + c \times \omega}{1 + h \times \omega} \times \pi_{t-1} - \frac{1 + c \times \omega}{1 + h \times \omega} \times \pi_{t-2} + \frac{h \times \omega \times m}{1 + h \times \omega}.$$

In this case $\pi_t \to m_t$, $Y_t \to Y_F$, and convergent oscillations take place as well. In this case the long-run AS curve is also vertical.

Indeed, according to the model, when $Y_t > Y_F$, π_t increases. And when $Y_t < Y_F$, π_t decreases. When $m_t > \pi_t$, Y_t increases. But when $m_t < \pi_t$, Y_t decreases. Figure 10(a) combines all types of equilibrium shift, and Figure 10(b) displays the general trajectory of its movement.

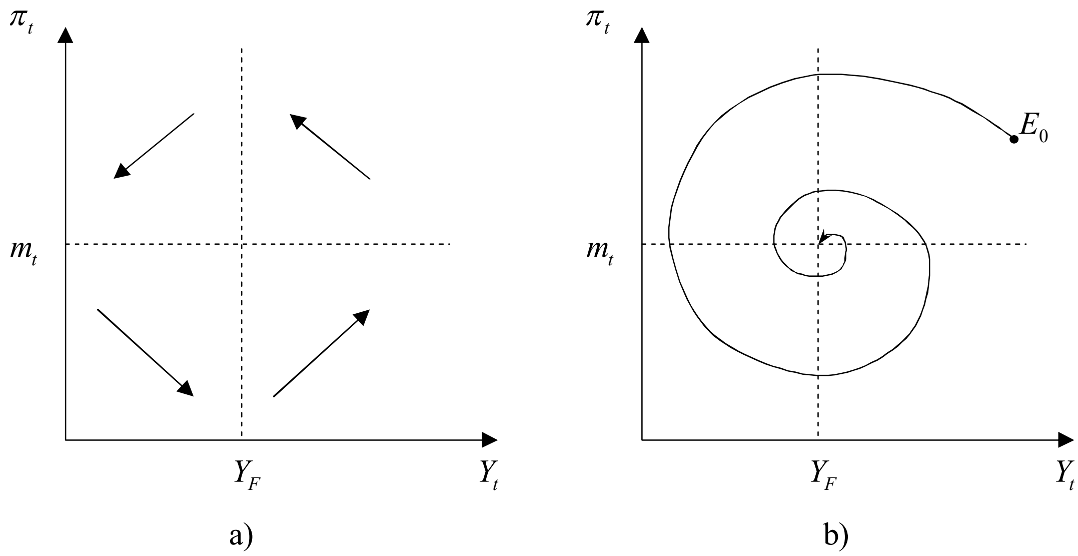


Figure 10. Direction of equilibrium change after monetary impulse

Consequences of an active fiscal policy

- *single fiscal impulse*, $\Delta A_{a\,1} = A > 0$; $\Delta A_{a\,t} = 0$ for $t = \overrightarrow{2,\infty}$ (while money supply grows at the constant rate: $m_t = m = const > 0$):

the 1[st] period:

$$\begin{cases} Y_1 = Y_F + \dfrac{(\pi_1 - m)}{\omega}; \\ Y_1 = Y_F + a \times A + h \times (m - \pi_1). \end{cases} \Rightarrow \pi_1 = \frac{m + \omega \times (a \times A + h \times m)}{1 + h \times \omega};\ Y_1 = Y_F + \frac{a \times A}{1 + h \times \omega};$$

each other period:

$$\begin{cases} Y_t = Y_F + \dfrac{\pi_t - \pi_{t-1}}{\omega}; \\ Y_t = Y_{t-1} + h \times (m - \pi_t) + c \times (\pi_{t-1} - \pi_{t-2}). \end{cases} \Rightarrow \pi_t = \frac{\omega \times h \times m + (2 + c \times \omega) \times \pi_{t-1} - (1 + c \times \omega) \times \pi_{t-2}}{1 + h \times \omega}.$$

For this case in the long-run $\pi_t \to m$, $Y_t \to Y_F$, and Y_t as well as π_t oscillations are convergent, and the graphs presented in Figure 10 are valid, too.

- *permanent expansive fiscal policy*, $\Delta A_{a\,t} = A$ (and constant money supply growth rate, $m_t = m = const > 0$):

$$\begin{cases} Y_t = Y_F + \dfrac{\pi_t - \pi_{t-1}}{\omega}; \\ Y_t = Y_{t-1} + h \times (m - \pi_t) + c \times (\pi_{t-1} - \pi_{t-2}). \end{cases} \Rightarrow$$

$$\pi_t = \frac{\omega \times (h \times m + a \times A) + (2 + c \times \omega) \times \pi_{t-1} - (1 + c \times \omega) \times \pi_{t-2}}{1 + h \times \omega}.$$

The steady level of inflation, meaning that $\pi_t = \pi_{t-1} = \pi_{t-2}$, is $\pi^* = m + \dfrac{a \times A}{h}$.

To define the character of Y_t and π_t changes, determine the Discriminant for $\Delta\pi_t$ dynamic function: $\Delta\pi_t = \dfrac{2 + c \times \omega}{1 + h \times \omega} \times \Delta\pi_{t-1} - \dfrac{1 + c \times \omega}{1 + h \times \omega} \times \Delta\pi_{t-2} \Rightarrow d = \left(\dfrac{2 + c \times \omega}{1 + h \times \omega}\right)^2 - 4 \times \left(\dfrac{1 + c \times \omega}{1 + h \times \omega}\right)$. The equilibrium is steady, when $\dfrac{1 + c \times \omega}{1 + h \times \omega} < 1 \Rightarrow c < h$. So far as $c = \dfrac{\beta \times l_i}{\varsigma \times l_i + \beta \times l_Y}$, $h \equiv b \times \dfrac{M_{t-1}}{P_t}$, and $b = \dfrac{\beta}{\varsigma \times l_i + \beta \times l_Y}$, we receive: $l_i < M_{t-1} / P_t$. Remember that LM function is $M / P = l_Y \times Y + l_i \times (i_{\max} - i)$, and both summands of the right-hand member of this equation are positive. Therefore the condition $l_i < M_{t-1} / P_t$ is always satisfied. So in the general case we have convergent oscillations for both endogenous parameters (Y_t and π_t) of the model.

3. ***Fiscal models of inflation (Seignorage and Inflation Tax)***. In these models, money emission is considered as a method of financing the state budget deficit when alternative means are not available or their resources are exhausted.

Seignorage is the government revenue obtained from additional money supply. Real value of it: $S = \frac{\dot{M}}{P} = \frac{\dot{M}}{M} \times \frac{M}{P} = g_M \times \frac{M}{P}$, where g_M is the rate of money growth.

Inflation tax is «the financial loss of value suffered by holders of cash and fixed-rate bonds, as well those on fixed income (not indexed to inflation), due to the effects of inflation»[3]. As opposed to seignorage, inflation tax means real depreciation of the money that circulated previously due to price rise. Real inflation tax: $IT = -\frac{d(M/P)}{dt}\Big|_{M=const} = \frac{M}{P^2} \times \frac{dP}{dt} = \frac{M}{P} \times \frac{\dot{P}}{P} = \pi \times \frac{M}{P}$, where π is the rate of inflation. Inflation tax is equal to seignorage, when money does not affect the real production, and economic growth is absent.

The model with seignorage is based on the equality of real supply and real demand for money: $\frac{M}{P} = L(i,Y) = L(r+\pi^e,Y) = L(\bar{r}+g_M,\bar{Y}), \quad L_i < 0, \quad L_Y > 0$. $\rightarrow$ $S = g_M L(\bar{r}+g_M,\bar{Y}) \rightarrow \frac{dS}{dg_M} = L(\bar{r}+g_M,\bar{Y}) + g_M L'(\bar{r}+g_M,\bar{Y})$. The first term of this equation is positive and the second term of it is negative and growing absolutely when $g_M \uparrow$. So we receive «*inflation tax Laffer curve*» (Figure 11). The maximum of this function (S^*) is achieved, when the elasticity of real money demand as to the rate of money change is equal to -1.

When government need for seignorage is fixed (G) and less than S^*, there are two equilibria in the model. In the case of adaptive expectations, the first one will be stable and the second one - unstable, so the system will come to the lower level of money growth and inflation. In the case of rational expectations, the second equilibrium will be stable as opposed to the first one, so the system achieves a greater level of money growth and inflation.

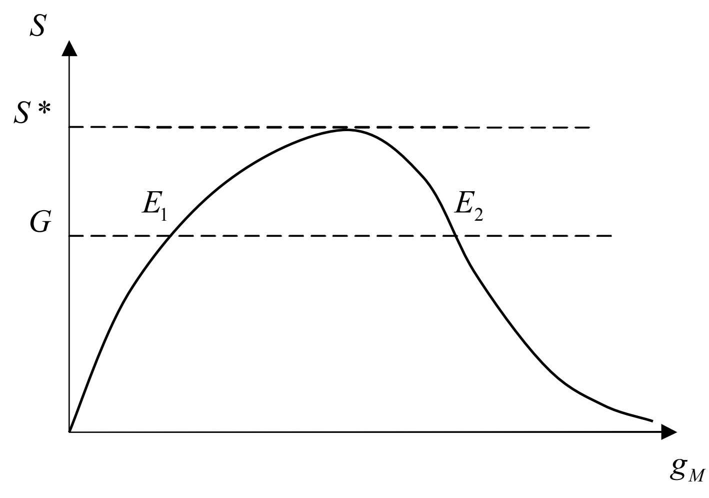


Figure 11. The inflation-tax Laffer curve

4. ***Dynamic Inconsistency of Low-Inflation Monetary Policy*** (Kydland-Prescott model). «*Dynamic inconsistency,* or *time inconsistency,* describes a situation where a decision-maker's pref-

[3] http://en.wikipedia.org/wiki/Inflation_tax.

erences change over time in such a way that what is preferred at one point in time is inconsistent with what is preferred at another point in time»[4].

Kydland-Prescott model is based on Lucas function, where rational expectations concerning inflation negatively affect aggregate supply, so the function of transformation takes the form: $y = \bar{y} + b(\pi - \pi^e),\ b > 0$, where $\bar{y}$ is the level of output for perfectly flexible prices. The welfare loss function is: $L(\pi) = \frac{1}{2}(y - y^*)^2 + \frac{1}{2}a(\pi - \pi^*)^2 \to \min$, where y^* and π^* are social optimums of output and inflation respectively, and $y^* > \bar{y}$, $a > 0$ (a reflects relative importance of inflation and output in welfare). After optimization it under limitation we receive the following solution: $\pi = \pi^* + \frac{b}{a+b^2}(y^* - \bar{y}) + \frac{b^2}{a+b^2}(\pi^e - \pi^*)$.

Equilibrium in this model is obtained where actual inflation and expected inflation coincide: $\pi^e = \pi^* + \frac{b}{a}(y^* - \bar{y}) \equiv \pi^{EQ}$. This yields: $y^* = \bar{y}$, that is the output does not change at all when inflation increases.

Two approaches for solution of the dynamic inconsistency problem: a) importance of reputation for policymakers held «the wide planning horizon» (the Backus&Driffill and Barro models of reputation); b) delegation of the control for policymakers to the third independent party (the Rogoff model).

4.3. Modern Peculiarities of Inflation

Types of modern inflation in the global context:

- *Agrarian inflation* (agflation) – leading growth of prices for food and other agrarian commodities.
- *Energy price inflation* – an advanced rise in prices for fuel and energy.
- *Assets prices inflation* – an excessive rise in prices for assets: financial instruments (stocks, bonds, derivatives etc.), real estate and capital goods. Usually it results in «financial bubbles». Their appearance can be identified through the growth of the q-Tobin coefficient and the rise of «the financial depth» – indicator by McKinsey Global Institute.

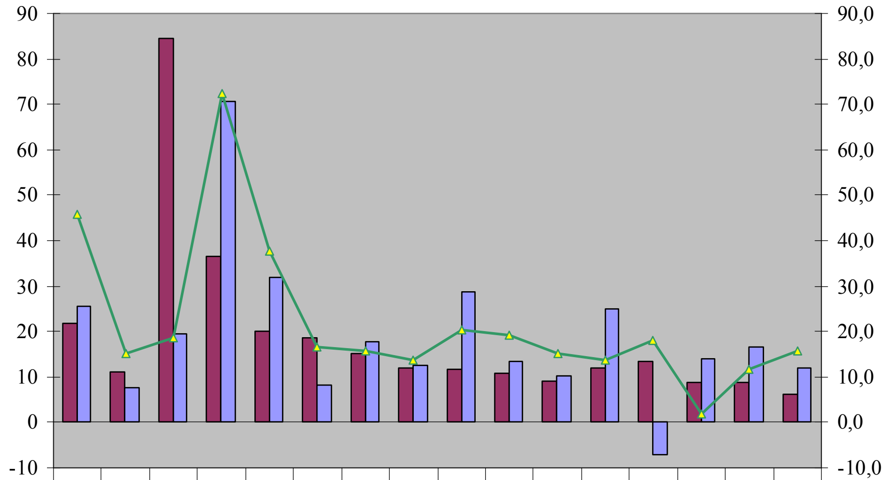
The peculiarities of Russian inflation:

- cyclical character of the average price level changes in long-run;
- alteration of the cost-push inflation and the demand-push inflation;

[4] http://en.wikipedia.org/wiki/Dynamic_inconsistency.

- particular cost-push inflation factors:
    - lack of competitive environments in some sectors of economy, the natural monopolies price-push behavior;
    - growth of the insurance tax payments from January 1, 2011;
    - devaluation of the ruble relative to the dollar (and later to the euro) influenced internal prices noticeably in the crisis 1998-1999, and had no perceptible effect in the crisis of 2008-2009.
- particular demand-push inflation factors:
    - inflows of the export revenues from petroleum, gas and other natural resources and conversion of foreign exchange into national money supply;
    - favorable world market conditions as to above-named products contributed to internal income growth without adequate real output production rise;
    - government expenditures changes fit into the politically-based business cycle.

Inflation rates in Russia in the long-run period of time are presented in Figure 12.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CPI (the left scale)	21,8	11	84,4	36,5	20,2	18,6	15,1	12	11,7	10,9	9	11,9	13,3	8,8	8,8	6,1
PPI, manufactured products (the left scale)	25,6	7,5	19,4	70,7	31,9	8,33	17,7	12,5	28,8	13,4	10,4	25,1	-7	13,9	16,7	12
Deflator (the right scale)	45,8	15,1	18,6	72,5	37,6	16,5	15,6	13,8	20,3	19,3	15,2	13,8	18,0	2,0	11,6	15,8

Figure 12. The rates of inflation in the Russian Federation, %

4.4. Problems

Problem 1. (*Models of inflation based on the market equilibriums).* Let's imagine some closed economics with static expectations, where the potential output is $Y_F = 1000$ units, and the initial real money supply is $\frac{M}{P} = 100$ units. The real liquidity demand function is $M/P = 0{,}05 \times Y + 3 \times (20 - i)$. The sensitivity of wage rate to previous period unemployment level is $\alpha = 0{,}5$, and Okun's coefficient: $\gamma = 2{,}5$. The function of consumption is presented as follows: $C_t = 80 + 0{,}75 \times Y_{t-1} \times (1 - 0{,}2)$, the function of investment: $I_t = 180 - 4 \times (i - \pi^e)$, and the government purchases at zero period is $G_{a0} = 200$. Suppose that at zero period the economy is in the condition of steady equilibrium.

Determine:

1) The autonomous expenditures (A_{a0}) and the equilibrium interest rate (i_{E0}) at the initial period;

2) The form of the dynamic aggregate supply function is presented as $Y_t^{AS} = f(\pi_t; \pi_t^{\,e})$;

3) The form of the dynamic aggregate demand function is presented as $Y_t^{AD} = f(Y_{t-1}; \Delta A_{at}; m_t; \pi_t; \pi_t^{\,e})$.

4) Let us assume that the Central Bank has increased the money supply by 20% just for the period $t = 1$ ($m_1 = 0{,}2$). Using the Excel program, describe the algorithm of π_t and Y_t time series calculation, draw the graphs of their time dependence and the graph of their interdependence ($\pi_t; Y_t$) – the so-called inflationary spiral of monetary shock.

5) Let us assume that the Central Bank has launched the permanent expansion monetary policy and now increases the money supply by 20% annually ($m_t = 0{,}2$). Using the Excel program, describe the algorithm of π_t and Y_t time series calculation, draw the graphs of their time dependence and the graph of their interdependence ($\pi_t; Y_t$) – the inflationary spiral of monetary expansion.

6) Let us assume that the Government has increased the public purchases by 80 units just at the period $t = 1$ ($\Delta G_{a1} = 80$). The Central Bank continues to increase the money supply by 20% annually ($m_t = 0{,}2$). Using the Excel program, describe the algorithm of π_t and Y_t time series calculation, draw the graphs of their time dependence and the graph of their interdependence ($\pi_t; Y_t$) – the inflationary spiral of fiscal shock ($\pi_t; Y_t$). What will be the steady level of inflation?

7) Let us assume that the Government has launched the permanent expansion fiscal policy and now increases the public purchases by 80 units annually. The Central Bank continues to increase money supply for 20% annually ($m_t = 0{,}2$). Using the Excel program, describe the algorithm of π_t and Y_t time series calculation, draw the graphs of their time dependence and the graph of their

interdependence ($\pi_t;Y_t$) – the inflationary spiral of fiscal expansion ($\pi_t;Y_t$).What will be the steady level of inflation in this case?

8) By using the developed algorithms of π_t and Y_t time series calculation, estimate the Discriminant value for each case. How does it depend on the value of the following parameters: α, β, γ, ς, l_i, l_Y?

Answer: 1) $i_{E0}=15$; $A_{a0}=460$; 2) $Y_t^{AS}=1000+5000\times(\pi_t-\pi_{t-1})$; 3) $Y_t^{AD}=Y_{t-1}+2{,}14\times\Delta A_{at}+285{,}7\times(m_t-\pi_t)+8{,}57\times\Delta\pi_t^{\,e}$; 6) $\pi^*=0{,}2$; 7) $\pi^*=0{,}8$.

Problem 2. How can you explain the leading rise of agricultural and energy prices in the world economy? By using the statistical data provided by the European commission (URL: http://epp.eurostat.ec.europa.eu/portal/page/portal/hicp/data/database), examine the prices indexes dynamics for separate goods and services included in the consumer basket. Estimate their relative changes as to all-terms harmonized CPI, and explain the result obtained on the basis of the theory of unbalanced inflation and branch markets determinants.

Problem 3. Analyze the figure 12 for Russian economy and explain the difference in inflation indexes relative changes. How their dynamics can be explained from the standpoint of «cost-push» and «demand-push» inflation theory? By using the national statistical data, construct the time series for the deflator, CPI and PPI in your country, draw relevant graphs and analyze divergence in their dynamics.

RECOMMENDED LITERATURE

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APPENDIX

(definitions are quoted from *Macroeconomics* by G. Mankiw)

Effects of economic policy

⇒ *Multiplier effect* – the additional shifts in aggregate demand that result when expansionary fiscal policy increases income and thereby increases consumer spending.

⇒ *Automatic stabilizers* – changes in fiscal policy that stimulate aggregate demand when the economy goes into a recession without policymakers having to take any deliberate action.

⇒ *Catch-up effect* – the property whereby countries that start off poor tend to grow more rapidly than countries that start off rich.

⇒ *Natural-rate hypothesis* – the claim that unemployment eventually returns to its normal, or natural, rate, regardless of the rate of inflation.

⇒ *Sacrifice ratio* – the number of percentage of annual output lost in the process of reducing inflation by 1 percentage point.

⇒ *Rational expectations* – the theory according to which people optimally use all the information they have, including information about government policies, when forecasting the future.

Main problems of economic policy

Five debates over macroeconomic policy (by G. Mankiw):

1. Consider whether policymakers should try to stabilize the economy.
2. Consider whether monetary policy should be made by rule rather than by discretion.
3. Consider whether the central bank should aim for zero inflation.
4. Consider whether the government should balance its budget.
5. Consider whether the tax laws should be reformed to encourage saving.

Glossary

⇒ *Nominal GDP* – the production of goods and services valued at current prices.

⇒ *Real GDP* – the production of goods and services valued at constant prices.

⇒ *GDP deflator* – a measure of the price level calculated as the ratio of nominal GDP to real GDP times 100.

⇒ *Consumer price index* (CPI) – a measure of the overall cost of the goods and services bought by a typical consumer. (The basket of goods and services).

⇒ *Inflation rate* – the percentage change in the price index from the preceding period.

⇒ *Producer price index* – a measure of the cost of a basket of goods and services bought by firms.

⇒ *Nominal interest rate* – the interest rate as usually reported without a correction for the effects of inflation.

⇒ *Real interest rate* – the interest rate corrected for the effects of inflation.

⇒ *Productivity* – the amount of goods and services produced from each hour of a worker's time.

⇒ *Physical capital* – the stock of equipment and structures that are used to produce goods and services.

⇒ *Human capital* – the knowledge and skills that workers acquire through education, training and experience.

⇒ *Natural resources* – the inputs into the production of goods and services that are provided by nature, such as land, rivers, and mineral deposits.

⇒ *Technological knowledge* – society's understanding of the best ways to produce goods and services.

⇒ *Financial markets* – financial institutions through which savers can directly provide funds to borrowers.

⇒ *Bond* – a certificate of indebtedness.

⇒ *Stock* – a claim to partial ownership in a firm.

⇒ *Financial intermediaries* – financial institutions through which savers can indirectly provide funds to borrowers.

⇒ *Mutual fund* – an institution that sells shares to the public and uses the proceeds to buy a portfolio of stocks and bonds.

⇒ *Market for loanable funds* – the market in which those who want to save supply funds those who want to borrow to invest demand funds.

⇒ *Labor force* – the total number of workers, including both the employed and the unemployed.

⇒ *Unemployment rate* – the percentage of the labor force that is unemployed.

⇒ *Labor-force participation rate* – the percentage of the adult population that is in the labor force.

⇒ *Natural rate of unemployment* – the normal rate of unemployment around which the unemployment rates fluctuate.

⇒ *Cyclical unemployment* – the deviation of unemployment from its natural level.

⇒ *Discouraged workers* – individuals who like to work but have given up looking for a job.

⇒ *Union* – a worker association that bargains with employers over wages and working conditions.

⇒ *Collective bargaining* – the process by which unions and firms agree on the terms of employment.

⇒ *Unemployment insurance* – a government program that partially protects worker's incomes when they become unemployed.

⇒ *Money* – the set of assets in an economy that people regularly use to buy goods and services from other people.

⇒ *Medium of exchange* – an item that buyers give to sellers when they want to purchase goods and services.

⇒ *Unit of account* – the yardstick people use to post prices and record debts.

⇒ *Store of value* – an item that people can use to transfer purchasing power from the present to the future.

⇒ *Liquidity* – the ease with which an asset can be converted into the economy's medium of exchange.

⇒ *Commodity money* – money that takes the form of commodity with intrinsic value.

⇒ *Fiat money* – money without intrinsic value that is used as money because of government decree.

⇒ *Currency* – the paper bills and coins in the hands of the public.

⇒ *Demand deposits* – balances in bank accounts that depositors can access on demand by writing a check.

⇒ *Central bank* – an institution designed to oversee the banking system and regulate the quantity of money in the economy.

⇒ *Money supply* – the quantity of money available in the economy.

⇒ *Monetary policy* – the setting of the money supply by policymakers in the central bank.

⇒ *Reserves* – deposits that banks have received but have not loaned out.

⇒ *Fractional-reserve banking* – a banking system in which banks hold only a fraction of deposits as reserves.

⇒ *Reserve ratio* – the fraction of deposits the banks hold as reserves.

⇒ *Money multiplier* – the amount of money the banking system generates with each dollar of reserves.

⇒ *Open-market operations* – the purchase and sale of the government bonds by the central bank.

⇒ *Reserve requirements* – regulations on the minimum amount of reserves that banks must hold against deposits.

⇒ *Discount rate* – the interest rate on the loans that the central bank makes to banks.

⇒ *Quantity theory of money* – a theory asserting that the quantity of money available determines the price level and the growth rate in the quantity of money available determines the inflation rate.

⇒ *Nominal variables* – variables measured in monetary units.

⇒ *Real variables* – variables measured in physical units.

⇒ *Classical dichotomy* – the theoretical separation of nominal and real variables.

⇒ *Monetary neutrality* – the proposition that changes in the money supply do not affect real variables.

⇒ *Velocity of money* – the rate at which money changes hands.

⇒ *Fisher effect* – the one-for-one adjustment of the nominal interest rate to the inflation rate.

⇒ *Shoeleather costs* – the resources wasted when inflation encourages people to reduce their money holdings.

⇒ *Menu costs* – the costs of changing prices.

⇒ *Net exports* – the value of a nation's exports minus the value of its imports, also called the trade balance.

⇒ *Net foreign investment* – the purchase of foreign assets by domestic residents minus the purchase of domestic assets by foreigners.

⇒ *Nominal exchange rate* – the rate at which a person can trade the currency of one country for the currency of another.

⇒ *Appreciation* – an increase in the value of a currency as measured by the amount of a foreign currency it can buy.

⇒ *Depreciation* – a decrease in the value of a currency as measured by the amount of a foreign currency it can buy.

⇒ *Real exchange rate* – the rate at which a person can trade the goods and services of one country for the goods and services of another.

⇒ *Purchasing-power parity* – a theory of exchange rates whereby a unit of any given currency should be able to buy the same quantity of goods in all countries.

⇒ *Aggregate-demand curve* – a curve that shows the quantity of goods and services that households, firms, and the government want to buy at any price level.

⇒ *Aggregate-supply curve* – a curve that shows the quantity of goods and services that firms choose to produce and sell at any price level.