HE1002 Macroeconomics I

Final Practice Examination 3 – Solutions

Academic Year 2025/2026, Semester 1

Quantitative Research Society @NTU

November 14, 2025

Question 1: Calculations – Complete Solutions (30 marks)

1.1 *[Source: T01-Q05]* – Solving for Investment (2 marks)

Given: $Y = 15{,}000$, $C = 9{,}000$, $G = 3{,}000$, $NX = 500$ (billions).

Formula:

$$Y = C + I + G + NX$$

Solution:

$$\begin{aligned} 15{,}000 &= 9{,}000 + I + 3{,}000 + 500 \\ 15{,}000 &= 12{,}500 + I \\ I &= \boxed{\$2{,}500 \text{ billion}} \end{aligned}$$

1.2 *[Source: T01-Q11]* – Real GDP Calculation (2 marks)

Given: Year 1: $\text{Nom}_1 = 500$, $\text{Defl}_1 = 100$. Year 2: $\text{Nom}_2 = 600$, $\text{Defl}_2 = 110$.

Formula:

$$\text{Real GDP} = \frac{\text{Nominal GDP}}{\text{GDP Deflator}} \times 100$$

Solution:

$$\text{Real GDP}_2 = \frac{600}{110} \times 100 = \boxed{\$545.45 \text{ billion}}$$

Interpretation: Despite 20% nominal growth ($500 → $600), real GDP grew only 9% due to 10% inflation.

1.3 *[Source: T02-Q08]* – Real Wage Calculation (2 marks)

Given: 2023: $W = 50{,}000$, CPI $= 200$. 2024: $W = 52{,}000$, CPI $= 210$.

Formula:

$$\text{Real Wage} = \frac{\text{Nominal Wage}}{\text{CPI}} \times 100$$

Solution:

$$\text{Real}_{2023} = \frac{50{,}000}{200} \times 100 = \boxed{\$25{,}000}$$

$$\text{Real}_{2024} = \frac{52{,}000}{210} \times 100 = \boxed{\$24{,}762}$$

Result: Real wage *decreased* despite nominal increase. Purchasing power fell by \$238.

1.4 *[Source: T02-Q11]* – Real Interest and Loan Value (2 marks)

Given: Loan $= \$10{,}000$, $i = 8\%$, $\pi = 3\%$.

Formulas:

$$r \approx i - \pi$$

$$\text{Real Repayment} = \frac{\text{Nominal Repayment}}{1 + \pi}$$

Solution:

(a) Real interest rate:

$$r = 8\% - 3\% = \boxed{5\%}$$

(b) Nominal repayment: $10{,}000 \times 1.08 = 10{,}800$

Real value:

$$\frac{10{,}800}{1.03} = \boxed{\$10{,}485}$$

Interpretation: Real cost of borrowing is 5%, not 8%. Inflation reduces real burden.

1.5 *[Source: T03-Q06]* – Labor Market Equilibrium (2 marks)

Given: $L^d = 80 - 3w$, $L^s = -10 + 2w$.

Equilibrium Condition:

$$L^d = L^s$$

Solution:

$$80 - 3w = -10 + 2w$$

$$90 = 5w$$

$$w^* = \boxed{\$18/\text{hour}}$$

Employment:

$$L^* = 80 - 3(18) = 26 \text{ or } L^* = -10 + 2(18) = 26 = \boxed{26{,}000 \text{ workers}}$$

1.6 *[Source: T04-Q06]* – Doubling Times (2 marks)

Given: Country A: $g = 2\%$, Country B: $g = 4\%$, Country C: $g = 6\%$.

Formula (Rule of 70):

$$\text{Years to double} \approx \frac{70}{g}$$

Solution:

$$\text{Country A:} \quad \frac{70}{2} = \boxed{35 \text{ years}}$$
$$\text{Country B:} \quad \frac{70}{4} = \boxed{17.5 \text{ years}}$$
$$\text{Country C:} \quad \frac{70}{6} = \boxed{11.7 \text{ years}}$$

Insight: Country C grows 3× faster than A, doubling income in one-third the time.

1.7 *[Source: T05-Q04]* – Multiplier Effect (2 marks)

Given: MPC $= 0.8$, $\Delta I = 100$ billion.

Formulas:

$$m = \frac{1}{1 - \text{MPC}}$$
$$\Delta Y = m \times \Delta I$$

Solution:

$$m = \frac{1}{1 - 0.8} = 5$$
$$\Delta Y = 5 \times 100 = \boxed{\$500 \text{ billion}}$$

1.8 *[Source: T05-Q13]* – Output Gap Analysis (2 marks)

Given: $Y = 5{,}000$, $Y_p = 6{,}000$, MPC $= 0.75$.

Formulas:

$$\text{Gap} = Y_p - Y$$
$$m = \frac{1}{1 - \text{MPC}}$$
$$\Delta A = \frac{\text{Gap}}{m}$$

Solution:

$$\text{Gap} = 6{,}000 - 5{,}000 = 1{,}000 \text{ (recessionary)}$$
$$m = \frac{1}{0.25} = 4$$
$$\Delta A = \frac{1{,}000}{4} = \boxed{\$250}$$

Result: Need \$250B increase in autonomous expenditure to close \$1,000B gap.

1.9 *[Source: T06-Q12]* – Equation of Exchange (2 marks)

Given: $V = 5$, $M = 400$ billion.

Formula (Equation of Exchange):

$$MV = PY = \text{Nominal GDP}$$

Solution:

$$\text{Nominal GDP} = 400 \times 5 = \boxed{\$2{,}000 \text{ billion}}$$

1.10 *[Source: T07-Q14]* – Government Debt Accumulation (2 marks)

Given: $\text{Debt}_{\text{start}} = 2{,}000$, Deficit $= 150$ (billions).

Formula:

$$\text{Debt}_t = \text{Debt}_{t-1} + \text{Deficit}_t$$

Solution:

$$\text{Debt}_{\text{end}} = 2{,}000 + 150 = \boxed{\$2{,}150 \text{ billion}}$$

1.11 *[Source: T08-Q07]* – Crowding Out Calculation (2 marks)

Given: Initial: $I_0 = 300$ at $r = 5\%$. After deficit: $r = 6\%$, total funds $= 320$ (includes \$50 deficit).

Analysis:

New private investment:

$$I_1 = 320 - 50 = 270$$

Crowding out:

$$\text{Crowded out} = I_0 - I_1 = 300 - 270 = \boxed{\$30 \text{ billion}}$$

Interpretation: Government borrowed \$50B but private investment fell \$30B. Partial crowding out (60% of deficit).

1.12 *[Source: T09-Q11]* – Open Market Purchase (2 marks)

Given: Fed buys \$2B bonds, RR = 0.10.

Formulas:

$$m_{\text{money}} = \frac{1}{\text{RR}}$$
$$\Delta M = m \times \text{Reserves}$$

Solution:

$$m = \frac{1}{0.10} = 10$$
$$\Delta M = 10 \times 2 = \boxed{\$20 \text{ billion}}$$

1.13 *[Source: T10-Q18]* – Quantity Theory Inflation (2 marks)

Given: $g_M = 8\%$, $g_Y = 3\%$, $g_V = 0$.

Formula:

$$g_M + g_V = g_P + g_Y$$

Solution:

$$g_P = 8\% + 0\% - 3\% = \boxed{5\%}$$

1.14 *[Source: T10-Q20]* – Cyclical Unemployment (2 marks)

Given: $u_n = 6\%$, $u_{\text{actual}} = 8\%$.

Formula:

$$u_{\text{cyclical}} = u - u_n$$

Solution:

$$u_{\text{cyclical}} = 8\% - 6\% = \boxed{2\%}$$

Interpretation: 2 percentage points of unemployment due to recession (demand-deficient).

1.15 *[Source: T12-Q13]* – Cross Exchange Rate (2 marks)

Given: 1 USD = 0.85 EUR, 1 EUR = 130 JPY.

Method: Chain conversion.

Solution:

$$1 \text{ USD} = 0.85 \text{ EUR} \times 130 \text{ JPY/EUR} = \boxed{110.5 \text{ JPY}}$$

Question 2: Short Answer – Complete Solutions (30 marks)

2.1 *[Source: T01-Q14]* – GDP Limitations (3 marks)

Answer:

GDP is an imperfect measure of well-being for several reasons: (1) **Excludes non-market production**—home production, volunteer work, and leisure time don't count, yet they provide real value; (2) **Ignores distribution**—GDP could rise while inequality worsens, with gains concentrated among few; (3) **Omits environmental costs**—pollution and resource depletion aren't subtracted from GDP; (4) **Doesn't capture quality of life**—health, education quality, political freedom not measured. A country could have high GDP but low life satisfaction.

2.2 *[Source: T02-Q10]* – GDP Deflator vs CPI (3 marks)

Answer:

The GDP deflator and CPI both measure inflation but differ in scope and methodology. The **GDP deflator** includes all domestically produced goods and services with weights that change each year (chain-weighted), reflecting current production patterns. The **CPI** measures only consumer goods purchased by typical households using a fixed basket of goods, making it subject to substitution bias. GDP deflator includes investment goods and government purchases but excludes imports, while CPI includes imports. For policy purposes, CPI is preferred for cost-of-living adjustments since it reflects consumer experience directly.

2.3 *[Source: T03-Q04]* – Unemployment Rise with Job Creation (3 marks)

Answer:

The unemployment rate can increase even when jobs are created if labor force growth exceeds employment growth. This occurs when: (1) Previously discouraged workers re-enter the labor force when job prospects improve, becoming classified as "unemployed" rather than "not in labor force"; (2) Population growth or immigration increases the working-age population faster than job creation; (3) Students graduating and entering the labor force exceed jobs created. The unemployment rate is a *ratio*: if the denominator (labor force) grows faster than the numerator adjustment (new jobs), the rate rises.

2.4 *[Source: T04-Q11]* – Convergence Theory (3 marks)

Answer:

The convergence hypothesis suggests that poor countries grow faster than rich countries, eventually catching up in income levels. This is based on diminishing returns to capital: each additional unit of capital produces smaller output gains in capital-rich countries but larger gains in capital-scarce countries. Convergence is most likely under **conditional convergence**—countries converge to their own steady-state income levels determined by institutions, savings rates, and policies. Absolute convergence (all countries reaching same income) requires identical fundamentals, which doesn't occur in practice.

2.5 *[Source: T05-Q01]* – PAE vs Actual Expenditure (3 marks)

Answer:

Planned aggregate expenditure (PAE) is the total amount households, firms, government, and foreigners *intend* to spend on goods and services: PAE $= C + I^p + G + NX$. Actual expenditure always equals GDP: $Y = C + I^a + G + NX$. The difference lies in **unplanned inventory changes**. When PAE exceeds actual output, inventories fall unexpectedly (unplanned inventory *investment* is negative), signaling firms to increase production. When PAE falls short, inventories accumulate (unplanned inventory investment is positive), prompting production cuts. Equilibrium occurs when PAE $= Y$ (no unplanned inventory changes).

2.6 *[Source: T06-Q05]* – Vertical LRAS (3 marks)

Answer:

The long-run aggregate supply (LRAS) curve is vertical at potential output (Y_p) because in the long run, output is determined by real factors—capital stock, labor force, technology, and natural resources—not by the price level. In the long run, all prices and wages are fully flexible and adjust to clear markets. If the price level rises, nominal wages rise proportionally, leaving real wages unchanged and maintaining employment at its natural level. The economy produces at its maximum sustainable output regardless of price level, making LRAS vertical and independent of inflation.

2.7 *[Source: T07-Q06]* – Automatic Stabilizers (3 marks)

Answer:

Automatic stabilizers are fiscal policy features that automatically counteract economic fluctuations without requiring new legislation. They **differ from discretionary policy** in timing and action: discretionary policy requires legislative approval and implementation lag, while automatic stabilizers work immediately and passively. Examples: (1) Progressive income taxes—tax revenue falls automatically in recessions as incomes decline, leaving more disposable income; (2) Unemployment insurance—payments rise automatically during downturns. These mechanisms dampen fluctuations without the recognition and implementation lags that plague discretionary policy.

2.8 *[Source: T08-Q15]* – Crowding Out Definition (3 marks)

Answer:

Crowding out occurs when government borrowing raises interest rates and reduces private investment. When the government runs a deficit, it demands loanable funds, shifting the demand curve right and increasing equilibrium interest rates. Higher interest rates make investment projects less profitable, causing businesses to cancel or postpone capital spending. This reduces fiscal policy effectiveness because increased government spending is partially offset by decreased private investment. The magnitude depends on interest rate sensitivity: perfectly elastic investment (high sensitivity) means complete crowding out; perfectly inelastic means zero crowding out.

2.9 *[Source: T09-Q05]* – Fed Monetary Policy Tools (3 marks)

Answer:

The Federal Reserve has three primary monetary policy tools: (1) **Open market operations**—buying/selling government securities to directly control bank reserves and money supply (most frequently used tool); (2) **Discount rate**—interest rate charged to banks for borrowing reserves from the Fed, signaling policy stance; (3) **Reserve requirements**—minimum fraction of deposits banks must hold as reserves, affecting the money multiplier. OMOs are preferred due to precision, flexibility, and easy reversibility, while reserve requirement changes are rarely used due to their disruptive impact on bank operations.

2.10 *[Source: T12-Q08]* – Currency Appreciation Effects (3 marks)

Answer:

Currency appreciation makes a country's currency more valuable relative to foreign currencies, causing **net exports to fall** through two channels: (1) **Exports become expensive**—foreign buyers pay more in their currency for domestic goods, reducing quantity demanded; (2) **Imports become cheap**—domestic residents pay less in domestic currency for foreign goods, increasing quantity demanded. For example, if the dollar appreciates from \$1 = €0.80 to \$1 = €1.00, U.S. exports become 25% more expensive for Europeans while imports become cheaper for Americans, worsening the trade balance.

Question 3: True or False – Complete Solutions (30 marks)

3.1 *[Source: T01-Q15]* – Exports and GDP (3 marks)

Statement: A country's GDP increases when a domestic company sells products to foreign buyers (exports).

Answer: **TRUE**

Explanation: Exports represent production of goods and services within the domestic economy that are sold abroad, so they count toward GDP in the net exports component: $Y = C + I + G + (X - M)$. When a domestic company exports \$1 million of products, those products were produced using domestic resources and labor, creating \$1 million of domestic value added. The fact that foreign buyers purchase the output doesn't change that it represents domestic production. This is why countries with strong export sectors (Germany, China, Japan) show higher GDP.

3.2 *[Source: T02-Q13]* – Inflation Calculation (3 marks)

Statement: If the CPI increases from 120 to 132 over a year, the inflation rate is 12%.

Answer: **FALSE**

Explanation: The inflation rate is the *percentage change* in CPI, not the absolute change. Correct calculation: $\pi = \frac{132-120}{120} \times 100\% = \frac{12}{120} \times 100\% = 10\%$. The CPI increased by 12 points, but this represents a 10% increase relative to the starting level of 120. A common mistake is treating the absolute change (12) as the inflation rate. The denominator must be the initial CPI (120), not 100, since we're measuring percentage change from 120.

3.3 *[Source: T03-Q08]* – Minimum Wage and Unemployment Type (3 marks)

Statement: Minimum wage laws that are set above the equilibrium wage increase structural unemployment.

Answer: **TRUE**

Explanation: Minimum wages above equilibrium create persistent labor market mismatch—quantity supplied exceeds quantity demanded—which is the definition of structural unemployment. Unlike frictional unemployment (temporary search), minimum wage unemployment persists as long as the wage floor remains binding. Workers willing to work at market-clearing wage w^* cannot find jobs because employers only hire $L^d(w_{\min}) < L^d(w^*)$ workers at the higher minimum wage. This structural barrier particularly affects low-skilled workers whose productivity doesn't justify the minimum wage, creating long-term unemployment.

3.4 *[Source: T04-Q12]* – Diminishing Returns (3 marks)

Statement: According to the principle of diminishing returns, as an economy accumulates more capital, each additional unit of capital produces smaller increases in output.

Answer: **TRUE**

Explanation: Diminishing returns to capital is a fundamental property of the production function: $\frac{\partial^2 Y}{\partial K^2} < 0$ (concave in capital). Intuitively, the first tractor on a farm dramatically increases productivity, but the 100th tractor adds little value. This principle explains: (1) Why poor countries can grow faster than rich ones (higher return to capital); (2) Why sustained growth requires technological progress, not just capital accumulation; (3) Why savings alone doesn't guarantee growth. Eventually, capital accumulation alone yields diminishing growth unless accompanied by productivity improvements.

3.5 *[Source: T05-Q09]* – MPC and Multiplier (3 marks)

Statement: An increase in the marginal propensity to consume (MPC) increases the expenditure multiplier.

Answer: **TRUE**

Explanation: The expenditure multiplier is $m = \frac{1}{1-\text{MPC}}$, which is increasing in MPC. When MPC rises (people spend larger fraction of additional income), each round of spending is larger, amplifying the multiplier effect. Example: If MPC increases from 0.75 to 0.80, the multiplier rises from $1/0.25 = 4$ to $1/0.20 = 5$. Higher MPC means less "leakage" to saving, so each dollar of initial spending generates more subsequent spending rounds, resulting in larger total impact on output.

3.6 *[Source: T06-Q16]* – AD Increase Short-Run Effect (3 marks)

Statement: In the short run, an increase in aggregate demand raises both output and the price level.

Answer: **TRUE**

Explanation: With upward-sloping SRAS, a rightward AD shift moves the economy up along SRAS, increasing both Y and P. This occurs because prices and wages are sticky in the short run—firms respond to higher demand by increasing both prices (moving up SRAS) and production (hiring more workers). The short-run trade-off exists until prices fully adjust. However, in the long run (vertical LRAS), AD increases only raise price level without changing output, as the economy returns to potential output with all prices proportionally higher.

3.7 *[Source: T07-Q16]* – Fiscal Policy and Cyclical Unemployment (3 marks)

Statement: Expansionary fiscal policy during a recession can reduce cyclical unemployment.

Answer: **TRUE**

Explanation: Expansionary fiscal policy (increased G or decreased T) shifts aggregate demand right, increasing output toward potential: $Y \to Y_p$. As output rises, firms hire more workers to meet higher demand, reducing unemployment. Since cyclical unemployment is specifically unemployment caused by insufficient aggregate demand during recessions, fiscal stimulus that boosts AD directly addresses this type of unemployment. However, fiscal policy cannot reduce frictional or structural unemployment, only the cyclical component. This is why fiscal stimulus is most effective during recessions when output is below potential.

3.8 *[Source: T09-Q15]* – Discount Rate Increase (3 marks)

Statement: When the Federal Reserve raises the discount rate, banks are more likely to borrow reserves and the money supply increases.

Answer: **FALSE**

Explanation: Raising the discount rate makes borrowing reserves from the Fed more expensive, *discouraging* banks from borrowing. Banks reduce their borrowing, decreasing bank reserves in the system. With fewer reserves, banks can make fewer loans, contracting the money supply through the money multiplier: $\Delta M = m_{\text{money}} \times \Delta\text{Reserves}$ (negative). Higher discount rates signal **contractionary** policy. The Fed raises discount rates to reduce money supply, increase interest rates, and cool inflationary pressures—not to expand money supply.

3.9 *[Source: T10-Q15]* – Long-Run Phillips Curve (3 marks)

Statement: According to the long-run Phillips curve, there is a permanent trade-off between inflation and unemployment.

Answer: **FALSE**

Explanation: The long-run Phillips curve is **vertical** at the natural rate of unemployment, meaning there is *no* permanent trade-off. In the short run, the Phillips curve is downward-sloping due to sticky wages and prices. However, in the long run, expectations adjust: if the central bank tries to maintain unemployment below u_n through monetary expansion, workers and firms eventually expect higher inflation and adjust wages/prices accordingly. The economy returns to u_n but at a higher inflation rate. Only unexpected inflation can temporarily reduce unemployment below its natural rate.

3.10 *[Source: T12-Q11]* – Trade Deficit and Capital Flows (3 marks)

Statement: A country with a trade deficit must be experiencing net capital inflow.

Answer: **TRUE**

Explanation: This follows from the fundamental balance-of-payments identity: $NCO = NX$. A trade deficit means $NX < 0$ (imports exceed exports), which implies $NCO < 0$ (net capital *out*flow is negative). Negative capital outflow equals capital *in*flow: $NCO < 0 \Rightarrow$

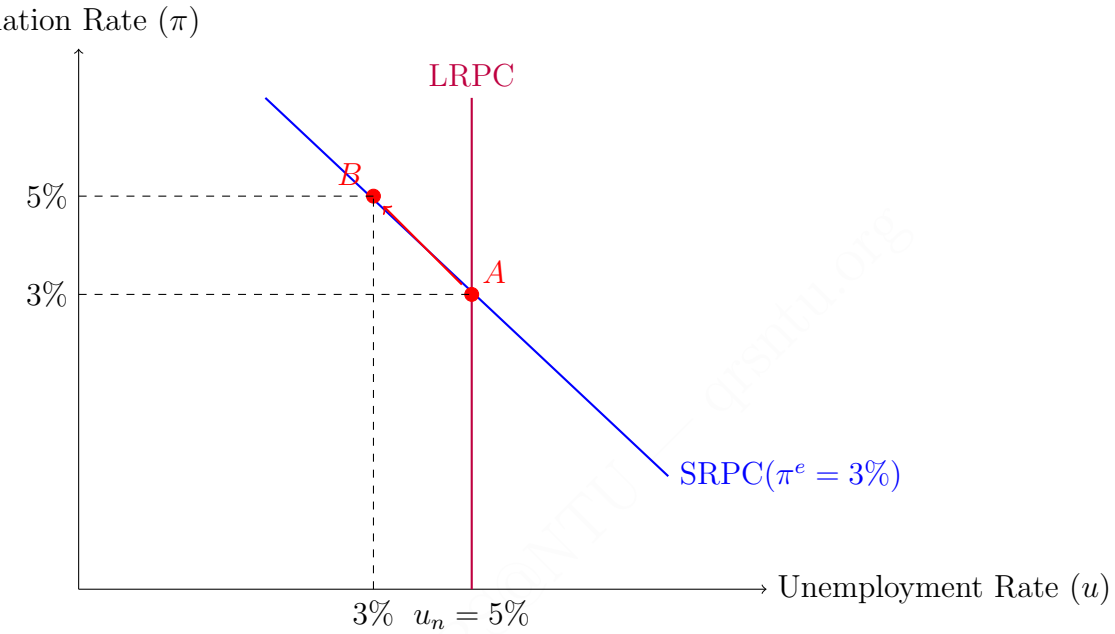
net capital inflow. Intuitively, when a country imports more than it exports, it must finance the difference by selling assets to foreigners (stocks, bonds, real estate) or borrowing from abroad. The U.S. trade deficit, for example, is matched by foreign purchase of U.S. Treasury bonds and other assets.

Question 4: Diagrams – Complete Solutions (10 marks)

4.1 *[Source: T10-Q19]* – Phillips Curve Analysis (5 marks)

Scenario: Phillips curve with unexpected monetary expansion.

Solution:



Analysis:

(a-c) **Initial equilibrium at point A**: Economy at natural rate $u_n = 5\%$ with expected inflation $\pi^e = 3\%$. SRPC drawn for $\pi^e = 3\%$, LRPC vertical at $u_n = 5\%$.

(d) **Unexpected monetary expansion effects**:

Short-run (move to point B):

- Money supply increase → lower interest rates
- Higher spending → higher output and employment
- Unemployment falls from 5% to 3%
- But inflation rises from 3% to 5%
- Movement *along* SRPC from A to B

Mechanism: Workers and firms don't immediately realize prices are rising. Real wages fall temporarily (nominal wages haven't adjusted yet), encouraging hiring. Unemployment drops below natural rate.

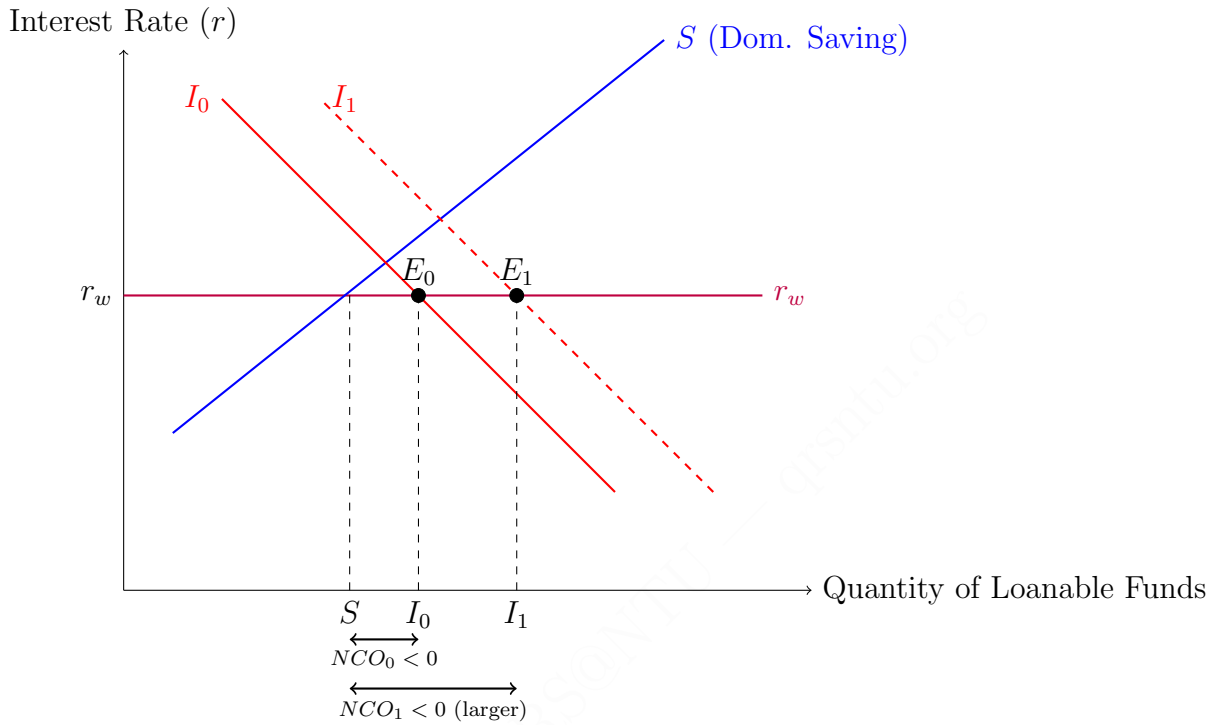
Long run: Workers realize inflation is 5%, not 3%. They demand higher wages. SRPC shifts up to $\pi^e = 5\%$. Economy returns to $u_n = 5\%$ but at 5% inflation. No lasting unemployment reduction—only higher inflation.

Policy Lesson: Monetary policy cannot permanently reduce unemployment below natural rate without accelerating inflation.

4.2 *[Source: T08-Q20]* – Open Economy Loanable Funds (5 marks)

Scenario: Small open economy with increased domestic investment demand.

Solution:



Analysis:

(a-b) **Initial equilibrium** E_0: Small open economy takes world interest rate r_w as given (horizontal line). Domestic saving at r_w is point on S curve. Domestic investment demand at r_w is point on I_0 curve. Since investment exceeds saving, the country borrows from abroad: $NCO_0 = S - I_0 < 0$ (net capital inflow).

(c) **Investment demand increase**: Business confidence improves, shifting investment demand right from I_0 to I_1. At unchanged world rate r_w, investment increases from E_0 to E_1.

(d) **International borrowing implications**:

The country becomes a **larger net borrower** (or less of a net lender if it was one initially).

Net capital outflow: $NCO_1 = S - I_1 < NCO_0$ (more negative). Since domestic saving unchanged but investment increased, the gap widens. Country must borrow more from abroad to finance higher investment.

Relationship: By identity $NCO = NX$, increased capital inflow (NCO more negative) matches increased trade deficit (NX more negative). Higher investment likely increases imports of capital goods, worsening trade balance.

NCO shown as horizontal distance between S and I_1 curves at r_w—negative (borrowing).

END OF SOLUTIONS

All solutions reference original tutorial questions
Complete working shown for all calculations

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