



Open Question 1. Human Capital Theory

The Human Capital Theory suggests that individuals invest in education when the present value of the investment is positive, therefore comparing the present value of the associated costs and benefits.

Let's suppose that Julia just finished High School. She must choose between three alternative career paths. There are only three periods of (working or studying) life after high school, for simplicity reasons. The three choices Julia faces are the following:

- Work as a cashier in a large supermarket chain with a salary of 12,000 euros for each of the three periods.
- Study Marine Biology at the University. She will have to study for one period with a tuition fee of 7,000 euro. After graduation, she will earn 30,000 euros for each of the remaining two periods.
- Study at Philosophy the University and receive a Doctoral Degree in Philosophy (DPhil). She will have to study for two periods with tuition fees of 5.000 euros per period. After graduation she will earn 60,000 euros for the remaining period.

Suppose the interest rate per period is set at 10%. Answer the following questions:

- (10 rp) Which of the three choices is best in terms of economic benefits for Julia?
- (10 rp) If Julia has a passion for Philosophy and always wanted to get a DPhil in that subject, will she have to sacrifice consumption to follow this career path? If yes, what is the present value of consumption she will have to sacrifice?
- (10 rp) Should the State finance tuition for Philosophy studies? Justify your answer.

Solution

- We must calculate the Present Value for each of the three career paths, taking into account of both costs and benefits and see which career path has a positive or the higher present value:

$$PV_{\text{CASHIER}} = 12,000 + \frac{12,000}{1.1} + \frac{12,000}{1.1^2} = 12,000 + 10,909 + 9,917 \approx 32,826 \text{ euros}$$

$$PV_{\text{BIOLOGY}} = -7,000 + \frac{30,000}{1.1} + \frac{30,000}{1.1^2} = -7,000 + 27,272 + 24,793 \approx 45,065 \text{ euros}$$

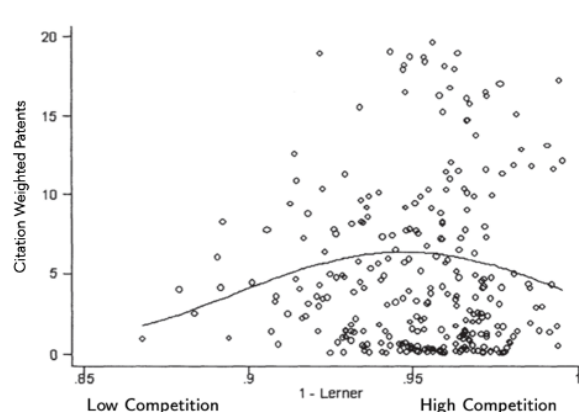
$$PV_{\text{PHILOSOPHY}} = -5,000 - \frac{5,000}{1.1} + \frac{60,000}{1.1^2} = -5,000 - 4,545 + 49,586 \approx 40,041 \text{ euros}$$

Julia will have to choose to study Marine Biology since this career choice (10 points)

- (b) If Julia decides to undertake studies in Philosophy she will have to sacrifice the economically better choice of studies in Marine Biology, that will bring her a higher income overall. In this case she will have to sacrifice the monetary value of the difference between the choice with the higher income and the choice she made due to her personal preferences, namely she will have to sacrifice the consumption of $45,065 - 40,041 = 5,024$ euros. (10 points)
- 8 points for correct process using wrong calculations
- (c) Investment in education is accompanied with significant positive externalities for the whole society. The social benefits from a more educated workforce are numerous, ranging from increased labour market participation, higher productivity, less need for social compensation and welfare benefits up to active and educated political participation and higher social involvement. Therefore, the Government should finance studies in a specific field when the social benefit exceeds the private (individual) benefit from studying and it is possible that the market cannot produce the optimum amount of workers educated in this field. (10 points)
- 3 points if a few positive externalities are mentioned
 - 8 points if answer is correct, but missing something or includes something wrong

Open Question 2. Competition, Innovation, Inflation

(a) (10 rp) In their 2005 paper¹, Philippe Aghion, Nick Bloom, Richard Blundell, Rachel Griffith, and Peter Howitt found the inverted-U empirical relationship between the level of competition and the level of innovation in various industries. That is, not much innovation is seen in very competitive industries as well as in highly concentrated industries, most patents are acquired by firms in moderately competitive industries.



Explain why this may be the case.

(b) (10 rp) One of the ways to regulate non-perfectly competitive markets and reduce their detrimental impact on social welfare is a price cap. In a standard model, the government sets the maximum price at the level where it would be in perfect competition ($P = MC$), so the firm(s) produce the socially efficient level of output. In some cases, however, this policy is not feasible, because it forces the firm(s) to leave the market, harming the society even worse. Provide an example of such a market where forcing $P = MC$ is clearly not the best idea and explain why. Suggest another way of regulation, that can help achieve the goal instead (or in addition to) the price cap.

(c) (10 rp) In macroeconomics textbooks, the authors often distinguish between two types of inflation: cost-push and demand-pull. Assume that two equivalent countries are in the long run macroeconomic equilibrium, and they simultaneously experience inflation — cost-push in country A and demand-pull in country B. Using the AD-AS model, explain for which country's government (the central bank) it will be relatively harder to fight this inflation.

Solution

(a) Crucial ideas:

- In highly competitive industries, the innovation rents cannot be high, unless the innovator makes a real breakthrough and acquires significant market share (which is unlikely). So, both incumbent and new firms do not find it profitable to invest in R&D.
- In monopolized industries, firms do usually have the money to invest in R&D, but are reluctant to do that, if their market power is secured. But more competition induces firms to innovate in order to “escape competition” (in the words of the authors of the paper), since being the first to introduce a new product or technology can give them a significant advantage over their competitors.

Other arguments may include:

- In highly competitive industries, the incumbent firms are typically small, do not earn high profits (that can be re-invested in innovation) and may have limited access to the credit market. Thus, it is difficult for them to fund R&D.

¹ Aghion, Philippe, et al. "Competition and innovation: An inverted-U relationship." *The Quarterly Journal of Economics* 120.2 (2005): 701-728.

- The firms in low-competition markets, if faced with the threat of increased competition, may start innovating more to avoid losing their market shares.

No more than one idea explaining a part of the inverted-U is awarded points (i.e., if there are two arguments explaining the increasing part, only one of them gets points). Each of the crucial ideas is worth 5 points.

Plausible, but not the same or not very well explained ideas are awarded with 3 points.

If there are both correct (earning 5 points) and incorrect arguments, the explanation gets 4 points for each part (\uparrow and \downarrow).

If the contestant provides correct arguments for low levels of innovation with low and high competition, but also says why under moderate level innovation will also be low (that is, fails to explain the inverted U), they get 5 points in total.

(b) If marginal cost is lower than average cost, setting $P = MC < ATC$ will induce the firm to leave the market. This may happen with natural monopolies or simply with firms with a high fixed component in their cost structure. For example, for a cinema, letting one more person in costs nothing ($MC \approx 0$), the situation is similar for airlines, digital content producers, public transportation, etc. Setting $P = MC$ there will mean destroying the revenue. For the pharmaceutical industry, setting P at the competitive level ($= MC$) would kill incentives for R&D, and new drugs will not be developed (see part (a)).

- *3 points for an example, 2 points for explaining why regulation is infeasible*
- *mentioning 'natural monopoly' or 'economies of scale' does not count as an example and brings 2 points out of 3*
- *a partially correct explanation gets 1 point out of 2.*

The solution can be, in addition to capping prices, to provide a subsidy which will cover the fixed cost (or, similarly, share the cost of R&D) for those firms that still operate in the market. This will make their profit positive again.

- *5 points for correct measure.*
- *If the measure returns firms back to the market but does not provide allocative efficiency, 2 points out of 5 (this includes the case where a contestant suggests subsidy but fails to identify the reason for the inefficiency correctly).*
- *If the measure is not obvious (i.e., not a subsidy in addition to price cap), up to 3 points out of 5 can be withdrawn for lack of explanation.*

(c) Cost-push inflation occurs when there is an increase in production costs, such as wages or raw materials, leading to a decrease in aggregate supply (AS). Demand-pull inflation, on the other hand, arises when there is an increase in aggregate demand (AD) that outpaces the economy's capacity to produce goods and services.

To combat the inflation, the central bank can implement contractionary policy, such as raising interest rates. These measures aim to reduce aggregate demand and shift the AD curve to the left, helping to mitigate the inflationary pressure.

In country A, the decrease in AS already reduced the output, and this contractionary policy will reduce it even further, driving the economy into a deeper recession. To prevent this, the government should use supply-side (fiscal) policies, which are harder to implement (legislation often needed) and which operate with lags. In country B, on the other hand, the output increased in the

short run, so the contractionary policy can return it back, without causing a recession. So, it is harder to deal with cost-push inflation.

10 points for correct explanation, including the understanding of the causes of cost-push and demand-pull inflation.

Partial credit:

- *one or the both mechanisms are explained — each gets 2 points;*
- *the policies that can combat inflation are explained with examples — 2 points in each case (or 4 points if measures apply to both cases)*
- *the argument is made that it is necessary to use the (operating with lags) supply-side policies in country A without explaining why (to prevent recession) — 1 point is subtracted from the explanation.*

Open Question 3. Public Debt Policy

The sovereign debt crisis in Europe and the fiscal deficit crisis in the United States have triggered global attention on government debt. Why is it necessary to control the government budget deficit reasonably and effectively? Please explain in detail some **positive** and **negative** effects of budget deficit on a country's economic development.

Solution

1. Positive – stimulate economic growth through
 - a. multiplier effect – government spending turns
 - b. ease social problems – government spending resources on crucial social issues might release social tensions, stabilize political situation (for example, COVID subsidies).

Mention at least one of them for 10 points.

2. Negative – hinder economic growth
 - a. (over-heating) an initial positive stimulus might over-heat the economy and result in higher levels of inflation. (Please note that while issuing government bonds has a contractionary effect on the money supply, it is important to take into account what the government does with the raised money, i.e. use the funds to increase government spending).
 - b. (level) higher share of government income devoted to servicing debt, hence, less money left for other programs, including public funding of education, medical care, research.
 - c. (volatility) makes country more vulnerable to economic shocks: a fall in GDP and collected taxes makes it harder to keep a balanced budget and leads to either more borrowing or cuts in critical social care programs; an increase in the interest rates leads to a higher cost of servicing debt, which then makes it harder to balance the budget.
 - d. (uncertainty) since the country might find it harder to balance budget in the future, there is more policy uncertainty. I.e. it is not clear today if the government will chose to issue more debt and/or increase taxes, by how much and when. An increase in policy uncertainty leads to a reduction in investment and slows down economic growth.
 - e. (social justice) an increase in the taxes necessary to repay the debt will likely be disproportionately more borne by future generations, hence, it creates a social tension. Older generation today benefit from an increase in spending and stimulus of economy, but it is future and younger generations that will have to bear the costs of such an expansion.

5 pts for discussing each of the mentioned issues up to 20 points. (i.e. should mention 4 out of 5 to get full credit).

Comments:

First of all, having government debt does not automatically mean that the government will have to raise taxes to repay it or will default on it or will have to borrow more to repay it. Think of it in the context of a business cycle – during

downturns the government is in deficit and borrows money to finance its expenditures, but in upturns its revenues are higher than expenses and it uses funds to repay debt. However, the higher the level of debt, the more concerns investors might have in the government's ability to deliver on its promises.

Many of contestants answered that the government will print money to finance its deficit. This is a rather strong assumption, which goes outside of the scope of the question for the following reasons.

"Printing money" is a process of the Fed (central bank) purchasing government bonds (treasuries), which was not specified that it would happen in the problem. When government finances its deficit, it issues bonds (treasuries), that are sold in auctions (i.e. through markets), and Fed might buy them or not, depending on its policy. The question was cast in the framework of US and Europe, so by default we assume that other investors (domestic or foreign) are buying the bonds, some of the bonds might be purchased by the Fed, but assumption that all of them or almost all of them every time there is a budget deficit is too much of a stretch. (Such an assumption might be more plausible for a developing country with a compromised central bank that finds itself unable to find investors willing to buy its bonds, i.e. already in crisis). Government bonds are purchased by banks, financial institutions such as insurance companies and mutual and pension funds, and individual investors, among others.

Therefore, in US and in Europe, a central bank buying some of the government bonds is one possible scenario, that might happen or might not. Importantly, in both US and in Europe, central banks are independent bodies, they are not directly controlled by the government. And while it might be the case that some politicians in Italy or Greece, hypothetically, would have liked the ECB to buy all of their bonds, they can hardly expect ECB to simply follow their will. Therefore, the concern that the first and foremost effect of budget deficit in US and Europe is "printing money" is incorrect.

There were many comments on inefficiencies in government spending. It is important to remember that they are not unique to situations with budget deficit and therefore, are not of first-order importance in this question.

Some answers talked about repayment of the loans as necessarily meaning something bad/negative for the economy. This is not the case, since repayment of the loan merely represents the second part of the transaction that transfers some funds from future periods to the present, i.e. a natural part of debt contract. Therefore, such repayments can not be analyzed in isolation and only together with the use of these borrowed funds today.

A few answers commented on the effect of budget deficit on the current account. This effect depends on the currency in which the debt is issued. Please note that the question was cast in the context of US and Europe, so it is expected that contestants assumed that the bonds were issued in domestic currency, as is the case in US and Europe. Hence, when the government issues bonds (and if the lending market can not absorb it and there is an upward pressure on interest rates), it creates an inflow of funds to the country and appreciation of the domestic currency (uncovered interest parity). This discussion was not expected in the answers, as it is beyond the scope of this question.

Open Question 4. Automation and the labour market

Automation is a term used to describe new technologies that allow machines to do the work that people used to do. Technological innovations that replace labour have been an essential part of the capitalist economy since the introduction of the spinning jenny in the eighteenth century. Explain five effects of the process of automation to the labour market, naming five historical examples from economic life.

Solution

Labour-saving technological progress allows more outputs to be produced with a given amount of labour, and it also contributes to the expansion of production. *(5 points)*

By incentivizing investment, it compensates for some of the jobs it has destroyed and may even create more jobs than previously existed. The total job reallocation process is the sum of job creation and destruction. Typically, the net growth of employment is typically small and positive. *(5 points)*

Relation to the rate of unemployment and the cyclical phase: when unemployment is high, the vacancy rate is low; and when unemployment is low, the vacancy rate is high. Some factors prevent newly unemployed people from being matched with newly posted jobs (process of labour market matching) *(5 points)*

Contrary to the initial fear against the machine, the constant increase in the amount produced in an hour of work has not resulted in ever-increasing unemployment. It is wages that on average have risen, not unemployment. The wage adjustment gap phenomenon *(5 points)*

The short-run effects depend on the kinds of work a worker does: The robots are labour-replacing. For routine jobs in which the machines and skills are substitutes, the value of a worker's endowment is reduced by the new technology because the robot can replace the worker.

The robots are also labour-enhancing: For those jobs in which the machines and skills are complements, the value of a worker's endowment is increased by the new technology.

In the long run, Additional employment and opportunities for career progression and rising wages: These opportunities could be in human services such as health and care, where jobs are non-routine but often poorly paid. Opportunities for workers with routine skills to upgrade their endowments: Their labour becomes machine-enhanced rather than machine-replaceable. *(5 points)*

Examples: information technology sector, manufacturing sector, retail sector, transport, tourism *(5 points)*

Open Question 5. Internal Rate of return

In case you forgot the formula:

$$w^n + w^{n-1} + w^{n-2} + \dots + w = \frac{w^{n+1} - w}{w - 1}$$

Let $P_0, P_1, P_2, \dots, P_k$ be a future payment flow. This means that at the time instant 0 we pay P_0 , at the time instant 1, we pay P_1 and so on. If a payment is negative, usually P_0 , this means that we receive money instead of paying.

The **Net Present Value** of this flow, denoted by **NPV(r)**, is defined as the sum of all present values of the above payments, for a given interest rate r . The rate r is the rate which is applied at each time instant. To find the **Internal Rate of Return (IRR)** of this flow, we follow the next steps:

1. We define a set of interest rates $r_0, r_1, r_2, \dots, r_n$.
2. We calculate the quantities: $NPV(r_0), NPV(r_1), NPV(r_2), \dots, NPV(r_n)$.
3. We find successive r_a, r_b such that $NPV(r_a) > 0$ and $NPV(r_b) < 0$.
4. We find a straight line joining the points: $(r_a, NPV(r_a)), (r_b, NPV(r_b))$.
5. We find the value r^* where this straight line meets the horizontal r -axis.
6. $IRR = r^*$

A company takes, at the "zero" time instant, a loan equal to 71 money units and plans to pay the first month 15 money units, the second 28 and the third 30, that is $P_1 = 15, P_2 = 28, P_3 = 30$

(a) (10 rp) Using the above procedure calculate the IRR for this payment flow. Use $r_0 = 0.14$, applied annually, and increase it with step $h = 0.01$ up to the value $r = 0.16$.

(b) (10 rp) If the company, instead of following this payment policy, decides to give 25 money units on the third month and some amount of money the fifth month, what should this amount be, in order the whole loan to be repaid? As an annual interest rate, use the IRR we found before.

(c) (10 rp) The company has started to repay the loan by 5 equal monthly payments, covering both principal and interest and with an interest rate equal to the IRR, found before. Suddenly after the second payment, the interest rate is increased by 3%. The government, in order to help, decides to cover the 25% of the loan which has not been paid yet and to extend the number of total payments from 5 to 8. Find the amount of each equal monthly payment, the company must pay from now on, to repay the loan.

Solution

(a) (10 points)

For $r_0=0,14$ we have:

$$\begin{aligned} NPV(0,14) &= P_0 \cdot \left(1 + \frac{0,14}{12}\right)^0 + P_1 \cdot \left(1 + \frac{0,14}{12}\right)^{-1} + P_2 \cdot \left(1 + \frac{0,14}{12}\right)^{-2} + P_3 \cdot \left(1 + \frac{0,14}{12}\right)^{-3} \\ &= 0,158975 \end{aligned}$$

For $r_0=0,15$ we have:

$$NPV(0,15) = P_0 \cdot \left(1 + \frac{0,15}{12}\right)^0 + P_1 \cdot \left(1 + \frac{0,15}{12}\right)^{-1} + P_2 \cdot \left(1 + \frac{0,15}{12}\right)^{-2} + P_3 \cdot \left(1 + \frac{0,15}{12}\right)^{-3}$$

$$= 0,0302743$$

For $r_0=0,16$ we have:

$$NPV(0,16) = P_0 \cdot \left(1 + \frac{0,16}{12}\right)^0 + P_1 \cdot \left(1 + \frac{0,16}{12}\right)^{-1} + P_2 \cdot \left(1 + \frac{0,16}{12}\right)^{-2} + P_3 \cdot \left(1 + \frac{0,16}{12}\right)^{-3}$$

$$= -0,09806$$

Therefore, we seek for a straight line $y=Ar+B$, passing through the points $(0,15, 0,0302743)$, $(0,16, 0,09806)$. By substitution we find:

$$A = -12,8334 \quad B=1,95529$$

So, this straight line is vanished at the point

$$-12,8334 \cdot r + 1,95529 = 0 \Rightarrow r^* = 0,152359$$

$$IRR \approx 0,15$$

(b) (10 points) The present value of the 25 money units, paid at the third month is:

$$\frac{25}{\left(1 + \frac{0,15}{12}\right)^3} = 24,0855$$

where, we have taken the interest rate equal to 0,15. So, the rest of the loan is:

$$71 - 24,0855 = 46,9145$$

In order to repay it the fifth month, we must pay:

$$46,9145 \cdot \left(1 + \frac{0,15}{12}\right)^5 = 49,9209$$

money units. This is the requested P_5 value.

c) (10 points) First, we have to calculate how much the original equal-payment was. Let us denote it by R , we have:

$$R \cdot \left(1 + \frac{0,15}{12}\right)^{-1} + R \cdot \left(1 + \frac{0,15}{12}\right)^{-2} + R \cdot \left(1 + \frac{0,15}{12}\right)^{-3} + R \cdot \left(1 + \frac{0,15}{12}\right)^{-4} + R \cdot \left(1 + \frac{0,15}{12}\right)^{-5} = 71$$

or

$$R \cdot (w^5 + w^4 + w^3 + w^2 + w) = 71$$

where $w = \left(1 + \frac{0,15}{12}\right)^{-1} = 0,987654$. Using the formula for adding terms of geometric progression, we get:

$$R \cdot \frac{w^6 - w}{w - 1} = 71 \Rightarrow R = 71 \cdot \frac{w - 1}{w^6 - w} = 14,7369$$

Therefore, the present value of the two already-done payments is:

$$R_w + R_w^2 = 14,7369 \cdot (0,987654 + (0,987654)^2) = 28,9302$$

So, the rest of the loan is $71-28,9302=42,0698$. This amount is reduced by 25%, due to the government intervention. So, the new rest of the loan is:

$$42,0698 - 0,25 \cdot 42,0698 = 31,5523$$

This quantity must be repaid with six equal payments (denoted by H), starting the third month, with new annually interest rate equal to $\tilde{r} = 18\%$. This means that:

$$H \cdot (s^3 + s^4 + s^5 + s^6 + s^7 + s^8) = 31,5523$$

with:

$$s = \left(1 + \frac{\tilde{r}}{12}\right)^{-1} = \left(1 + \frac{0,18}{12}\right)^{-1} = 0,985222$$

Working as before, we get:

$$H \cdot (s^3 + s^4 + s^5 + s^6 + s^7 + s^8) = H \cdot s^3 \cdot (1 + s + s^2 + s^3 + s^4 + s^5) =$$

$$H \cdot s^3 \cdot \frac{s^6 - 1}{s - 1} = 31,5523 \Rightarrow H = 31,5523 \cdot \frac{s - 1}{s^9 - s^3} \Rightarrow H = 5,70561$$

This is the new monthly payment, upon request.