HE1002 Macroeconomics I

Final Practice Examination 5 – Solutions

Academic Year 2025/2026, Semester 1

Quantitative Research Society @NTU

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Question 1: Calculations – Complete Solutions (30 marks)

1.1 *[Source: T01-Q10]* – GDP Deflator Changes (2 marks)

Given: Year 1: $\text{Nom}_1 = 850$, $\text{Real}_1 = 800$. Year 2: $\text{Nom}_2 = 920$, $\text{Real}_2 = 840$.
   Formula:
$$\text{GDP Deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100$$

Solution:
(a) Deflator in Year 2:

$$\text{Deflator}_2 = \frac{920}{840} \times 100 = \boxed{109.52}$$

(b) Percentage change:
First, calculate Year 1 deflator: $\frac{850}{800} \times 100 = 106.25$

$$\%\Delta = \frac{109.52 - 106.25}{106.25} \times 100\% = \boxed{3.08\%}$$

Interpretation: Deflator rose 3.08%, indicating price inflation exceeded real growth.
   (Original Tutorial Question: Calculate GDP deflator with different nominal and real GDP values)

1.2 *[Source: T01-Q06]* – Production Approach GDP (2 marks)

Given: 100 computers @ \$1,500, 50 smartphones @ \$800, 200 textbooks @ \$120.
   Formula:
$$\text{GDP} = \sum(\text{Quantity} \times \text{Price})$$

Solution:

$$\begin{aligned} \text{GDP} &= 100(1{,}500) + 50(800) + 200(120) \\ &= 150{,}000 + 40{,}000 + 24{,}000 \\ &= \boxed{\$214{,}000} \end{aligned}$$

(Original Tutorial Question: Calculate value of production with different goods and prices)

1.3 *[Source: T02-Q01]* – CPI Calculation (2 marks)

Given: Basket: 20 pizzas, 15 movies. 2023: $P_{\text{pizza}} = 12$, $P_{\text{movie}} = 15$. 2024: $P_{\text{pizza}} = 13$, $P_{\text{movie}} = 16$.

Formulas:

$$\begin{aligned} \text{Cost}_t &= \sum (Q_i \times P_{i,t}) \\ \text{CPI}_t &= \frac{\text{Cost}_t}{\text{Cost}_{\text{base}}} \times 100 \\ \pi &= \frac{\text{CPI}_{2024} - \text{CPI}_{2023}}{\text{CPI}_{2023}} \times 100\% \end{aligned}$$

Solution:
Cost in 2023 (base): $20(12) + 15(15) = 240 + 225 = 465$
Cost in 2024: $20(13) + 15(16) = 260 + 240 = 500$
CPI in 2024:

$$\text{CPI}_{2024} = \frac{500}{465} \times 100 = \boxed{107.53}$$

Inflation rate:

$$\pi = \frac{107.53 - 100}{100} \times 100\% = \boxed{7.53\%}$$

(Original Tutorial Question: Same CPI methodology with different basket items and prices)

1.4 *[Source: T03-Q05]* – Labor Force Statistics (2 marks)

Given: Total pop = 300,000, Under 16 = 80,000, Institutionalized = 5,000, Not in LF = 85,000, Unemployed = 18,000.

Key relationships:

$$\begin{aligned} \text{WAP} &= \text{Total} - \text{Under 16} - \text{Institutionalized} \\ \text{LF} &= \text{WAP} - \text{Not in LF} \\ \text{Employed} &= \text{LF} - \text{Unemployed} \end{aligned}$$

Solution:

(a) Working-age population:

$$\text{WAP} = 300{,}000 - 80{,}000 - 5{,}000 = \boxed{215{,}000}$$

(b) Labor force:

$$\text{LF} = 215{,}000 - 85{,}000 = \boxed{130{,}000}$$

(c) Unemployment rate:

$$u = \frac{18{,}000}{130{,}000} \times 100\% = \boxed{13.85\%}$$

(Original Tutorial Question: Same calculation structure with different population statistics)

1.5 *[Source: T04-Q07]* – Compound Growth (2 marks)

Given: $\text{GDP/cap}_0 = \$45{,}000$ (2015), $g = 2.8\%$, $t = 10$ years.
Formula:
$$\text{GDP/cap}_t = \text{GDP/cap}_0 \times (1 + g)^t$$

Solution:

$$\begin{aligned}
\text{GDP/cap}_{2025} &= 45{,}000 \times (1.028)^{10} \\
&= 45{,}000 \times 1.3159 \\
&= \boxed{\$59{,}216}
\end{aligned}$$

Interpretation: Income grew 31.6% over decade, adding $14,216 per capita.
(Original Tutorial Question: Same compound growth calculation with different initial values and rates)

1.6 *[Source: T05-Q07]* – Consumption Function (2 marks)

Given: $C_0 = 400$, $\text{MPC} = 0.72$, $Y_d = 3{,}000$.
Formula:
$$C = C_0 + \text{MPC} \times Y_d$$

Solution:
$$C = 400 + 0.72(3{,}000) = 400 + 2{,}160 = \boxed{\$2{,}560}$$

(Original Tutorial Question: Calculate consumption with different parameters)

1.7 [Source: T05-Q10] – Government Spending Multiplier (2 marks)

Given: MPC = 0.78, $\Delta G = \$250$M.

   Formulas:

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

   Solution:

$$m = \frac{1}{1 - 0.78} = \frac{1}{0.22} = 4.545$$
$$\Delta Y = 4.545 \times 250 = \boxed{\$1{,}136 \text{ million}}$$

   (Original Tutorial Question: Same multiplier calculation with different MPC)

1.8 [Source: T06-Q11] – Equation of Exchange (2 marks)

Given: $M = 650$B, $V = 4.5$, Real GDP = 2,700B.

   Formula:
$$MV = PY \implies P = \frac{MV}{Y}$$

   Solution:
$$P = \frac{650 \times 4.5}{2{,}700} = \frac{2{,}925}{2{,}700} = \boxed{1.083}$$

   Interpretation: Price level is 108.3 (8.3% above base year 100).

   (Original Tutorial Question: Calculate nominal GDP from MV=PY; adapted to solve for P)

1.9 [Source: T07-Q13] – Tax Cut Multiplier (2 marks)

Given: MPC = 0.75, $\Delta T = -\$180$B (tax cut).

   Formulas:

$$\Delta C = \text{MPC} \times |\Delta T|$$
$$m_T = \frac{-\text{MPC}}{1 - \text{MPC}}$$
$$\Delta Y = m_T \times \Delta T$$

   Solution:
(a) Initial consumption change:

$$\Delta C = 0.75 \times 180 = \boxed{\$135 \text{ billion}}$$

(b) Total GDP change:

$$m_T = \frac{-0.75}{0.25} = -3$$
$$\Delta Y = (-3) \times (-180) = \boxed{+\$540 \text{ billion}}$$

(Original Tutorial Question: Calculate fiscal multiplier effects with different values)

1.10 *[Source: T08-Q10]* – Investment Function (2 marks)

Given: $I = 800 - 30r$, $r_0 = 4\%$, $r_1 = 6\%$.
   Solution:

$$I_0 = 800 - 30(4) = 800 - 120 = 680$$
$$I_1 = 800 - 30(6) = 800 - 180 = 620$$
$$\Delta I = 620 - 680 = \boxed{-\$60 \text{ billion}}$$

Interpretation: 2 percentage point rate increase reduces investment by \$60B (inverse relationship).
   (Original Tutorial Question: Calculate investment change with different function parameters)

1.11 *[Source: T09-Q10]* – Reserve Management (2 marks)

Given: Deposit = \$8,000, RR = 0.15.
   Formulas:

$$\text{Required Reserves} = \text{Deposit} \times \text{RR}$$
$$\text{Excess Reserves} = \text{Deposit} - \text{Required}$$

Solution:
(a) Required reserves:

$$\text{Required} = 8,000 \times 0.15 = \boxed{\$1,200}$$

(b) Excess reserves:
$$\text{Excess} = 8,000 - 1,200 = \boxed{\$6,800}$$

(c) Maximum loans:
$$\text{Max Loans} = \boxed{\$6,800}$$

(Original Tutorial Question: Same reserve calculation with different deposit and ratio)

1.12 *[Source: T10-Q17]* – Phillips Curve Inflation (2 marks)

Given: $u_n = 5.5\%$, $u = 7.0\%$, $\beta = 0.6$, $\pi^e = 2.5\%$.

    Formula:
$$\pi = \pi^e - \beta(u - u_n)$$

    Solution:

$$\begin{aligned}
\pi &= 2.5\% - 0.6(7.0\% - 5.5\%) \\
&= 2.5\% - 0.6(1.5\%) \\
&= 2.5\% - 0.9\% \\
&= \boxed{1.6\%}
\end{aligned}$$

    Interpretation: High unemployment (7% ¿ 5.5%) creates downward pressure, reducing inflation below expectations.

    (Original Tutorial Question: Phillips curve calculation with different parameters)

1.13 *[Source: T10-Q14]* – Okun's Law Application (2 marks)

Given: $Y_p = 6{,}000B$, $Y = 5{,}700B$, $u_n = 5\%$, Okun's coefficient = 2.

    Formula:
$$\frac{Y - Y_p}{Y_p} = -2(u - u_n)$$

    Solution:

Output gap:

$$\frac{5{,}700 - 6{,}000}{6{,}000} = -0.05 = -5\%$$

Applying Okun's law:

$$\begin{aligned}
-0.05 &= -2(u - 0.05) \\
-0.05 &= -2u + 0.10 \\
-0.15 &= -2u \\
u &= \boxed{7.5\%}
\end{aligned}$$

    (Original Tutorial Question: Same Okun's law calculation with different GDP values)

1.14 *[Source: T12-Q05]* – Currency Conversion (2 marks)

Given: US$10,000, Exchange rate = 1.25 CAD/USD.

    Formula:
$$\text{Foreign Currency} = \text{Domestic} \times \text{Exchange Rate}$$

    Solution:
$$\text{CAD} = 10{,}000 \times 1.25 = \boxed{\$12{,}500 \text{ CAD}}$$

    (Original Tutorial Question: Currency conversion with different amounts and rates)

1.15 *[Source: T12-Q14]* – Interest Rate Parity (2 marks)

Given: $i_{\text{US}} = 4.5\%$, $i_{\text{Canada}} = 3.2\%$.

    Analysis:

    Interest rate differential: US rate is 1.3 percentage points higher.

    Capital flow direction: Capital flows | from Canada to U.S. | (seeking higher returns).

    Exchange rate effect: Capital inflow into U.S. increases demand for USD, causing USD to | appreciate | against CAD (or CAD depreciates).

    Equilibrium: USD appreciates until expected depreciation offsets interest differential (uncovered interest parity).

    (Original Tutorial Question: Interest rate parity with different country rates)

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

2.1 *[Source: T01-Q12]* – Digital Economy GDP Measurement (3 marks)

Answer:

Measuring GDP in the digital economy is challenging because many valuable services are provided free to users (Google search, social media, Wikipedia). These services generate enormous consumer surplus but no market transactions, so they don't count in GDP. Additionally, digital goods have near-zero marginal cost—producing one more copy costs nothing—making traditional price-quantity frameworks problematic. The value created through network effects, data generation, and attention economy doesn't appear in national accounts. GDP also struggles to capture quality improvements in software and digital services, potentially understating real economic value creation in the modern economy.

(Original Tutorial Question: Asked about GDP limitations generally; adapted to focus on digital economy)

2.2 *[Source: T02-Q12]* – Substitution Bias Mechanism (3 marks)

Answer:

Substitution bias occurs because CPI uses a fixed basket of goods, but consumers substitute away from goods that become relatively more expensive. For example, if beef prices rise 30% while chicken prices rise only 5%, consumers buy more chicken and less beef. The CPI assumes consumers still buy the original beef quantity, overstating their cost of living increase. In reality, substitution mitigates the impact of price changes. This makes CPI systematically overstate inflation compared to a chain-weighted index (like GDP deflator) that updates weights annually to reflect actual consumption patterns.

(Original Tutorial Question: Listed CPI biases; adapted to focus specifically on substitution bias mechanism)

2.3 *[Source: T03-Q11]* – Structural Unemployment Trade-Off (3 marks)

Answer:

Policies to reduce structural unemployment (job training, education subsidies, relocation assistance) can conflict with labor market flexibility. For example, strict regulations protecting workers from layoffs reduce structural unemployment by preserving jobs, but make it harder for firms to adapt to changing conditions and reallocate labor to more productive uses. Similarly, generous unemployment benefits fund job search (reducing mismatch) but may reduce work incentives, extending unemployment duration. Policymakers face a trade-off: more protection and support reduces structural unemployment but may slow economic dynamism and productivity growth by hindering efficient labor reallocation.

(Original Tutorial Question: Discussed structural unemployment policies; adapted to emphasize policy trade-off)

2.4 *[Source: T04-Q07]* – Catch-Up Effect (3 marks)

Answer:

The catch-up effect (or convergence) occurs because poor countries have low capital per worker, so additional capital generates high marginal returns—the first tractor is very productive, while the 100th tractor adds little. Rich countries face diminishing returns to capital accumulation. Poor countries can also adopt existing technologies from rich countries ("technology transfer") rather than inventing from scratch, enabling rapid productivity gains. However, convergence is conditional—it requires appropriate institutions, openness to trade and investment, stable property rights, and human capital. Without these prerequisites, poor countries may stay poor despite low capital (poverty traps).

(Original Tutorial Question: Asked about growth over time; adapted to focus on catch-up mechanism)

2.5 *[Source: T05-Q05]* – Deriving Saving Function (3 marks)

Answer:

Given: $C = 500 + 0.75Y_d$. By definition, $S = Y_d - C$.
Substituting:
$$S = Y_d - (500 + 0.75Y_d) = -500 + 0.25Y_d$$

The saving function is $S = -500 + 0.25Y_d$, where autonomous saving is $-\$500$ (dissaving at zero income) and marginal propensity to save (MPS) is 0.25.

Relationship: MPC+MPS $= 1$ always holds because every dollar of additional income is either consumed or saved. Here, $0.75+0.25 = 1$. Higher MPC means lower MPS—households that consume more save less.

(Original Tutorial Question: Asked about consumption function; adapted to derive saving function)

2.6 *[Source: T06-Q07]* – Price Adjustment Speeds (3 marks)

Answer:

Prices adjust at different speeds due to varying adjustment costs and contract structures. **Commodity prices** (oil, wheat) adjust almost instantly because they trade in organized markets with many buyers/sellers and no contracts—prices clear continuously. **Wages** adjust slowly because they're set in long-term contracts (yearly or multi-year), involve negotiation costs, and firms worry about morale effects of wage cuts. The faster prices adjust relative to wages, the *steeper* the SRAS—if all prices were perfectly flexible, SRAS would be vertical (classical case). Slow wage adjustment relative to output prices creates the upward slope, as higher prices temporarily boost profitability when wages lag.

(Original Tutorial Question: Asked why SRAS slopes up; adapted to focus on adjustment speed differences)

2.7 *[Source: T07-Q04]* – Fiscal Policy Lags (3 marks)

Answer:

Recognition lag is the time between when economic conditions change and when policymakers recognize the need for action. **Implementation lag** is the time between recognizing the need and actually implementing policy (passing legislation, disbursing funds). Implementation lag is typically *longer* because fiscal policy requires Congressional approval, committee hearings, political negotiations, and administrative setup—often 6-12 months or more. Recognition lag is shorter (2-3 months) with modern real-time data. These lags explain why fiscal policy is poorly suited for stabilizing short recessions, and why automatic stabilizers are more effective than discretionary measures.

(Original Tutorial Question: Listed fiscal policy lags; adapted to compare recognition vs implementation)

2.8 *[Source: T08-Q09]* – Risk-Return Trade-Off (3 marks)

Answer:

Investors require higher returns on riskier assets because risk is costly—it creates uncertainty about outcomes and most investors are risk-averse (prefer certainty). A risky corporate bond must offer higher yield than a safe Treasury bond to compensate for default risk. This "risk premium" ensures markets clear: if risky assets didn't offer higher expected returns, no one would buy them. The equilibrium interest rate reflects both the risk-free rate (time value of money) plus a risk premium scaled to the asset's uncertainty. Assets with higher variance in returns must promise higher expected returns to attract buyers, establishing the fundamental risk-return relationship in finance.

(Original Tutorial Question: Discussed interest rate determinants; adapted to focus on risk-return mechanism)

2.9 *[Source: T09-Q02]* – Liquidity Preference Motives (3 marks)

Answer:

Keynes identified three motives for holding money: (1) **Transactions motive**—holding money to purchase goods/services in daily life; (2) **Precautionary motive**—holding money for unexpected expenses or emergencies; (3) **Speculative motive**—holding money to take advantage of future investment opportunities or avoid capital losses on bonds. The **speculative motive is most interest-sensitive** because higher interest rates make bonds more attractive relative to money, inducing people to reduce money holdings and buy bonds. Transactions and precautionary motives depend primarily on income and uncertainty, not interest rates.

(Original Tutorial Question: Defined functions of money; adapted to Keynesian liquidity preference framework)

2.10 *[Source: T12-Q09]* – J-Curve Effect (3 marks)

Answer:

The J-curve describes the time pattern of net exports following currency depreciation. Initially (first 3-6 months), net exports *worsen* because: (1) Existing contracts are denominated in foreign currency—import bills rise immediately in domestic currency while export revenues don't increase yet; (2) Quantities adjust slowly due to production lags, delivery schedules, and consumer habits. Later (6-18 months), quantities adjust: exports become more competitive and rise, imports become expensive and fall. Net exports improve, tracing a "J" shape (down first, then up). This explains why trade deficits often worsen initially after depreciation before improving.

(Original Tutorial Question: Asked about depreciation effects; adapted to focus on J-curve timing)

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

3.1 [Source: T01-Q13] – GDP vs GDP Per Capita (3 marks)

Statement: If Country A has higher GDP than Country B, then Country A necessarily has higher GDP per capita than Country B.

Answer: **FALSE**

Explanation: Higher total GDP doesn't guarantee higher GDP per capita because per capita income depends on population size: GDP/capita = GDP/Population. China has much higher GDP than Switzerland ($18T vs $0.8T) but *lower* GDP per capita ($13,000 vs $94,000) because China's population is 175 times larger. India has higher GDP than Norway but one-tenth the income per person. Total GDP measures economic size; per capita GDP measures average living standards. Large, poor countries can have higher total GDP than small, rich countries.

(Original Tutorial Question: Stated GDP per capita is average (TRUE); reversed to test GDP vs GDP/cap distinction)

3.2 [Source: T02-Q14] – Core CPI vs Headline CPI (3 marks)

Statement: Core CPI, which excludes food and energy prices, is a better measure of underlying inflation trends than headline CPI.

Answer: **TRUE**

Explanation: Core CPI is superior for measuring persistent inflation because food and energy prices are extremely volatile due to weather shocks, geopolitical events, and seasonal factors. These volatile components create noise that obscures underlying inflation trends driven by monetary policy and aggregate demand. Central banks focus on core inflation when setting policy because temporary oil price spikes shouldn't trigger interest rate increases if underlying inflation remains stable. However, headline CPI is important for cost-of-living adjustments since consumers actually pay for food and energy. Core CPI is better for policy; headline CPI is better for measuring consumer experience.

(Original Tutorial Question: Discussed CPI components; adapted to compare core vs headline)

3.3 [Source: T03-Q12] – Student Internship Classification (3 marks)

Statement: A college student actively searching for an internship during summer is counted as unemployed in official unemployment statistics.

Answer: **FALSE**

Explanation: To be classified as unemployed, a person must be actively seeking *employment*, not just an internship. Most internships are temporary positions, and students typically aren't seeking permanent employment. More importantly, many students aren't in the labor force during the academic year—they're primarily students, not workers. However,

if a student is genuinely seeking a paid job (not just internship) and available for work, they could be counted as unemployed. The key issue is whether they're seeking actual employment versus experiential learning. BLS classification depends on job search intent and availability for work.

(Original Tutorial Question: Discussed unemployment classifications; adapted to test student/internship boundary)

3.4 *[Source: T04-Q13]* – Property Rights and Growth (3 marks)

Statement: Strong property rights protection is essential for economic growth because they encourage investment and innovation.

Answer: **TRUE**

Explanation: Property rights are foundational for growth because they ensure investors and entrepreneurs can keep returns from their efforts. Without secure property rights, individuals won't invest in capital or develop innovations (why build a factory if government might seize it?). Strong rights provide: (1) Investment incentives—assured returns encourage capital accumulation; (2) Innovation rewards—patents and copyrights incentivize R&D; (3) Contract enforcement—enables complex transactions and specialization. Empirical evidence shows strong correlation between property rights and growth. Countries with weak rights (arbitrary expropriation, corruption) remain poor despite other resources.

(Original Tutorial Question: Listed growth determinants; adapted to focus specifically on property rights)

3.5 *[Source: T05-Q07]* – Consumer Confidence and AE Line (3 marks)

Statement: An increase in consumer confidence that raises autonomous consumption will shift the aggregate expenditure line downward.

Answer: **FALSE**

Explanation: Increased autonomous consumption shifts the PAE line *upward* (parallel shift). The PAE function is $PAE = C_0 + MPC(Y - T) + I + G + NX$. When C_0 increases (due to higher confidence), the intercept rises, shifting the entire line up. This is *not* a slope change—MPC stays constant. The upward shift means at every income level, planned spending is higher. Graphically, the intersection with the 45-degree line moves right, increasing equilibrium output. Downward shifts occur when autonomous expenditure components *fall* (e.g., investment collapse during financial crisis).

(Original Tutorial Question: Asked about confidence effects on spending; reversed polarity to test PAE shift direction)

3.6 *[Source: T06-Q11]* – Menu Costs and Price Stickiness (3 marks)

Statement: Menu costs—the costs of changing prices—help explain why prices are sticky in the short run, contributing to the positive slope of SRAS.

Answer: **TRUE**

Explanation: Menu costs are the literal and figurative costs of changing prices—printing new catalogs, updating price tags, notifying customers, negotiating with suppliers. Even small menu costs can prevent firms from continuously adjusting prices. When aggregate demand rises, firms face trade-off: pay menu costs to raise prices immediately, or keep prices fixed and increase output instead. With menu costs, many firms choose the latter, especially if demand change seems temporary. This creates the short-run positive relationship between price level and output (SRAS slope). As prices eventually adjust (long run), SRAS becomes vertical. Menu costs are a key component of New Keynesian economics explaining nominal rigidities.

(Original Tutorial Question: Asked about price stickiness causes; adapted to focus specifically on menu costs)

3.7 *[Source: T07-Q13]* – Permanent vs Temporary Tax Cuts (3 marks)

Statement: Permanent tax cuts have larger short-run multiplier effects than temporary tax cuts because households adjust their permanent income expectations.

Answer: **TRUE**

Explanation: According to permanent income hypothesis, consumption depends on *permanent* (lifetime) income, not current income. A temporary tax cut (e.g., one-year rebate) provides windfall income that's largely saved because permanent income barely changes—MPC out of temporary income is low (perhaps 0.3). A permanent tax cut raises expected lifetime income substantially, inducing larger consumption increase—MPC out of permanent income is high (perhaps 0.9). Therefore, permanent cuts have larger multipliers. Empirical evidence confirms this: 2001 tax rebates (temporary) had small effects, while 2017 tax cuts (permanent) had larger consumption responses. This explains why permanent policy changes are more powerful.

(Original Tutorial Question: Compared fiscal multipliers; adapted to test permanent vs temporary effects)

3.8 *[Source: T08-Q11]* – Deficit Financing and Crowding Out (3 marks)

Statement: When government increases borrowing to finance a budget deficit, interest rates always rise, reducing private investment through complete crowding out.

Answer: **FALSE**

Explanation: The statement is too strong—crowding out is typically *partial*, not complete, and interest rates don't always rise. If the economy is in recession with excess saving, government borrowing may not raise rates because idle funds are available (Keynesian case). Even when rates rise, crowding out is partial: if deficit is $100B and investment falls $40B, crowding out is 40%, not 100%. Complete crowding out requires perfectly inelastic investment or perfectly elastic money demand. In reality, investment responds to rates

(slopes down) but not infinitely, and higher government spending raises income, increasing saving (shifting supply), which moderates rate increases. Open economy factors also matter—capital inflows can satisfy demand without rate spikes.

(Original Tutorial Question: Defined crowding out; adapted to test whether it's always complete)

3.9 *[Source: T09-Q13]* – Quantitative Easing (3 marks)

Statement: Quantitative easing differs from conventional monetary policy because it targets long-term interest rates by purchasing long-term securities.

> **Answer**: **TRUE**

> **Explanation**: Conventional monetary policy (open market operations) targets the overnight federal funds rate by buying/selling short-term Treasury bills. When short-term rates hit zero lower bound (2008-2015), the Fed implemented quantitative easing (QE)—purchasing long-term Treasury bonds and mortgage-backed securities to directly lower long-term interest rates. QE works through portfolio balance effects: buying long bonds reduces their supply, raising prices and lowering yields. This reduces mortgage rates, corporate borrowing costs, and stimulates investment/consumption even when short rates can't fall further. QE also signals policy commitment, affecting expectations. It's "unconventional" because it bypasses the usual transmission mechanism.

> *(Original Tutorial Question: Discussed unconventional policy; adapted to focus specifically on QE mechanism)*

3.10 *[Source: T10-Q13]* – Rational Expectations and Phillips Curve (3 marks)

Statement: If workers have rational expectations and immediately adjust wage demands when they observe expansionary policy, the short-run Phillips curve becomes steeper.

> **Answer**: **FALSE** (more precisely: it becomes **vertical**, not steeper)

> **Explanation**: With rational expectations and immediate adjustment, the SRPC doesn't just become steeper—it becomes *vertical* even in the short run, collapsing to the LRPC. When workers instantly recognize expansionary policy and adjust expectations, π^e equals actual π immediately. The Phillips curve $\pi = \pi^e - \beta(u - u_n)$ implies $u = u_n$ always (no unemployment deviation). Monetary policy becomes impotent even short-run because anticipated inflation fully incorporates into wages immediately. This is the rational expectations critique: only *unanticipated* policy affects real variables. If "steeper" means "more vertical," the statement approaches truth, but technically the curve is fully vertical with perfect foresight.

> *(Original Tutorial Question: Discussed expectations adjustment; adapted to test speed effects on SRPC slope)*

Question 4: Diagrams – Complete Solutions (10 marks)

4.1 *[Source: T05-Q17]* – Keynesian Cross Investment Shock (5 marks)

Scenario: Investment decline in Keynesian Cross framework.
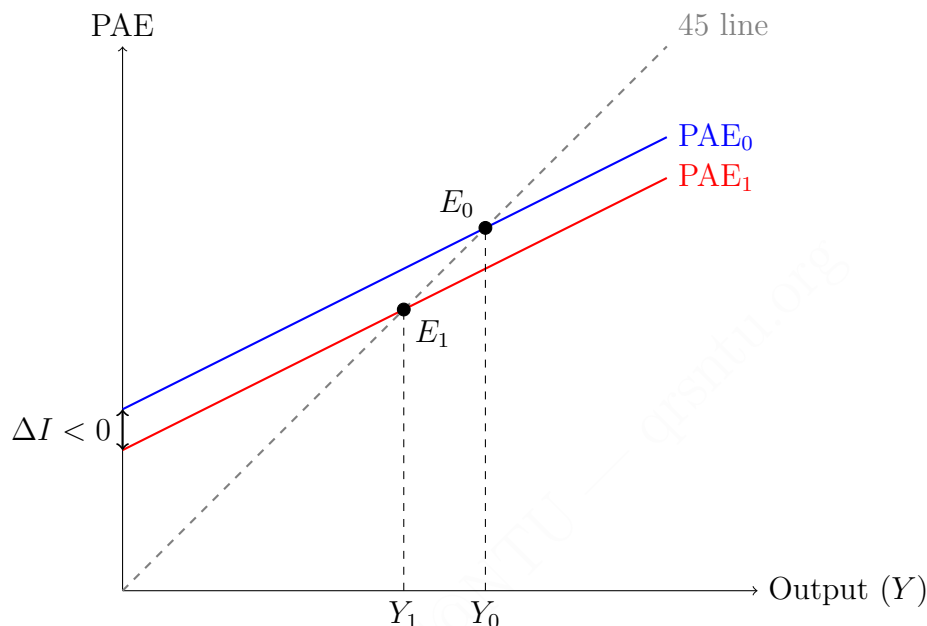
Analysis:

(a-b) **Initial equilibrium** E_0: PAE intersects 45° line at output Y_0. At this point, planned spending equals actual output: $\text{PAE}_0 = Y_0$, so no unplanned inventory changes.

(c) **Investment decline**: Firms become pessimistic, reducing investment (component of PAE). PAE line shifts down parallel by ΔI from PAE_0 to PAE_1. New equilibrium at E_1 with lower output Y_1.

(d) **Multiplier process explanation**:

Why output falls by MORE than $|\Delta I|$?

Round-by-round mechanism:

1. **Round 1**: Investment falls by ΔI (say $-\$100\text{B}$)
2. **Round 2**: Income falls by \$100B → consumption falls by $\text{MPC} \times 100$ (say \$75B)
3. **Round 3**: Income falls another \$75B → consumption falls by $\text{MPC} \times 75 = \$56.25\text{B}$
4. **Round 4+**: Process continues with declining amounts...

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

If $\text{MPC} = 0.75$, multiplier = 4, so \$100B investment drop causes \$400B output fall.

Intuition: Initial spending decline reduces income, inducing further consumption cuts (*induced consumption changes*), which further reduce income, creating downward spiral. The multiplier magnifies the shock because spending cuts propagate through the economy.
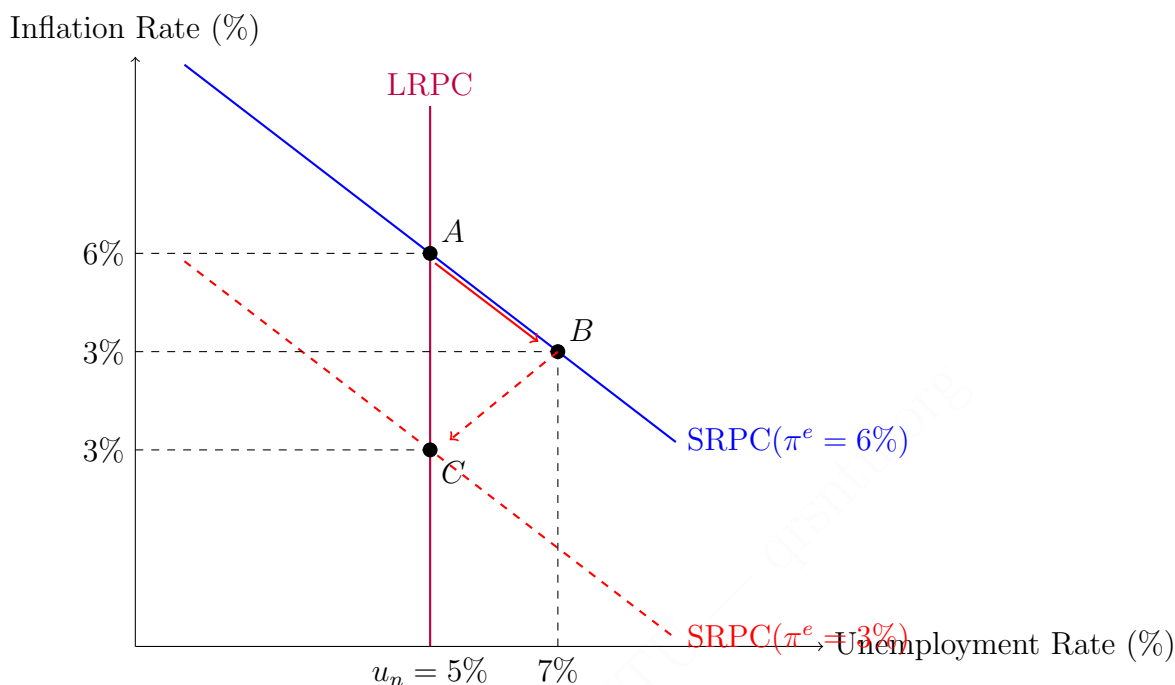
Graphically: Horizontal distance $(Y_0 - Y_1) = \Delta I \times m$, which exceeds vertical shift $|\Delta I|$ by factor of m.

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(Original Tutorial Question: Showed equilibrium determination; adapted to analyze investment shock and multiplier)

4.2 [*Source: T10-Q23*] – **Sacrifice Ratio and Disinflation (5 marks)**

Scenario: Central bank reduces inflation through contractionary policy.

Analysis:

(a) **Initial equilibrium at A**: Economy at natural rate $u_n = 5\%$ with inflation $\pi = 6\%$ (expected inflation also 6%). On SRPC($\pi^e = 6\%$).

(b-c) **Disinflation policy (A $\to$ B)**:

Central bank implements contractionary policy (reduces money supply growth). Short-run effects:

- Lower money growth $\to$ reduced spending
- Output falls, unemployment rises to 7%
- Inflation falls from 6% to 3%
- Movement along SRPC($\pi^e = 6\%$) from A to B

Long-run adjustment (B $\to$ C):

As expectations adjust downward (π^e falls from 6% to 3%), SRPC shifts down. Economy returns to natural unemployment at lower inflation (point C).

(d) **Sacrifice ratio definition and calculation**:

Definition: Sacrifice ratio measures the percentage points of annual output lost for each percentage point reduction in inflation:

$$\text{Sacrifice Ratio} = \frac{\text{Cumulative Output Loss (\%)}}{\text{Inflation Reduction (pp)}}$$

Calculation:

Inflation reduction: $6\% - 3\% = 3$ percentage points

Unemployment increase: $7\% - 5\% = 2$ percentage points
Using Okun's law (-2% output for each 1pp unemployment increase):
Output loss: $2 \times 2\% = 4\%$ of GDP
If disinflation takes 2 years with average 2pp cyclical unemployment:
Total cumulative output loss: $4\% \times 2 = 8\%$ GDP-years
Sacrifice ratio:

$$\text{SR} = \frac{8\%}{3\text{pp}} = \boxed{2.67}$$

Or using the given data directly (1-year scenario):
Cyclical unemployment $= 2\text{pp} \rightarrow$ output loss $= 4\%$ for 1 year

$$\text{SR} = \frac{4\%}{3\text{pp}} = \boxed{1.33}$$

Interpretation: For every percentage point of inflation reduced, output falls by 1.33-2.67% (depends on adjustment speed). Lower sacrifice ratio means less costly disinflation—achievable through: (1) Credible central bank (faster expectation adjustment); (2) Flexible wages (faster real adjustment); (3) Supply-side improvements during disinflation.

Policy implication: High sacrifice ratios make disinflation politically difficult—unemployment costs can be substantial. This is why central banks emphasize credibility to anchor expectations and reduce SR.

(Original Tutorial Question: Basic Phillips curve diagram; adapted to include sacrifice ratio calculation and policy analysis)

END OF SOLUTIONS

All solutions reference original tutorial questions
Complete working shown with economic interpretations
Adaptation notes included for transparency

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